VIII

Local Road Infrastructure in the United States:

Requirements under Sprawl and Alternative Development

INTRODUCTION

The purpose of this chapter is to provide estimates of the number of lane-miles and the cost of new local roads required for the population growth expected during the next 25 years under two alternative development futures for the United States. One future is uncontrolled growth, or sprawl; the other is more-controlled or "smart" growth. In the controlled-growth scenario, growth is encouraged in the more built-up portions of each EA, both in developed counties and in developed areas of counties. Each development alternative involves growth of a magnitude that produces 23.5 million new households, containing 60.7 million persons, and 49.4 million new jobs. The question to be addressed is whether the extent and cost of the required new road infrastructure to support this additional population is less for controlled (compact/smart) growth than it is for uncontrolled (sprawl) growth.

The chapter first describes a regression-based Rutgers Road Model, which predicts road-mile density as a function of population density. Equations for the model that are applicable at the national level are derived and their implications discussed. The chapter concludes with the application of the road model and costs to the two alternative growth scenarios.

CONCEPTUAL OVERVIEW AND ASSESSMENT MODEL

Infrastructure is the publicly owned and maintained development hardware or structures through and from which public services are provided (Creighton 1970). This chapter's infrastructure analysis involves development's demand for local roads. It draws heavily on procedures used in existing versus alternative development evaluations in the *Impact Assessment of the New Jersey State Development and Redevelopment Plan* (Burchell et al. 1992b, Burchell et al. 2000) and similar studies on the Delaware Estuary (Burchell et al. 1994); Lexington, Kentucky (Burchell et al. 1995); Michigan (Burchell 1997a); South Carolina (Burchell 1997b); and Florida (Burchell et al. 1999).

The demand for additional lane-mile capacity of local roads is related to the distribution and density of population across space (Stopher and Meyberg 1975). The Rutgers Road Model, developed by Richard Brail and George Lowenstein of Rutgers University, relates population density to road density based upon historical incidence in subcounty areas. Through regression analysis, an ideal relationship between road-mile density and population density is generated for different types of areas within counties. These are either the developed or undeveloped portions of counties.

Using the projected population density in 2025 through the derived relationship, an ideal level of lane-miles is established for each area of the county. The model predicts the need for new road construction by comparing the ideal level of required lane-miles with the existing lane-miles found in a county. If additional lane-miles are required to support growth, they are added and charged; if not, new lane-miles are neither added nor charged.

The strength of the model lies in two factors. First, it uses data readily available for most counties (lane-miles of local roads) and in every state (cost of road construction). Second, the model shows a very strong correlation between the dependent and independent variables. Given this, the explained variance is high. A variable cost factor is then applied to project future road costs. The model does not project the costs associated with land acquisition, bridges, or the repair or upkeep of roads.

The Rutgers Road Model is a power function that takes the following form:

$$\text{RoadDens} = \text{Constant} * \text{PopDens}^{\text{Exponent}}$$

"RoadDens" is the mileage of roads per square mile; "PopDens" is the number of people per square mile.

Both growth scenarios involve differing growth patterns within all six types of counties (urban center, urban, suburban, rural center, rural, and undeveloped). The uncontrolled-growth scenario follows present or more-sprawled growth patterns, while the controlled-growth scenario constrains intercounty and intracounty growth to the most developed counties and the most developed areas within counties. As growth occurs within each scenario, counties cross the threshold densities within the originally defined area types. Different thresholds are breached, depending upon the scenario. The model, therefore, has to perform well in different subcounty areas in addition to being an accurate predictor of countywide road demand. The road model is calibrated differently for the developed and undeveloped areas of counties, creating a simple yet accurate predictor of the need for local roads. The model takes a bird's-eye view of development in a county and an ideal level of local roads supporting that development. It assumes that future development will be served by a similar pattern of local roads and projects local road requirements accordingly. This projection does not involve a transportation model utilizing the four-step transportation modeling process. Instead, ideal relationships between population and road density at the subcounty level are determined and compared with what is already there.

Courtesy of T. Delcorso

Road-Demand Model

Population and road data from states (road data is not available from Alaska) are used to calibrate the model functions predicting road density of the developed and undeveloped areas of a county. The road data employed provides centerline miles of roads but not the number of lanes associated with them. The model is calibrated with centerline road densities, with miles added as projections are made.

The data for road density comes from the Highway Performance Monitoring System (HPMS) (U.S. Department of Transportation 1992). The HPMS is the most recent in a series of road inventories; it reflects information supplied by state highway departments. The HPMS provides a comprehensive picture of the road infrastructure in the United States. It is a database incorporating centerline road mileage for various designations of roadways (e.g., interstates, expressways, arterials, collectors, and local roads). Only

Table 8.1
Road Model Parameters

	Developed Areas	Undeveloped Areas
Constant	0.1510	0.3448
Exponent	0.4314	0.3924
R-Squared	0.532	0.608
F-Statistic	733.66	4,579.71
Degrees of Freedom	646	2951
Significance Level	0.00000	0.00000

Source: Center for Urban Policy Research, Rutgers University.

collectors and local roads are used in this model, since national (e.g., interstates) and state highways are through-roads linking population centers and are usually unaffected by local development patterns. Whether in-between locations are more compact or population growth is more dispersed does not significantly affect the scale or direction of these in-state, region-linking roads. Collectors and local roads are summed for the developed and undeveloped areas in each county and divided by their respective land areas.

Courtesy of T. Delcorso

The 1990 U.S. Census population count is adequate for obtaining the required population densities because its data correlates timewise with the 1992 determination of road densities. The Census provides the percentage of county population considered urban (synonymous with the study's developed-area population). Using this percentage, the population for the developed and undeveloped areas in each county is calculated and divided by its respective land area. Land areas for developed and undeveloped areas of counties have been determined from Ranally information also available for this period (1992). If the urban percentage is zero or the developed area portion is zero (due to insignificant or very small land areas involved), no data point is included.

The road and population densities for the developed and undeveloped areas of each county type are curve-fitted to the power function of the Rutgers Road Model and model parameters determined. The resulting parameters are presented below and in Table 8.1.

In the developed areas of counties:

$$RoadDens = 0.1510 * PopDens^{0.4314}$$

In the undeveloped areas of counties:

$$RoadDens = 0.3448 * PopDens^{0.3924}$$

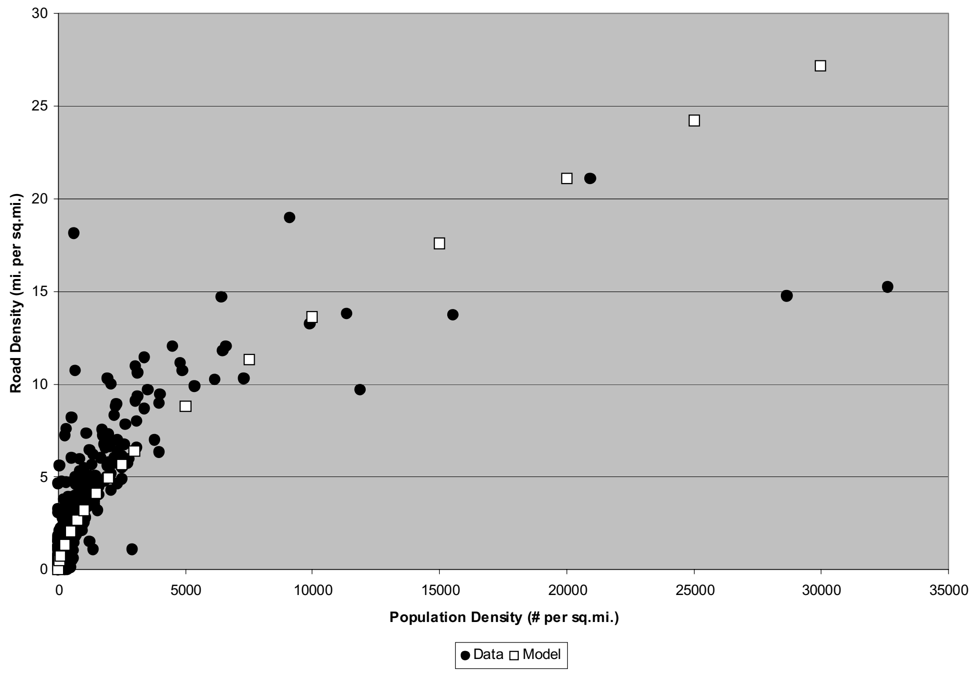
R-squared is an indicator of the variance explained and conveys the usefulness of the independent variable in explaining variation in the data of the dependent variable.

For both equations, the amount of variance explained (R-squared) is equal to or greater than 50 percent, indicating adequate explanatory power. Both equations are highly significant. The data and the curve-fitted model for the developed and undeveloped areas of the nation's counties are shown in Figures 8.1 and 8.2, respectively. Note that the horizontal scale in Figure 8.1 is ten times that of Figure 8.2. Both curves have similar shapes and low population density groupings, and would look even more similar if the horizontal scales were identical.

Future Road Demand

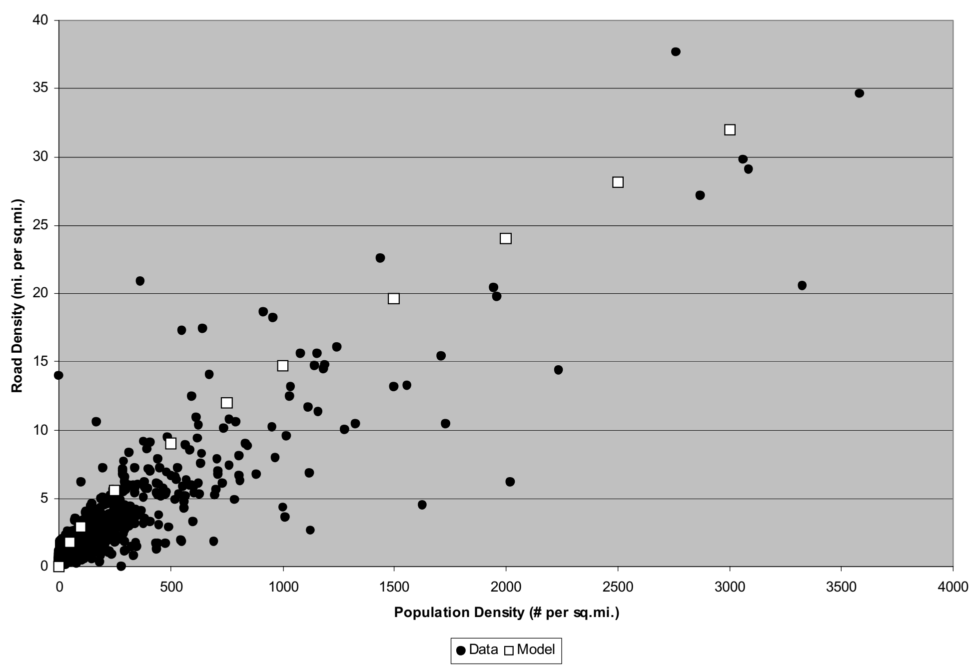
Future population densities are calculated from the projections of 2025 population growth in the developed and undeveloped areas of each county under uncontrolled- and controlled-growth development

Figure 8.1
Road Density as a Function of Population Density in Developed Areas of All Counties



Source: Center for Urban Policy Research, Rutgers University.

Figure 8.2
Road Density as a Function of Population Density in Undeveloped Areas of All Counties



Source: Center for Urban Policy Research, Rutgers University.


Courtesy of G. Lowenstein

scenarios. In the developed areas, this occurs by adding the new population and dividing by a slightly larger development area. Increased development density in undeveloped areas under the controlled-growth scenario is incorporated into the model by treating the clustered developments in the undeveloped areas (which occur only in this scenario) as developed areas and by adjusting the developed areas' population densities to reflect the increase in density obtained. Consequently, in the areas that are undeveloped, two population densities are calculated: one for clustered residential developments and the other for the remaining nonclustered development.

Substituting these densities into the Rutgers Road Model yields the 2025 demand for roadway mileage for the areas in the two development scenarios. For those areas that are deficient in roadway mileage in 2025, the model calculates the need for additional lane-miles of roadway. Since the database year is 1992, the mileage attributable to the 2000 to 2025 time increment is determined by linear interpolation. Approximately 75 percent of overall demand is assigned as the demand for the 25-year study period (25 of 33 years). For those areas that are deficient in roadway mileage in 2000, the model calculates a portion of that need for additional roadway mileage and attributes it to 2000 to 2025 demand, even if no additional population is projected. Similarly, areas that have excess roadway capacity that can support the projected demand will show no requirement for additional roadway mileage in 2025. Since the input used in the road-demand function is total length of roads, not the number of lanes, an average roadway width of two lanes is assumed for all local roads added (municipal and county). This converts miles to lane-miles.


Courtesy of G. Lowenstein

Future Road Costs

Development standards for roads (lane widths, center dividers, sidewalks, etc.) affect the costs of roadway construction. These standards are typically different for rural roads, where a two-lane highway with five-foot-wide shoulders may be sufficient, than for urban roads, where the standards may include curbs, gutters, and a 12-foot auxiliary lane. Both national and state sources provide per-mile construction costs for urban and rural development environments.

The individual costs of new road infrastructure are calculated from average state road construction costs that have been assembled from a number of state departments of transportation nationwide (Arizona, California, Florida, Illinois, New Jersey, and Texas). The costs are for both rural and urban collector and local roads. The per-mile costs are those associated with roadway construction, not the costs associated with land acquisition or those related to associated structures (e.g., bridges).

New roads can have either asphalt- or concrete-finished surfaces. This mix varies with location, but for consistency, the study uses concrete roadway construction costs. Most new roads, especially in the Southeast, Southwest, and Western regions of the United States, are concrete. Asphalt-surfaced roads

Table 8.2
Roadway Construction Costs per Lane-Mile

County Development Type	Undeveloped Areas	Developed Areas
Undeveloped, Rural, and Rural Center	$ 500,000	$750,000
Suburban	$ 670,000	$1,000,000
Urban and Urban Center	$ 840,000	$1,250,000

Source: Center for Urban Policy Research, Rutgers University.

typically cost from 20 percent to 25 percent less than concrete. Since new lanes can be added by widening existing roadways, it should be noted that the cost of widening roadways is only 10 percent to 20 percent less per lane-mile than new construction, since land acquisition costs are not included. To be conservative with urban/suburban versus rural/undeveloped differences, the study assumes new roadway construction costs in all cases.

Rural road costs are assumed in the developed areas of undeveloped, rural, and rural center counties; urban road costs are assumed in the developed areas of urban and urban center counties. To estimate developed-area costs for suburban counties, a cost midway between urban and rural is used. Two-thirds of this latter cost is used for undeveloped areas of suburban counties. Lane-mile construction costs are found in Table 8.2. The nominal costs for lane-mile construction in Table 8.2 are adjusted by individual county to account for the differences in labor costs that exist in those counties. This is done using the variation in average household income by county.

RESULTS OF THE ASSESSMENT: THE UNITED STATES AND ITS REGIONS

Uncontrolled Growth

To accommodate growth during the period 2000 to 2025 of 23.5 million new households containing 60.7 million persons and a corresponding growth of 49.4 million new jobs, more than 2 million additional collector and local road lane-miles will be required (Table 8.3). These additional lane-miles could be in the form of new roads or supplemental lanes added to existing roads. The requirement within developed areas (174,000 lane-miles) is less than one-tenth that in undeveloped areas (1.87 million lane-miles), since the latter areas have no extensive road infrastructure in place, yet receive the bulk of growth under the uncontrolled-growth scenario.

Of the four census regions of the United States, the South will require the largest number of new lane-miles (43 percent of the nationwide total). By 2025, almost 886,000 lane-miles of road will be required in this region. The West, which has the second-largest share of growth over the next 25 years, will require 586,000 lane-miles of road, 29 percent of the nationwide total. The Northeast and the Midwest combined will require the remainder (28 percent of the nationwide total), approximately 286,000 lane-miles of local roads each.

The cost to construct these required lane-miles in the United States during the period 2000 to 2025 is $927 billion (Table 8.4). These costs are solely attributable to the construction of the new lane-miles of roads, excluding both required structures and land acquisition. In the South, almost $377 billion (40.6 percent of the total) will be spent for new roads. In the West, $283.5 billion (30.5 percent of the total) will be spent for new roads. In the Northeast and Midwest, $136 billion and $131 billion, respectively, will be spent. These figures represent 14.7 percent and 14.2 percent of total future local road expenditures.

Controlled Growth

Under the controlled-growth scenario, additional lane-miles of local roads are reduced by 188,000 lane-miles (Table 8.3). This corresponds to a decrease of more than 9 percent nationwide. The West region evidences the most savings, with 85,000 saved lane-miles, or more than 45 percent of all lane-miles saved. The South saves 79,000 lane-miles, 42 percent of all lane-miles saved. The Midwest shows one-fifth of the South savings—17,500 lane-miles, or 9 percent of all lane-miles saved. The Northeast shows the least number of lane-miles saved—7,000 lane-miles, or 4 percent of all lane-miles saved. The Northeast region exhibits the lowest savings due both to less growth and the existing higher road density found in this region; the West region exhibits the largest savings, due to its significant growth and lower road-mile density relative to population density.

The total cost for the added road infrastructure under the controlled-growth scenario is just over $817 bil-

Table 8.3
Road Lane-Mile Savings—Uncontrolled- and Controlled-Growth Scenarios
United States and by Region: 2000 to 2025
(in Miles)

	Uncontrolled Growth			Controlled Growth			Lane-Mile Savings		
Region	Developed Areas	Un-developed Areas	Total Lane-Miles Required	Developed Areas	Un-developed Areas	Total Lane-Miles Required	Developed Areas	Un-developed Areas	Total Lane-Miles Saved
Northeast	30,675	257,385	288,059	32,218	249,033	281,251	-1,543	8,352	6,809
Midwest	28,164	256,000	284,164	30,397	236,217	266,614	-2,232	19,782	17,550
South	53,467	832,477	885,944	45,405	761,550	806,955	8,062	70,927	78,989
West	62,122	523,890	586,011	29,910	471,145	501,055	32,212	52,744	84,957
United States	**174,428**	**1,869,751**	**2,044,179**	**137,929**	**1,717,945**	**1,855,874**	**36,499**	**151,805**	**188,305**

Source: Center for Urban Policy Research, Rutgers University.
Note: Alaska is not included in the West region.

Table 8.4
Road Cost Savings—Uncontrolled- and Controlled-Growth Scenarios
United States and by Region: 2000 to 2025
(in Billions of Dollars)

	Uncontrolled Growth			Controlled Growth			Road Cost Savings		
Region	Developed Areas	Un-developed Areas	Total Lane-Mile Costs	Developed Areas	Un-developed Areas	Total Lane-Mile Costs	Developed Areas	Un-developed Areas	Total Road Cost Savings
Northeast	27.35	108.41	135.77	25.01	104.57	129.57	2.35	3.85	6.20
Midwest	24.11	106.65	130.76	23.58	98.57	122.15	0.53	8.08	8.61
South	44.62	332.37	376.99	33.84	304.23	338.07	10.78	28.14	38.92
West	59.56	223.93	283.49	25.44	202.08	227.52	34.12	21.85	55.98
United States	155.65	771.36	927.01	107.86	709.45	817.31	47.78	61.91	109.70

Source: Center for Urban Policy Research, Rutgers University.
Note: Alaska is not included in the West region.

lion, compared with the $927 billion spent under the uncontrolled-growth scenario (Table 8.4). This is a difference of $110 billion, a saving of almost 12 percent. The savings in the West is by far the largest dollar value—$56 billion, or 51 percent of the total. The road lane-mile cost savings in the West equals the total lane-mile cost savings in the rest of the country. In the South, a $39 billion reduction in road infrastructure costs amounts to more than 35 percent of the national savings. The local road lane-mile infrastructure saving in the Midwest and the Northeast is projected to be about $8.6 billion and $6.2 billion, respectively, representing 8 percent and 6 percent of all road cost savings.

STATES

Uncontrolled Growth

The states that have the greatest amount of new road demand under uncontrolled growth essentially parallel the states that have the largest combined residential and nonresidential development over the 25-year projection period. Table 8.5 lists the states in descending order of total lane-miles required. The top 20 states will need new road capacity amounting to 1.5 million lane-miles, or three-quarters of all future required lane-miles. Forty percent of the nation's states (20) require three-quarters of the nation's fu-

Table 8.5
Road Lane-Mile Savings—Uncontrolled- and Controlled-Growth Scenarios by State: 2000 to 2025
(in Miles)

State	Uncontrolled Growth			Controlled Growth			Lane-Mile Savings		
	Developed Areas	Un-developed Areas	Total Lane-Miles Required	Developed Areas	Un-developed Areas	Total Lane-Miles Required	Developed Areas	Un-developed Areas	Total Lane-Miles Saved
California	32,799	190,066	222,865	11,220	176,787	188,007	21,579	13,280	34,858
Texas	9,756	143,749	153,505	5,948	127,133	133,081	3,807	16,617	20,424
Pennsylvania	17,020	123,798	140,817	18,545	121,506	140,051	-1,526	2,292	766
Florida	10,773	96,313	107,086	5,960	88,310	94,270	4,813	8,003	12,815
North Carolina	5,053	96,858	101,910	5,710	92,073	97,783	-657	4,785	4,128
Arizona	6,122	76,798	82,920	2,838	71,146	73,984	3,284	5,652	8,936
Georgia	2,542	79,467	82,008	2,356	70,499	72,855	186	8,968	9,153
New York	6,120	56,867	62,987	4,776	55,011	59,787	1,344	1,856	3,201
Virginia	5,934	57,036	62,971	5,272	52,973	58,245	663	4,064	4,726
Ohio	5,125	56,551	61,677	5,873	53,974	59,847	-748	2,577	1,829
Washington	7,153	52,202	59,354	5,432	46,877	52,309	1,720	5,325	7,045
Tennessee	2,776	53,526	56,301	2,889	47,113	50,002	-113	6,413	6,300
Louisiana	2,220	50,301	52,521	2,059	48,711	50,770	161	1,591	1,751
Kentucky	556	45,836	46,392	716	43,583	44,299	-160	2,254	2,093
Michigan	5,130	39,548	44,679	6,110	36,462	42,572	-980	3,086	2,106
Colorado	3,608	40,188	43,795	2,415	33,372	35,788	1,193	6,815	8,008
South Carolina	3,618	39,442	43,060	4,548	36,388	40,937	-930	3,054	2,123
Indiana	3,482	36,977	40,459	4,569	32,966	37,535	-1,087	4,011	2,924
Alabama	999	39,311	40,310	1,125	35,475	36,600	-126	3,836	3,710
New Mexico	1,157	38,225	39,382	831	34,104	34,935	326	4,121	4,447
Mississippi	831	32,020	32,851	1,204	30,354	31,558	-373	1,666	1,293
Missouri	3,067	29,657	32,725	3,272	26,834	30,106	-204	2,823	2,619
Oregon	3,095	26,865	29,960	2,820	22,094	24,914	275	4,771	5,046
Illinois	4,483	25,193	29,677	3,896	23,982	27,878	588	1,211	1,799
Arkansas	497	28,939	29,436	854	25,949	26,803	-357	2,989	2,633
Wisconsin	2,869	25,461	28,330	3,405	23,406	26,812	-537	2,055	1,518
Maryland	5,040	22,797	27,838	3,013	19,440	22,453	2,028	3,358	5,385
Maine	762	26,796	27,559	1,419	25,970	27,389	-657	827	170
West Virginia	1,198	24,502	25,701	1,981	23,290	25,270	-782	1,213	430
Hawaii	2,607	22,158	24,765	2,161	17,663	19,824	446	4,495	4,941
Utah	2,195	21,745	23,940	849	18,741	19,590	1,347	3,004	4,350
Minnesota	2,153	20,319	22,471	1,661	17,711	19,372	492	2,608	3,100
Oklahoma	985	17,891	18,876	1,226	16,011	17,237	-241	1,880	1,639
Idaho	787	17,665	18,452	515	16,133	16,648	272	1,532	1,804
New Hampshire	1,078	16,454	17,532	1,502	14,913	16,415	-424	1,542	1,117
Montana	97	17,217	17,314	170	15,817	15,987	-73	1,400	1,327
New Jersey	4,268	10,509	14,777	3,044	9,902	12,946	1,224	607	1,832
Nevada	2,503	11,109	13,612	658	9,667	10,325	1,845	1,442	3,286
Wyoming	0	9,653	9,653	0	8,745	8,745	0	907	907
Iowa	732	8,788	9,520	782	8,391	9,174	-50	397	347
Vermont	202	8,921	9,124	359	8,465	8,824	-157	456	299
Massachusetts	794	7,852	8,646	1,361	7,588	8,949	-567	264	-303
Kansas	219	7,676	7,895	228	7,315	7,543	-10	362	352
Connecticut	430	4,976	5,407	1,211	4,848	6,059	-780	128	-652
Delaware	690	4,489	5,179	544	4,249	4,793	146	239	386
Nebraska	402	3,393	3,795	179	3,138	3,317	222	255	478
South Dakota	113	2,082	2,195	59	1,744	1,803	54	338	392
Rhode Island	0	1,210	1,210	0	831	831	0	379	379
North Dakota	389	352	741	362	294	656	27	59	86
Top 20 States	**131,941**	**1,413,059**	**1,545,000**	**99,194**	**1,304,462**	**1,403,655**	**32,748**	**108,597**	**141,345**
United States	**174,428**	**1,869,751**	**2,044,179**	**137,929**	**1,717,945**	**1,855,874**	**36,499**	**151,805**	**188,305**

Source: Center for Urban Policy Research, Rutgers University.
Note: Alaska is not included.

Courtesy of C. Galley

ture lane-miles of local roads for the period 2000 to 2025. The fastest-growing state (California) requires more than 223,000 local lane-miles, more than one-tenth of the future new local road requirements nationwide. The next four states requiring significant new road mileage (Texas, Pennsylvania, Florida, and North Carolina) each require 100,000 to 155,000 future local lane-miles.

The top 20 states will pay almost $700 billion for their new road infrastructure (Table 8.6). This again represents 75 percent of the nation's cost for additional lane-miles during the period 2000 to 2025. California, with the largest number of additional lane-miles, will pay almost twice what will be paid by the next two states requiring extensive new road mileage (Texas and Pennsylvania). The cost for California is $116 billion; the costs for Texas and Pennsylvania are $67.8 billion and $63.8 billion, respectively.

Controlled Growth

For the top 20 states, representing three-quarters of the future national local road demand, required future lane-miles are reduced from 1.55 million to 1.40 million, a saving of 141,300 lane-miles (Table 8.5). Of the top two states, California enjoys a saving of 35,000 lane-miles, while Texas saves 20,500 lane-miles. California and Texas save 16 percent and 13 percent, respectively, of their uncontrolled-growth requirements. The other states of note are Texas and Florida, which exhibit savings of 20,000 and 13,000 lane-miles, respectively. All of the states have at least some savings under the controlled-growth scenario, except for Massachusetts and Connecticut, which exhibit small lane-mile increases of 300 and 650 miles, respectively. This increase occurs because these two states are part of EAs that cross state boundaries, and they contain the receiving counties under the controlled-growth scenario. Thus, they require more urban lane-miles.

The top 20 states, again representing 75 percent of the new local road costs, reduce their costs from $696 billion to $611 billion, a saving of $85 billion, or 12 percent (Table 8.6). Of the 20 states, California has the largest savings, $29 billion. The next largest savings are in Texas, with almost $10.4 billion saved, and Florida, with approximately $7.7 billion saved.

EAs

Uncontrolled Growth

New lane-mile-demand requirements in the EAs throughout the United States follow the pattern presented for the United States as a whole, its regions, and its states. Most of the new lane-mile demand and resulting infrastructure growth are taking place in the southern and western EAs. Road infrastructure requirements are directly related to the household and employment growth of these EAs. Of the top 30 EAs in local road demand, 11 are in the West, nine are in the South, five are in the Midwest, and four are in the Northeast. These top 30 EAs must construct 1.04 million additional lane-miles of local roads in the future (Table 8.7). This additional local road construction in 17 percent of the EAs represents 50 percent of the future local road construction nationwide for the period.

The West is represented twice in the top four EAs in future required local road lane-miles. The Los Angeles-Riverside-Orange, CA EA has the highest future local road demand with 87,000 required lane-miles; the San Francisco-Oakland-San Jose, CA EA is third with a future requirement of 58,000 lane-miles. Surprisingly, second in terms of road-mile demand is the Northeast, New York-Northern New Jersey-Long Is-

Courtesy of C. Galley

Table 8.6
Road Cost Savings—
Uncontrolled- and Controlled-Growth Scenarios by State: 2000 to 2025
(in Billions of Dollars)

	Uncontrolled Growth			Controlled Growth			Road Cost Savings		
State	Developed Areas ($B)	Un-developed Areas ($B)	Total Lane-Mile Costs ($B)	Developed Areas ($B)	Un-developed Areas ($B)	Total Lane-Mile Costs ($B)	Developed Areas ($B)	Un-developed Areas ($B)	Total Road Cost Savings ($B)
California	33.71	82.46	116.17	9.86	77.01	86.88	23.85	5.45	29.30
Texas	8.87	58.93	67.80	5.08	52.37	57.45	3.78	6.56	10.35
Pennsylvania	13.90	49.86	63.77	14.25	48.94	63.19	-0.34	0.92	0.58
Florida	8.70	42.59	51.29	4.32	39.26	43.57	4.39	3.33	7.71
North Carolina	4.17	37.18	41.36	4.15	35.32	39.47	0.02	1.86	1.88
Arizona	4.38	29.62	34.00	1.74	27.51	29.25	2.64	2.12	4.75
Georgia	2.32	31.72	34.04	1.90	28.08	29.99	0.42	3.64	4.06
New York	6.33	24.32	30.65	3.34	23.53	26.87	2.99	0.79	3.78
Virginia	5.45	22.38	27.83	4.12	20.65	24.77	1.33	1.73	3.06
Ohio	3.77	22.79	26.56	3.82	21.75	25.57	-0.05	1.03	0.98
Washington	6.47	23.60	30.07	4.42	21.31	25.73	2.05	2.29	4.34
Tennessee	2.39	20.37	22.75	2.19	17.96	20.15	0.20	2.40	2.60
Louisiana	1.62	19.69	21.31	1.38	19.10	20.48	0.24	0.59	0.83
Kentucky	0.35	16.92	17.27	0.41	16.11	16.52	-0.06	0.82	0.75
Michigan	4.74	16.75	21.49	4.86	15.50	20.36	-0.13	1.26	1.13
Colorado	2.90	18.10	21.00	1.83	15.02	16.86	1.07	3.08	4.15
South Carolina	2.49	15.78	18.27	3.07	14.51	17.58	-0.58	1.27	0.69
Indiana	2.66	14.80	17.45	3.33	13.26	16.59	-0.68	1.54	0.86
Alabama	0.66	14.96	15.62	0.78	13.57	14.35	-0.12	1.39	1.27
New Mexico	1.08	15.83	16.91	0.75	14.13	14.88	0.32	1.71	2.03
Mississippi	0.61	12.27	12.88	0.87	11.62	12.48	-0.26	0.65	0.40
Missouri	2.49	11.62	14.11	2.59	10.55	13.14	-0.10	1.08	0.98
Oregon	2.58	10.63	13.21	2.19	8.76	10.95	0.39	1.87	2.25
Illinois	4.38	10.58	14.96	3.26	10.05	13.31	1.12	0.53	1.65
Arkansas	0.35	11.60	11.95	0.59	10.46	11.05	-0.24	1.14	0.90
Wisconsin	2.48	11.71	14.19	2.94	10.78	13.72	-0.46	0.93	0.47
Maryland	4.66	10.03	14.68	2.43	8.55	10.98	2.22	1.48	3.70
Maine	0.61	10.36	10.97	1.09	10.02	11.11	-0.48	0.33	-0.15
West Virginia	0.85	9.76	10.62	1.43	9.24	10.67	-0.57	0.52	-0.05
Hawaii	3.39	9.17	12.56	2.81	7.30	10.11	0.58	1.87	2.45
Utah	2.00	9.23	11.23	0.69	7.98	8.67	1.30	1.25	2.55
Minnesota	2.02	8.77	10.79	1.50	7.70	9.19	0.52	1.07	1.59
Oklahoma	0.66	6.39	7.05	0.80	5.73	6.53	-0.14	0.66	0.52
Idaho	0.74	8.02	8.76	0.42	7.37	7.79	0.32	0.65	0.98
New Hampshire	0.93	8.19	9.11	1.32	7.25	8.56	-0.39	0.94	0.55
Montana	0.05	6.43	6.49	0.10	5.91	6.00	-0.04	0.52	0.48
New Jersey	4.45	5.77	10.22	2.81	5.45	8.26	1.64	0.33	1.97
Nevada	2.26	6.89	9.15	0.62	6.20	6.81	1.65	0.69	2.34
Wyoming	0.00	3.94	3.94	0.00	3.58	3.58	0.00	0.36	0.36
Iowa	0.63	3.82	4.45	0.64	3.62	4.26	-0.01	0.19	0.18
Vermont	0.16	3.56	3.73	0.29	3.39	3.68	-0.13	0.18	0.05
Massachusetts	0.64	3.41	4.05	1.01	3.29	4.31	-0.37	0.11	-0.26
Kansas	0.16	3.13	3.29	0.17	2.97	3.15	-0.01	0.15	0.14
Connecticut	0.33	2.37	2.70	0.90	2.31	3.21	-0.57	0.06	-0.51
Delaware	0.47	1.79	2.27	0.31	1.71	2.01	0.17	0.09	0.26
Nebraska	0.39	1.70	2.10	0.16	1.58	1.73	0.24	0.13	0.36
South Dakota	0.10	0.84	0.95	0.05	0.71	0.76	0.05	0.14	0.19
Rhode Island	0.00	0.57	0.57	0.00	0.39	0.39	0.00	0.18	0.18
North Dakota	0.28	0.14	0.42	0.25	0.11	0.36	0.03	0.02	0.06
Top 20 States	**116.94**	**578.67**	**695.61**	**75.63**	**534.89**	**610.52**	**41.31**	**43.78**	**85.09**
United States	**155.65**	**771.36**	**927.01**	**107.86**	**709.45**	**817.31**	**47.78**	**61.91**	**109.70**

Source: Center for Urban Policy Research, Rutgers University.

Note: Alaska is not included.

Table 8.7
Road Lane-Mile Savings—
Uncontrolled- and Controlled-Growth Scenarios by EA: 2000 to 2025
(Top 30 EAs—in Miles)

	Uncontrolled Growth			Controlled Growth			Lane-Mile Savings		
EA	**Developed Areas**	**Un-developed Areas**	**Total Lane-Miles Required**	**Developed Areas**	**Un-developed Areas**	**Total Lane-Miles Required**	**Developed Areas**	**Un-developed Areas**	**Total Lane-Miles Saved**
Los Angeles-Riv.-Orange, CA-AZ	13,718	73,638	87,355	2,407	66,574	68,981	11,311	7,063	18,375
New York-North NJ-L. Isl., NY-NJ-CT-PA-MA-VT	10,126	53,108	63,234	8,089	51,318	59,407	2,037	1,790	3,827
San Francisco-Oak.-San Jose, CA	10,000	48,087	58,087	3,939	44,546	48,485	6,060	3,542	9,602
Washington-Baltimore, DC-MD-VA-WV-PA	6,941	47,061	54,003	4,190	40,619	44,808	2,752	6,443	9,194
Atlanta, GA-AL-NC	1,661	48,301	49,962	1,085	41,589	42,674	576	6,712	7,288
Seattle-Tacoma-Bremerton, WA	6,263	36,651	42,914	4,771	32,620	37,391	1,492	4,031	5,523
Houston-Galves.-Brazoria, TX	687	41,453	42,140	467	36,133	36,600	220	5,320	5,540
Denver-Boulder-Gree., CO-KS-NE	3,556	34,443	37,999	2,300	28,112	30,412	1,256	6,331	7,587
Dallas-Fort Worth, TX-AR-OK	2,786	34,078	36,863	2,033	30,045	32,078	753	4,033	4,786
Philadelphia-Wil.-Atlantic City, PA-NJ-DE-MD	10,103	25,784	35,886	8,937	24,715	33,652	1,166	1,068	2,235
Orlando, FL	3,778	31,737	35,515	2,462	30,120	32,583	1,316	1,617	2,933
Nashville, TN-KY	822	34,053	34,875	986	29,583	30,570	-165	4,470	4,305
Lexington, KY-TN-VA-WV	112	34,589	34,701	119	33,518	33,637	-7	1,071	1,064
Fresno, CA	909	31,287	32,195	897	29,870	30,767	12	1,416	1,428
Phoenix-Mesa, AZ-NM	3,282	26,071	29,354	408	24,429	24,837	2,874	1,643	4,517
Sacramento-Yolo,CA	1,681	26,141	27,822	907	24,493	25,400	774	1,648	2,421
Jacksonville,FL-GA	1,024	26,544	27,568	1,023	22,981	24,004	1	3,563	3,564
Flagstaff, AZ-UT	0	27,475	27,475	0	25,808	25,808	0	1,667	1,667
San Antonio, TX	1,542	25,766	27,308	105	22,347	22,452	1,437	3,419	4,856
Portland-Salem, OR-WA	3,301	23,813	27,114	2,631	19,304	21,935	670	4,509	5,179
Pittsburgh, PA-WV	2,735	24,223	26,958	3,573	24,125	27,697	-838	99	-739
Boston-Wor.-Law.-Lowell-Brocktn, MA-NH-RI-VT	1,848	23,129	24,978	2,603	20,902	23,504	-754	2,228	1,473
Honolulu, HI	2,607	22,158	24,765	2,161	17,663	19,824	446	4,495	4,941
St. Louis, MO-IL	1,913	21,253	23,166	2,005	19,601	21,607	-92	1,651	1,559
Las Vegas, NV-AZ-UT	2,051	20,216	22,267	336	18,262	18,598	1,714	1,954	3,668
Raleigh-Durham-Chapel Hill, NC	2,274	19,714	21,988	2,373	18,544	20,917	-99	1,170	1,071
Columbus, OH	1,369	20,433	21,802	1,139	19,140	20,280	230	1,293	1,522
Cleveland-Akron, OH-PA	1,130	20,588	21,718	1,769	19,914	21,683	-640	674	34
Indianapolis, IN-IL	2,607	18,157	20,764	3,418	15,911	19,329	-811	2,247	1,436
Chicago-Gary-Keno., IL-IN-WI	4,511	16,161	20,672	3,591	15,405	18,996	920	757	1,676
Top 30 EAs	**105,334**	**936,112**	**1,041,446**	**70,726**	**848,189**	**918,915**	**34,608**	**87,923**	**122,531**
United States	**174,428**	**1,869,751**	**2,044,179**	**137,929**	**1,717,945**	**1,855,874**	**36,499**	**151,805**	**188,305**

Source: Center for Urban Policy Research, Rutgers University.

Table 8.8
Road Cost Savings—
Uncontrolled- and Controlled-Growth Scenarios by EA: 2000 to 2025
(Top 30 EAs—in Billions of Dollars)

	Uncontrolled Growth			Controlled Growth			Road Cost Savings		
EA	**Developed Areas**	**Un-developed Areas**	**Total Lane-Mile Costs**	**Developed Areas**	**Un-developed Areas**	**Total Lane-Mile Costs**	**Developed Areas**	**Un-developed Areas**	**Total Road Cost Savings**
Los Angeles-Riv.-Orange, CA-AZ	14.79	31.91	46.70	1.82	28.99	30.81	12.97	2.93	15.89
New York-North NJ-L. Isl., NY-NJ-CT-PA-MA-VT	10.35	24.15	34.50	6.32	23.36	29.68	4.03	0.79	4.82
San Francisco-Oak.-San Jose, CA	10.59	21.60	32.19	3.74	20.20	23.94	6.85	1.40	8.25
Washington-Baltimore, DC-MD-VA-WV-PA	6.87	20.36	27.23	3.73	17.53	21.26	3.14	2.83	5.97
Atlanta, GA-AL-NC	1.77	19.82	21.59	1.06	17.00	18.06	0.71	2.82	3.52
Seattle-Tacoma-Bremerton, WA	5.75	17.12	22.87	3.89	15.39	19.28	1.86	1.73	3.59
Houston-Galves.-Brazoria, TX	0.58	18.51	19.08	0.34	16.26	16.60	0.23	2.25	2.48
Denver-Boulder-Gree., CO-KS-NE	2.87	15.94	18.80	1.76	13.04	14.80	1.10	2.90	4.00
Dallas-Fort Worth, TX-AR-OK	2.99	14.33	17.32	2.10	12.67	14.77	0.89	1.66	2.55
Philadelphia-Wil.-Atlantic City, PA-NJ-DE-MD	9.71	12.06	21.77	8.30	11.55	19.85	1.41	0.51	1.92
Orlando, FL	2.96	12.87	15.84	1.70	12.21	13.91	1.26	0.66	1.92
Nashville, TN-KY	0.52	13.32	13.84	0.67	11.60	12.28	-0.15	1.71	1.57
Lexington, KY-TN-VA-WV	0.09	12.22	12.31	0.07	11.86	11.93	0.03	0.36	0.38
Fresno, CA	0.56	12.34	12.90	0.54	11.78	12.33	0.02	0.55	0.57
Phoenix-Mesa, AZ-NM	2.73	11.00	13.73	0.34	10.31	10.65	2.39	0.69	3.09
Sacramento-Yolo, CA	1.30	11.31	12.61	0.62	10.61	11.23	0.68	0.70	1.38
Jacksonville, FL-GA	0.71	10.55	11.26	0.71	9.14	9.86	-0.01	1.41	1.40
Flagstaff, AZ-UT	0.00	9.98	9.98	0.00	9.42	9.42	0.00	0.56	0.56
San Antonio, TX	1.48	9.83	11.32	0.06	8.53	8.59	1.43	1.30	2.73
Portland-Salem, OR-WA	2.89	9.82	12.71	2.21	7.99	10.21	0.68	1.82	2.50
Pittsburgh, PA-WV	1.70	9.62	11.32	2.21	9.58	11.80	-0.51	0.04	-0.47
Boston-Wor.-Law.-Lowell-Brocktn, MA-NH-RI-VT	1.56	11.06	12.62	2.17	9.81	11.98	-0.61	1.25	0.64
Honolulu, HI	3.39	9.17	12.56	2.81	7.30	10.11	0.58	1.87	2.45
St. Louis, MO-IL	1.61	8.25	9.86	1.65	7.63	9.28	-0.04	0.62	0.58
Las Vegas, NV-AZ-UT	1.82	8.38	10.20	0.30	7.53	7.83	1.52	0.85	2.37
Raleigh-Durham-Chapel Hill, NC	2.01	8.18	10.19	2.01	7.67	9.68	0.01	0.50	0.51
Columbus, OH	1.17	7.76	8.94	0.73	7.28	8.00	0.45	0.49	0.93
Cleveland-Akron, OH-PA	0.75	8.48	9.22	1.14	8.17	9.32	-0.39	0.30	-0.09
Indianapolis, IN-IL	1.99	6.91	8.90	2.49	6.07	8.55	-0.50	0.85	0.35
Chicago-Gary-Keno., IL-IN-WI	4.52	7.57	12.09	3.20	7.22	10.42	1.32	0.35	1.67
Top 30 EAs	100.03	394.41	494.44	58.69	357.71	416.40	41.34	36.70	78.04
United States	155.65	771.36	927.01	107.86	709.45	817.31	47.78	61.91	109.70

Source: Center for Urban Policy Research, Rutgers University.

Courtesy of A. Nelessen

land, NY-NJ-CT-PA-MA-VT EA. This EA has a future requirement of 63,000 additional local road lane-miles. The fourth EA in local road lane-mile demand is from the South, but in the northernmost portion of the South. The Washington-Baltimore, DC-MD-VA-WV-PA EA has a requirement of 54,000 additional lane-miles for the period 2000 to 2025. One other EA requires about 50,000 new lane miles for the projection period; the Atlanta, GA-AL-NC EA. All the remaining EAs in the top 30 have future local road requirements of significantly less than 50,000 lane-miles. Requirements range from 20,000 new lane-miles in the Chicago-Gary-Kenosha, IL-IN-WI EA to 43,000 new lane-miles in the Seattle-Tacoma-Bremerton, WA EA.

The cost of future road construction is a direct outgrowth of the demand for future lane-miles. The top 30 EAs will incur costs of $494 billion for additional required local road capacity during the period 2000 to 2025 (Table 8.8). This represents one-half of the nation's total costs for new local road lane-miles for the projection period. The first six EAs of the 30 listed have projected road costs that range from $47 million to $22 million and collectively represent 20 percent of total local road costs nationwide. As expected, the Los Angeles-Riverside-Orange, CA EA evidences the highest future road costs, with spending projected at $46.7 billion. The second two EAs (the New York-Northern New Jersey-Long Island, NY-NJ-CT-PA-MA-VT EA and the San Francisco-Oakland-San Jose, CA EA) are in the $30 billion range in terms of future local road construction costs. For the New York-Northern New Jersey-Long Island, NY-NJ-CT-PA-MA-VT EA and the San Francisco-Oakland-San Jose, CA EA, costs are $34.5 billion and $32.2 billion, respectively. The remaining three EAs (the Washington-Baltimore, DC-MD-VA-WV-PA EA, the Atlanta, GA-AL-NC EA, and the Seattle-Tacoma-Bremerton, WA EA) range in costs from $21.6 billion to $27.2 billion.

Controlled Growth

In the top 30 EAs, representing one-half of the future national local road demand, lane-miles are reduced from 1.04 million to 919,000, a saving of 123,000 lane-miles (Table 8.7). Of the top three EAs in lane-mile savings, the Los Angeles-Riverside-Orange, CA, Washington-Baltimore, DC-MD-VA-WV-PA EA, and the San Francisco-Oakland-San Jose, CA EA save a total of 37,000 lane-miles. The Los Angeles-Riverside-Orange, CA EA savings of 18,000 lane-miles is equal to the next two EAs in savings; these amount to ap-

Table 8.9
Road Lane-Mile Savings—
Uncontrolled- and Controlled-Growth Scenarios by County: 2000 to 2025
(Top 50 Counties—in Miles)

	Uncontrolled Growth			Controlled Growth			Lane-Mile Savings		
County	Developed Areas	Un-developed Areas	Total Lane-Miles Required	Developed Areas	Un-developed Areas	Total Lane-Miles Required	Developed Areas	Un-developed Areas	Total Lane-Miles Saved
Riverside, CA	1,304	21,869	23,173	0	18,481	18,481	1,304	3,388	4,692
Kern, CA	0	15,031	15,031	0	13,355	13,355	0	1,676	1,676
Yavapai, AZ	0	13,960	13,960	0	12,999	12,999	0	961	961
San Bernardino, CA	451	13,289	13,739	0	12,807	12,807	451	482	933
Maricopa, AZ	3,282	8,498	11,780	408	7,970	8,378	2,874	528	3,402
San Diego, CA	6,749	4,182	10,931	3,359	4,182	7,541	3,391	0	3,391
Hawaii, HI	0	10,696	10,696	0	8,734	8,734	0	1,962	1,962
Tulare, CA	178	10,001	10,179	484	9,658	10,142	-306	343	38
Montgomery, TX	0	9,873	9,873	0	8,453	8,453	0	1,420	1,420
Fresno, CA	731	8,915	9,645	413	8,575	8,988	318	340	657
Los Angeles, CA	6,488	1,750	8,238	0	1,750	1,750	6,488	0	6,488
Maui+Kalawao, HI	0	8,188	8,188	0	5,819	5,819	0	2,370	2,370
Washington, UT	0	7,959	7,959	0	7,267	7,267	0	692	692
Lake, FL	0	7,889	7,889	0	7,415	7,415	0	474	474
Sonoma, CA	707	7,010	7,718	545	6,022	6,566	163	989	1,151
Cochise, AZ	0	7,566	7,566	0	7,279	7,279	0	288	288
San Luis Obispo, CA	0	7,331	7,331	0	7,065	7,065	0	266	266
Valencia+Cibola, NM	0	7,012	7,012	0	5,350	5,350	0	1,662	1,662
Coconino, AZ	0	6,897	6,897	0	7,220	7,220	0	-323	-323
Mohave, AZ	0	6,865	6,865	0	6,352	6,352	0	512	512
El Dorado, CA	0	6,724	6,724	0	6,373	6,373	0	351	351
Pima, AZ	2,479	4,220	6,700	1,996	3,842	5,838	483	379	862
Lancaster, PA	785	5,893	6,678	847	5,564	6,411	-62	329	267
Navajo, AZ	0	6,618	6,618	0	5,589	5,589	0	1,029	1,029
Madera, CA	0	6,594	6,594	0	6,122	6,122	0	471	471
Pinal, AZ	0	6,592	6,592	0	6,137	6,137	0	456	456
Snohomish, WA	1,934	4,432	6,367	1,928	4,178	6,106	6	254	260
Imperial, CA	0	6,235	6,235	0	5,943	5,943	0	292	292
Baldwin, AL	0	6,189	6,189	0	5,668	5,668	0	522	522
Williamson, TX	521	5,594	6,115	367	4,361	4,728	155	1,232	1,387
Deschutes, Or	0	5,949	5,949	0	3,673	3,673	0	2,276	2,276
Polk, FL	0	5,865	5,865	0	5,700	5,700	0	165	165
Stanislaus, CA	310	5,472	5,782	20	4,690	4,711	290	782	1,072
Kings, CA	0	5,777	5,777	0	5,515	5,515	0	262	262
Brazoria, TX	0	5,774	5,774	103	4,662	4,764	-103	1,112	1,010
Placer, CA	559	5,096	5,655	620	4,773	5,393	-61	323	262
Clark, NV	2,051	3,456	5,506	336	2,934	3,270	1,714	522	2,236
Apache, AZ	0	5,434	5,434	0	5,029	5,029	0	406	406
Larimer, CO	589	4,795	5,384	503	4,205	4,708	86	590	676
Ventura, CA	1,893	3,346	5,238	1,385	3,293	4,678	507	53	560
Benton, AR	0	5,119	5,119	0	4,313	4,313	0	806	806
Humboldt, CA	0	5,119	5,119	0	4,992	4,992	0	127	127
Skagit, WA	0	5,090	5,090	0	4,367	4,367	0	723	723
Westmoreland, PA	1,082	3,893	4,975	1,354	3,886	5,240	-272	7	-265
Rutherford, TN	0	4,952	4,952	0	4,574	4,574	0	379	379
Pasco, FL	307	4,564	4,871	0	3,708	3,708	307	856	1,163
Collier, FL	342	4,434	4,776	420	4,162	4,582	-78	272	194
Palm Beach, FL	1,939	2,818	4,758	530	2,818	3,349	1,409	0	1,409
Chester, PA	1,782	2,939	4,720	1,689	2,810	4,499	92	129	221
Monterey, CA	891	3,795	4,686	743	3,795	4,538	148	0	148
Top 50 Counties	**37,354**	**337,558**	**374,913**	**18,051**	**304,424**	**322,475**	**19,304**	**33,134**	**52,438**
United States	**174,428**	**1,869,751**	**2,044,179**	**137,929**	**1,717,945**	**1,855,874**	**36,499**	**151,805**	**188,305**

Source: Center for Urban Policy Research, Rutgers University.

proximately 9,000 lane-miles each. One other EA of note is the Atlanta, GA-AL-NC EA, which evidences a local road savings of 7,300 lane-miles. All of the remaining EAs in the top 30 of future local road demand have at least nominal savings under the controlled-growth scenario. The one exception is the Pittsburgh, PA-WV EA, which experiences an increase of 739 lane-miles. This reflects Pennsylvania's prevailing road-mile density, which is generally lower in both developed and undeveloped areas of counties compared with other northeastern states.

The top 30 EAs, again representing 50 percent of new road cost, reduce their costs from $494 billion to $416 billion, a saving of $78 billion (Table 8.8). Of the top two EAs in road cost savings, the Los Angeles-Riverside-Orange, CA EA saves the most at $15.9 billion. That EA is followed by the San Francisco-Oakland-San Jose, CA EA with a saving of $8.3 billion. Three other EAs are noteworthy. The Washington-Baltimore, DC-MD-VA-WV-PA EA, the New York-Northern New Jersey-Long Island, NY-NJ-CT-PA-MA-VT EA, and the Denver-Boulder-Greeley,CO EA, all save more than $4 billion each. All of the remaining EAs in the top 30 in local road demand exhibit some cost savings under the controlled-growth scenario. The exceptions are the Pittsburgh, PA-WV and Cleveland-Akron, OH EAs, which show *increases* in costs under the controlled-growth scenario of $474 million and $91 million, respectively. Again, these areas contain less road density in developed areas, meaning they require augmentation as growth occurs there.

COUNTIES

Uncontrolled Growth

Table 8.9 presents the top 50 counties ranked by future local road demand. These 50 counties (out of

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Courtesy of C. Galley

3,091 counties nationwide) account for approximately 20 percent of all future road demand. Approximately 1.5 percent of all the counties nationwide account for one-fifth of future required local road lane-miles. The top eight counties each require in excess of 10,000 new local road lane-miles for the development period 2000 to 2025. These eight counties are all in the West region and are led by Riverside County, CA, with a requirement of 23,000 new local road-lane miles. Riverside County, CA, is also a prime contributor to the top road-requirement EA (Los Angeles-Riverside-Orange, CA). The next seven counties range in demand from a requirement of 15,000 (Kern County, CA) to 10,000 (Tulare County, CA) additional lane-miles. Within this group are the counties with the largest new demand for local roads in *developed* areas. These are San Diego County, CA, with a requirement of more than 6,700 new lane-miles, and Los Angeles County, CA, with a requirement of 6,500 additional lane-miles in the developed areas.

The cost of this new road infrastructure is presented in Table 8.10 for the nation's top 50 counties in road demand. The cost for those counties, which amounts to almost 20 percent of total national cost, is $178.4 billion. Thus, 1.5 percent of the counties nationwide will bear 20 percent of the future local road construction costs. Riverside County, CA, with the largest future local road demand, will pay more than $10 billion over the period 2000 to 2025 on road construction. Two other southern California counties (San Diego and Los Angeles) will experience future road costs in the mid–$9 billion range for the projection period.

Controlled Growth

Under the controlled-growth scenario, the top 50 counties, representing about one-fifth of future national demand for local roads, reduce their requirements for lane-miles from 375,000 to 322,000, a saving of 55,000 lane-miles (Table 8.9). Los Angeles

Table 8.10
Road Cost Savings—
Uncontrolled- and Controlled-Growth Scenarios by County: 2000 to 2025
(Top 50 Counties—in Billions of Dollars)

	Uncontrolled Growth			Controlled Growth			Road Cost Savings		
County	Developed Areas	Un-developed Areas	Total Lane-Mile Costs	Developed Areas	Un-developed Areas	Total Lane-Mile Costs	Developed Areas	Un-developed Areas	Total Road Cost Savings
Riverside, CA	0.85	9.53	10.38	0.00	8.05	8.05	0.85	1.48	2.33
Kern, CA	0.00	5.95	5.95	0.00	5.29	5.29	0.00	0.66	0.66
Yavapai, AZ	0.00	4.84	4.84	0.00	4.51	4.51	0.00	0.33	0.33
San Bernardino, CA	0.28	5.58	5.86	0.00	5.38	5.38	0.28	0.20	0.49
Maricopa, AZ	2.73	4.72	7.45	0.34	4.42	4.76	2.39	0.29	2.69
San Diego, CA	6.61	2.73	9.35	3.29	2.73	6.02	3.32	0.00	3.32
Hawaii, HI	0.00	4.12	4.12	0.00	3.36	3.36	0.00	0.76	0.76
Tulare, CA	0.11	3.96	4.06	0.29	3.82	4.11	-0.18	0.14	-0.05
Montgomery, TX	0.00	5.27	5.27	0.00	4.51	4.51	0.00	0.76	0.76
Fresno, CA	0.45	3.70	4.15	0.26	3.56	3.81	0.20	0.14	0.34
Los Angeles, CA	8.00	1.44	9.44	0.00	1.44	1.44	8.00	0.00	8.00
Maui+Kalawao, HI	0.00	3.60	3.60	0.00	2.56	2.56	0.00	1.04	1.04
Washington, UT	0.00	3.04	3.04	0.00	2.77	2.77	0.00	0.26	0.26
Lake, FL	0.00	3.23	3.23	0.00	3.03	3.03	0.00	0.19	0.19
Sonoma, CA	0.51	3.36	3.87	0.39	2.89	3.28	0.12	0.47	0.59
Cochise, AZ	0.00	2.74	2.74	0.00	2.63	2.63	0.00	0.10	0.10
San Luis Obispo, CA	0.00	3.00	3.00	0.00	2.89	2.89	0.00	0.11	0.11
Valencia+Cibola, NM	0.00	3.20	3.20	0.00	2.44	2.44	0.00	0.76	0.76
Coconino, AZ	0.00	2.84	2.84	0.00	2.97	2.97	0.00	-0.13	-0.13
Mohave, AZ	0.00	2.57	2.57	0.00	2.38	2.38	0.00	0.19	0.19
El Dorado, CA	0.00	3.04	3.04	0.00	2.89	2.89	0.00	0.16	0.16
Pima, AZ	1.45	1.64	3.09	1.17	1.50	2.66	0.28	0.15	0.43
Lancaster, PA	0.53	2.64	3.17	0.57	2.49	3.06	-0.04	0.15	0.11
Navajo, AZ	0.00	2.29	2.29	0.00	1.94	1.94	0.00	0.36	0.36
Madera, CA	0.00	2.51	2.51	0.00	2.33	2.33	0.00	0.18	0.18
Pinal, AZ	0.00	2.30	2.30	0.00	2.14	2.14	0.00	0.16	0.16
Snohomish, WA	1.64	2.51	4.15	1.64	2.36	4.00	0.01	0.14	0.15
Imperial, CA	0.00	2.47	2.47	0.00	2.36	2.36	0.00	0.12	0.12
Baldwin, AL	0.00	2.37	2.37	0.00	2.17	2.17	0.00	0.20	0.20
Williamson, TX	0.31	2.21	2.51	0.22	1.72	1.94	0.09	0.49	0.58
Deschutes, Or	0.00	2.36	2.36	0.00	1.46	1.46	0.00	0.90	0.90
Polk, FL	0.00	2.34	2.34	0.00	2.27	2.27	0.00	0.07	0.07
Stanislaus, CA	0.18	2.10	2.28	0.01	1.80	1.82	0.17	0.30	0.47
Kings, CA	0.00	2.17	2.17	0.00	2.07	2.07	0.00	0.10	0.10
Brazoria, TX	0.00	2.39	2.39	0.06	1.93	1.99	-0.06	0.46	0.40
Placer, CA	0.39	2.36	2.74	0.43	2.21	2.64	-0.04	0.15	0.11
Clark, NV	1.82	2.04	3.86	0.30	1.74	2.03	1.52	0.31	1.83
Apache, AZ	0.00	1.90	1.90	0.00	1.76	1.76	0.00	0.14	0.14
Larimer, CO	0.37	1.98	2.35	0.31	1.74	2.05	0.05	0.24	0.30
Ventura, CA	1.56	1.84	3.40	1.14	1.81	2.95	0.42	0.03	0.45
Benton, AR	0.00	2.13	2.13	0.00	1.79	1.79	0.00	0.34	0.34
Humboldt, CA	0.00	1.96	1.96	0.00	1.92	1.92	0.00	0.05	0.05
Skagit, WA	0.00	2.14	2.14	0.00	1.83	1.83	0.00	0.30	0.30
Westmoreland, PA	0.68	1.64	2.33	0.86	1.64	2.49	-0.17	0.00	-0.17
Rutherford, TN	0.00	2.09	2.09	0.00	1.93	1.93	0.00	0.16	0.16
Pasco, FL	0.18	1.83	2.02	0.00	1.49	1.49	0.18	0.34	0.53
Collier, FL	0.30	2.63	2.93	0.37	2.47	2.84	-0.07	0.16	0.09
Palm Beach, FL	2.09	2.02	4.11	0.57	2.02	2.59	1.52	0.00	1.52
Chester, PA	1.58	1.74	3.32	1.50	1.67	3.17	0.08	0.08	0.16
Monterey, CA	0.70	1.98	2.68	0.58	1.98	2.57	0.12	0.00	0.12
Top 50 Counties	33.33	145.05	178.38	14.30	131.06	145.36	19.03	13.99	33.02
United States	155.65	771.36	927.01	107.86	709.45	817.31	47.78	61.91	109.70

Source: Center for Urban Policy Research, Rutgers University.

County, CA, is by far the county with the greatest savings, with 6,500 lane-miles saved. The second-largest number of lane-miles saved is in Riverside County, CA, with 4,600 lane-miles saved. On the other hand, Coconino County, AZ, and Westmoreland County, PA, which serve as major receiving suburban counties, require 323 and 265 additional lane-miles, respectively, under the controlled-growth scenario.

Future lane-mile requirements directly affect a county's future infrastructure costs. Table 8.10 lists future road construction costs for the top 50 local road demand counties. The combined cost for these 50 counties is $145 billion, representing nearly 20 percent of all future local road costs. This is a saving of $33 billion, or 18.5 percent, over the 25-year projection period. The largest individual saving is found in Los Angeles County, CA, with $8 billion saved for the period. The second-largest saving is in San Diego County, CA, with a $3.3. billion saving. As noted earlier, Westmoreland County, PA, and Coconino County, AZ, need additional roads, under the controlled-growth scenario, costing these counties $133 million and $169 million, respectively.


Courtesy of G. Lowenstein


Courtesy of G. Lowenstein

Tulare County, CA, must expend an additional $46 million in future local road construction.

CONCLUSION

For the projection period 2000 to 2025, under traditional or uncontrolled growth, the United States will spend more than $927 billion to provide necessary road infrastructure amounting to an additional 2.05 million lane-miles of local roads. Under controlled growth, 1.85 million lane-miles of local roads will be required, amounting to $817 billion in local road costs. Overall, a saving of 188,300 lane-miles of local roads and $110 billion can be achieved with more-compact growth patterns. This is a saving of 9.2 percent in local lane-miles and 11.8 percent in local road costs. Why is this saving not greater? Under either scenario, development takes place in the outer reaches of metropolitan areas and local roads must be built. Even in the close-in areas where growth is directed, local roads must be widened to accommodate development, resulting in additional lane-miles of local roads.

Thus, whether you have sprawl or controlled growth, approximately 2 million lane-miles (potentially minus 9 percent) of local roads must be put in place and $927 billion (potentially minus 12 percent) must be spent. A controlled-growth regimen could reduce these outlays. While not extraordinary, savings would be clearly in evidence. Appreciable savings in lane-miles constructed and costs incurred could be achieved under a growth regimen emphasizing more-compact development patterns.

Courtesy of R. Ewing

IX

Local Public-Service Costs in the United States:

Requirements under Sprawl and Alternative Conditions

INTRODUCTION

The purpose of this chapter is to discuss the local public-service costs of development generated under two different development futures. The question to be answered here is whether compact development, emphasized in the controlled-growth future, is less expensive to service than traditional or sprawl development. Does compact development, which may contain more single-family attached and multifamily units as a component of all development, produce more net revenues than traditional, single-family development? The same number of people, households, and employees will be generated under each alternative. The only difference is that people, households, and employees will be directed to the more developed parts of counties and the more central counties of economic areas (EAs).

Counties will again play a significant role in determining public-service costs, as all local services will be assumed to be delivered at the county level. This is true because the costs and the revenues of all local jurisdictions in a county, including municipalities and school districts, are added to the costs and revenues strictly of the county to provide a comprehensive inventory of local (county and below) public services provided and public revenues generated. These local services will be disaggregated and assigned to developed (urbanized) and undeveloped (rest of county) areas within counties. If one developed and one undeveloped area exist within each county, as many as 6,200 individual fiscal impact analyses must be performed (Burchell, Dolphin, and Galley 2000).

Fiscal impact analyses will be undertaken at the subcounty level, and the differing numbers of population en route to developed and undeveloped areas in counties will be evaluated with respect to the cost and revenue relationships found in these areas under the two growth alternatives. Fiscal impact analysis is a technique used extensively by the Center for Urban Policy Research, Rutgers University, and other research organizations nationwide to evaluate the cost and revenue impacts of land development (Burchell, Listokin, Listokin, and Pashman 1994).

BACKGROUND

Fiscal impact is the public-service costs versus revenues of future development (Burchell and Listokin 1978). Fiscal impact *analysis* measures how a public-service jurisdiction will fare in the future in terms of the magnitude of revenues raised to pay for the level of costs incurred. On the cost side of the ledger are operating, statutory, and capital costs; on the revenue side are property tax, nontax, and intergovernmental transfer revenues (Siegel 2000). These are estimated for the jurisdiction in which development is taking place. For noneducational costs—police, fire, public works, general government, and recreation/culture—the jurisdiction is the county including all separate municipalities; for educational costs, including those involved with both instruction and administration, the jurisdiction is also the county including all separate school districts. The county is further involved in the provision of nonmunicipal, non-school-district county public services. These include health, welfare, incarceration, courts, parks, roads, and so on. When costs are subtracted from revenues, the net fiscal impact on the county's fiscal status is determined. Taking into consideration an array of local circumstances and characteristics, the increment of development is evaluated as producing either a positive or negative annual impact over time. Factors considered are the amount, type, size, and value of projected development; the existing value and composition of real estate in the county; and the county's basic fiscal indices, such as tax rate, equalization ratio, tax base per capita, and levels of intergovernmental and nontax revenue per capita. County fiscal impact (including municipality and school district) indicates whether a development is a net contributor to or a net drain on the subsequent taxes of that county. Usually, residential types of development of conventional size and price (single-family homes, town houses, and garden apartments) are net fiscal drains to a local jurisdiction; open spaces (agricultural, forest, and parklands) are fiscally neutral; and nonresidential types (office, industrial, and retail) are net contributors to the local fiscal status.


Courtesy of C. Galley

Public services are provided and consumed on a daily basis in a variety of local jurisdictions in the United States. A wide array and scope of services for the most part meet the educational and noneducational needs of those who reside in these jurisdictions. They are delivered in large and small, developed and developing, and rich and poor locations with an amazing amount of competency and consistency. Further, they are funded through a bundle of revenues, the composition of which varies often by the financial culture of an individual state. This is the context within which the fiscal impacts of growth—with and without controls—will be evaluated.

CONCEPTUAL OVERVIEW AND ASSESSMENT MODEL

The Rutgers Fiscal Impact Analysis Model

The Rutgers Fiscal Impact Analysis Model measures how a public-service jurisdiction (region, EA, state, or county) will fare in the future in terms of the magnitude of revenues raised to pay for the level of costs incurred. When costs are subtracted from revenues, a net fiscal impact on the jurisdiction is determined. This is either a positive or negative annual impact that begins the day the development's structures are occupied and continues forever into the future unless either the development or local fiscal factors are altered (Burchell, Listokin, and Pashman 1994).

An analysis of the fiscal impacts of public-service provision involves three basic steps. These are (1) the calculation of costs; (2) the pairing of costs with revenues; and (3) the determination of net fiscal impact. Each, in turn, will be discussed below.

Cost Calculation

The population and employment figures introduced by the growth projections of chapter 3 are translated


Courtesy of C. Galley

into the public services required and resulting costs associated with this growth. To determine costs on a unit or per capita basis, one cannot simply divide all incurred costs by the local resident population in the jurisdictions where those costs occur, because such services benefit both residential and nonresidential development. Both residents and workers consume local services. Service costs must therefore be apportioned between these two types of service users. In this study, per capita charges will be developed for *residentially* induced costs, including education, and *nonresidentially* induced costs, excluding education. The former will be expressed per new resident; the latter will be expressed per new worker.

In order to relate the above costs to the appropriate causal factors, several steps must be taken. First, the residential share of all service costs must be estimated by dividing existing residential property value by the sum of existing residential and nonresidential property value. This calculation produces the *residential* share of combined residential and nonresidential property value. The resulting fraction is then applied to the various levels of noneducational costs (municipal and county) to derive the estimated residential share of total county and municipal noneducational costs. Educational costs are subsequently added to this number and the sum is expressed per existing resident. The remainder of noneducational costs is expressed per existing employee by dividing this number by the number of employees that currently work in the county.

The above procedure can be illustrated by the following example. In a hypothetical county of 250,000 residents and 100,000 employees, county and municipal outlays total $400 million. The local tax base, comprising 90,000 parcels, amounts to $10 billion. Of this total, 85,000 residential parcels are valued at $9 billion; 5,000 nonresidential parcels are valued at $1 billion. The residential share of total valuation is 90 percent ($9 billion divided by $10 billion). The 90 percent figure is applied to the total noneducational (county and municipal) cost outlay of $200 million to yield estimated residentially induced expenditures of $180 million; the remaining $20 million is assigned to services induced by nonresidential land uses. Adding the educational expenses to noneducational expenses (i.e., $200 million plus $180 million) yields total residentially induced costs of $380 million. With a local population of 250,000 and a workforce of 100,000 employees, the county's residentially induced costs per capita are $1,520 ($380,000,000/250,000), while the nonresi-dentially induced costs per worker are $200 ($20,000,000/100,000).

Future growth-induced public-service costs for the jurisdiction are then calculated by multiplying the per capita cost by the total number of people and employees introduced by development. If the growth in this county was projected to add 30,000 people and 15,000 workers, at a per-unit cost of $1,520 per capita and $200 per employee, the per capita method would project annual costs of about $46.6 million to serve new residents and approximately $3.0 million to serve new workers.

Costs are calculated for the developed and undeveloped portions of each county nationwide in the following way. It is assumed that municipal costs apply only to developed areas. County and school district costs are assigned to developed areas by the ratio of the population in the developed areas to the total population in the county. The remainder of these costs are assigned to undeveloped areas. If the county has all developed areas or all undeveloped areas, no apportionment is undertaken and all costs are assigned as generated in the county.

Revenue Calculations

Public-service jurisdictions rely on revenues that include both local and nonlocal sources. Local sources comprise a variety of local tax and nontax levies, while nonlocal sources comprise intergovernmental transfers from the state and federal governments.

Local sources are usually the more significant revenues and encompass taxes, charges, and other miscellaneous revenues. The most significant tax is the property tax commonly levied on real property. Other taxes include levies on personal property, utility use, consumer products, and income. In addition to taxes,

Table 9.1
Current Average Per Capita and Per-Worker Annual Public-Service Expenditures: United States and by State
(in Dollars)

	Average Per Capita Expenditures			Average Per-Worker Expenditures		
State	Developed Areas	Undeveloped Areas	Overall	Developed Areas	Undeveloped Areas	Overall
Alabama	1,476	913	1,012	74	46	51
Alaska	2,383	4,910	4,676	119	246	234
Arizona	2,817	1,901	2,050	141	95	103
Arkansas	1,451	991	1,019	73	50	51
California	2,562	2,192	2,475	128	110	124
Colorado	2,191	2,432	2,543	110	122	127
Connecticut	1,950	1,963	1,963	97	98	98
Delaware	1,306	1,203	1,309	65	60	65
Florida	1,939	1,636	1,799	97	82	90
Georgia	1,546	1,324	1,362	77	66	68
Hawaii	900	1,260	1,146	45	63	57
Idaho	1,550	1,532	1,553	78	77	78
Illinois	1,935	1,157	1,264	97	58	63
Indiana	1,837	1,328	1,400	92	66	70
Iowa	1,833	1,588	1,636	92	79	82
Kansas	1,985	1,840	1,870	99	92	94
Kentucky	1,504	1,084	1,115	75	54	56
Louisiana	1,871	1,321	1,410	94	66	71
Maine	1,667	1,646	1,646	83	82	82
Maryland	1,745	1,459	1,539	87	73	77
Massachusetts	2,433	778	1,904	122	39	95
Michigan	2,341	1,498	1,598	117	75	80
Minnesota	2,827	2,107	2,216	141	105	111
Mississippi	1,331	1,183	1,211	67	59	61
Missouri	1,429	910	955	71	45	48
Montana	1,485	2,308	2,325	74	115	116
Nebraska	1,496	1,572	1,589	75	79	79
Nevada	2,072	2,839	2,892	104	142	145
New Hampshire	2,629	1,505	1,766	131	75	88
New Jersey	3,096	1,744	2,493	155	87	125
New Mexico	1,592	1,689	1,750	80	84	88
New York	3,547	2,216	2,710	177	111	135
North Carolina	2,107	1,342	1,406	105	67	70
North Dakota	1,626	1,560	1,599	81	78	80
Ohio	2,651	1,373	1,520	133	69	76
Oklahoma	1,732	1,251	1,281	87	63	64
Oregon	3,181	1,844	1,942	159	92	97
Pennsylvania	2,025	1,243	1,405	101	62	70
Rhode Island	1,464	1,464	1,464	73	73	73
South Carolina	1,457	1,105	1,157	73	55	58
South Dakota	1,899	1,309	1,328	95	65	66
Tennessee	1,477	946	1,003	74	47	50
Texas	1,999	1,788	1,849	100	89	92
Utah	1,358	1,946	2,001	68	97	100
Vermont	1,644	1,509	1,541	82	75	77
Virginia	1,821	1,181	1,324	91	59	66
Washington	2,010	1,788	1,937	101	89	97
West Virginia	1,341	1,199	1,232	67	60	62
Wisconsin	2,264	1,767	1,888	113	88	94
Wyoming	2,208	2,601	2,649	110	130	132
United States	**1,940**	**1,625**	**1,734**	**97**	**81**	**87**

Source: Center for Urban Policy Research, Rutgers University.
Note: Washington, DC, is included in the United States totals.

government jurisdictions receive income from interest earnings, permits, charges for services, fines and penalties, and so on.

To model the way in which growth affects both local and nonlocal revenues, the basis for each revenue source is considered and a determination is made as to how future development affects each revenue source. For the smaller sources of revenue, they are typically grouped prior to projection. To illustrate, the property tax is a percentage levy on the value of land and improvements (real property). To project the property tax revenues from growth, one first determines the equalized or market value of residential and nonresidential growth in a county under one or the other alternative. The equalized value is then multiplied by the prevailing equalized property tax rate. In this analysis, property tax rates for developed and undeveloped areas of counties are constructed by dividing existing property tax revenues raised in these areas by their current equalized property valuation. This produces an equalized property tax rate which then can be applied to future growth in property valuation in developed and undeveloped areas.

Other local revenues (fees, fines, permits, etc.) are grouped, assigned proportionately to developed and undeveloped areas and expressed per $1,000 valuation. They are projected into the future according to the value of forthcoming development in developed or undeveloped areas expressed in thousands of dollars.

Intergovernmental revenues are projected similarly but this time on a per capita basis. Thus, if a state granted $75 per capita annually to counties to undertake road repairs, the future generated income for such aid would equal the projected number of new residents going to developed or undeveloped areas, multiplied by their respective weighted share of the $75.

Comparing Costs to Revenues: Net Fiscal Impact

Once the growth-induced costs and revenues are projected, the next step is to determine the results of the fiscal impact assessment by comparing these annual costs and revenues. If costs exceed revenues, a deficit is incurred; if revenues exceed costs, a surplus is realized. This comparison is made for developed and undeveloped areas in counties and summed for viewing at the county, EA, state, region, and national levels. This analysis is undertaken for the uncontrolled-growth scenario using the cost and revenue relationships

Courtesy of C. Galley

that exist for the most current period reported, in this case 1992. This year is used because it reflects information on the value of properties reported by the U.S. Census in 1990. Nonresidential property value is determined by multiplying the number of employees in a jurisdiction by the average space per employee, and again by the average value of existing nonresidential property per square foot. The latter is made to vary by household income differences across counties (Woods and Poole 1998).

Data Sources and Manipulations: Data Sources

In order to calculate fiscal impacts due to future growth, two baseline sets of data are required: first, the current local expenditures and revenues taken from municipal and county budgets, and second, the current demographics and equalized property values are determined. The former are summarized from the *1992 U.S. Census of Governments* for the almost 85,000 units of local government at or below the county level. The census contains data by budgetary category for governmental fiscal years ending between July 1, 1991, and June 1, 1992, for municipalities, school districts, and counties with appropriate Tiger File overlays to account for each. The latter is available from the *1990 U.S. Census of Population and Housing* and has been updated through census information published since the *1990 Census*s (U.S. Department of Commerce 1992).

Data Sources and Manipulations: Costs

Expenditures for municipal, school, and county functions plus capital improvement debt service and deferred charges are aggregated by county, again using information from the *1992 U.S. Census of Govern-*

Table 9.2
Current Average Per Capita and Per-Worker Annual Public-Service Revenues: United States and by State
(in Dollars)

	Average Per Capita Revenues			Average Per-Worker Revenues		
State	Developed Areas	Undeveloped Areas	Overall	Developed Areas	Undeveloped Areas	Overall
Alabama	159	212	276	494	168	214
Alaska	97	2,053	2,149	615	1,613	1,521
Arizona	444	672	795	571	367	366
Arkansas	62	249	269	414	177	183
California	632	564	922	387	287	293
Colorado	220	993	1,111	665	349	363
Connecticut	1,117	1,142	1,244	494	385	450
Delaware	332	239	401	189	209	173
Florida	548	532	796	475	448	376
Georgia	125	508	548	503	391	363
Hawaii	114	559	657	154	215	195
Idaho	25	304	323	219	143	147
Illinois	153	268	354	703	227	240
Indiana	191	413	477	616	322	336
Iowa	53	323	351	389	211	224
Kansas	38	431	459	714	262	272
Kentucky	56	235	259	460	156	168
Louisiana	252	430	528	676	438	370
Maine	352	787	923	1,257	260	333
Maryland	485	670	879	488	490	367
Massachusetts	1,253	615	1,362	494	76	324
Michigan	289	763	863	955	468	458
Minnesota	175	483	556	725	259	279
Mississippi	67	333	348	397	259	260
Missouri	77	218	259	436	136	151
Montana	23	518	525	466	220	228
Nebraska	12	261	269	211	129	134
Nevada	110	719	764	431	312	298
New Hampshire	662	1,346	1,557	899	393	493
New Jersey	1,833	717	1,500	678	705	582
New Mexico	52	296	324	202	139	151
New York	843	1,100	1,455	1,002	680	722
North Carolina	237	411	464	558	264	263
North Dakota	43	233	261	393	123	134
Ohio	481	454	595	1,025	433	422
Oklahoma	97	264	290	550	149	160
Oregon	209	586	647	997	293	324
Pennsylvania	445	534	694	797	391	393
Rhode Island	1,133	873	1,121	443	354	428
South Carolina	237	390	453	388	343	321
South Dakota	38	246	257	595	148	155
Tennessee	101	326	360	430	221	235
Texas	146	474	534	537	277	288
Utah	53	653	694	232	299	318
Vermont	71	997	1,019	504	302	314
Virginia	303	438	620	528	284	301
Washington	235	407	529	386	213	247
West Virginia	51	382	407	925	266	264
Wisconsin	188	583	654	630	317	358
Wyoming	44	767	800	272	388	382
United States	**299**	**559**	**678**	**551**	**319**	**327**

Source: Center for Urban Policy Research, Rutgers University.

Note: Washington, DC, is included in the United States totals. These revenues do not include intergovernmental transfers which are shown on Table 9.4 at about one-third of their actual value. Certain intergovernmental revenues are not projected to increase with future growth.

ments (U.S. Department of Commerce 1992). These annual county expenditures are subsequently scaled to be equal to the adjusted general revenue of the county for that same time period (see description below). Establishing a cost-revenue equality for all jurisdictions in a given budget year eliminates the possibility of a skewed fiscal impact analysis due to abnormal budget imbalances in a jurisdiction in a particular year. Expenditures are then associated with the county's developed and undeveloped areas using both the *Census of Population and Housing*'s definition of urbanized areas and specific budgetary categories found in the *Census of Governments.* Municipal expenditures, as well as a share of county and school district expenditures, apply to developed areas; solely the remaining share of county and school district expenditures apply to undeveloped areas.

Next, area expenditures are divided between services rendered to local residences and businesses. This is done by using ratios of residential to residential and nonresidential property values in a county. Across the nation, an average of 95 percent of public-service expenditures serve the needs of residents, and 5 percent of public-service expenditures serve the needs of workers. This reflects the ratio of residential to residential and nonresidential real property valuation. This calculation is performed for each county. The requisite percentage of county expenditures is divided by the population count in each county to establish a per capita servicing cost for residential development. The remaining portion of the county costs are divided by the existing amount of "at-place" employment to establish a per-employee servicing cost for nonresidential development. Residential and nonresidential per capita and per-employee costs are then assigned to developed and undeveloped areas by the ratio of population in these areas. Table 9.1 is a summary of these costs for the nation and by state.

The next step is to translate per capita and per-worker costs into future aggregate local expenditures. Residential per capita costs in developed and undeveloped areas are multiplied by the number of residents that will emerge from future residential development in developed and undeveloped areas of counties. Per-employee costs are acted upon in the same manner. Expressed per employee for developed and undeveloped areas, they are multiplied by the number of workers that will result from future nonresidential development in developed and undeveloped areas of counties. Future local public costs are the sum of residential and nonresidential development costs. This calculation is performed for the full growth increment in each of the two development scenarios.

Data Sources and Manipulations: Revenues

Revenues for the municipality, school district (both local and regional), and county come from the *1992 U.S. Census of Governments* and are aggregated to the county level in three groupings: (1) real estate taxes; (2) other taxes, fines, fees, interest earnings, and miscellaneous revenues; and (3) state and federal intergovernmental transfers to the county. These revenue streams are further subdivided into two groupings: revenues associated with the developed areas of the county, and revenues associated with the undeveloped areas of the county. Revenues for these areas are handled in the same way as costs. Revenue from municipal sources and a share of county and school district revenues (by relative population amounts) are assigned to the developed areas of counties. The remaining share of county and school district revenues is assigned to undeveloped areas of counties. Table 9.2 is a summary of these costs for the nation and by state.

For the first grouping, *revenue* from real estate taxes is divided by the total equalized real estate value of residential and nonresidential properties to develop an equalized tax rate. Information on the sales price of housing is available from the *1990 U.S. Census of Population and Housing.* This information is accessed through the Public Use Microdata Sample (PUMS) for housing types available for sale, and is of the same vintage as the information from the *1992 U.S. Census of Governments,* which reports financial data of one to two years earlier. For rental properties, the monthly value of rent is multiplied by 100 to estimate value. For nonresidential properties, existing employment by type is converted to space through

Courtesy of A. Nelessen

Table 9.3
Average Per Capita and Per-Worker Annual Equalized Valuation:
United States and by State
(in Dollars)

	Average Per Capita Equalized Valuation			Average Per-Worker Equalized Valuation		
State	**Developed Areas**	**Undeveloped Areas**	**Overall**	**Developed Areas**	**Undeveloped Areas**	**Overall**
Alabama	30,793	20,627	22,805	21,714	16,440	17,261
Alaska	46,450	30,350	33,248	26,656	21,382	21,863
Arizona	48,148	26,688	32,060	19,769	14,625	15,488
Arkansas	29,097	22,303	23,228	20,721	14,881	15,193
California	73,158	40,970	62,918	23,462	17,466	19,747
Colorado	42,188	48,257	51,927	22,049	14,228	14,894
Connecticut	75,383	70,741	75,819	28,963	23,151	26,887
Delaware	81,029	27,729	53,439	25,142	19,233	22,051
Florida	52,995	24,359	37,067	20,984	15,859	17,526
Georgia	35,340	24,901	26,679	22,388	16,525	17,074
Hawaii	79,665	60,594	65,716	26,889	18,745	20,022
Idaho	34,455	30,085	31,797	21,232	14,157	14,412
Illinois	38,516	23,302	24,975	23,657	15,418	16,216
Indiana	50,426	25,178	26,588	23,897	17,560	18,358
Iowa	41,847	23,178	23,563	21,438	14,135	14,467
Kansas	28,021	22,286	23,303	22,087	12,765	12,977
Kentucky	30,343	21,097	22,411	21,022	13,491	13,807
Louisiana	35,378	19,106	22,704	19,555	14,336	15,121
Maine	56,608	51,054	51,614	22,418	17,452	18,095
Maryland	67,653	41,280	52,670	25,298	19,162	20,945
Massachusetts	110,071	73,714	98,213	25,433	19,882	23,031
Michigan	39,036	31,889	35,457	24,404	16,887	17,757
Minnesota	41,260	27,933	30,301	23,018	14,635	15,213
Mississippi	33,233	20,410	21,325	20,718	15,346	15,686
Missouri	32,196	24,841	25,531	21,570	13,575	14,004
Montana	22,215	30,308	29,530	18,833	12,066	12,245
Nebraska	28,343	24,003	24,510	23,271	11,650	11,835
Nevada	45,501	34,681	37,728	20,811	14,617	15,082
New Hampshire	64,243	64,237	65,981	26,340	19,383	20,478
New Jersey	76,725	45,495	68,821	27,646	22,240	26,445
New Mexico	42,205	29,837	31,979	20,807	13,432	13,878
New York	51,865	37,471	42,276	25,102	18,261	19,899
North Carolina	40,489	29,114	31,863	23,236	17,025	17,763
North Dakota	26,813	23,043	24,120	18,487	10,844	11,091
Ohio	36,165	23,402	26,793	23,575	17,601	18,729
Oklahoma	25,710	23,461	24,673	18,644	12,735	13,018
Oregon	39,338	31,074	33,334	21,663	15,495	16,175
Pennsylvania	52,599	31,385	36,064	22,988	17,434	18,830
Rhode Island	68,109	53,787	67,561	26,136	20,891	25,111
South Carolina	44,455	22,559	27,207	22,602	17,791	18,794
South Dakota	21,596	19,511	19,779	18,937	11,263	11,396
Tennessee	35,567	24,441	25,843	21,570	16,089	16,558
Texas	37,302	25,408	27,507	20,481	12,943	13,452
Utah	29,908	30,723	34,435	22,573	15,025	15,762
Vermont	49,739	54,970	55,484	25,243	16,789	17,089
Virginia	48,892	35,529	40,371	22,919	17,099	18,344
Washington	45,439	31,944	37,661	22,040	15,766	16,916
West Virginia	18,051	26,541	24,920	20,412	14,066	14,579
Wisconsin	32,962	30,975	32,424	24,543	16,675	17,657
Wyoming	35,195	30,426	32,660	19,253	14,737	15,048
United States	**45,054**	**32,944**	**37,578**	**22,652**	**16,065**	**17,085**

Source: Center for Urban Policy Research, Rutgers University.
Note: Washington, DC, is included in the United States totals.

employee space measures. This space is then valued at a dollar level per square foot and values are calculated for the counties of the United States according to differences in average household income in the counties. For farm properties, agricultural employment is divided into the value of farm acreage by county in New Jersey to develop a value per worker; this figure is similarly adjusted across the United States through differences in average county household income. Total equalized valuation per capita and per worker are shown by state in Table 9.3.

Fees, fines, permits, interest earned, and other miscellaneous revenues are expressed per $1,000 of current property value and are allocated to developed and undeveloped areas of counties according to relative population differences of those areas.

Federal and state revenue transfers are allocated to the resident population in counties. Revenues reported in the *1992 U.S. Census of Governments* are scaled back to reflect the reality that some may not increase with increasing population. They are then assigned by the ratio of population in developed and undeveloped areas of counties as reported in the *1990 U.S. Census of Population.* The result is per capita intergovernmental transfer revenues for a subarea of a county. Table 9.4 is a tabulation of these revenue values for the nation and by state.

The next step is to translate the real estate tax revenue per unit; fees, fines, and permit revenue per $1,000 valuation; and intergovernmental transfer revenues per capita into future aggregate local revenues. Real estate tax rates are multiplied by the real estate value of projected residential and nonresidential development for the 2000 to 2025 time period in developed and undeveloped areas of each county. (Table 9.4 is a tabulation of these equalized tax rates.) The determination of residential and nonresidential real estate values is discussed in the following chapter. Other tax revenues—fees, fines, permit revenue, and miscellaneous revenues—are expressed per $1,000 property value and projected into the future according to different property values occurring in developed and undeveloped areas of each county. The remaining revenue component, per capita intergovernmental transfer revenues, is calculated by multiplying per capita revenues by the projected population growth in developed and undeveloped areas for the projection period. Future local revenue is the sum of these three revenue streams. This calculation is performed for the full growth increment of each development scenario in each county, EA, state, and region, and for the nation as a whole.

Data Sources and Manipulations: Net Fiscal Impact

Net fiscal impact is the subtraction of total local public costs from total local public revenues (municipality, school district, and county). It requires separate calculations for residential and nonresidential development; the resulting fiscal impact is the summation of the two individual impacts. The difference between total local revenues and total local costs for the subareas of each county is the net fiscal impact of the increment of development on local public services in these subareas. This difference is summed for each county, EA, state, and region, and for the nation as a whole. The differences in the summed values represent the differences in fiscal impacts caused by the differing amounts of development in different jurisdictions under the uncontrolled- and controlled-growth scenarios.

FISCAL PARAMETERS USED IN THE ANALYSIS

This portion of the exercise shows the base data employed in the fiscal analysis. It is done solely to communicate a sense of the order of magnitude of these numbers. The fiscal parameters for both uncontrolled- and controlled-growth scenarios are post hoc summaries of individual data for counties for the purpose of displaying weighted nationwide averages. In actuality, the most current individual county data are used in each of the thousands of fiscal impact calculations undertaken in this chapter. Basic fiscal data are applied to the development that takes place in a jurisdiction over the projection period, yielding a fiscal impact for that jurisdiction. These

Courtesy of G. Lowenstein

Table 9.4
Average Per Capita and Per-Worker Intergovernmental Transfers and Equalized Tax Rates: United States and by State (in Dollars)

	Average Per Capita Intergovernmental Transfers			Average County Equalized Tax Rates		
State	Developed Areas	Undeveloped Areas	Overall	Developed Areas	Undeveloped Areas	Overall
Alabama	205	214	220	0.023	0.010	0.012
Alaska	410	873	830	0.023	0.079	0.074
Arizona	412	341	358	0.030	0.026	0.025
Arkansas	239	209	211	0.020	0.012	0.012
California	471	468	497	0.017	0.016	0.015
Colorado	248	322	329	0.031	0.024	0.023
Connecticut	242	266	266	0.017	0.017	0.017
Delaware	274	285	294	0.007	0.011	0.008
Florida	250	296	309	0.023	0.027	0.021
Georgia	221	228	233	0.023	0.023	0.021
Hawaii	55	138	116	0.006	0.012	0.010
Idaho	308	318	321	0.011	0.010	0.010
Illinois	253	201	214	0.031	0.014	0.014
Indiana	262	217	227	0.026	0.018	0.018
Iowa	266	263	267	0.018	0.015	0.015
Kansas	212	217	218	0.035	0.020	0.020
Kentucky	195	241	243	0.023	0.011	0.012
Louisiana	249	240	247	0.035	0.028	0.023
Maine	264	261	261	0.054	0.015	0.018
Maryland	221	185	202	0.020	0.024	0.017
Massachusetts	328	80	240	0.020	0.004	0.014
Michigan	304	214	227	0.041	0.027	0.026
Minnesota	460	439	451	0.033	0.017	0.018
Mississippi	220	254	258	0.019	0.017	0.016
Missouri	181	177	181	0.021	0.010	0.010
Montana	210	273	275	0.025	0.018	0.018
Nebraska	216	189	191	0.009	0.011	0.011
Nevada	367	571	580	0.021	0.023	0.022
New Hampshire	145	97	113	0.033	0.021	0.024
New Jersey	417	190	334	0.025	0.034	0.022
New Mexico	337	399	408	0.010	0.010	0.011
New York	468	336	403	0.040	0.037	0.036
North Carolina	357	283	292	0.025	0.015	0.015
North Dakota	209	261	263	0.022	0.011	0.011
Ohio	348	242	257	0.044	0.024	0.022
Oklahoma	232	265	267	0.031	0.012	0.012
Oregon	347	308	317	0.047	0.018	0.020
Pennsylvania	268	204	222	0.036	0.022	0.021
Rhode Island	136	136	136	0.017	0.017	0.017
South Carolina	220	209	215	0.017	0.019	0.017
South Dakota	145	168	169	0.032	0.013	0.013
Tennessee	209	169	177	0.020	0.014	0.014
Texas	254	236	239	0.027	0.021	0.021
Utah	229	315	318	0.010	0.021	0.021
Vermont	124	178	180	0.020	0.018	0.018
Virginia	244	191	209	0.023	0.016	0.016
Washington	373	406	418	0.018	0.013	0.014
West Virginia	216	255	257	0.045	0.019	0.017
Wisconsin	396	325	351	0.027	0.019	0.020
Wyoming	538	417	430	0.014	0.026	0.026
United States	**275**	**271**	**285**	**0.025**	**0.019**	**0.019**

Source: Center for Urban Policy Research, Rutgers University.
Note: Washington, DC, is included in the United States totals.

Table 9.5
Post Hoc Weighted Average Fiscal Parameters for Developed and Undeveloped Areas: Uncontrolled- and Controlled- Growth Scenarios (in Dollars)

	Developed Areas		Undeveloped Areas		Overall	
	Per Capita	Per Worker	Per Capita	Per Worker	Per Capita	Per Worker
Uncontrolled-Growth Scenario						
Expenditures	2,473	129	1,833	92	2,267	120
Revenues						
Tax and Nontax	997	607	692	362	894	537
Intergovernmental Transfers	349	N/A	307	N/A	335	N/A
Total	1,346	607	999	362	1,229	537
Equalized Tax Base	46,244	32,862	36,919	22,538	42,249	30,349
Equalized Tax Rate ($ per $100 val.)	0.020		0.018		0.020	
Controlled-Growth Scenario						
Expenditures	2,388	125	1,729	87	2,203	117
Revenues						
Tax and Nontax	912	585	592	355	825	533
Intergovernmental Transfers	356	N/A	312	N/A	344	N/A
Total	1,268	585	904	355	1,169	533
Equalized Tax Base	42,529	31,849	31,536	22,073	39,452	29,745
Equalized Tax Rate ($ per $100 val.)	0.021		0.018		0.020	

Source: Center for Urban Policy Research, Rutgers University.

fiscal impacts are summed and presented for different geographic levels.

Uncontrolled Growth

Costs

For the 2025 projection, nationwide annual costs, averaged and weighted for the counties in which development takes place under uncontrolled-growth conditions, are approximately $2,267 per capita and $120 per employee (see Table 9.5). These represent costs for municipal, county, and school services in the first case, and municipal and county services in the second. These average weighted county costs are about 10 percent higher per capita and per employee in the developed areas of each county ($2,473 and $129, respectively) and about 20 percent lower in the undeveloped areas ($1,833 and $92, respectively).

Revenues

For the 2025 projection, nationwide annual revenues are $1,229 per capita and $537 per employee (see Table 9.5). Two-thirds of per capita revenues come from the property tax; all of the per-employee revenues come from this source. Revenues per capita and per employee are 10 percent higher in the developed areas of each county ($1,346 and $607, respectively) and 20 percent lower in the undeveloped areas ($999 and $362, respectively).

County Tax Base/Rate

Residential equalized valuation per capita nationwide under the uncontrolled-growth scenario amounts to $42,249; nonresidential valuation per employee is $30,349 (see Table 9.5). This produces an equalized tax rate of about 20 mils, or $2.00 per $100 equalized valuation (see Table 9.5). Tax base per capita and per employee are 10 percent higher in the developed areas of each county ($46,244 and $32,862, respectively) and 15 percent to 25 percent lower in the undeveloped areas ($36,919 and $22,538, respectively).

Controlled Growth

Costs

For the 2025 projection, annual costs nationwide, averaged and weighted for the counties in which development takes place under controlled-growth con-

Table 9.6
Annual Net Fiscal Impact—Uncontrolled- and Controlled-Growth Scenarios
United States and by Region: 2000 to 2025
(in $ Million)

	Uncontrolled-Growth Scenario			Controlled-Growth Scenario			Difference Controlled minus Uncontrolled
Region	Costs	Revenues	Impact	Costs	Revenues	Impact	
Northeast	9,329	11,170	1,841	9,252	12,928	3,676	1,835
Midwest	18,914	15,352	-3,562	18,340	16,339	-2,001	1,561
South	58,441	38,845	-19,532	57,655	39,062	-18,531	1,001
West	56,558	34,023	-22,535	53,942	31,215	-22,728	-192
United States	**143,242**	**99,389**	**-43,788**	**139,190**	**99,544**	**-39,583**	**4,205**

Source: Center for Urban Policy Research, Rutgers University.

ditions, are approximately $2,203 per capita and $117 per employee (see Table 9.5). Again, these represent costs for municipal, county, and school expenses in the first case, and municipal and county services in the second. These average weighted county costs are also about 10 percent higher per capita and per employee in the developed areas of each county ($2,388 and $125, respectively) and about 20 percent lower in the undeveloped areas ($1,729 and $87, respectively).

Revenues

For the 2025 analysis, annual revenues nationwide are $1,169 per capita and $533 per employee (see Table 9.5). About 70 percent of per capita revenues come from the property tax, as do all per-employee revenues. Revenues per capita and per employee are about 10 percent higher in the developed areas of each county ($1,268 and $585, respectively), and 20 percent lower in the undeveloped areas ($904 and $355, respectively).

County Tax Base/Rate

Residential assessed evaluation per capita nationwide under the controlled-growth scenario amounts to $39,452; nonresidential valuation per employee is $29,745. This produces an equalized tax rate of about 20 mils, or $2.00 per $100 equalized valuation (see Table 9.5). Tax base per capita and per employee are 10 percent higher in the developed areas of each county ($42,529 and $31,849, respectively) and 20 percent to 25 percent lower in the nondeveloped areas ($31,536 and $22,073, respectively).

RESULTS OF THE ASSESSMENT: FISCAL IMPACT

This portion of the chapter examines how the two primary development alternatives affect the fiscal impact of providing services in various geographic divisions of the United States.

THE UNITED STATES AND ITS REGIONS

Uncontrolled Growth

Costs

The aggregate local cost of providing public services for 60.7 million new residents housed in 26.5 million residential units and for 49.5 million new workers in 26.5 million nonresidential units (or 26.5 billion square feet of nonresidential space) is approximately $143.2 billion annually in 2025. The aggregate cost includes all municipal, school district, and county services that would be required by the new residents and workers. The costs represent current expenditures; that is, the costs are calculated under the assumption that all development over the period would occur according to today's fiscal parameters.

Two-thirds of the annual public-service costs will be concentrated in the West and South regions of the country (approximately $56.5 billion and $58.5 billion, respectively); 13 percent will be in the Midwest ($18.9 billion); and approximately 6.5 percent will be in the Northeast ($9.3 billion) (see Table 9.6). For the South and West, the percentage share of future public-service costs is approximately 30 percent less than the percentage distribution of future population; and for the Northeast and Midwest, the percentage distribution of future public-service costs is approximately 20 percent higher than the percentage distribution of future population. This would indicate significantly lower-than-average existing service costs per person and employee in the South and West, and somewhat higher-than-average existing service costs per person and employee in the Northeast and Midwest.

Revenues

Revenues raised under uncontrolled-growth conditions to support development during the period 2000 to 2025 will amount to $99.4 billion annually by period end. By region, the annual distribution of future revenues to support development will be approximately the same as the distribution of incurred costs—40 percent in the South region ($38.8 billion); 34 percent in the West region ($34.0 billion); 15 percent in the Midwest region ($15.4 billion); and 11 percent in the Northeast region ($11.2 billion) (see Table 9.6).

Net Fiscal Impact

Under the uncontrolled-growth scenario, development during the period 2000 to 2025 will cause an annual fiscal deficit of $43.8 billion, or 30 percent less revenues than costs by the final year of the projection period. This is expected, given the fact that most development will be deficit-producing residential development. This deficit will occur in all regions except the Northeast, where there will be a positive fiscal impact of $1.8 billion annually. The Northeast region has about the same cost structure per capita as the West region, but revenues raised per capita are considerably higher. The overall fiscal deficit will be proportionally higher in the West region and lower in the Midwest region (see Table 9.6).

Controlled Growth

Costs

Overall costs generated by development under the controlled-growth scenario will be $139.2 billion annually at build-out. That amount is the annual cost of providing the full array of local services—municipal, school district, and county—to new development. Annual costs under the controlled-growth scenario will reflect the differing development that will take place in particular types of locations. Aggregate costs will be highest in the South ($57.7 billion), followed closely by the West ($53.9 billion), the Midwest ($18.3 billion), and finally, the Northeast ($9.3 billion) (see Table 9.6).

Costs under the controlled-growth scenario in 2025 will be 3 percent ($4.1 billion) lower than they would be under the uncontrolled-growth scenario. This lower cost is seen in all four regions of the United States and reflects the servicing cost efficiencies of larger and more mature service providers under the controlled-growth scenario.

Revenues

Overall revenues under the controlled-growth scenario will reach $99.5 billion annually. These revenues represent the sum of property tax, nontax revenues, and intergovernmental transfers. Revenues under controlled growth follow the same distribution pattern as costs. The South will receive $39.1 billion annually; the West, $31.2 billion; the Midwest,

Courtesy of T. Delcorso

Table 9.7
Annual Net Fiscal Impact—Uncontrolled- and Controlled-Growth Scenarios
United States and by State: 2000 to 2025 (in $ Million)

	Uncontrolled-Growth Scenario			Controlled-Growth Scenario			Difference Controlled minus Uncontrolled
State	**Costs**	**Revenues**	**Impact**	**Costs**	**Revenues**	**Impact**	
California	27,878	16,030	-11,848	26,954	14,514	-12,440	-592
Florida	16,430	10,270	-6,160	15,558	9,613	-5,945	215
Texas	15,947	8,795	-7,087	15,280	8,389	-6,828	259
Arizona	6,273	3,942	-2,331	5,916	3,627	-2,289	42
Washington	5,100	2,874	-2,226	4,800	2,741	-2,058	168
North Carolina	4,880	2,947	-1,933	4,664	3,458	-1,207	727
Georgia	4,841	3,719	-1,122	5,079	3,754	-1,325	-203
Colorado	4,480	3,655	-825	4,103	3,312	-792	33
Virginia	3,746	3,301	-445	3,479	2,822	-657	-212
Minnesota	3,138	1,874	-1,264	3,054	1,979	-1,075	189
Nevada	3,117	1,934	-1,183	2,945	1,730	-1,216	-32
Ohio	2,866	2,802	-64	2,806	3,261	456	520
New York	2,812	3,970	1,159	2,761	4,502	1,742	583
Illinois	2,734	2,652	-82	2,717	2,515	-202	-120
Oregon	2,494	1,469	-1,025	2,593	1,487	-1,106	-82
Michigan	2,480	2,587	106	2,360	2,611	250	144
Tennessee	2,454	1,726	-728	2,488	2,022	-466	263
Maryland	2,336	2,203	-133	2,231	1,924	-306	-173
New Jersey	2,313	2,036	-277	1,965	1,927	-38	239
Utah	2,305	1,253	-1,052	2,142	1,065	-1,077	-25
Wisconsin	2,218	1,569	-649	2,085	1,642	-443	206
Indiana	2,155	1,517	-638	2,074	2,077	3	640
South Carolina	1,994	1,416	-578	1,854	1,605	-248	329
Louisiana	1,403	1,100	-304	1,355	1,107	-249	55
New Mexico	1,400	652	-748	1,395	682	-713	36
Pennsylvania	1,399	2,102	703	1,674	2,278	604	-99
Alabama	1,286	907	-379	1,292	990	-302	77
Alaska	1,248	789	-459	1,012	723	-289	170
Massachusetts	1,185	1,234	48	1,294	1,357	63	14
Missouri	1,090	835	-255	1,115	805	-309	-54
Kentucky	1,015	635	-381	934	630	-304	77
Oklahoma	905	539	-366	875	616	-259	107
Idaho	879	389	-490	833	368	-466	24
Mississippi	657	478	-180	624	539	-85	95
Kansas	652	541	-111	629	491	-138	-28
Hawaii	592	453	-139	493	347	-146	-7
Arkansas	585	370	-216	595	419	-176	39
Iowa	577	398	-179	547	406	-141	39
Nebraska	569	261	-309	541	244	-297	12
New Hampshire	514	626	112	338	1,284	947	835
Maine	417	396	-21	505	627	122	143
Wyoming	397	309	-88	375	301	-75	13
Montana	395	273	-122	380	318	-62	60
South Dakota	279	204	-75	265	204	-61	14
Delaware	259	154	-105	228	140	-87	17
Rhode Island	233	236	3	247	331	84	81
Vermont	228	225	-4	217	235	18	22
Connecticut	227	345	118	252	386	135	17
West Virginia	195	186	-9	136	159	23	32
North Dakota	155	113	-42	147	104	-43	-1
Top 20 States	**118,624**	**80,038**	**-38,521**	**113,895**	**77,254**	**-36,578**	**1,943**
United States	**143,242**	**99,389**	**-43,788**	**139,190**	**99,544**	**-39,583**	**4,205**

Source: Center for Urban Policy Research, Rutgers University.
Note: Washington, DC, is included in the United States totals.

$16.3 billion; and the Northeast, $12.9 billion (see Table 9.6).

Revenues under the controlled-growth scenario in 2025 ($99.5 million) will be slightly higher annually than they will be under the uncontrolled-growth scenario.

Net Fiscal Impact

The net fiscal impact under the controlled-growth scenario will be a deficit of $39.6 billion annually. Development under this scenario will cost local governments $39.6 billion more annually than it will introduce in revenues. The negative fiscal impact under this scenario will be greatest in the West ($22.7 billion); less in the South ($18.5 billion); and the least in the Midwest ($2.0 billion). The Northeast is again the exception—revenues there will exceed costs by $3.7 billion annually (see Table 9.6).

Controlled versus Uncontrolled Growth

Fiscal Impact Differences

The controlled-growth scenario's net fiscal impact will be $4.2 billion less negative than the net fiscal impact under the uncontrolled-growth scenario. The controlled-growth scenario's fiscal impact will reduce operating deficits to local governments by $4.2 billion annually by the time full build-out takes place in 2025. Significant deficit reductions over uncontrolled growth will occur in every region except the West. The reductions will range from $1.0 billion in the South to $1.8 billion in the Northeast (see Table 9.6). In the West, an enhanced fiscal deficit of $192 million annually occurs under controlled growth as the new population is accommodated by higher-cost service systems in this region.

Although a $39.6 million fiscal deficit will be realized annually under the controlled-growth scenario, the deficit will be reduced by nearly 10 percent from the fiscal deficit that would occur under the uncontrolled-growth scenario (see Table 9.6). This reduction will be a result of greater use of the existing service structure in more densely developed areas. Also, in more densely developed areas, the real property tax may be slightly higher than it is in less densely developed areas; thus, revenues will be proportionately higher. In general, deficit reductions as opposed to real cost savings will be available to these public-service providers in such areas. This is because both scenarios are dominated by residential development that causes fiscal deficits in either scenario. Only the magnitude of the deficit varies.

STATES

Uncontrolled Growth

Costs

The states with the highest annual public-service costs under uncontrolled growth basically parallel the states with the largest combined residential and nonresidential growth during the period 2000 to 2025. Table 9.7 lists all states in descending order of their total annual local public-service costs. The top 20 states will expend $118.6 billion annually for public services. These 20 states, representing just 40 percent of the nation's total states, will incur 83 percent of the country's future local public-service costs annually at the end of the period 2000 to 2025. The fastest-growing state (California) will spend $27.9 billion annually, over 70 percent more than the next-fastest-growing state (Florida), and one-fifth of the total additional annual local public-service costs nationwide. Florida's projected household growth is 80 percent that of California; its projected public-service-cost growth is only 60 percent that of California. The third fastest-growing state (Texas) will also incur more than $10 billion in added local annual public-service costs; this is again a lower percentage of all service cost increases than its percentage of all growth increases. All of the aforementioned states are in either the South or the West, the fastest-growing regions of the United States during the projection period.

Revenues

Future revenue income basically parallels future concentrations of population growth and property investment. The top 20 states will receive $80.0 billion annually in revenues to support local public services (see Table 9.7). The top 20 states (sorted by public-service costs) will receive 81 percent of the nation's future annual revenue in 2025. Two states will receive more than $10 billion annually; these are California and Florida, with $16.0 billion and $10.3 billion, respectively. All of the states in the top 20 will receive more than $1 billion in revenues annually.

Table 9.8
Annual Net Fiscal Impact—Uncontrolled- and Controlled-Growth Scenarios
United States and by EA: 2000 to 2025
(in $ Million)

	Uncontrolled-Growth Scenario			Controlled-Growth Scenario			Difference Controlled minus Uncontrolled
EA	**Costs**	**Revenues**	**Impact**	**Costs**	**Revenues**	**Impact**	
Los Angeles-Riverside-Orange, CA-AZ	11,899	7,203	-4,696	11,607	6,447	-5,160	-464
San Francisco-Oakland-San Jose, CA	6,971	3,893	-3,078	6,742	3,516	-3,226	-148
Miami-Fort Lauderdale, FL	5,321	3,406	-1,915	5,037	2,880	-2,157	-242
Dallas-Fort Worth, TX-AR-OK	4,886	2,681	-2,205	4,706	2,461	-2,246	-41
Houston-Galveston-Brazoria, TX	4,508	2,843	-1,600	4,299	2,750	-1,486	114
Phoenix-Mesa, AZ-NM	4,439	2,727	-1,711	4,214	2,493	-1,720	-9
Denver-Boulder-Greeley, CO-KS-NE	4,314	3,543	-771	3,946	3,200	-747	25
San Diego, CA	4,265	2,434	-1,831	4,052	1,973	-2,079	-248
Washington-Baltimore, DC-MD-VA-WV-PA	4,085	4,259	174	5,165	4,339	-826	-1,000
Orlando, FL	4,043	2,446	-1,597	3,841	2,204	-1,637	-40
Seattle-Tacoma-Bremerton, WA	3,858	2,271	-1,587	3,708	2,133	-1,576	11
Atlanta, GA-AL-NC	3,802	2,952	-850	4,062	2,967	-1,096	-246
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA-MA-VT	3,181	4,469	1,288	3,099	5,018	1,918	630
Minneapolis-St. Paul, MN-WI-IA	3,069	1,832	-1,237	2,954	1,885	-1,069	168
Las Vegas, NV-AZ-UT	2,824	1,846	-978	2,683	1,642	-1,042	-63
Chicago-Gary-Kenosha, IL-IN-WI	2,806	2,645	-161	2,748	2,662	-86	75
Sacramento-Yolo, CA	2,798	1,596	-1,202	2,671	1,591	-1,080	122
Tampa-St. Petersburg-Clearwater, FL	2,462	1,473	-988	2,278	1,328	-950	39
San Antonio, TX	2,453	1,204	-1,248	2,334	1,125	-1,208	40
Portland-Salem, OR-WA	2,359	1,338	-1,021	2,372	1,305	-1,067	-47
Salt Lake City-Ogden, UT-ID	2,018	1,058	-960	1,869	873	-996	-36
Boston-Worcester-Lawrence-Lowell-Brocktn, MA-NH-RI-VT	1,975	2,101	125	1,915	2,965	1,050	925
Jacksonville, FL-GA	1,821	1,230	-591	1,752	1,369	-383	208
Fresno, CA	1,680	774	-906	1,596	852	-744	162
Raleigh-Durham-Chapel Hill, NC	1,615	1,006	-608	1,543	1,038	-505	103
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	1,505	1,787	281	1,561	1,712	151	-130
Austin-San Marcos, TX	1,435	792	-643	1,362	799	-564	80
Indianapolis, IN-IL	1,389	978	-410	1,368	1,325	-43	367
Columbus, OH	1,358	994	-364	1,286	1,170	-116	249
Charlotte-Gastonia-Rock Hill, NC-SC	1,323	794	-529	1,262	872	-390	139
Top 30 EAs	**100,462**	**68,577**	**-31,820**	**98,033**	**66,892**	**-31,078**	**742**
United States	**143,242**	**99,389**	**-43,788**	**139,190**	**99,544**	**-39,583**	**4,205**

Source: Center for Urban Policy Research, Rutgers University.

Net Fiscal Impact

The net fiscal impact for the top 20 spending states will be a cost to local governments of $38.5 billion more annually than they will collect in revenues (see Table 9.7). The largest fiscal deficit under the uncontrolled-growth scenario is in the state of California ($11.8 billion). Michigan and Ohio evidence a fiscal surplus relative to development, of $0.1 billion each.

Controlled Growth

Costs

Under a controlled-growth scenario, the top 20 states, representing 82 percent of future national public-service costs, experience annual local government costs of $113.9 billion (Table 9.7). The pattern of costs, though at a slightly lower level, essentially follows that of the uncontrolled-growth scenario. Like the uncontrolled-growth scenario, most annual expenditures take place in California ($27.8 billion), Florida ($15.6 billion), and Texas ($15.3 billion).

Revenues

The top 20 spending states will receive $77.3 billion in annual revenues out of a national total of $99.6 billion. California receives the most at $14.5 billion. Florida and Texas follow closely behind with annual revenues of $9.6 billion and $8.4 billion, respectively. The order of the states with respect to revenues under the controlled-growth scenario remains essentially unchanged when compared with the order of states under the uncontrolled-growth scenario. The lowest expected annual revenue total to support the costs of development for a top-20 state, is just over $1 billion.

Net Fiscal Impact

The net fiscal impact for the top 20 spending states under the controlled-growth scenario will be a net annual cost to local governments of $36.6 billion more than they will collect in revenues (see Table 9.7). The three largest annual fiscal deficits again occur in California ($12.4 billion), Florida ($5.9 billion), and Texas ($6.8 billion). In the top 20 states, Ohio and Michigan have annual surpluses of $456 million and $250 million, respectively. The balance of the states have deficits no greater than $500 million or surpluses no greater than $950 million(see Table 9.7).

Courtesy of A. Nelessen

Controlled versus Uncontrolled Growth

Fiscal Impact Differences

While the top 20 states still have a $36.6 billion annual deficit under the controlled-growth scenario, this deficit is reduced by 5 percent or $1.9 billion relative to the controlled-growth scenario (see Table 9.7). Sixty percent (12) of these 20 states have reduced annual fiscal deficits, with the notable exception of California, whose annual deficit increases by $0.6 billion over the period. Only 25 percent of the 50 states show increases in their annual deficits, with 60 percent under $0.1 billion. The largest annual surplus occurs in New Hampshire, which increases its existing surplus by 53 percent from 2000 to 2025.

EAs

Uncontrolled Growth

Costs

Table 9.8 lists the top 30 EAs in public-service costs in descending order of their magnitude of spending. The top 30 EAs will expend $100.5 billion annually for new public services. These 30 EAs, which make up 17 percent of the nation's EAs, will incur 70 percent of the nation's additional annual public-service costs in 2025. The first five EAs in order of annual spending are from the three fastest-growing states, California, Florida, and Texas, and are the EAs that contribute heavily to the growth of these states. California is represented by the top two EAs on the list, the Los Angeles-Riverside-Orange, CA-AZ EA and the San Francisco-Oakland-San Jose, CA EA. They will expend $11.9 billion and $6.9 billion annually for new public services, respectively. Florida is home to the third-highest EA in costs for new public services, the Miami-Fort Lauderdale, FL EA, spending $5.3 billion annually. The final two EAs of the top five are in Texas, the Dallas-Fort Worth, TX-AR-OK EA and the Houston-Galveston-Brazoria, TX, EA, which will spend $4.9 billion and $4.5 billion annually, respectively. All top 30 EAs have public-service costs in excess of $1.3 billion annually under the uncontrolled-growth scenario.

Revenues

The top 30 EAs, representing 17 percent of the nation's EAs, receive annual local public-service revenues of $68.6 billion out of national total revenue receipts of $99.4 billion (Table 9.8). The top two EAs, the Los Angeles-Riverside-Orange, CA-AZ EA and the San Francisco-Oakland-San Jose, CA EA, will receive $7.2 billion and $3.9 billion annually, respectively. The other EA with revenues above $3 billion is the Miami-Fort Lauderdale, FL EA, with an income of $3.4 billion annually. All 30 EAs have revenues of at least $750 million annually.

Net Fiscal Impact

The net fiscal impact for the top 30 spending EAs will be a cost to local governments of $31.8 billion more than they will collect in revenues annually (see Table 9.8). The largest two fiscal deficits under the uncontrolled-growth scenario occur in the Los Angeles-Riverside-Orange, CA-AZ ($4.7 billion annually) and the San Francisco-Oakland-San Jose, CA EA ($3.1 billion annually). Only four East Coast EAs in the top 30 show a surplus. They are the New York-Northern New Jersey-Long Island, NY-NJ-CT-PA-MA-VT EA ($1.3 billion annually); the Washington-Baltimore, DC-MD-VA-WV-PA EA ($174 million annually), the Boston-Worcester-Lawrence-Lowell-Brockton, MA-NH-RI-VT EA ($125 million annually) and the Philadelphia-Wilmington-Atlantic City, PA-DE-NJ EA ($281 million annually).

Controlled Growth

Costs

Under a controlled-growth scenario, the top 30 EAs, representing 70 percent of future national public-service costs, experience annual costs of $98.0 billion, a saving of $2.4 billion (Table 9.8). The pattern of costs, though at a lower level, follows that of the uncontrolled-growth scenario.

Revenues

The top 30 spending EAs will receive annual revenues of $66.9 billion out of a national total of $99.5 billion. The Los Angeles-Riverside-Orange, CA-AZ EA receives the most annual revenues at $6.4 billion. The New York-Northern New Jersey-Long Island, NY-NJ-CT-PA-MA-VT EA, which is 13th on the list of highest-spending EAs, is second in revenues raised, with $5.0 billion annually. The lowest expected annual revenue for a top-30 EA is just below $800 million (Austin-San Marcos, TX EA).

Net Fiscal Impact

The net fiscal impact for the top 30 spending EAs under the controlled-growth scenario will be a cost to local governments of $31.0 billion more than they will collect in revenues (see Table 9.8). The largest two fiscal deficits again occur in Los Angeles-Riverside-Orange, CA-AZ ($5.2 billion annually) and San Francisco-Oakland-San Jose, CA ($3.2 billion annually). Only three of the original four East Coast EAs now show a surplus. They are: the New York-Northern New Jersey-Long Island, NY-NJ-CT-PA-MA-VT EA ($1.9 billion annually), the Boston-Worcester-Lawrence-Lowell-Brockton, MA-NH-RI-VT EA ($1.1 billion annually), and the Philadelphia-Wilmington-Atlantic City, PA-DE-NJ EA ($151 million annually).

Controlled versus Uncontrolled Growth

Fiscal Impact Differences

While the top 30 EAs will have a $31.1 billion annual deficit under the controlled-growth scenario, this deficit is reduced by $742 million annually from the uncontrolled-growth scenario (see Table 9.8). Nearly 60 percent of these EAs will exhibit reduced deficits, with two notable exceptions: the Washington-Baltimore, DC-MD-VA-WV-PA EA and the Los Angeles-Riverside-Orange, CA-AZ EA, whose annual deficits will increase by $1.0 billion and $0.5 billion, respectively.

COUNTIES

Uncontrolled Growth

Costs

The annual costs of future public services are presented in Table 9.9 for the nation's top 50 spending counties. Aggregate costs for these counties are $62.0 billion annually. Thus, only 1.5 percent of the counties nationwide will experience 43 percent of the total future annual public-service costs. San Diego, CA, Maricopa, AZ, and Los Angeles, CA, the top three counties, will experience annual public-service costs of $4.3 billion, $3.9 billion, and $3.1 billion, respectively. These counties are in California, or the West region; all spend in excess of $3 billion annually. Each county in the top 50 will expend at least $1 billion annually in public-service costs.

Revenues

The top 50 spending counties will collect $38.5 billion annually out of a total of $99.4 billion, or 39 percent. The two top counties, San Diego, CA, and Maricopa, AZ, will collect over $2 billion each annually. All top 50 counties will collect at least $200 billion each annually (see Table 9.9).

Net Fiscal Impact

The 50 top counties will experience a total deficit of $23.5 billion annually out of a total of $43.8 billion, or 54 percent. The three top counties (San Diego, CA; Maricopa, AZ; and Los Angeles, CA) will each experience annual deficits of over $1 billion, with essentially all top 50 counties experiencing deficits (Table 9.9).

Controlled Growth

Costs

Under the controlled-growth scenario, the top 50 counties, representing 40 percent of future annual national public-service costs, remain essentially stable at $62.0 billion annually (Table 9.9). This is true even though national public-service costs as a whole will drop by 3 percent, or $4 billion, annually by the end of the projection period. The largest change in the top 50 counties occurs in Los Angeles County, CA, which experiences a doubling in costs to $6.4 billion annually over the period. This $3.3 billion increase is due to the magnitude of redirected growth that is projected for this large county under the controlled-growth scenario.

Revenues

The top 50 counties will collect revenues that in the aggregate will amount to $34.8 billion annually. This reduction from $38.5 billion to $34.8 billion, represents a 10 percent decrease. The largest increase in a top 50 county is in Los Angeles County, CA, wherein public-service revenues increase by $1.8 billion to a total of $3.2 billion annually.

Net Fiscal Impact

The net fiscal impact for the top 50 spending counties under the controlled-growth scenario will be a cost to local governments of $27.2 billion more annually than they will collect in revenues (see Table 9.9). The largest fiscal deficits again occur in San Diego County, CA; Maricopa County, AZ; and Los Angeles County, CA. There are significant deficits in Orange County, CA, and Harris County, TX. Fiscal deficits in the counties range from $1.1 billion to $2.1 billion annually. All other counties in the top 50 have deficits of less than $1 billion annually. Only Bronx County, NY, shows a surplus of about $100 million annually.

Controlled- versus Uncontrolled-Growth

Fiscal Impact Differences

While overall the total deficits decrease under the controlled-growth scenario, the top 50 counties, which provide the largest increases in public-service costs, show fiscal impact deficit increases. These top 50 counties have a $23.5 billion annual deficit under the uncontrolled-growth scenario, which increases by $3.7 billion to $27.2 billion under the controlled-growth scenario (see Table 9.9). Thirty-two percent of these counties (16) have decreased deficits under the controlled-growth scenario, with the largest savings occurring in Riverside County, CA—$768 million annually.

In the top 50 counties, lower revenues contribute to a deficit for the controlled-growth scenario. This anomaly of costs exceeding revenues under controlled-growth is a function of reduced property values due to non-single-family housing options available under the controlled-growth scenario in these areas.

Table 9.9
Annual Net Fiscal Impact—Uncontrolled- and Controlled-Growth Scenarios
United States and by County: 2000 to 2025
(in $ Million)

	Uncontrolled-Growth Scenario			Controlled-Growth Scenario			Difference Controlled minus Uncontrolled
County	Costs	Revenues	Impact	Costs	Revenues	Impact	
San Diego, CA	4,265	2,434	-1,831	4,052	1,973	-2,079	-248
Maricopa, AZ	3,941	2,485	-1,456	3,744	2,137	-1,608	-152
Los Angeles, CA	3,107	1,788	-1,319	6,389	3,187	-3,202	-1,883
Clark, NV	2,393	1,558	-835	2,273	1,359	-914	-80
Orange, CA	2,336	1,466	-870	2,444	1,317	-1,126	-256
Riverside, CA	2,302	1,378	-924	810	653	-156	768
San Bernardino, CA	2,228	1,357	-871	823	464	-359	512
Harris, TX	2,182	1,507	-675	2,436	1,388	-1,047	-372
Palm Beach, FL	1,819	971	-848	1,338	592	-746	102
Broward, FL	1,600	1,189	-411	1,594	975	-619	-207
Orange, FL	1,569	1,090	-479	1,490	939	-551	-72
Bexar, TX	1,553	775	-779	1,669	770	-900	-121
Tarrant, TX	1,498	783	-715	1,423	651	-772	-57
Hillsborough, FL	1,403	792	-611	1,538	807	-731	-120
Contra Costa, CA	1,378	722	-657	1,309	585	-724	-68
Sacramento, CA	1,378	772	-606	1,370	680	-690	-85
King, WA	1,273	829	-444	1,446	794	-653	-209
Santa Clara, CA	1,260	696	-563	1,757	876	-881	-318
Dade, FL	1,217	862	-355	1,715	1,102	-613	-258
Fairfax, F'fx City + Falls Church, VA	1,089	1,057	-32	1,035	793	-242	-210
Pima, AZ	994	695	-299	944	625	-319	-20
Wake, NC	993	680	-313	944	685	-259	55
Arapahoe, CO	988	816	-173	939	661	-278	-105
Fresno, CA	975	447	-528	927	455	-472	57
Dallas, TX	944	826	-119	1,132	822	-310	-192
Mecklenburg, NC	868	494	-374	825	451	-374	0
Collin, TX	855	344	-511	812	336	-476	34
Hidalgo, TX	847	295	-552	777	266	-511	41
Alameda, CA	832	461	-370	1,543	689	-854	-484
Salt Lake, UT	830	446	-384	906	424	-481	-97
El Paso, TX	783	315	-469	745	285	-460	9
Pierce, WA	778	463	-315	744	400	-344	-29
Gwinnett, GA	754	485	-269	716	399	-317	-47
Solano, CA	741	449	-291	178	95	-83	209
Seminole, FL	695	422	-273	660	348	-312	-39
Snohomish, WA	688	391	-297	654	394	-260	37
Kern, CA	686	373	-313	367	309	-59	255
Franklin, OH	684	494	-190	692	436	-257	-67
Cobb, GA	672	540	-132	638	425	-213	-81
Fort Bend, TX	670	369	-301	637	379	-257	43
Washington, OR	660	214	-446	627	182	-446	1
Travis, TX	657	348	-308	886	391	-495	-186
Lake, IL	650	511	-139	617	413	-205	-66
Ventura, CA	607	443	-164	289	181	-109	55
Oakland, MI	591	750	159	567	663	96	-63
Montgomery, TX	570	396	-174	446	319	-127	47
Placer, CA	568	344	-224	540	460	-80	144
Du Page, IL	554	559	5	537	454	-83	-88
Bronx, NY	548	420	-128	529	628	99	227
Dakota, MN	543	232	-311	516	196	-320	-9
Top 50 Counties	**62,017**	**38,532**	**-23,485**	**61,990**	**34,812**	**-27,177**	**-3,693**
United States	**143,242**	**99,389**	**-43,788**	**139,190**	**99,544**	**-39,583**	**4,205**

Source: Center for Urban Policy Research, Rutgers University.


Courtesy of C. Galley

CONCLUSION—LOCAL PUBLIC-SERVICE COSTS IN THE UNITED STATES

All of the classical findings of fiscal impact analysis are borne out in this study. Overall, residentially driven growth is costly, especially if it takes place in counties that do not have sophisticated public-service systems. In these cases, dramatic changes must be undertaken to adjust to the service demands of increasing development. In undeveloped areas of counties nationwide, reasonably sophisticated public safety, public works, general government, and education services must be provided. Governments in these locations must respond to public-service demands of both residential and nonresidential development, often using full-time staffs, which soon may have union representation. As such, providing public services is expensive.

On the other hand, once a critical mass has been reached (as in close-in counties and reasonably developed areas of the nation), there are few service areas that must be either initiated in whole or significantly expanded. Government services can be provided by adding incrementally to a staff that need not expand to a level that small public-service staffs might need to. This is done within a context of revenues that maximize the yield from real property valuation. Costs are often lower in such locations and revenue yields from property tax and non-property-tax sources may be somewhat higher. The controlled-growth scenario steers development into locations of established service providers. In these locations, the system is large enough to absorb demand without causing a proportional increase in costs. Further, in these locations, the revenue structure is more varied and encompassing and is better able to respond to the costs of growth.

During the period 2000 to 2025, under normal or uncontrolled-growth, the nation will expend $143.2 billion annually for public services and will collect revenues in the amount of only $99.4 billion annually, for an annual fiscal deficit of $43.8 billion by 2025. This is the reality of providing services mainly to residential development, which typically produces a negative fiscal impact due to the costs of schools.

Because more growth will take place in already developed areas under a controlled-growth scenario, where public services are underutilized although somewhat more costly, annual local public-service costs will total only $139.2 billion. The decrease in costs will be accompanied by a slight increase in local revenues that will result in a total income of $99.5 billion annually. This is true because tax rates are somewhat higher in these areas. The result will be a reduced annual net fiscal impact deficit of $39.6 billion by 2025—a reduction of $4.2 billion annually under the controlled-growth scenario compared with the fiscal deficit under the uncontrolled-growth scenario. Staying close in and being served by mature service providers results in less of an annual fiscal loss under the controlled-growth scenario.

Courtesy of R. Ewing

X

Real Estate Development Costs in the United States:

Requirements under Sprawl and Alternative Conditions

INTRODUCTION

The purpose of this chapter is to provide estimates of the cost of new residential and nonresidential structures required to house the population and employment growth expected during the next 25 years under two alternative development futures for the United States. One future is uncontrolled growth, or sprawl; the other is more-controlled or "smart" growth. In the controlled-growth scenario, growth is encouraged in the more built-up portions of each EA, both in the more-developed counties and in the developed areas of all counties. In addition, more non-single-family development and higher densities occur in developed areas under the controlled-growth alternative.

In the course of implementing growth management, redevelopment should take place in more central locations, saving land at the periphery, and this should be accomplished without raising regional property development costs. If the processes that are used to contain development are too growth limiting or intrusive, they may well increase the costs of residential and nonresidential development. The question to be addressed here is whether newly formed households and places of employment face higher or lower property costs due to sprawl compared with more compact and controlled development. Do the growth centralization and other mechanisms employed here for alternative development cause households and businesses to experience a difference in property acquisition costs?

Three factors influence whether growth measures affect development costs. The first is the cost of development in the areas in which households and employees are locating; the second is the housing mix offered in these locations; and the third is the density of future property development. The Rutgers Development Cost Model incorporates each of these factors in its property cost determinations.

The chapter first describes the Rutgers Development Cost Model and the procedure used to calculate the costs of the residential and nonresidential structures needed to accommodate future household and job growth. Relationships inherent to a model that functions at the national level yet is sensitive to subcounty development differences are discussed. The chapter concludes with the application of the Development Cost Model to the alternative national growth scenarios (see also Burchell et al. 1992).

CONCEPTUAL OVERVIEW AND ASSESSMENT MODEL

The Rutgers Development Cost Model

The Rutgers Development Cost Model calculates changes in the price of residential and nonresidential space related to the location, mix, and density at which this space is developed. Typically, in urban center, urban, suburban, and rural center counties, densities and FARs are higher. This lowers the land cost of property development as well as the price of developed properties there. In rural and undeveloped counties, densities and FARs are lower. This raises the land component of property costs and the price of developed properties in typically higher-priced locations.

The model is sensitive to the types of changes taking place under one or the other development scenario. The model stores property value by location and further calculates changes in property values relative to changes in property mix and density of development. These differences—location, mix, and density—are the basic differences between the development scenarios. Aggregate property prices are determined for the two scenarios, and differences between the alternatives are viewed in light of development differences in the counties in which households and employees have settled.

The basic differences between the two primary development scenarios have been discussed in earlier chapters of this report. Projected household and employment growth for each county under the uncontrolled-growth scenario are presented in chapter 3. The alternative or controlled-growth scenario is discussed in chapter 4. The specific types and numbers of residential dwelling units and amounts of nonresidential space for each alternative are presented in chapter 6. The scale and amounts of intercounty and intracounty household and employment redirection are also contained in chapter 6, together with residential and nonresidential densities for each scenario. Other required data for the Development Cost Model are the average costs of developing residential and nonresidential structures in each county nationwide. These will be discussed below.

Residential housing costs are the selling prices or values of single-family detached and attached dwellings, mobile homes, and multifamily units. The Rutgers Development Cost Model requires inputs of current housing prices (or rents, which are capitalized) for these dwelling-unit types, for all counties of the country. The model also requires the land-cost share of the housing price. This information is derived from the *1990 U.S. Census of Population and Housing* updated to 2000 by the change in housing prices noted in the *American Housing Survey* for the 10-year period from 1987 to 1997. Thus, current information on housing prices is approximated for 2000 by type of housing and by location.

Information on the land and structure components of total housing costs is also required. This information is obtained from the development community, both residential and nonresidential. In the average case, land costs are approximately 25 percent of total costs for single-family detached dwellings; 20 percent for single-family attached dwellings; 60 percent for mobile homes; and about 10 percent for multifamily dwellings. For the average nonresidential development, land costs are about 20 percent of total costs for office buildings; 30 percent for retail structures; 25 percent for industrial buildings; and about 15 percent for warehouse structures (Burchell, Dolphin, and Galley 2000).

Residential and nonresidential cost changes as a function of alternative development comprise both location and housing mix differences. Moving in to the extreme central part of a region often means lower overall housing costs due to more single-family attached and multifamily dwellings and the lower housing prices found there. On the other hand, the overall housing mix in peripheral areas does not exhibit the variety of more urban areas and usually density is considerably lower; as a result, housing prices overall (not per unit) are generally higher there than in

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urban areas. On the other hand, for single-family detached housing, peripheral areas offer less expensive housing than neighborhoods closer-in.

To calculate the effects of uncontrolled- and controlled-growth development futures on housing costs, the prices of various types of new housing are calculated for each of the counties. Price by structure type, including the value of multifamily units determined through rent capitalization, is disaggregated into land and structure components according to the relationships discussed above. Thus, if a new single-family dwelling costs \$160,000, \$120,000 is assumed to be structure cost; \$40,000 is land cost. If density is *increased* by 10 percent under controlled development, the land portion of overall housing costs is *decreased* by an appropriate amount, and a new price is calculated. In this case, it would be \$120,000 (structure) + \$36,000 (land), or \$156,000 (total value). These relationships will be discussed in detail in subsequent sections.

Data Sources and Manipulations: Residential

The U.S. Census Public Use Microdata Sample (PUMS) is used to provide county housing prices for each of the basic housing types (single-family detached and attached, mobile homes, and multifamily units). To obtain the most current housing mix and costs as a basis for the projection from 2000 to 2025, the array and pricing structures of dwelling units built between 1980 and 1990 were considered. Price by type of unit was adjusted to 2000 by applying rates of change in housing price by structure type from 1987 to 1997, using the 1987 and 1997 *American Housing Surveys*. Next, it was necessary to determine current pricing structure below the county level in both developed and undeveloped areas. Tables 10.1 and 10.2 present this data for the uncontrolled- and controlled-growth scenarios, respectively.

To establish the appropriate costs for areas within each county, the following assumption was made. In undeveloped, rural, and rural renter counties that essentially are undeveloped, the average values obtained from PUMS are considered representative of the undeveloped areas of those counties. In their developed areas, housing prices (structure and land) are increased by 50 percent. This was verified by checking housing prices for freestanding large cities in counties. In the suburban, urban, and urban center counties, a similar procedure is employed. The PUMS-determined county average is used for the developed areas of these counties; in undeveloped areas, prices are reduced by one-third. Again, this was checked whenever possible using comparable municipal information on housing price.

Under the controlled-growth scenario, the growth of single-family attached and multifamily housing types is increased by 25 percent. Further, the density of all development types is increased by 20 percent, except in the undeveloped areas of rural and undeveloped counties. The latter is a “design” density increase, which means it is an increase usually not visible to the naked eye. In the undeveloped areas of all counties, approximately 20 percent of the residential units are developed in cluster developments wherein density is twice as high as the prevailing density of undeveloped areas. Additionally, all redirected residential units into developed areas were priced five percent higher than uncontrolled-growth units to accommodate the expected increased amenities in housing units demanded by these households.

Data Sources and Manipulations: Nonresidential

Average household incomes from PUMS data are used to adjust data on construction costs per square foot, obtained from the building industry, to provide a unique per-square-foot cost by type of nonresidential property. This is done through the application of differences in household income in counties to real property construction costs. Costs per square foot are determined for representative types of construction (office, retail, industrial, warehouse) in a single county. In determining these costs, information from building industry cost sources was used to construct the following regimen.

Table 10.1
Average Residential Property Development Costs per Unit—Uncontrolled-Growth Scenario (in Dollars)

		Developed Areas				Undeveloped Areas			Average of All Areas				
Census Region	**County Development Type**	**Single-Family Detached**	**Single-Family Attached**	**Multi-family**	**Mobile Homes**	**Single-Family Detached**	**Single-Family Attached**	**Mobile Homes**	**Single-Family Detached**	**Single-Family Attached**	**Multi-family**	**Mobile Homes**	**All Housing Types**
Northeast	Undeveloped	277,439	195,702	90,138	89,675	184,967	130,475	59,786	220,430	204,373	106,438	62,557	167,090
	Rural	359,938	233,169	114,926	99,347	240,291	155,645	66,317	295,057	200,770	110,203	68,259	235,647
	Rural Center	230,215	157,123	79,690	56,488	154,034	105,138	37,782	216,151	157,130	82,622	50,678	154,192
	Suburban	404,060	255,349	128,622	90,446	270,667	171,052	60,582	357,903	249,718	137,213	95,327	279,891
	Urban	415,594	271,711	146,350	106,722	278,448	182,047	71,504	341,140	252,619	149,075	76,895	240,304
	Urban Center	345,264	247,474	149,628	N/A	231,136	165,653	N/A	265,324	214,470	149,628	N/A	228,162
Midwest	Undeveloped	190,250	161,111	72,636	65,284	126,837	107,410	43,524	140,557	117,886	76,470	44,941	94,727
	Rural	221,302	172,596	82,432	60,161	147,673	115,161	40,136	196,665	152,481	79,244	43,940	139,751
	Rural Center	186,475	145,654	80,378	56,418	124,552	97,288	37,676	152,091	130,718	71,871	43,567	117,253
	Suburban	213,983	148,950	80,113	44,780	143,275	99,716	29,978	222,292	145,485	82,365	41,564	160,882
	Urban	245,964	160,556	92,735	41,978	164,796	107,572	28,125	281,132	178,721	98,686	43,202	197,852
	Urban Center	240,678	160,460	92,514	52,290	161,254	107,508	35,034	253,581	159,738	105,405	66,968	176,783
South	Undeveloped	196,107	131,468	69,866	66,072	130,743	87,648	44,049	166,073	121,775	118,060	47,412	98,629
	Rural	219,748	152,355	79,457	66,134	146,625	101,654	44,125	186,020	144,339	91,211	52,592	130,958
	Rural Center	186,385	132,378	74,650	54,212	124,553	88,462	36,224	154,947	131,506	69,069	41,349	100,923
	Suburban	204,063	134,904	77,575	52,006	136,600	90,296	34,809	207,656	163,921	99,757	53,879	156,021
	Urban	226,388	140,979	87,643	44,245	151,680	94,456	29,644	234,152	180,338	86,873	46,354	165,153
	Urban Center	295,976	204,345	108,193	22,759	198,304	136,911	15,249	196,698	129,422	76,463	40,384	127,292
West	Undeveloped	256,097	180,615	95,295	102,696	170,760	120,426	68,475	229,305	182,197	98,028	82,930	175,881
	Rural	310,477	193,119	107,584	101,139	207,442	129,021	67,558	293,015	259,163	106,337	89,455	235,391
	Rural Center	206,823	131,016	76,933	76,476	138,235	87,568	51,106	183,199	133,986	74,804	64,142	120,164
	Suburban	258,778	160,862	92,818	77,549	173,159	107,631	51,879	252,361	176,467	98,891	75,226	174,203
	Urban	367,139	242,200	129,101	89,651	245,877	162,215	60,030	396,642	313,268	136,575	105,684	264,516
	Urban Center	268,586	228,752	121,157	35,195	179,953	153,264	23,581	190,703	127,930	76,409	45,250	128,792
United States	Undeveloped	206,572	152,522	75,614	72,366	137,723	101,686	48,247	194,145	163,645	103,313	57,466	131,506
	Rural	242,192	170,365	86,293	70,485	161,638	113,691	47,036	223,465	193,190	94,152	56,899	163,001
	Rural Center	197,397	138,694	77,636	61,907	131,921	92,689	41,364	176,058	135,943	73,875	55,778	118,774
	Suburban	246,843	161,789	88,683	60,004	165,267	108,312	40,167	239,873	178,589	99,648	62,672	174,353
	Urban	283,495	182,613	104,722	60,816	189,922	122,340	40,740	289,412	240,778	105,978	71,357	205,256
	Urban Center	288,840	206,016	115,658	29,194	193,477	137,993	19,560	204,831	144,432	78,529	42,021	135,756

Source: U.S. Census. Data interpretation by the Center for Urban Policy Research.

Table 10.2
Average Residential Property Development Costs per Unit—Controlled-Growth Scenario (in Dollars)

Census Region	County Development Type	Developed Areas: Single-Family Detached	Developed Areas: Single-Family Attached	Developed Areas: Multi-family	Developed Areas: Mobile Homes	Undeveloped Areas: Single-Family Detached	Undeveloped Areas: Single-Family Attached	Undeveloped Areas: Mobile Homes	Average of All Areas: Single-Family Detached	Average of All Areas: Single-Family Attached	Average of All Areas: Multi-family	Average of All Areas: Mobile Homes	Average of All Areas: All Housing Types
Northeast	Undeveloped	277,439	195,702	90,138	89,675	180,344	130,475	56,199	213,850	207,160	107,889	58,669	161,205
	Rural	359,938	233,169	114,926	99,347	234,285	155,645	62,338	286,620	192,825	109,935	64,315	223,585
	Rural Center	220,630	151,906	78,366	50,837	144,349	105,138	32,098	211,465	153,503	82,407	45,970	147,671
	Suburban	387,180	246,826	126,482	81,386	253,767	162,517	60,582	342,603	253,961	136,427	83,195	251,153
	Urban	398,256	262,637	143,923	96,037	261,045	172,955	71,504	314,654	240,150	143,606	62,750	225,184
	Urban Center	330,856	239,210	147,142	N/A	216,696	157,380	N/A	249,655	210,542	164,209	N/A	210,642
Midwest	Undeveloped	190,250	161,111	72,636	65,284	123,667	107,410	40,917	136,927	114,144	75,863	42,469	91,302
	Rural	221,302	172,596	82,432	60,161	143,982	115,161	37,733	188,007	156,401	80,160	42,252	130,746
	Rural Center	178,679	140,820	79,037	50,782	116,726	97,288	32,016	141,707	129,202	72,625	38,823	109,683
	Suburban	205,082	143,981	78,787	40,298	134,319	94,722	29,978	210,670	143,587	81,591	37,099	144,015
	Urban	235,763	155,212	91,197	37,784	154,490	102,190	28,125	271,540	173,423	97,113	37,329	179,130
	Urban Center	230,693	155,115	90,980	47,062	151,173	102,126	35,034	269,160	178,116	110,385	55,550	172,117
South	Undeveloped	196,107	131,468	69,866	66,072	127,475	87,648	41,406	162,197	131,675	123,431	44,644	94,518
	Rural	219,748	152,355	79,457	66,134	142,960	101,654	41,477	177,468	138,628	90,524	49,747	120,277
	Rural Center	178,651	127,961	73,404	48,808	116,682	88,462	30,709	150,851	128,570	68,945	37,380	96,118
	Suburban	195,556	130,425	76,289	46,784	128,065	85,786	34,809	193,485	161,257	97,314	48,506	139,323
	Urban	216,955	136,272	86,190	39,801	142,201	89,732	29,644	221,408	165,845	86,973	40,714	143,035
	Urban Center	283,639	197,516	106,413	20,472	185,912	130,065	15,249	188,488	205,822	80,051	32,719	121,857
West	Undeveloped	256,097	180,615	95,295	102,696	166,489	120,426	64,366	212,685	177,143	94,880	77,443	161,113
	Rural	310,477	193,119	107,584	101,139	202,255	129,021	63,505	277,638	264,236	105,446	83,060	219,604
	Rural Center	198,191	126,660	75,655	68,834	129,623	87,568	43,470	178,795	131,582	74,487	58,491	111,424
	Suburban	248,005	155,476	91,267	69,794	162,316	102,256	51,879	243,566	180,208	98,558	67,913	158,181
	Urban	351,856	234,107	126,934	80,690	230,480	154,096	60,030	372,308	306,720	141,456	91,098	238,904
	Urban Center	257,405	221,110	119,124	31,675	168,684	145,592	23,581	196,882	132,115	88,566	47,014	122,682
United States	Undeveloped	206,572	152,522	75,614	72,366	134,280	101,686	45,353	181,820	157,265	107,859	53,363	120,622
	Rural	242,192	170,365	86,293	70,485	157,597	113,691	44,215	210,045	187,606	92,473	52,739	147,783
	Rural Center	189,169	134,081	76,343	55,724	123,641	92,689	35,142	169,438	133,520	73,615	50,142	110,928
	Suburban	236,555	156,397	87,211	53,991	154,938	102,900	40,167	227,416	179,496	98,829	55,909	156,939
	Urban	271,694	176,518	102,980	54,725	178,046	116,222	40,740	275,841	238,697	109,424	60,990	186,013
	Urban Center	276,812	199,138	113,740	26,271	181,383	131,093	19,560	203,879	185,383	84,814	39,178	131,106

Source: U.S. Census. Data interpretation by the Center for Urban Policy Research.

Table 10.3
Average Nonresidential Property Development Costs per Square Foot
Uncontrolled-Growth Scenario
(in Dollars)

	Developed Areas				Undeveloped Areas			
County Type	**Office**	**Retail**	**Industrial**	**Warehouse**	**Office**	**Retail**	**Industrial**	**Warehouse**
Undeveloped/Rural	67	61	43	26	54	49	34	21
Rural Center	87	79	56	33	70	63	44	26
Suburban	99	91	64	37	80	72	51	30
Urban/Urban Center	123	99	79	46	99	90	63	37

Source: Center for Urban Policy Research, Rutgers University.

Table 10.4
Average Nonresidential Property Development Costs per Square Foot
Controlled-Growth Scenario
(in Dollars)

	Developed Areas				Undeveloped Areas			
County Type	**Office**	**Retail**	**Industrial**	**Warehouse**	**Office**	**Retail**	**Industrial**	**Warehouse**
Undeveloped/Rural	66	59	42	25	54	49	34	21
Rural Center	85	77	54	32	70	63	44	26
Suburban	97	88	62	37	80	72	51	30
Urban/Urban Center	121	96	77	45	99	90	63	37

Source: Center for Urban Policy Research, Rutgers University.

Table 10.5
Aggregate Property Development Costs—Uncontrolled- and Controlled-Growth Scenarios by Region: 2000 to 2025
(in Billions of Dollars)

	Uncontrolled Growth			Controlled Growth			Savings			
Region	**Residential**	**Non-residential**	**Total Cost**	**Residential**	**Non-residential**	**Total Cost**	**Residential**	**Non-residential**	**Total Savings**	**Percentage Savings**
Northeast	434.5	256.1	690.6	385.9	250.3	636.2	48.6	5.8	54.4	7.9
Midwest	565.6	402.8	968.4	522.7	393.8	916.5	42.9	9.1	51.9	5.4
South	1,711.6	761.5	2,473.1	1,554.0	748.7	2,302.7	157.6	12.8	170.4	6.9
West	1,665.6	577.7	2,243.3	1,530.5	569.3	2,099.8	135.1	8.4	143.5	6.4
United States	**4,377.3**	**1,998.1**	**6,375.4**	**3,993.0**	**1,962.1**	**5,955.1**	**360.2**	**38.4**	**420.3**	**6.6**

Source: Center for Urban Policy Research, Rutgers University.

Costs per square foot for a developed location in suburban Monmouth County, New Jersey, are $125 per square foot for office space; $115 per square foot for retail space; $80 per square foot for industrial space; and $46 per square foot for warehouse space. These costs include land. Nonresidential costs in *undeveloped* areas of counties are 25 percent less than in *developed* areas. These base values, once put in place, are adjusted for counties nationwide by differences in household income.

Nonresidential costs are shown in Table 10.3. In an unweighted average of county nonresidential costs, there are reasonable construction cost differences by county type. Under the controlled-growth scenario, nonresidential density is increased only in developed areas; undeveloped-area costs remain the same (Table 10.4). The decrease in nonresidential-development costs in the developed areas will be relatively small under the controlled-growth scenario. Nonresidential developments normally do not consume much land, therefore the difference in costs reflects the small decrease in overall delivery price afforded by the increase in density under the controlled-growth scenario. The redirection of businesses to more-developed areas increases the construction costs, further eroding the savings achieved by the increased density. There is no change in types of nonresidential use under the controlled-growth scenario.

Courtesy of G. Lowenstein

RESULTS OF THE ASSESSMENT: THE UNITED STATES AND ITS REGIONS

Uncontrolled Growth

To accommodate a growth of 23.5 million new households, containing 60.7 million persons, and a corresponding growth of 49.4 million new jobs, residential and nonresidential space costing \$6.4 trillion, must be put in place during the period 2000 to 2025 (Table 10.5). Sixty-nine percent, or \$4.4 trillion will be required for residential development; 31 percent, or \$2.0 trillion, will be required for nonresidential development. These amounts represent the costs of delivering 26.5 million new dwelling units and 26.5 billion square feet of nonresidential space for the projected 25-year future.

Of the four census regions of the United States, the South will require the largest number of new homes and nonresidential space. By 2025, almost \$2.5 trillion in new construction, or 39 percent of the nationwide total, will be required in this region. The breakdown for future residential and nonresidential property development is 69/31, which is the same as the distribution in the rest of the nation. The West, with almost as much construction required as in the South, will evidence \$2.2 trillion in new construction, approximately 35 percent of the nationwide total. In this case, nonresidential property development costs are less than 31 percent of all property development costs. The Midwest, which has the third-largest share of growth over the next 25 years, will experience \$1.0 trillion in new property development; this is 15 percent of the nationwide total. The Midwest region also has the highest nonresidential share of overall development costs, making up about 42 percent of the total. The Northeast will require the remainder, approximately \$0.7 trillion of new construction costs, or 11 percent of the nationwide total. In this region, nonresidential development costs represent 37 percent of overall development costs.

Courtesy of G. Lowenstein

The average per-unit residential and nonresidential costs for the nation as a whole and for each region are presented in Table 10.6. The nationwide average residential development cost per unit in 2000 dollars is \$167,038. Nonresidential average development cost is \$75.46 per square foot, or 75,463 per 1,000 square feet. These are the weighted averages of the individual costs encountered by new households and employees being housed in counties under the uncontrolled-growth scenario.

Residential value represents the average cost for all households. It is a combination of all housing types, ranging from the relatively high-cost single-family detached home to the relatively low-cost multifamily dwelling unit. Residential and nonresidential costs in the Midwest and the South are less than the U.S. averages; while the Northeast and the West exceed the nationwide averages. Although it appears that residential-unit costs are twice as high as nonresidential-unit costs, this is misleading, since residential units are at least twice the size, on average, of the 1,000-square-foot size of the nonresidential unit of space. Actually, their average per-square-foot development costs are relatively comparable.

Table 10.6
Per-Unit Property Development Costs—Uncontrolled- and Controlled-Growth Scenarios by Region: 2000 to 2025
(in Dollars)

	Uncontrolled Growth		Controlled Growth		Residential Savings		Nonresidential Savings	
Region	Residential	Non-residential	Residential	Non-residential	Unit Savings	Percentage Savings	Unit Savings	Percentage Savings
Northeast	246,418	85,705	228,329	84,277	18,089	7.3	1,428	1.7
Midwest	150,377	73,643	140,907	72,789	9,470	6.3	854	1.2
South	140,118	71,945	128,381	71,033	11,737	8.4	912	1.3
West	196,747	77,695	181,793	77,119	14,954	7.6	576	0.7
United States	**167,038**	**75,463**	**154,035**	**74,598**	**13,003**	**7.8**	**865**	**1.1**

Source: Center for Urban Policy Research, Rutgers University.
Note: A nonresidential unit equals 1,000 square feet.

Table 10.7
Per-Unit Property Development Cost Savings by Region: 2000 to 2025
(in Dollars)

	Residential-Unit Savings				Nonresidential-Unit Savings			
Region	Single-Family Detached	Single-Family Attached	Multifamily	Mobile Homes	Office	Retail	Industrial	Warehouse
Northeast	13,419	-1,690	-1,534	6,755	1,902	2,410	1,558	520
Midwest	7,849	-814	-720	2,814	1,185	1,774	824	379
South	9,655	-1,116	597	3,777	1,109	1,706	724	308
West	11,947	-9,728	-4,550	7,830	858	1,641	836	152
United States	**11,095**	**-4,529**	**-1,612**	**5,167**	**1,152**	**1,788**	**841**	**306**

Source: Center for Urban Policy Research, Rutgers University.

Over the next 25 years, the property development costs of single-family detached homes amount to $2.1 trillion, or 48 percent of total development costs of $4.4 trillion (Table 10.5). Thus, under the uncontrolled-growth scenario in the United States, the value of single-family detached development is one-third the cost of all development, including nonresidential development.

Controlled Growth

Under the controlled-growth scenario, overall development costs are reduced by $420 billion (Table 10.5). This amounts to a decrease of nearly 7 percent nationwide. Thus, by (1) moving to the more developed counties of a region and to the more developed portions of all counties, (2) increasing the share of single-family attached and multifamily housing by 25 percent, and (3) increasing density/FARs in developed areas of counties by 20 percent, a near 7 percent saving can be realized in property development costs. The South region experiences the largest aggregate savings of $170 billion, or approximately 7 percent of overall property development costs. The West saves in aggregate $144 billion, or over 6 percent of overall property development costs. The Northeast evidences one-third of the South's aggregate savings—$54 billion, or 8 percent of overall property development costs. The Midwest shows a similar amount saved—$52 billion, or 5 percent of overall property development costs. The Northeast and Midwest regions exhibit the least savings due to less growth and existing higher-density areas; the West and South regions exhibit the most savings due to their significant growth and lower overall population density.

Average property development costs under controlled growth are lowered in every region (Table 10.6). Controlled growth lowers property development costs because it is characterized by higher density, a redirection of development, and more variation in housing mix (residential development only). On a percent basis, overall savings nationwide amount to about 8 percent for residential development under the controlled-growth scenario. Average nonresidential development cost savings per unit are less significant, with only a 1 percent saving nationwide under the controlled-growth scenario.

Courtesy of C. Galley

The specific per-unit cost savings for each of the residential- and nonresidential-unit types are presented in Table 10.7. Specific per-unit savings vary by region. The Northeast evidences the largest savings in single-family detached housing costs ($13,419) but experiences increases in single-family attached costs ($1,690) and multifamily housing costs ($1,534) per unit. These are the direct consequences of the differences in development costs in these regions, as well as differences in pricing structure between their developed and undeveloped areas. These differences are large in the Northeast and West for the types of housing found in developed areas: single-family attached and multifamily units. Only the South experiences savings in multifamily units as a result of the policies of the controlled-growth scenario. The West exhibits the second largest savings in single-family attached units ($11,947) and the largest savings in mobile homes ($7,830). All mobile home units decrease in cost under the controlled-growth scenario.

With regard to nonresidential development, the Northeast experiences the largest savings for the four nonresidential types. The Midwest has the second highest per-unit cost savings for most nonresidential types. Every type of nonresidential use exhibits cost savings under the controlled-growth scenario (Table 10.7).

As stated previously, overall real estate cost savings in the controlled-growth scenario is the product of three different growth control measures affecting residential development and two different growth control measures affecting nonresidential development. These are restated below. Residential and nonresidential units are redirected to more-developed areas producing different costs due to pricing and building mixes at the new locations. The increase in design density for all types of units (residential and nonresidential) reduces expenses by lowering the land component of building costs. Finally, the increase in single-family attached and multifamily units of residential development in more central locations offers potentially less-expensive housing due to the size and density of the units. All redirected residential units were priced five percent higher than uncontrolled-growth units to accommodate the expected increased amenities in housing units demanded by these households.The effect of all these measures is the achievement of the overall $420 billion savings nationwide in the controlled-growth scenario. Table 10.8 illustrates the impact of each of the above growth control measures on overall savings achieved.

The values presented in Table 10.8 represent the savings that result from a specific control measure separately imposed on uncontrolled growth, thus provid-

Table 10.8
Controlled-Growth Scenario—Residential and Nonresidential Per-Unit Property Development Cost Savings for Each Control Measure Taken Separately
(in Dollars)

Growth Control Change	Residential Savings	Nonresidential Savings
Development density/FAR increase (no household and job redirection)	5,448	1,523
Household and job redirection using the existing housing mix in all locations (no increase in density)	-35,550	808
25% additional SFA & MF units in existing housing mix (no redirection or increase in density)	19,767	
All of the above components	13,003	865

Source: Center for Urban Policy Research, Rutgers University.

Table 10.9
Controlled-Growth Scenario—Residential Per-Unit Property Development Cost Savings for Each Control Measure Taken Cumulatively
(in Dollars)

Growth Control Change	Savings Due to Increased Density	Additional Savings Due to Household Redirection	Additional Savings Due to 25% Increase in SFA & MF Units
Separate Savings	5,448	-35,078	42,081
Cumulative Savings	5,448	-29,630	13,003

Source: Center for Urban Policy Research, Rutgers University.

Table 10.10
Controlled-Growth Scenario—Nonresidential Per-Unit Property Development Cost Savings for Each Control Measure Taken Cumulatively
(in Dollars)

Growth Control Change	Savings Due to Increased Density/FAR	Additional Savings Due to Job Redirection
Development density/FAR increase (no relocations)	1,523	-658
Cumulative Savings	1,523	865

Source: Center for Urban Policy Research, Rutgers University.

ing a sense of each unique impact of that control measure on future property development costs. Due to the separateness of application, each specification of input fails to catch any savings or costs that might occur if two or more controls act simultaneously. Consequently, their sum does not add to the total savings, cumulatively achieved.

If it is desired to view the cumulative effect of a specific control measure given one or more of the other controls previously imposed, the saving is computed acknowledging a sequence involving those prior conditions. The savings are then incremental and additive.

A residential sequence is presented in Table 10.9 to show the cumulative effects. Separate and cumulative per-unit savings for residential development is shown. The sequence starts with increased density. As expected, the increase in density for the projected growth produces a per-unit savings of $5,448 since it reduces the cost of land at most of the existing development sites. The next control imposed is the redirection of households, which results in an incremental average cost *increase* of $35,078 per unit, producing a total *increase* in cost of $29,630. Contrary to expectations, redirecting portions of growth to more-developed areas (often higher-cost areas) produces an increase in overall development costs (cost increases or negative savings). Finally, the shift to 25 percent more single-family attached (SFA) and multifamily (MF) units saves an additional $42,633 per unit. Encouraging more single-family attached and multifamily housing as part of the controlled-growth scenario produces significant savings in overall housing costs. The combined savings of the three components of growth control adds to savings of $13,003 per unit as shown in Table 10.6.

The per-unit savings for nonresidential development under the controlled-growth scenario is presented in Table 10.10. Since there are only two controls, the increased FAR and the redirection of jobs, only two steps are required to show the savings. The initial savings due to density increase ($1,523) are identical to the dollar values shown in Table 10.8. The second savings due to job redirection ($-658) is actually a cost increase. These combine to produce an overall cost savings of $865 per unit or per 1000 square feet of nonresidential development.

Thus, the controlled-growth scenario, which involves three residential and two nonresidential controls, exhibits a savings in property development costs overall even though one component of this overall saving amounts to a cost increase. In both the residential and nonresidential case, this cost increase is the result of moving from a farther-out to a closer-in county. Thus, in order for a redistribution of households and jobs to take place for growth control measures, this must be accompanied by a density and residential mix change to prevent overall residential and nonresidential development costs from increasing. This is consistent with the findings of chapter 14, in which it was found that development costs decrease with distance from a central county or city.

Courtesy of C. Galley

Courtesy of C. Galley

STATES

Uncontrolled Growth

Table 10.11 lists the states in descending order of total future property development costs incurred. The top 20 states will require new residential and nonresidential construction amounting to $5.0 trillion. These 20 states, which make up 40 percent of the nation, will incur 79 percent of the nation's future property development costs for the period 2000 to 2025. The fastest-growing state (California) will spend $1.2 trillion, more than twice as much as the next highest state (Florida) and almost one-fifth of future development costs nationwide. This is primarily the result of the high cost of housing in California. Florida's projected household growth is 80 percent that of California; its residential property development costs are only 48 percent of those of California. The next state (Texas) will also incur more than $500 billion in new property development costs. All of the aforementioned states are in either the South or the West regions, the fastest-growing regions of the United States over the projection period.

Residential development costs will average $176,301 per dwelling unit in the top 20 states, approximately 6 percent higher than the national average of $167,037 (Table 10.12). Although in the middle section of future aggregate property development costs due to its moderate growth, Hawaii will spend $353,113 per future residential unit, more than any other state and twice the national average. Seven other states will spend in excess of $250,000 per unit for new residential dwellings. Four of the seven are in the top 20

Table 10.11
Aggregate Property Development Costs—Uncontrolled- and Controlled-Growth Scenarios by State: 2000 to 2025
($ Billions)

State	Uncontrolled Growth			Controlled Growth			Savings			
	Residential	Non-residential	Total Cost	Residential	Non-residential	Total Cost	Residential	Non-residential	Total Savings	Percentage Savings
California	867.1	289.9	1,157.0	798.2	285.1	1,083.3	68.9	4.8	73.7	6.4
Florida	399.2	151.0	550.2	374.3	148.4	522.7	24.9	2.6	27.5	5.0
Texas	353.3	163.9	517.2	321.8	161.4	483.2	31.5	2.5	34.0	6.6
Virginia	180.1	69.4	249.5	150.9	65.6	216.5	29.2	3.8	33.0	13.2
Georgia	163.5	68.7	232.2	153.0	67.7	220.7	10.4	1.0	11.5	4.9
Arizona	158.9	51.0	209.9	144.9	49.6	194.5	14.0	1.4	15.4	7.3
Washington	150.4	52.7	203.1	134.4	51.7	186.2	16.0	0.9	16.9	8.3
North Carolina	122.4	59.3	181.7	112.9	58.6	171.5	9.5	0.7	10.2	5.6
Illinois	105.1	76.5	181.6	94.8	74.9	169.7	10.2	1.6	11.8	6.5
Maryland	135.4	45.9	181.3	100.5	42.2	142.7	34.9	3.7	38.6	21.3
Colorado	118.9	46.8	165.7	103.4	46.0	149.4	15.5	0.9	16.3	9.8
New York	77.2	71.2	148.4	74.4	71.3	145.7	2.8	-0.1	2.7	1.8
Ohio	83.1	61.0	144.1	80.3	60.0	140.3	2.8	1.0	3.8	2.6
Pennsylvania	86.3	56.7	143.0	73.5	57.7	131.2	12.8	-1.0	11.8	8.3
Michigan	81.8	60.0	141.8	74.6	58.7	133.3	7.2	1.3	8.5	6.0
New Jersey	88.9	47.3	136.2	76.0	42.4	118.4	12.9	4.9	17.8	13.0
Tennessee	87.1	41.4	128.6	81.5	41.0	122.5	5.7	0.5	6.1	4.8
Massachusetts	76.5	41.0	117.6	75.5	39.7	115.1	1.1	1.3	2.4	2.0
Minnesota	73.1	42.5	115.6	69.9	42.6	112.5	3.3	-0.1	3.2	2.7
South Carolina	76.5	31.1	107.6	69.4	30.8	100.2	7.1	0.4	7.4	6.9
Indiana	68.0	39.5	107.4	62.6	38.3	100.8	5.4	1.2	6.6	6.1
Nevada	72.1	28.3	100.4	64.9	27.9	92.8	7.2	0.3	7.5	7.5
Utah	63.2	26.9	90.1	57.8	26.5	84.3	5.5	0.4	5.9	6.5
Wisconsin	56.2	33.6	89.8	48.8	32.1	80.9	7.4	1.5	8.9	9.9
Oregon	62.5	27.0	89.4	59.5	27.4	87.0	2.9	-0.5	2.5	2.8
Hawaii	63.1	13.8	77.0	63.8	14.5	78.3	-0.7	-0.6	-1.3	-1.7
Alabama	46.6	25.5	72.1	43.1	25.0	68.1	3.5	0.5	4.0	5.5
Missouri	39.4	32.2	71.6	37.3	30.4	67.7	2.0	1.8	3.8	5.3
Louisiana	35.4	23.3	58.7	30.3	22.9	53.1	5.1	0.4	5.5	9.5
New Mexico	39.0	14.3	53.3	36.9	14.1	51.0	2.1	0.2	2.3	4.3
Kentucky	29.8	22.6	52.4	27.4	22.1	49.5	2.4	0.5	2.9	5.5
New Hampshire	38.5	9.2	47.7	23.1	9.0	32.1	15.4	0.2	15.6	32.7
Oklahoma	21.8	16.9	38.6	20.4	16.7	37.1	1.4	0.2	1.6	4.0
Kansas	20.2	16.7	36.8	18.0	16.4	34.4	2.2	0.3	2.4	6.6
Idaho	26.1	9.7	35.8	24.8	9.3	34.2	1.3	0.3	1.6	4.5
Maine	25.2	7.1	32.3	23.7	7.0	30.7	1.5	0.0	1.6	4.8
Mississippi	19.5	12.7	32.2	18.7	12.7	31.4	0.8	0.0	0.9	2.7
Iowa	13.3	18.5	31.9	12.6	18.3	30.9	0.7	0.3	1.0	3.1
Arkansas	18.2	13.4	31.6	17.4	13.6	30.9	0.8	-0.1	0.7	2.1
Alaska	22.3	8.8	31.1	20.4	8.7	29.1	1.9	0.1	2.0	6.5
Connecticut	13.4	15.0	28.4	13.7	14.5	28.2	-0.3	0.6	0.3	0.9
Nebraska	14.7	11.5	26.2	13.7	11.3	25.0	1.0	0.2	1.2	4.5
Rhode Island	14.5	5.4	19.9	12.8	5.5	18.2	1.7	0.0	1.7	8.4
Montana	13.8	5.5	19.3	13.4	5.5	18.9	0.4	0.0	0.4	2.2
Delaware	14.5	4.4	18.9	13.8	4.7	18.5	0.7	-0.2	0.4	2.2
Vermont	14.0	3.2	17.2	13.3	3.2	16.5	0.6	0.0	0.7	3.9
West Virginia	8.3	8.1	16.3	5.3	7.5	12.8	3.0	0.6	3.5	21.7
South Dakota	6.5	6.2	12.7	6.2	6.1	12.4	0.3	0.1	0.3	2.6
Wyoming	8.2	2.9	11.1	7.9	2.9	10.8	0.2	0.0	0.3	2.4
North Dakota	4.1	4.8	8.9	3.8	4.7	8.5	0.4	0.1	0.4	5.0
Top 20 States	**3,484.9**	**1,527.3**	**5,012.2**	**3,164.3**	**1,495.4**	**4,659.7**	**320.6**	**31.9**	**352.5**	**7.0**
United States	**4,377.3**	**1,998.1**	**6,375.4**	**3,993.0**	**1,962.1**	**5,955.1**	**384.2**	**36.0**	**420.3**	**6.6**

Source: Center for Urban Policy Research, Rutgers University.

most costly property development states. They are California, Maryland, New Jersey, and Massachusetts at $266,703, $270,046, $295,915 and $265,311 per residential unit, respectively. The other three are New Hampshire, Connecticut and Rhode Island, with costs of $284,550, $319,502 and $258,168 per residential unit, respectively.

Future concentrations of aggregate nonresidential property investment costs basically parallel future concentrations of residential property investment costs. Jobs follow people and vice versa. Thus, there is a fairly consistent ratio of nonresidential to residential property costs. On a per-unit basis, the average cost for a nonresidential unit (1,000 square feet)

Table 10.12
Per-Unit Property Development Costs—Uncontrolled- and Controlled-Growth Scenarios by State: 2000 to 2025
(in Dollars)

	Uncontrolled Growth		Controlled Growth		Residential Savings		Nonresidential Savings	
State	Residential	Non-residential	Residential	Non-residential	Unit Savings	Percentage Savings	Unit Savings	Percentage Savings
California	266,703	88,662	247,250	87,748	19,454	7.3	914	1.0
Florida	147,252	75,987	138,337	74,269	8,915	6.1	1,718	2.3
Texas	119,971	70,920	109,315	69,873	10,655	8.9	1,048	1.5
Virginia	234,315	90,467	209,619	88,383	24,696	10.5	2,085	2.3
Georgia	148,398	74,058	137,163	74,022	11,234	7.6	36	0.0
Arizona	132,857	66,947	122,026	65,980	10,831	8.2	968	1.4
Washington	164,285	74,652	150,001	73,949	14,285	8.7	703	0.9
North Carolina	126,922	68,493	116,926	67,659	9,997	7.9	834	1.2
Illinois	243,889	83,367	224,638	82,412	19,251	7.9	956	1.1
Maryland	270,046	95,129	228,473	93,651	41,572	15.4	1,479	1.6
Colorado	161,601	67,987	141,280	67,960	20,321	12.6	27	0.0
New York	231,767	85,513	222,614	84,667	9,153	3.9	846	1.0
Ohio	140,815	71,519	135,376	70,935	5,439	3.9	584	0.8
Pennsylvania	204,820	76,712	190,626	75,683	14,194	6.9	1,029	1.3
Michigan	143,882	78,253	133,419	77,019	10,463	7.3	1,234	1.6
New Jersey	295,915	94,124	282,843	92,707	13,071	4.4	1,417	1.5
Tennessee	125,926	65,853	117,341	65,715	8,586	6.8	138	0.2
Massachusetts	265,311	95,628	240,001	92,594	25,309	9.5	3,033	3.2
Minnesota	164,379	79,130	155,060	79,394	9,319	5.7	-264	-0.3
South Carolina	126,185	67,602	117,356	66,826	8,829	7.0	776	1.1
Indiana	133,767	67,207	124,341	66,284	9,426	7.0	924	1.4
Nevada	147,977	74,522	133,338	73,078	14,639	9.9	1,444	1.9
Utah	137,608	66,859	126,387	66,228	11,221	8.2	631	0.9
Wisconsin	138,213	68,646	126,193	67,585	12,020	8.7	1,061	1.5
Oregon	137,519	67,199	126,609	68,090	10,910	7.9	-891	-1.3
Hawaii	353,113	88,377	364,111	92,144	-10,998	-3.1	-3,768	-4.3
Alabama	98,429	60,855	91,200	60,722	7,229	7.3	132	0.2
Missouri	116,013	69,988	115,102	68,697	912	0.8	1,292	1.8
Louisiana	95,181	61,807	86,178	61,427	9,004	9.5	380	0.6
New Mexico	129,915	62,879	123,498	62,486	6,417	4.9	393	0.6
Kentucky	100,994	60,172	94,432	59,454	6,562	6.5	718	1.2
New Hampshire	284,550	76,260	246,520	75,888	38,030	13.4	372	0.5
Oklahoma	94,663	64,787	88,913	64,370	5,750	6.1	417	0.6
Kansas	153,988	72,073	139,810	70,586	14,178	9.2	1,487	2.1
Idaho	135,372	54,417	129,153	53,880	6,219	4.6	537	1.0
Maine	208,557	67,908	196,064	67,685	12,493	6.0	223	0.3
Mississippi	91,772	55,583	87,789	55,676	3,983	4.3	-93	-0.2
Iowa	107,939	66,730	102,125	65,806	5,814	5.4	923	1.4
Arkansas	97,594	52,573	92,727	53,079	4,867	5.0	-507	-1.0
Alaska	167,045	82,803	152,874	81,551	14,171	8.5	1,252	1.5
Connecticut	319,502	100,988	301,575	100,274	17,927	5.6	714	0.7
Nebraska	127,507	66,760	118,730	65,664	8,778	6.9	1,095	1.6
Rhode Island	258,168	84,337	206,501	85,005	51,667	20.0	-669	-0.8
Montana	137,350	52,395	133,333	52,234	4,017	2.9	162	0.3
Delaware	188,944	82,805	193,480	82,601	-4,537	-2.4	204	0.2
Vermont	212,648	67,434	202,986	66,989	9,662	4.5	445	0.7
West Virginia	105,209	55,889	86,309	55,430	18,900	18.0	459	0.8
South Dakota	101,249	59,151	97,237	58,479	4,013	4.0	672	1.1
Wyoming	135,080	56,448	131,783	56,059	3,297	2.4	389	0.7
North Dakota	108,990	64,138	99,555	62,946	9,435	8.7	1,191	1.9
Top 20 States	**176,301**	**78,592**	**161,867**	**77,533**	**14,434**	**8.2**	**1,059**	**1.3**
United States	**167,037**	**75,463**	**154,036**	**74,598**	**13,001**	**7.8**	**865**	**1.1**

Source: Center for Urban Policy Research, Rutgers University.

in the top 20 states is $78,592; this is $3,129 higher than the national average. Three states exceed $94,000 for nonresidential property development costs per 1,000 square feet: New Jersey at $94,124, Massachusetts at $95,628, and Connecticut at $100,988.

Controlled Growth

The top 20 states, representing 80 percent of future property development costs, reduce their costs from $5.0 trillion to $4.7 trillion, a saving of $353 billion, or 7 percent (Table 10.11). This amounts to 84 percent of the overall $420 billion saving. Of the

Table 10.13
Per-Unit Property Development Savings by State: 2000 to 2025
(in Dollars)

	Residential-Unit Savings				Nonresidential-Unit Savings			
State	Single-Family Detached	Single-Family Attached	Multifamily	Mobile Homes	Office	Retail	Industrial	Warehouse
California	-2,471	-5,055	-9,099	6,760	1,402	2,109	643	1,801
Florida	5,274	995	1,290	3,711	1,310	1,926	1,169	-902
Texas	5,305	497	13	3,910	1,085	1,801	965	565
Virginia	14,954	-4,467	-3,103	4,823	2,969	3,159	2,763	3,482
Georgia	-1,042	-6,015	-1,027	3,897	594	1,397	591	3,101
Arizona	7,161	2,297	543	4,516	1,175	1,919	1,014	1,032
Washington	6,885	-1,508	-970	8,268	799	1,519	821	844
North Carolina	6,603	-419	429	2,664	776	1,308	513	225
Illinois	11,138	-2,180	177	1,910	1,628	2,241	1,314	3,167
Maryland	19,812	21,324	-6,244	17,751	3,409	3,147	456	7,631
Colorado	5,838	-1,388	-1,594	4,761	1,020	1,676	562	2,678
New York	7,367	-1,265	2,729	5,130	939	1,609	819	853
Ohio	696	403	-11	2,769	1,107	1,766	537	1,932
Pennsylvania	11,366	4,203	-72	3,450	1,847	2,333	719	2,562
Michigan	10,996	3,442	915	3,689	1,544	2,216	969	1,211
New Jersey	6,178	-1,532	-2,088	8,267	2,161	2,406	2,228	5,723
Tennessee	4,162	3,293	-2,482	3,041	305	716	399	1,047
Massachusetts	6,222	-7,598	-6,780	11,054	3,553	3,814	1,800	1,960
Minnesota	4,597	-682	-3,367	2,455	250	903	431	2,564
South Carolina	6,134	-1,816	-379	2,296	725	1,227	500	133
Indiana	9,745	2,423	420	2,576	1,020	1,482	568	934
Nevada	3,902	2,034	707	6,414	1,141	1,820	1,098	-342
Utah	7,786	900	412	3,435	1,029	1,506	943	1,845
Wisconsin	11,089	1,790	995	3,057	1,493	1,910	1,229	2,414
Oregon	740	3,609	-261	5,592	-384	395	776	2,696
Hawaii	-28,640	-4,356	0	40,807	-4,417	-4,262	-1,936	-1,529
Alabama	9,250	-5,945	3,235	2,180	809	1,368	756	2,914
Missouri	-1,640	-14,147	-6,562	2,456	1,520	2,134	1,200	1,934
Louisiana	9,995	616	363	1,972	886	1,616	584	1,406
New Mexico	-1,110	-1,716	-585	4,942	432	928	489	756
Kentucky	7,769	2,660	338	2,428	852	1,345	687	295
New Hampshire	32,895	16,328	4,834	9,556	291	550	108	548
Oklahoma	1,991	69	-187	2,885	431	971	256	424
Kansas	11,470	1,882	509	3,270	1,300	2,168	785	-233
Idaho	6,707	-1,364	494	3,969	215	575	721	563
Maine	10,374	-2,388	1,304	7,100	67	407	75	-13
Mississippi	2,046	-918	1,105	1,906	-144	249	-32	75
Iowa	6,283	79	359	2,581	908	1,430	326	196
Arkansas	2,633	-11,807	-2,424	2,814	-807	-552	-404	-637
Alaska	14,033	2,885	718	4,315	1,261	1,729	936	446
Connecticut	8,032	688	-310	5,885	402	721	96	-922
Nebraska	6,430	1,615	378	3,671	1,110	1,642	516	133
Rhode Island	9,165	8,834	6,619	8,926	688	1,105	-349	9,006
Montana	3,232	2,113	216	3,585	132	277	50	42
Delaware	2,831	-5,302	-7,392	2,668	614	948	155	-1,185
Vermont	8,110	-2,286	388	5,420	412	639	322	252
West Virginia	13,850	2,017	3,613	2,795	196	452	232	1,196
South Dakota	3,584	2,586	362	3,294	649	1,021	331	153
Wyoming	2,240	-7,480	0	3,626	346	747	230	319
North Dakota	13,487	2,772	450	3,596	1,183	1,707	714	267
Top 20 States	**10,815**	**-2,032**	**-1,966**	**5,617**	**1,387**	**2,048**	**995**	**337**
United States	**11,095**	**-4,529**	**-1,612**	**5,167**	**1,152**	**1,788**	**841**	**306**

Source: Center for Urban Policy Research, Rutgers University.

20 states, California evidences the largest saving, $74 billion, amounting to a 6 percent saving statewide. California's saving is $35 billion more than the second highest state, Maryland, which evidences a property development cost saving of approximately $39 billion. Nonresidential savings are minimal for most states, with California experiencing also the largest savings in nonresidential costs under the controlled-growth scenario ($5 billion). Four other states (Maryland, Texas, Virginia, and Florida) have combined residential and nonresidential property development cost savings that exceed $25 billion. They range from $38.6 billion in Maryland to just above $27 billion in Florida. The only state that has a very small increase in overall property development costs ($1.3 billion) under the controlled-growth scenario

is Hawaii. This is due to the stronger central- or developed-area markets in that state. Redirection to the central areas causes additional costs of real estate development in Hawaii. Five states (New Hampshire, Maryland, West Virginia, Virginia, and New Jersey) have combined residential and nonresidential property development cost percentage savings that exceed 10 percent. They range from 32 percent in New Hampshire to 13 percent in New Jersey.

In the top 20 states, the average cost of housing is reduced from $176,301 to $161,867, a saving of $14,434, or more than 8 percent, due to the controlled-growth regimen (Table 10.12). Maryland exhibits the largest percentage decrease of 15 percent, reducing housing costs from $270,046 to $228,473 per unit. This aggregate savings is due primarily to a larger variety of housing types and increased density at the site of household and job relocation. Outside of the top 20 states, Rhode Island exhibits the absolute largest percentage decrease (20 percent), reducing housing costs from $258,168 to $206,501 per unit.

The average cost of housing for households that will require it during the period 2000 to 2025 will decrease in every state but two under the controlled-growth scenario (Table 10.12). The only two states showing a small increase in the average cost of housing are Hawaii and Delaware, where costs rise 2 percent to 3 percent under the controlled-growth scenario. Again, these are states typified by stronger real estate markets in their developed areas.

On a percentage basis, nonresidential property development cost savings, as pointed out previously, are not significant. The top 20 states exhibit savings on average of $1,059 per 1,000 square feet, or just over 1 percent of overall nonresidential property costs. Nonresidential property development cost savings per unit statewide vary from $27 to $3,033 per unit; in one case controlled-growth causes extra nonresidential development costs of $264 per unit. Massachusetts has the largest absolute nonresidential cost saving at $3,033 (3 percent); Hawaii, has the largest absolute nonresidential cost increase at $3,768 (4 percent).

Courtesy of G. Lowenstein

Courtesy of C. Galley

Specific savings by type of unit are presented in Table 10.13. Both across the nation and for the top 20 states, controlled development saves significant property costs for single-family housing and mobile homes but increases somewhat property development costs for single-family attached and multifamily housing. For the nation as a whole and in the top 20 states, every category of nonresidential land use exhibits decreases in property development costs under the controlled-growth regimen. The per-unit cost savings in the top 20 states always exceeds the national average.

EAS

Uncontrolled Growth

New property development costs incurred in EAs throughout the United States follow the pattern pre-

Courtesy of C. Galley

sented for the United States as a whole, its regions, and its states. Most of the future property development costs are being experienced in the southern and western EAs. New property investment is directly related to the household and employment growth of these EAs. The top 30 EAs in total property development costs must expend $4.5 trillion over the next 25 years (Table 10.14). This additional local construction in 17 percent of the EAs represents more than 70 percent of future nationwide property development costs for the period.

Of the top four EAs in future property development costs, each experiencing $245 billion to $470 billion in the next 25 years for new development, the West is represented twice, and surprisingly, the East is also represented twice. The Los Angeles-Riverside-Orange, CA EA has the highest future property development costs, $468 billion; the Washington-Baltimore, DC-MD-VA-WV-PA EA is second with future property development costs of $346 billion; the San Francisco-Oakland-San Jose, CA EA is third with property development costs of $333 billion; and the New York-Northern New Jersey-Long Island, NY-NJ-CT-PA-MA-VT EA is fourth with property development costs of $245 billion. The latter EA has an unusually high future ratio (0.73) of nonresidential to residential property development costs, which moves it significantly higher in the overall ranking. All the remaining EAs in the top 30 have property development costs of $54 billion to $202 billion in total. Fourteen, or just under 50 percent, of the top 30 EAs require more than $150 billion each in real-property investment over the projected period.

On a per-unit basis, residential development will cost, on average, $192,132 per housing unit in the top 30 EAs, 15 percent more than the national average of $167,037 (Table 10.15). Three EAs have average per-unit property costs of more than $300,000. These are (1) the San Francisco-Oakland-San Jose, CA EA; (2) the New York-Northern New Jersey-Long Island, NY-NJ-CT-PA-MA-VT EA; and (3) the Honolulu, HI EA. Their residential costs range from $307,266 (New York) to $353,113 (Honolulu). All of the EAs in the top 30 will have per-unit residential property costs in excess of $100,000.

Aggregate nonresidential property development costs vary in a similar manner to aggregate residential property development costs. Evidencing a higher ratio of nonresidential to residential property development costs is the New York-Northern New Jersey-Long Island, NY-NJ-CT-PA-MA-VT EA (0.73); evidencing a lower ratio is the Honolulu, HI EA (0.22) (Table 10.14). The average cost per 1,000 square feet of nonresidential space in the top 30 EAs is $81,701, about $6,200 higher than the national average (Table 10.15). Each EA in the top 30 has nonresidential costs of at least $62,614 per 1,000 square feet.

Controlled Growth

Under the controlled-grwoth scenario, the top 30 EAs, again representing 70 percent of new property development costs, reduce their costs from $4.5 trillion to

Courtesy of C. Galley

Table 10.14
Aggregate Property Development Costs—Uncontrolled- and Controlled-Growth Scenarios by EA: 2000 to 2025
($ Billions)

	Uncontrolled Growth			Controlled Growth			Savings			
EA	Residential	Non-residential	Total Cost	Residential	Non-residential	Total Cost	Residential	Non-residential	Total Savings	Percentage Savings
Los Angeles-Riverside-Orange, CA-AZ	327.1	140.4	467.5	297.4	138.1	435.5	29.7	2.3	32.0	6.8
Washington-Baltimore, DC-MD-VA-WV-PA	253.1	92.5	345.5	211.6	89.7	301.3	41.5	2.7	44.3	12.8
San Francisco-Oakland-San Jose, CA	258.6	74.3	332.9	249.6	72.9	322.6	8.9	1.4	10.3	3.1
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA-MA-VT	141.3	103.5	244.8	131.8	101.5	233.4	9.4	2.0	11.4	4.7
San Diego, CA	158.5	43.4	201.9	135.2	42.4	177.6	23.2	1.1	24.3	12.0
Dallas-Fort Worth, TX-AR-OK	139.2	60.9	200.1	124.3	60.1	184.4	14.9	0.8	15.7	7.8
Atlanta, GA-AL-NC	141.9	53.2	195.1	131.2	52.4	183.7	10.6	0.8	11.5	5.9
Boston-Worcester-Lawrence-Lowell-Brockton, MA-NH-RI-VT	130.2	54.0	184.2	112.0	52.4	164.5	18.2	1.5	19.7	10.7
Miami-Fort Lauderdale, FL	132.5	51.0	183.6	117.1	49.7	166.8	15.4	1.3	16.8	9.1
Chicago-Gary-Kenosha, IL-IN-WI	111.4	69.7	181.2	99.0	68.1	167.1	12.5	1.6	14.1	7.8
Seattle-Tacoma-Bremerton, WA	122.9	43.0	165.9	110.7	42.5	153.2	12.1	0.5	12.7	7.6
Denver-Boulder-Greeley, CO-KS-NE	114.5	45.1	159.6	99.2	44.3	143.5	15.3	0.9	16.2	10.1
Houston-Galveston-Brazoria, TX	105.6	46.0	151.6	97.3	45.1	142.4	8.3	0.9	9.2	6.1
Phoenix-Mesa, AZ-NM	113.2	38.2	151.4	102.5	37.4	140.0	10.7	0.8	11.5	7.6
Orlando, FL	99.7	33.7	133.4	93.2	33.0	126.1	6.6	0.7	7.3	5.5
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	88.0	36.6	124.6	69.8	34.9	104.8	18.2	1.7	19.8	15.9
Sacramento-Yolo, CA	90.6	21.1	111.7	84.4	20.8	105.1	6.3	0.3	6.6	5.9
Minneapolis-St. Paul, MN-WI-IA	71.4	40.2	111.6	67.5	39.9	107.5	3.9	0.3	4.2	3.7
Las Vegas, NV-AZ-UT	67.3	25.9	93.2	60.6	25.4	85.9	6.8	0.5	7.3	7.8
Detroit-Ann Arbor-Flint, MI	45.7	42.5	88.2	40.2	41.5	81.7	5.4	1.0	6.5	7.4
Portland-Salem, OR-WA	61.5	25.1	86.6	55.7	24.9	80.6	5.8	0.2	6.0	7.0
Salt Lake City-Ogden, UT-ID	55.0	25.1	80.1	49.7	24.7	74.4	5.2	0.4	5.6	7.0
Honolulu, HI	63.1	13.8	77.0	63.8	14.5	78.3	-0.7	-0.6	-1.3	-1.7
Tampa-St. Petersburg-Clearwater, FL	51.6	23.0	74.6	50.1	22.9	73.0	1.5	0.1	1.6	2.2
Indianapolis, IN-IL	43.0	22.6	65.7	40.2	22.2	62.4	2.8	0.4	3.2	4.9
San Antonio, TX	43.2	20.8	64.0	39.8	20.4	60.2	3.3	0.4	3.7	5.8
Nashville, TN-KY	46.2	16.6	62.8	42.1	16.5	58.6	4.1	0.1	4.2	6.7
Jacksonville, FL-GA	39.3	17.6	56.9	37.9	17.3	55.2	1.4	0.3	1.7	3.0
Raleigh-Durham-Chapel Hill, NC	37.5	16.8	54.3	33.6	16.6	50.2	3.9	0.2	4.1	7.6
Charlotte-Gastonia-Rock Hill, NC-SC	37.7	16.3	54.0	34.8	16.1	50.8	2.9	0.2	3.1	5.8
Top 30 EAs	**3,190.9**	**1,313.0**	**4,503.9**	**2,882.5**	**1,288.1**	**4,170.6**	**308.4**	**24.8**	**333.3**	**7.4**
United States	**4,377.3**	**1,998.1**	**6,375.4**	**3,993.0**	**1,962.1**	**5,955.1**	**384.2**	**36.0**	**420.3**	**6.6**

Source: Center for Urban Policy Research, Rutgers University.

$4.2 trillion, a saving of $333 billion (Table 10.14). Of the top 30 EAs, the Washington-Baltimore, DC-MD-VA-WV-PA EA saves the most at $44 billion over the period. This is almost a 13 percent saving from property development costs under the uncontrolled-growth scenario. Four other EAs have savings of $20 billion. These are (1) the Los Angeles-Riverside-Orange, CA EA, with a savings of $32 billion; (2) the San Diego, CA EA, with a savings of $24 billion; (3) the Philadelphia-Wilmington-Atlantic City, PA-DE-NJ EA, with a savings of $20 billion; and (4) the Boston-Worscester-Lawrence-Lowell-Brockton, MA-

Table 10.15
Per-Unit Property Development Costs—Uncontrolled- and Controlled-Growth Scenarios by EA: 2000 to 2025
(in Dollars)

	Uncontrolled Growth		Controlled Growth		Residential Savings		Nonresidential Savings	
EA	Residential	Non-residential	Residential	Non-residential	Unit Savings	Percentage Savings	Unit Savings	Percentage Savings
Los Angeles-Riverside-Orange, CA-AZ	260,320	89,718	241,173	89,347	19,147	7.4	371	0.4
Washington-Baltimore, DC-MD-VA-WV-PA	281,280	99,011	249,901	97,879	31,379	11.2	1,133	1.1
San Francisco-Oakland-San Jose, CA	305,569	93,383	297,449	92,546	8,120	2.7	837	0.9
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA-MA-VT	307,266	93,873	293,944	92,583	13,322	4.3	1,291	1.4
San Diego, CA	264,979	89,737	226,159	87,485	38,820	14.7	2,252	2.5
Dallas-Fort Worth, TX-AR-OK	135,397	75,475	120,945	74,531	14,452	10.7	943	1.2
Atlanta, GA-AL-NC	163,452	77,807	150,187	77,935	13,265	8.1	-128	-0.2
Boston-Worcester-Lawrence-Lowell-Brockton, MA-NH-RI-VT	269,090	90,656	236,343	88,550	32,747	12.2	2,106	2.3
Miami-Fort Lauderdale, FL	172,466	77,180	153,412	74,743	19,054	11.0	2,437	3.2
Chicago-Gary-Kenosha, IL-IN-WI	251,853	86,662	231,376	85,843	20,478	8.1	820	0.9
Seattle-Tacoma-Bremerton, WA	178,537	78,159	161,360	77,413	17,177	9.6	746	1.0
Denver-Boulder-Greeley, CO-KS-NE	162,336	68,762	141,334	68,762	21,002	12.9	1	0.0
Houston-Galveston-Brazoria, TX	129,722	72,649	119,641	71,279	10,081	7.8	1,370	1.9
Phoenix-Mesa, AZ-NM	137,513	69,242	124,550	67,807	12,963	9.4	1,434	2.1
Orlando, FL	145,932	77,214	136,317	75,592	9,615	6.6	1,623	2.1
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	251,052	88,916	240,178	87,116	10,875	4.3	1,800	2.0
Sacramento-Yolo, CA	246,421	78,762	229,587	78,102	16,833	6.8	660	0.8
Minneapolis-St. Paul, MN-WI-IA	163,017	80,815	154,830	81,248	8,187	5.0	-433	-0.5
Las Vegas, NV-AZ-UT	142,674	72,990	128,336	71,573	14,338	10.0	1,417	1.9
Detroit-Ann Arbor-Flint, MI	171,134	85,698	155,988	84,304	15,146	8.9	1,394	1.6
Portland-Salem, OR-WA	144,319	70,044	131,260	71,072	13,059	9.0	-1,028	-1.5
Salt Lake City-Ogden, UT-ID	136,616	68,924	124,367	68,237	12,250	9.0	687	1.0
Honolulu, HI	353,113	88,377	364,111	92,144	-10,998	-3.1	-3,768	-4.3
Tampa-St. Petersburg-Clearwater, FL	121,548	75,004	118,153	73,249	3,395	2.8	1,755	2.3
Indianapolis, IN-IL	137,866	69,537	128,551	68,308	9,315	6.8	1,230	1.8
San Antonio, TX	102,364	65,969	94,503	64,765	7,860	7.7	1,204	1.8
Nashville, TN-KY	139,942	62,614	127,345	63,033	12,598	9.0	-420	-0.7
Jacksonville, FL-GA	125,566	74,022	121,116	72,707	4,450	3.5	1,315	1.8
Raleigh-Durham-Chapel Hill, NC	136,757	73,224	122,411	72,263	14,346	10.5	961	1.3
Charlotte-Gastonia-Rock Hill, NC-SC	143,030	72,586	131,980	71,587	11,050	7.7	999	1.4
Top 30 EAs	**192,132**	**81,701**	**175,725**	**80,740**	**16,408**	**8.5**	**961**	**1.2**
United States	**167,037**	**75,463**	**154,036**	**74,598**	**13,001**	**7.8**	**865**	**1.1**

Source: Center for Urban Policy Research, Rutgers University.

NH-RI-VT EA, with a saving of $20 billion. The EA with the largest percentage savings is the Philadelphia-Wilmington-Atlantic City, PA-DE-NJ EA with a 16 percent saving in future property development costs as a result of the controlled-growth regimen. All of the remaining EAs in the top 30 exhibit some cost savings under the controlled-growth scenario. These vary from $2 billion (Jacksonville, FL) to $17 billion (Miami-Fort Lauderdale, FL) over the period. The exception is the Honolulu, HI EA, which shows an increase in costs of $1 billion under the controlled-growth scenario.

Table 10.16
Per-Unit Property Development Savings by EA: 2000 to 2025
(in Dollars)

	Residential-Unit Savings				Nonresidential-Unit Savings			
EA	Single-Family Detached	Single-Family Attached	Multifamily	Mobile Homes	Office	Retail	Industrial	Warehouse
Los Angeles-Riverside-Orange, CA-AZ	-22,739	3,075	-13,995	3,942	1,253	1,921	432	2,275
Washington-Baltimore, DC-MD-VA-WV-PA	9,526	5,905	-13,474	15,495	2,805	3,266	411	6,419
San Francisco-Oakland-San Jose, CA	-28,895	-15,908	-13,234	8,528	1,500	2,298	-199	2,879
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA-MA-VT	11,645	1,204	-588	7,781	1,648	2,176	2,026	1,813
San Diego, CA	19,124	6,286	923	9,264	2,129	2,913	1,704	600
Dallas-Fort Worth, TX-AR-OK	4,982	-108	-5	4,272	897	1,643	776	216
Atlanta, GA-AL-NC	-2,104	-5,654	-986	4,734	832	1,638	674	3,937
Boston-Worcester-Lawrence-Lowell-Brockton, MA-NH-RI-VT	14,711	-7,683	-3,288	11,083	2,725	2,952	1,230	2,111
Miami-Fort Lauderdale, FL	7,595	5,252	3,490	8,132	2,316	2,907	1,696	-518
Chicago-Gary-Kenosha, IL-IN-WI	16,391	-3,288	-488	3,050	1,856	2,493	1,277	4,346
Seattle-Tacoma-Bremerton, WA	7,203	-1,177	-476	9,039	763	1,557	673	613
Denver-Boulder-Greeley, CO-KS-NE	5,415	-1,402	-1,594	5,104	1,100	1,736	556	2,834
Houston-Galveston-Brazoria, TX	4,533	2,626	71	3,821	1,421	2,071	1,098	357
Phoenix-Mesa, AZ-NM	7,789	2,084	503	4,165	1,538	2,277	1,310	430
Orlando, FL	6,481	1,296	198	3,192	1,485	2,170	1,172	453
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	1,626	871	-342	5,941	3,851	4,522	1,731	9,875
Sacramento-Yolo, CA	4,748	1,737	75	5,672	1,132	1,318	704	1,196
Minneapolis-St. Paul, MN-WI-IA	3,389	-728	-4,317	1,600	147	761	373	3,370
Las Vegas, NV-AZ-UT	10,131	1,790	544	5,303	1,421	2,049	1,098	356
Detroit-Ann Arbor-Flint, MI	11,431	4,608	897	4,053	1,887	2,858	968	2,368
Portland-Salem, OR-WA	-609	2,570	-1,209	7,115	-199	593	861	4,237
Salt Lake City-Ogden, UT-ID	8,200	900	412	3,812	1,138	1,646	1,082	2,100
Honolulu, HI	-28,640	-4,356	0	40,807	-4,417	-4,262	-1,936	-1,529
Tampa-St. Petersburg-Clearwater, FL	-10,772	-4,902	-5,151	4,078	492	1,030	666	-4,306
Indianapolis, IN-IL	6,405	2,080	383	2,136	1,312	1,850	701	320
San Antonio, TX	3,028	-906	8	3,417	1,192	1,858	879	300
Nashville, TN-KY	5,447	5,252	-2,190	3,928	-3	368	278	1,972
Jacksonville, FL-GA	-1,697	3,498	-747	3,893	1,229	1,721	995	233
Raleigh-Durham-Chapel Hill, NC	6,511	-1,026	227	2,871	800	1,598	694	477
Charlotte-Gastonia-Rock Hill, NC-SC	5,407	209	417	2,403	991	1,566	704	183
Top 30 EAs	**9,724**	**-3,638**	**-2,099**	**6,473**	**1,414**	**2,079**	**1,005**	**293**
United States	**11,095**	**-4,529**	**-1,612**	**5,167**	**1,152**	**1,788**	**841**	**306**

Source: Center for Urban Policy Research, Rutgers University.

Under the controlled-growth scenario, the average cost of residential property development decreased in very EA in the top 30 but one (Table 10.15). The average cost of housing development was reduced from $192,132 to $175,725, a saving of $16,408, or almost 9 percent. Again, this is a function of savings due to redirection, housing mix, and density. The EA with the largest absolute decrease ($38,820) and the largest percentage decrease (15 percent) is San Diego, CA, where the cost of housing is reduced from $264,979 to $226,159 due to more centralized development. This EA is characterized by significant differences in housing costs in developed compared with undeveloped areas.

Courtesy of G. Lowenstein

Nonresidential property development cost savings, as pointed out previously, are not significant. The top 30 EAs have average savings of $961, or 1.2 percent of their overall property development costs. The top 30 EAs varied up to $2,437 per unit in savings. Honolulu, HI, has the largest absolute increase per nonresidential unit (1000 square feet) at $3,768, or 4.3 percent; Honolulu, HI also has the largest absolute increase in costs per residential unit at $10,998, or 3.1 percent.

The specific unit savings are presented in Table 10.16. Although many EAs have property cost decreases in most land-use categories under the controlled-growth regimen, every category of land use has at least one EA with an increase in unit costs, except for mobile homes.

COUNTIES

Uncontrolled Growth

The cost of future property development is presented in Table 10.17 for the nation's top-spending 50 counties. Aggregate property development costs for these counties, which amount to 40 percent of total national property development costs, are $2.6 trillion. Thus, 1.5 percent of the counties nationwide will experience 41 percent of future residential and nonresidential property investment. San Diego County, CA, with the largest future real-property investment, will experience more than $202 billion in development during the period 2000 to 2025. Three other western counties (Orange County, CA; Maricopa County, AZ; and Los Angeles County, CA) will experience future development investment ranging from $109 billion (Los Angeles County) to $142 billion (Maricopa County) over the projection period. Only San Diego County will have residential property development investment in excess of $200 billion.

Residential development will cost, on average, $197,916 per dwelling unit in the top 50 counties, almost 18 percent more than the national average of $167,037 (Table 10.18). The highest residential development cost will be in Ventura County, CA, at $438,947 per dwelling unit. Four counties will have average residential development costs of more than $350,000. These are Fairfax County, VA ($375,412); Contra Costa, CA ($361,146); Honolulu County, HI ($389,645) and Rockingham, NH ($355,967). All the counties in the top 50 will have residential unit costs greater than $113,422, with the exception of Cook County, IL. Its zero residential unit property cost re-

Table 10.17
Aggregate Property Development Costs—Uncontrolled- and Controlled-Growth Scenarios by County: 2000 to 2025
(in Billions of Dollars)

	Uncontrolled Growth			Controlled Growth			Savings			
County	Residential	Non-residential	Total Cost	Residential	Non-residential	Total Cost	Residential	Non-residential	Total Savings	Percentage Savings
San Diego, CA	158.5	43.4	201.9	135.2	42.4	177.6	23.2	1.1	24.3	12.0
Maricopa, AZ	105.4	36.1	141.5	94.9	35.4	130.2	10.5	0.8	11.3	8.0
Orange, CA	99.2	39.5	138.7	96.4	42.2	138.6	2.8	-2.6	0.1	0.1
Los Angeles, CA	56.9	52.0	108.9	130.1	74.3	204.4	-73.2	-22.3	-95.5	-87.7
Fairfax, F'fx City + Fall	68.3	19.1	87.4	59.0	18.6	77.7	9.3	0.5	9.7	11.2
Harris, TX	50.4	30.8	81.2	52.7	30.1	82.8	-2.3	0.7	-1.6	-1.9
Clark, NY	55.4	23.1	78.5	49.0	22.6	71.6	6.4	0.5	6.9	8.8
Contra Costa, CA	65.7	10.8	76.5	58.2	10.6	68.7	7.5	0.3	7.8	10.2
Riverside, CA	57.2	14.4	71.6	18.2	5.0	23.3	39.0	9.4	48.4	67.5
San Bernardino, CA	52.5	14.5	66.9	18.2	5.9	24.0	34.3	8.6	42.9	64.1
Palm Beach, FL	52.4	12.8	65.2	35.3	11.0	46.2	17.1	1.9	19.0	29.1
King, WA	43.0	22.1	65.1	43.7	24.3	67.9	-0.7	-2.1	-2.8	-4.3
Santa Clara, CA	48.2	16.4	64.6	67.5	20.7	88.2	-19.2	-4.4	-23.6	-36.5
Tarrant, TX	38.8	18.8	57.6	33.9	18.4	52.2	4.9	0.4	5.4	9.4
Broward, FL	37.4	17.5	54.9	35.5	15.0	50.5	1.9	2.5	4.4	8.0
Sacramento, CA	37.5	11.9	49.4	35.0	12.3	47.3	2.5	-0.4	2.1	4.3
Orange, FL	30.6	18.2	48.8	27.8	17.8	45.6	2.8	0.4	3.3	6.7
Bexar, TX	28.5	17.1	45.6	29.2	16.8	46.0	-0.8	0.4	-0.4	-0.9
Hillsborough, FL	30.0	15.4	45.4	32.4	15.3	47.7	-2.4	0.0	-2.4	-5.2
Cobb, GA	33.3	11.1	44.4	29.6	10.8	40.4	3.7	0.3	4.0	9.0
Ventura, CA	32.9	10.5	43.4	15.5	4.1	19.6	17.5	6.3	23.8	54.9
Dallas, TX	23.5	18.9	42.4	24.9	20.3	45.2	-1.4	-1.4	-2.8	-6.6
Lake, IL	30.3	12.0	42.3	27.9	11.7	39.6	2.4	0.3	2.7	6.4
Oakland, MI	21.3	20.9	42.2	19.7	20.4	40.2	1.5	0.5	2.0	4.8
Honolulu, HI	30.8	9.5	40.3	49.2	12.4	61.6	-18.3	-3.0	-21.3	-52.8
Dade, FL	23.0	16.1	39.0	36.2	20.2	56.4	-13.2	-4.1	-17.3	-44.4
Collin, TX	31.0	7.9	38.9	27.8	7.8	35.6	3.2	0.1	3.3	8.5
Alameda, CA	25.5	11.7	37.2	44.1	13.8	57.9	-18.5	-2.1	-20.6	-55.5
Du Page, IL	25.4	11.0	36.4	22.8	11.3	34.1	2.6	-0.3	2.3	6.2
Salt Lake, UT	21.8	13.4	35.2	22.2	14.2	36.3	-0.4	-0.7	-1.1	-3.1
Montgomery, MD	24.5	10.0	34.5	23.1	10.5	33.7	1.3	-0.5	0.8	2.4
Wake, NC	23.8	10.1	33.8	20.9	9.9	30.8	2.9	0.2	3.1	9.1
Mecklenburg, NC	22.9	10.5	33.4	20.4	10.3	30.7	2.5	0.2	2.7	8.1
Gwinnett, GA	24.6	8.4	33.0	22.1	8.2	30.3	2.5	0.2	2.7	8.0
Pima, AZ	23.1	8.0	31.1	21.3	7.8	29.1	1.8	0.2	1.9	6.2
Seminole, FL	24.2	5.9	30.1	21.7	5.8	27.5	2.5	0.1	2.6	8.6
Snohomish, WA	23.4	6.3	29.7	21.0	5.3	26.4	2.4	0.9	3.3	11.1
Arapahoe, CO	19.0	10.0	28.9	16.4	9.8	26.2	2.5	0.2	2.8	9.6
Solano, CA	23.7	3.9	27.7	5.4	1.3	6.6	18.4	2.7	21.1	76.1
Shelby, TN	17.1	10.4	27.5	15.6	10.2	25.8	1.5	0.2	1.7	6.1
Pierce, WA	19.8	7.6	27.3	18.4	6.2	24.5	1.4	1.4	2.8	10.2
Franklin, OH	14.1	11.8	25.9	13.3	11.5	24.8	0.8	0.3	1.1	4.2
Cook, IL	0.0	25.7	25.7	6.3	29.3	35.6	-6.3	-3.5	-9.8	-38.3
Washington, OR	18.4	7.1	25.5	16.8	6.9	23.7	1.6	0.2	1.8	7.1
Rockingham, NH	20.9	4.3	25.2	7.5	4.2	11.8	13.4	0.0	13.4	53.3
Middlesex, MA	11.2	14.0	25.2	17.8	12.3	30.1	-6.6	1.7	-4.9	-19.5
Travis, TX	14.7	10.4	25.1	17.9	11.9	29.8	-3.2	-1.5	-4.7	-18.8
Placer, CA	21.8	3.1	24.8	21.4	3.0	24.5	0.4	0.0	0.4	1.5
Sonoma, CA	21.8	3.0	24.8	8.3	1.5	9.9	13.5	1.4	14.9	60.2
Howard, MD	18.8	5.6	24.5	6.0	2.8	8.8	12.8	2.8	15.6	63.9
Top 50 Counties	**1,802.4**	**752.9**	**2,555.3**	**1,693.7**	**754.2**	**2,447.9**	**108.6**	**-1.3**	**107.3**	**4.2**
United States	**4,377.3**	**1,998.1**	**6,375.4**	**3,993.0**	**1,962.1**	**5,955.1**	**384.2**	**36.0**	**420.3**	**6.6**

Source: Center for Urban Policy Research, Rutgers University.

flects the fact that no net new residential construction is projected for this county under the uncontrolled-growth scenario.

Controlled Growth

Under the controlled-growth scenario, the top 50 counties, representing about 40 percent of future national real property investment, reduce aggregate property investment from $2.56 trillion to $2.45 trillion, a saving of $107 billion over the period (Table 10.17). Riverside County, CA, is the county with by far the greatest property development cost savings, with $48 billion saved for the period, or 68 percent less development costs than would have been experienced under uncontrolled growth. The

Table 10.18
Per-Unit Property Development Costs—Uncontrolled- and Controlled-Growth Scenarios by County: 2000 to 2025
(in Dollars)

	Uncontrolled Growth		Controlled Growth		Residential Savings		Nonresidential Savings	
County	Residential	Non-residential	Residential	Non-residential	Unit Savings	Percentage Savings	Unit Savings	Percentage Savings
San Diego, CA	264,979	89,737	226,159	87,485	38,820	14.7	2,252	2.5
Maricopa, AZ	140,210	70,794	126,234	69,248	13,976	10.0	1,545	2.2
Orange, CA	337,413	96,799	296,923	94,193	40,490	12.0	2,606	2.7
Los Angeles, CA	225,519	92,122	213,075	89,758	12,445	5.5	2,364	2.6
Fairfax, F'fx City + Fall	375,412	122,533	324,501	119,410	50,911	13.6	3,123	2.5
Harris, TX	125,338	78,724	112,111	76,867	13,227	10.6	1,857	2.4
Clark, NY	142,773	77,260	126,293	75,582	16,480	11.5	1,678	2.2
Contra Costa, CA	361,146	102,144	319,846	99,604	41,300	11.4	2,540	2.5
Riverside, CA	223,109	84,801	218,665	82,976	4,444	2.0	1,825	2.2
San Bernardino, CA	219,305	77,310	206,361	79,213	12,944	5.9	-1,903	-2.5
Palm Beach, FL	195,578	82,699	174,612	80,798	20,966	10.7	1,901	2.3
King, WA	206,332	86,732	176,498	84,392	29,835	14.5	2,340	2.7
Santa Clara, CA	346,987	102,371	326,509	99,636	20,478	5.9	2,734	2.7
Tarrant, TX	126,776	77,642	110,609	75,814	16,167	12.8	1,828	2.4
Broward, FL	151,001	78,897	135,458	77,228	15,543	10.3	1,669	2.1
Sacramento, CA	216,907	87,185	192,904	85,107	24,002	11.1	2,079	2.4
Orange, FL	143,017	82,040	129,842	80,108	13,175	9.2	1,933	2.4
Bexar, TX	102,138	69,921	93,562	68,468	8,575	8.4	1,453	2.1
Hillsborough, FL	129,100	80,645	117,947	78,938	11,153	8.6	1,706	2.1
Cobb, GA	194,233	90,711	172,429	88,530	21,804	11.2	2,181	2.4
Ventura, CA	438,947	101,055	422,437	98,672	16,510	3.8	2,384	2.4
Dallas, TX	131,062	79,617	111,814	77,777	19,248	14.7	1,840	2.3
Lake, IL	331,695	99,032	305,211	96,693	26,483	8.0	2,339	2.4
Oakland, MI	205,441	97,393	189,071	95,187	16,370	8.0	2,206	2.3
Honolulu, HI	389,645	99,247	382,455	97,320	7,189	1.8	1,927	1.9
Dade, FL	164,193	73,344	152,555	71,281	11,638	7.1	2,062	2.8
Collin, TX	196,428	95,963	176,334	94,341	20,094	10.2	1,622	1.7
Alameda, CA	281,416	88,253	250,722	85,804	30,694	10.9	2,449	2.8
Du Page, IL	300,600	98,641	265,255	96,118	35,345	11.8	2,523	2.6
Salt Lake, UT	127,565	74,919	115,885	73,163	11,680	9.2	1,756	2.3
Montgomery, MD	348,250	123,252	300,748	120,657	47,502	13.6	2,594	2.1
Wake, NC	155,533	83,874	136,514	82,551	19,019	12.2	1,322	1.6
Mecklenburg, NC	154,123	82,779	137,390	81,125	16,733	10.9	1,655	2.0
Gwinnett, GA	170,902	85,110	153,842	83,128	17,060	10.0	1,982	2.3
Pima, AZ	112,874	69,037	104,211	67,713	8,663	7.7	1,324	1.9
Seminole, FL	178,204	83,068	160,116	81,084	18,088	10.2	1,984	2.4
Snohomish, WA	189,432	80,635	169,581	79,551	19,851	10.5	1,084	1.3
Arapahoe, CO	117,349	69,115	101,647	67,491	15,702	13.4	1,623	2.3
Solano, CA	274,085	86,711	259,821	84,534	14,264	5.2	2,177	2.5
Shelby, TN	159,447	82,324	145,739	80,733	13,708	8.6	1,591	1.9
Pierce, WA	142,341	71,079	130,956	69,638	11,385	8.0	1,440	2.0
Franklin, OH	119,470	79,298	106,309	77,353	13,160	11.0	1,944	2.5
Cook, IL	0	91,776	213,903	89,718	0	0.0	2,058	2.2
Washington, OR	154,871	76,832	141,041	75,007	13,830	8.9	1,825	2.4
Rockingham, NH	355,967	74,318	333,301	74,209	22,665	6.4	109	0.1
Middlesex, MA	230,102	115,853	217,587	112,924	12,515	5.4	2,929	2.5
Travis, TX	113,422	73,016	100,871	71,512	12,550	11.1	1,503	2.1
Placer, CA	303,590	77,675	298,700	77,241	4,890	1.6	433	0.6
Sonoma, CA	319,633	80,377	313,850	79,740	5,783	1.8	637	0.8
Howard, MD	301,948	109,829	260,203	107,429	41,745	13.8	2,400	2.2
Top 50 Counties	**197,916**	**85,493**	**176,763**	**83,788**	**21,153**	**10.7**	**1,705**	**2.0**
United States	**167,037**	**75,463**	**154,036**	**74,598**	**13,001**	**7.8**	**865**	**1.1**

Source: Center for Urban Policy Research, Rutgers University.

second-largest saving is in San Bernardino, CA, with a $43 billion saving in development costs, or 64 percent. The largest increase in development costs observed among the top 50 counties is Los Angeles County, CA, which increases from $109 billion to $204 billion in real property investment, an 88 percent change. This is due primarily to its role as a major development-receiving county under the controlled-growth regimen. Savings and increases vary between these extremes depending upon whether the county is a receiving or sending county. The above figures can be somewhat misleading when reporting at the county level.

Table 10.19
Per-Unit Property Development Savings by County: 2000 to 2025
(in Dollars)

County	Residential-Unit Savings: Single-Family Detached	Single-Family Attached	Multi-family	Mobile Homes	Nonresidential-Unit Savings: Office	Retail	Industrial	Warehouse
San Diego, CA	19,124	6,286	923	9,264	2,129	2,913	1,704	600
Maricopa, AZ	6,964	2,106	513	6,243	1,704	2,419	1,394	465
Orange, CA	23,784	6,997	550	14,655	2,510	3,433	2,008	708
Los Angeles, CA	15,250	300	-2,517	11,088	2,143	2,932	1,715	604
Fairfax, F'fx City + Fall	23,353	6,923	1,169	4,771	2,848	3,896	2,278	803
Harris, TX	7,321	1,711	87	3,947	1,912	2,643	1,540	535
Clark, NY	6,924	1,790	544	7,151	1,648	2,375	1,362	444
Contra Costa, CA	22,104	7,261	1,055	8,867	2,419	3,310	1,936	682
Riverside, CA	-7,889	0	0	-1,771	1,103	1,868	1,011	248
San Bernardino, CA	-1,211	0	0	-202	1,920	2,668	1,551	534
Palm Beach, FL	12,451	5,617	2,491	7,541	2,076	2,841	1,661	586
King, WA	14,876	3,852	92	13,916	2,151	2,942	1,721	606
Santa Clara, CA	17,317	532	-1,134	11,306	2,157	3,086	1,774	585
Tarrant, TX	7,485	2,186	512	4,050	1,900	2,632	1,532	530
Broward, FL	12,182	2,911	525	5,556	1,877	2,600	1,513	524
Sacramento, CA	13,005	3,684	481	11,255	1,983	2,713	1,587	559
Orange, FL	7,070	2,079	568	6,603	1,769	2,493	1,441	486
Bexar, TX	3,855	533	118	4,278	1,431	2,082	1,189	382
Hillsborough, FL	4,864	411	-45	6,164	1,502	2,201	1,254	398
Cobb, GA	11,122	3,407	628	12,525	2,379	3,254	1,903	671
Ventura, CA	-1,663	0	0	-217	2,354	3,256	1,896	658
Dallas, TX	8,218	1,173	-89	5,380	1,813	2,557	1,478	498
Lake, IL	17,760	6,115	871	4,841	2,619	3,583	2,095	739
Oakland, MI	9,858	3,477	627	5,047	2,194	3,099	1,790	602
Honolulu, HI	6,286	-4,356	0	0	1,655	2,535	1,421	420
Dade, FL	11,313	1,099	-1,174	4,168	1,879	2,574	1,504	529
Collin, TX	3,532	-1,062	350	5,189	1,512	2,474	1,354	356
Alameda, CA	15,021	1,448	-1,722	9,460	2,164	2,961	1,731	610
Du Page, IL	17,702	5,783	821	5,804	2,560	3,502	2,048	722
Salt Lake, UT	7,601	2,405	187	3,660	1,884	2,577	1,507	531
Montgomery, MD	20,027	2,295	385	3,463	2,388	3,453	1,977	641
Wake, NC	2,879	-1,480	251	4,155	1,138	1,946	1,049	253
Mecklenburg, NC	5,574	1,111	450	4,438	1,595	2,365	1,341	418
Gwinnett, GA	8,353	2,265	543	4,098	2,148	2,997	1,739	596
Pima, AZ	3,611	3,147	355	5,355	1,327	2,005	1,129	341
Seminole, FL	9,302	2,646	642	8,513	2,013	2,799	1,626	560
Snohomish, WA	1,585	-1,930	340	11,251	1,116	1,907	1,029	248
Arapahoe, CO	7,213	2,352	508	4,914	1,765	2,432	1,418	495
Solano, CA	0	0	0	0	2,111	2,887	1,688	595
Shelby, TN	4,335	314	408	3,626	1,463	2,236	1,254	372
Pierce, WA	6,247	1,979	472	8,367	1,646	2,343	1,349	448
Franklin, OH	7,811	2,221	383	3,396	1,911	2,614	1,529	539
Cook, IL	0	0	0	0	1,861	2,601	1,508	515
Washington, OR	8,175	2,667	677	7,855	2,007	2,777	1,617	560
Rockingham, NH	23,858	6,338	3,263	17,804	36	211	86	-18
Middlesex, MA	26,000	1,718	-1,310	12,633	2,339	3,266	1,895	648
Travis, TX	5,664	457	-297	5,155	1,660	2,363	1,361	452
Placer, CA	-3,729	-2,783	-1,476	-153	164	962	395	-82
Sonoma, CA	-4,155	0	0	-172	565	1,321	648	64
Howard, MD	19,139	7,476	2,317	5,725	2,670	3,653	2,136	753
Top 50 Counties	**14,327**	**-4,712**	**-1,664**	**9,268**	**1,890**	**2,624**	**1,431**	**466**
United States	**11,095**	**-4,529**	**-1,612**	**5,167**	**1,152**	**1,788**	**841**	**306**

Source: Center for Urban Policy Research, Rutgers University.

Relative to the above, at the county level, there is a fourth factor affecting aggregate property development costs, and it overwhelms any other factor. This is the amount of development that is taking place in a county; this factor can vary significantly under the two alternatives. At the EA level and above, the number of households and jobs moving to a location are equal under the two alternatives, but levels of development can vary significantly. This is not so at the county level for both sending and receiving counties. Thus, the only reliable indicators are per-unit costs.

The average per-unit cost of housing decreased in every county in the top 50 under the controlled-growth scenario (Table 10.18). The average cost of housing in those 50 counties was reduced from $197,916 to

$176,763 per unit, a saving of $21,153, or 11 percent. San Diego County, CA, and Dallas County, TX, had the largest percentage decrease in housing costs (15 percent), with costs reduced from $264,979 to $226,159 and $131,062 to $111,814, respectively. The county with the largest absolute decrease ($50,911) is Fairfax County, VA, where the cost of housing is reduced from an average of $375,412 to $324,501. Since Cook County, IL, had no residential development under the uncontrolled-growth scenario, no property cost savings or increases are shown for this county.

Nonresidential development investment in the top 50 counties exhibits an overall decrease in costs of approximately $1,705 per unit, or 2 percent. Individual counties for the most part indicate savings of up to $2,929, though collectively they have an average decrease in costs of just half of that amount. Middlesex County, MA, has the largest absolute savings at $2,929 (2.5 percent), and San Bernardino County, CA, has the largest absolute increase in costs at $1,903 (2.5 percent).

The specific investment cost savings by type of residential and nonresidential development are presented in (Table 10.19). For the top 50 counties, almost every residential category of land use exhibits per-unit property cost savings with a scattering of increases. In the same 50 counties, every nonresidential category of land use exhibits per-unit property cost savings.

CONCLUSION

For the projection period 2000 to 2025, under traditional or uncontrolled growth, individuals and businesses in the United States will spend more than $6 trillion to develop the residential and nonresidential units necessary to accommodate the nation's household and employment growth. A combined saving of $420 billion can be achieved through more centralized growth and more compact development patterns, and a greater variety in housing mix. This is a saving of 7 percent in overall property development investment costs.

Average residential housing cost will decrease from $167,038 to $154,035, lowering the average housing cost nationwide by $13,003, or 7.8 percent. Ideally, the purchase price home buyers will pay would reflect this savings. The specific costs and savings will certainly vary by housing type. Single-family detached dwellings will show the most savings, almost $11,095 per dwelling unit, while the cost of mobile homes will offer the smallest savings, $5,167 per dwelling unit. Savings of approximately 1.1 percent, or an average of $865 per 1,000 square feet, will be in evidence for nonresidential development.

What were the original questions to be answered in this chapter? They were: Are the approaches used to manage growth, saving natural and man-made resources from consumption, cost-effective? Are the processes used to contain development too intrusive

Courtesy of C. Galley


Courtesy of T. Delcorso

or growth limiting? Do they increase the cost of housing? Property development cost savings are significant enough to conclude that the growth-control regimen, if it includes a density increase and a larger share of non-single-family development types, not only saves natural and man-made resources, it reduces personal and business operating costs in a region by reducing the capital outlays necessary to develop residential and nonresidential structures.

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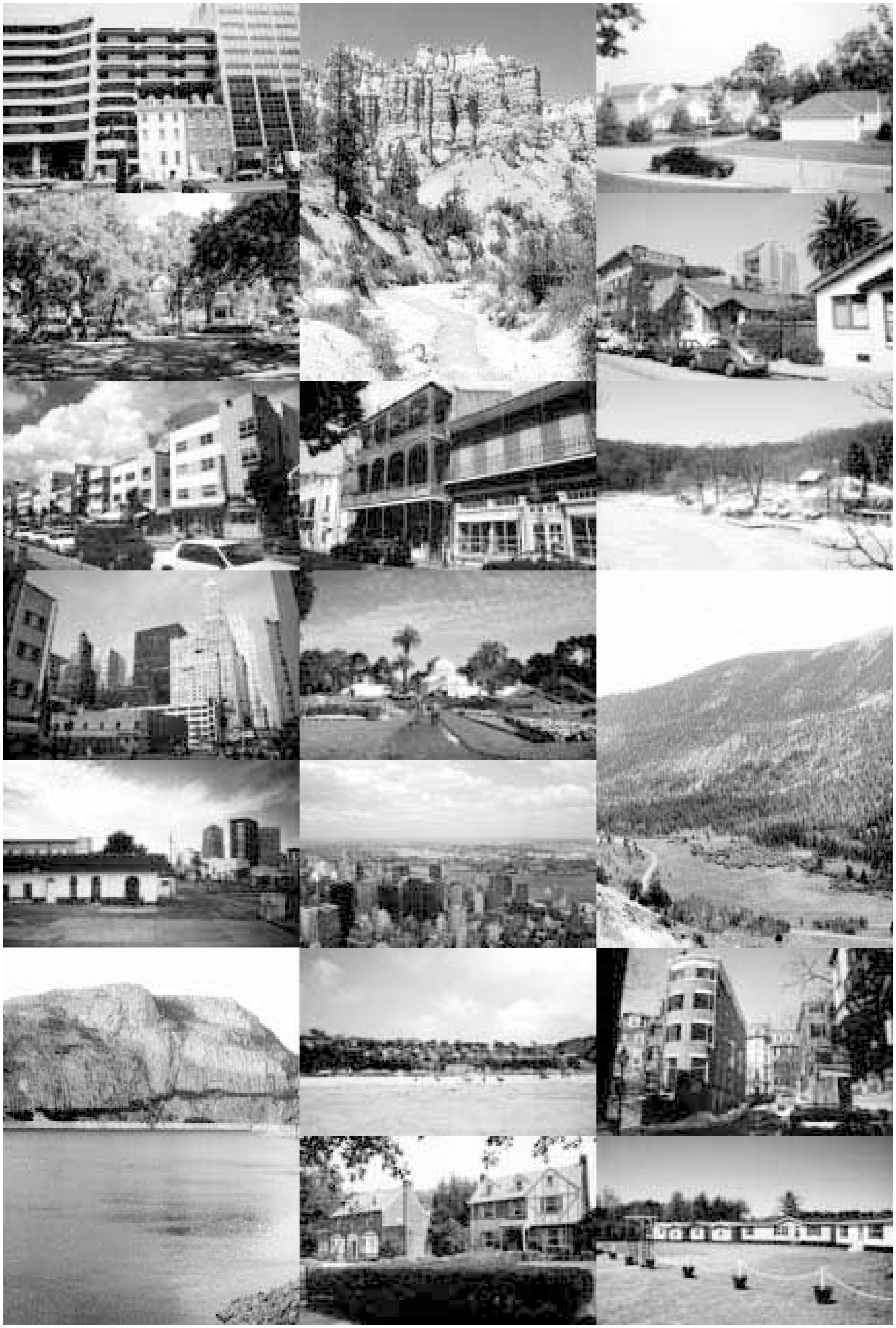
PART III

THE PERSONAL COSTS OF SPRAWL



Introduction to Part III

This part of the report examines the personal costs of sprawl, including its impacts on individual travel costs, quality of life, and the livability of cities.

Each of these chapters includes much more modeling and some departure from the top-down impacts (national, regional, state, and county level) evidenced in the previous 10 chapters. Chapter 11 begins with an analysis of the impacts of sprawl as opposed to compact development on personal travel costs. A model is built depicting travel modes and costs according to type of county: urban, suburban, rural, and undeveloped. The resulting mode share and costs of personal travel vary across the nation according to the amount of population directed to both types of counties and their urbanized or nonurbanized subareas. These differences can be summed and compared for the two growth alternatives.

Chapter 12 concerns the impacts of sprawl versus compact growth on the quality of life of future residents. Variables that depict quality of life are assembled and a quality-of-life rating is given to each county as well as subareas of counties nationwide. As households and jobs are projected to locate differently within subareas of counties and to different counties as a whole, they receive a different quality-of-life score. (The sum of the individual scores on quality of life is the difference in quality of life experienced under the two growth scenarios.) Quality of life is typically higher in the outer fringes than at the inner edges of a metropolitan area. The controlled-growth or nonsprawl scenario, which emphasizes closer-in growth, exhibits lower quality of life during the 25-year observation period. The overall disparities in quality of life narrow considerably, however, over the course of the years.

The final chapter, chapter 13, deals with the impacts of sprawl development on urban decline. A model is created using sprawl's characteristics (single-use, low-density, skipped-over development and unlimited outward extension) to profile this type of development compared to all other development. Certain basic characteristics of development with or without sprawl are also identified. These include: fragmented and ratable-concerned local governments, economic and racial exclusion, single-family and single-use zoning, and the aging and filtering of housing as the primary source of shelter for the poor. All these factors produce urban decline, whether or not sprawl is the chief form of development. Under these conditions, nonsprawl development produces very similar results to sprawl development.

Courtesy of R. Ewing

XI

Travel Miles and Costs in the United States:

Requirements under Sprawl and Alternative Conditions

INTRODUCTION

The purpose of this chapter is to provide estimates of the miles and costs of travel under two alternative development futures for the United States. One future is uncontrolled growth, or sprawl; another is more controlled—or smart growth.

The chapter first describes a regression-based travel model, which predicts person-miles of travel as a function of urban form while accounting for important socioeconomic characteristics. Travel time and the derivation of time costs are discussed next, followed by an accounting of the other costs of travel according to mode. The chapter concludes with the application of travel and time costs to the two alternative growth scenarios.

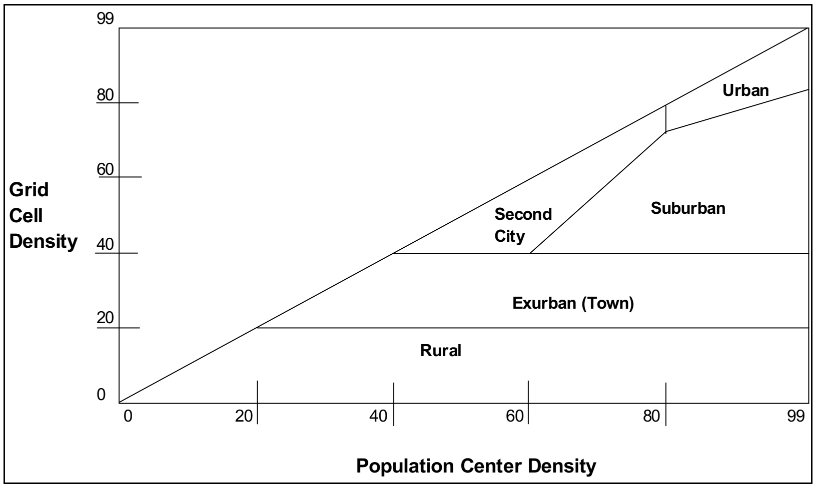
For the purposes of this study, the travel model must be national in scope, rather than focusing on one region or metropolitan area. The goal is not to compare costs between modes per se, but rather to apply full per-mile costs to each person's travel so that comparisons can be made between alternative scenarios of future growth. To do so, the model must distinguish between personal vehicles and transit use, because the costs of these modes vary, and distance must be expressed at the person-mile level so there is a common denominator between modes. Thus, rather than aggregating the total costs of suburban versus urban travel, the study focuses on the costs faced by individuals with similar demographics in different urban settings (counties) due to one or the other growth scenario.

DATA

The data for the travel models developed for this study come from the 1995 National Personal Transportation Survey (NPTS) conducted by the Federal Highway Administration (FHWA). The 1995 NPTS is the most recent in a series of surveys dating back to 1969, each designed to provide a comprehensive look at travel characteristics in the United States. By including numerous statistics developed by the U.S. Census Bureau, the NPTS provides researchers with a rich data set to be used in carrying out national-level statistical investigations such as the current one.

The NPTS includes data collected from 42,033 households; 95,360 individuals; and 409,025 trips. When weighted appropriately (using the frequency weights derived by NPTS), the sample is expanded to represent travel behavior for the United States as a whole. The use of the weights is important. Without them, the data will reflect the oversampling of large metropolitan areas as well as several "add-on" areas such

Figure 11.1
Urban Place Type



Source: Miller and Hodges (1994).

as Tulsa, Oklahoma, and the Puget Sound Region. The FHWA develops two data sets. A public file suppresses information that might reveal the identity of individuals or households, and therefore collapses many of the variables into ranges. The so-called DOT files provide this information more fully. This analysis uses the public file for all but a few variables in order to take advantage of its full range of information on such variables as density and age, and to have access to zip codes for mapping purposes.

This analysis looks closely at the variables that could be used to describe different development patterns. The current NPTS incorporated a new density-based classification system for places; it is described below (FHWA 1998).

Urban Place Type

Noting that many of the commonly used urban–rural designators are based on arbitrary municipal boundaries, researchers have developed a taxonomy to describe five place types: urban, suburban, second city, exurban, and rural. These classifications are density based but go beyond a simple comparison of absolute density differences. Working at the block group level, a contextual density measure is developed that takes into consideration the geography surrounding a given block group. The process is as follows:

The United States is segmented into a grid structure based on 1/30th of a degree latitude and longitude, which results in about 900,000 cells, each with an area of approximately four square miles. A block group is assigned to a given cell according to its centroid, with the result that about 550,000 cells contain at least one block group. Each cell's contextual density is determined by summing the total population of it and its surrounding eight cells (picture a 3 x 3 matrix with the cell being assessed in the middle) and dividing the result by their total land area. Each cell's contextual density is then a combination of its own characteristics as well as the characteristics of the surrounding cells.

Figure 11.1 graphically depicts the five urban place types. The *y* axis shows the contextual grid cell density centiles, 0 to 99, while the *x* axis shows the population center density ranges. The long diagonal line maps grid cells and population centers of equal density centiles. This graph shows that rural and exurban

Courtesy of R. Ewing

Table 11.1
NPTS Variables for Modeling Person-Miles Traveled

Factors Affecting Travel	Variables Available in NPTS
Land Use	Urban place type, population density at household location, employment density at household location, employment density at individual's workplace, percent of housing stock less than 10 years old, size of metropolitan area.
Transportation Supply	Household distance to transit stop, presence of transit in household location, household vehicle ownership.
Socioeconomic	Age and sex of the individual, number of workers in the household, number of children, household size, household income.

Source: Parsons Brinckerhoff Quade and Douglas, Inc.

areas occupy the lowest density regions. Above a grid cell density of 40, or about 959 persons per square mile, places are classified according to their relationship to population centers. A population center density of 79 serves as the break point between urban and second-city areas (visible as the short vertical line separating second cities from urban areas on the graph). This corresponds to a population density between 4,163 and 4,324 persons per square mile. Lines with different slopes demarcate the transition from urban and second-city areas to suburban areas. Thus, although suburban areas have a relative population density that is greater than exurban and rural areas, they are at a greater distance from population centers (of varying sizes) relative to second-city and urban areas.

The urban classification system described above offers an interesting approach for the current study. Because it goes beyond a simple reliance on absolute density differences, the urban place type variable provides a description of household location that includes the context of its geographic surroundings. Yet like the current study, it allows for the fact that a relatively high density location in South Dakota would not compare in absolute terms to a high-density area in New York.

MODEL DEVELOPMENT

Recognizing in advance the difficulties inherent in modeling the relationship between density and miles traveled using national-level data, this section describes the development of models to predict daily person-miles of travel in both private automobiles and in transit as a function of urban form, while accounting for the influence of key socioeconomic factors.

The models consider only the travel behavior of adults in metropolitan areas. Those younger than 16 are often dependent upon others for their travel, so it is logical to restrict the models to individuals old enough to get around on their own. Certainly, the *effect* of young children on an adult's travel decisions is important, and this factor is taken into account. The models look at travel in metropolitan statistical areas (MSAs) only because the primary interest of this study is to look at travel in urbanized settings. The links between urban form and miles traveled in very low density, nonmetropolitan areas are likely to be weakened, so much so that the number of miles traveled is the result of substantially different factors.

With these points in mind, see the left column of Table 11.1, which shows the broad categories that travel models and research indicate are important explanatory factors for travel. The right column shows the household and person-level variables in the NPTS data set that link to these factors.

Each of the variables in Table 11.1 was explored singly and in groups to determine its possible contribution to the models. The NPTS data set is large enough

Courtesy of C. Galley

Table 11.2
Descriptive Statistics (Weighted) for Dependent Variables

		PMTPOV	PVMTTRAN
N	*Valid*	191,112,536	7,928,688
	Missing *	50,562,466	233,746,314
Mean		44.59	25.08
Median		26.00	10.00
Minimum		0.10	0.10
Maximum		1600.00	1250.00
Percentiles	*25*	10.60	4.00
	50	26.00	10.00
	75	52.40	24.67
	95	141.00	92.00
	99	332.00	260.00

Source: Parsons Brinckerhoff Quade and Douglas, Inc.
Note: * Records having no miles traveled via privately owned vehicles or transit, respectively.

that, even in its unweighted form, the usual tests for significance are rendered ineffective. In its raw form, the person-level data totals 95,360 observations. Although these models do not include non-MSAs or observations on persons less than 16 years old, filtering them still leaves 66,913 observations. Due to the sampling technique for the NPTS, it is necessary to apply frequency weights, which are provided in each data file. Applying this weight to the filtered person-level data gives a total of 158.4 million observations, further amplifying the size. Such a large sample size yields t-scores and F-statistics that are very large as well, due to the fact that some correlation is bound to exist between almost any variable in such a large data set. This being the case, the traditional tests should not be relied upon when judging the significance of variables, nor are most tests of correct functional form reliable.

Dependent Variables

The dependent variables are daily person-miles traveled in privately operated vehicles (PMTPOV) and daily person-miles traveled by transit (PMTTRAN). Both of these variables are taken from reported trip miles (TRPMILES) in the NPTS travel day file and summed to the person level. The POV category includes all travel in autos, vans, utility vehicles, RVs, pickup trucks, motorcycles, and other trucks. The transit category includes all travel in buses, commuter trains, streetcars, elevated rail, and subways. PMTPOV and PMTTRAN have the following characteristics (Table 11.2):

These statistics are generated using the full data file (an unweighted size of 95,360) and therefore include miles traveled in non-MSAs as well as by all individuals five years and older (both of these elements are later filtered from the set). The number of observations for POV miles traveled far outweighs (by about 24 times) those for transit miles. POV trips also tend to be longer. The maximum value for both modes appears to be quite large for daily travel. The 99th percentile was selected as a cutoff for possible outliers. All miles in a POV greater than or equal to 332, and by transit greater than or equal to 252, are recoded as missing.

Model Specification

Despite the availability and use of more complex methods to model travel and urban form, it was felt that a straightforward and transparent method would ultimately serve present purposes best. Thus, this study uses ordinary least squares with dependent variables transformed to natural logs (providing a much better fit to the data based on a visual examination of scatterplots) to model person-miles traveled.

Preliminary Models

Initially, two models are explored, one to predict daily person-miles of travel in privately operated vehicles and one for transit. The selection and testing proceeded as follows: An initial small model was run to examine the relationships between the dependent variable, a household income measure (originally in 18 categories), and the urban place type dichotomous variable set. Following this, various combinations of

Courtesy of C. Galley

the other variables listed in Table 11.1 were tested to observe their relative merits within the model.

Many of the variables that describe household socioeconomic characteristics (such as number of workers, number of children, and annual household income) are, in their raw form, *limited continuous* variables. That is, they have only a few possible values relative to the number of observations.[1] These variables do not perform well with so many observations on a dependent variable with such great variation. Thus, all explanatory variables in the final models are in a binary form, which performed much better.

The initial models generated reasonable predictions of daily person-miles traveled by mode, but made it difficult to derive a total daily number of miles per person. A binary variable in each model was used to capture the use of the mode not being modeled. That is, a *used transit* binary variable in the PMTPOV model allowed an estimate of the number of POV miles traveled for those just using a POV, as well as the number of POV miles for those who also used transit. A *used POV* variable in the PMTTRAN model served the same (but opposite) purpose.

In theory, this should allow for the prediction of three types of travel possibilities: 1) the person's travel is all in POVs; 2) the person's travel is all by transit; and 3) the person's travel is by both POV and transit. While the first two cases are straightforward enough, the third requires adding the predicted miles from the PMTPOV model to the predicted miles from the PMTTRAN model (calculated with both binary variables described above equal to one). Because these two models have very different sample sizes, among other things, adding their results in this way seemed problematic. Instead, four new models were specified, segmenting the data into the three categories of travelers; these are then modeled separately. The first model predicts the number of miles traveled by persons who traveled in POVs only. The second model predicts travel for those who traveled by transit only. The third and fourth models (one for each mode) predict travel for those who used both modes during their day's travel, POV *and* transit. The four models were run using a single data set and filtering out the trips not of interest for a given set of models. Thus, adding

[1] Most of the variables are naturally in this form: The number of children ranges from one to eight, as does the number of workers. Household size ranges from one to 10, as does number of vehicles. Household income is reported in 18 ranges, which were recoded according to their midpoints for this study.

Table 11.3
Weighted Statistics for Variables Used in Final Models

Variable Name	Description	Mean	Median	Standard Deviation	Number
Mode Groups					
pov only	Equals one if person only used POV	0.95	-	-	130,290,626
tran only	Equals one if person only used transit	0.03	-	-	130,290,626
used both	Equals one if person used POV and transit	0.02	-	-	130,290,626
Dependent Variables					
log pmtpov	Natural log of person-miles traveled in a POV	3.17	3.33	1.15	126,163,394
log pmtran	Natural log of person-miles traveled in transit	2.34	2.30	1.25	6,618,427
Explanatory Variables					
Urban Place Type					
urban	Equals one if in urban area (base)	0.19	-	-	129,502,832
suburb	Equals one if in suburb	0.32	-	-	129,502,832
second city	Equals one if in second city	0.21	-	-	129,502,832
exurban	Equals one if in exurb	0.20	-	-	129,502,832
rural	Equals one if in rural area	0.09	-	-	129,502,832
Income					
low inc	Equals one if household income is less than $15,000 (base)	0.11	-	-	109,260,470
mid inc1	Equals one if household income is between $15,000 and $39,000	0.40	-	-	109,260,470
mid inc2	Equals one if household income is between $40,000 and $59,000	0.24	-	-	109,260,470
high inc	Equals one if household income is greater than $60,000	0.25	-	-	109,260,470
sex	Equals one if person is a male	0.50	-	-	130,290,626
kids	Equals one if there are children less than 16 in the household	0.39	-	-	130,290,626

Source: Parsons Brinckerhoff Quade and Douglas, Inc.

the POV to the transit results seems to be a safer maneuver because the results were modeled from the same group of individuals.

Final Models

The selection of variables for the final models followed the same process as did the preliminary models. The result is a simple model that includes the urban place type variable, household income, sex, and the presence of children. Collinearity does not appear to be a problem, based on evaluation of condition indices. Although several models yielded adjusted R^2s with substantially higher values, this combination of variables came the closest to meeting the criterion of providing meaningful coefficients within the theoretical context.

Table 11.3 provides a key to the variables used in the models, as well as key descriptive statistics. The median and standard deviation are reported for the two dependent variables only. For the dichotomous variables, the mean represents the percent of the cases for which the variable equals one. In the case of a set of dichotomous variables (such as urban place type), the mean shows the percentage within that set of a given observation.

Of those who used a POV or transit on the designated travel day, the vast majority of the trips were taken by POV only (95 percent), and only a small percentage were by transit only or by both modes.[2]

[2] These statistics do not include those who used other modes, such as bike or foot.

Also, of the five urban place types, there are more persons living in suburban areas (32 percent). These statistics are consistent with observed trends over the last several decades of increased automobile use as well as increased suburbanization. Of the persons in this data set, only 39 percent are in households with children, and all but 11 percent are in the middle- and upper-income categories.

TRAVEL MODEL RESULTS

This section describes the results of the four models that were run for the three mode groups. To reiterate, a total of four models were estimated, one for individuals who traveled by POV only, one for those who traveled by transit only, and one each for the POV portion and transit portion of travel for those individuals who used both modes. Each of the four models uses the same explanatory variables, with two small exceptions, noted below. Also, all models use *urban* and *low income* as the base variables.

POV Only

Table 11.4 shows descriptive statistics for the POV Only model. For a given set of dichotomous variables, the means are the percent of the set represented by that variable. For example, *suburb* represents 32 percent of the urban form type variable set, and *mid inc1* represents 40 percent of the set of household income dichotomous variables. The relative sizes of the base variables (*urban* and *low inc*) can be inferred. Thus, *urban* and *low inc* represent 17 and 10 percent of their variable sets, respectively, meaning that the group that uses only POVs is largely suburban and has higher incomes.

Table 11.5 contains the results of the POV Only regression. The presence of the very large t-scores was

Courtesy of T. Delcorso

Table 11.4
Descriptive Statistics, POV Only Model

	Mean	Standard Deviation
log pmtpov	3.22	1.12
suburb	0.32	0.47
second city	0.21	0.41
exurban	0.21	0.40
rural	0.09	0.29
mid inc1	0.40	0.49
mid inc2	0.24	0.43
high inc	0.26	0.44
sex	0.50	0.50
kids	0.41	0.49

Source: Parsons Brinckerhoff Quade and Douglas, Inc.

previously discussed; they are reported here only to illustrate the point. It appears that, as a whole, the income variables have a slightly stronger effect on miles traveled, relative to the urban form type variables, a result often seen in other studies of this type. The differences between *urban, exurban,* and *rural* areas are greatest, based on the coefficients for these variables, which express the percentage difference in miles traveled relative to *urban.*

Transit Only

Table 11.6 shows descriptive statistics from the Transit Only model. In each of the three remaining models, the top two income categories (*mid inc2* and *high inc*) are collapsed into one category due to the smaller number of observations in these models for those income groups. The *exurban* and *rural* urban place type categories are filtered out for the same reason. Transit service to these areas is substantially less than in urban, suburban, and second-city areas, and all of the remaining models involve individuals who traveled all or part of their miles on transit. Compared to the POV Only mode group, the Transit Only mode group exhibits quite different characteristics. On average, these individuals are more urban and have lower incomes. The average household also has slightly fewer children.

Table 11.7 contains the results of the Transit Only model. The model for the Transit Only mode group indicates that the difference between urban and suburban areas is much greater than in the POV Only group. However, the relatively large coefficient for *suburb* should not be taken to indicate that there is greater transit usage in the suburbs—indeed, the sub-

Table 11.5
Results of the POV Only Model

Dependent Variable: log pmtpov			
	Coefficients	Standardized Beta Coefficients	t
(constant)	2.45		5732.51
suburb	0.17	0.07	514.61
second city	0.13	0.05	362.37
exurban	0.37	0.14	1043.66
rural	0.54	0.14	1229.25
mid inc1	0.37	0.16	972.21
mid inc2	0.56	0.21	1348.65
high inc	0.61	0.24	1493.67
sex	0.16	0.07	756.96
kids	0.08	0.04	376.28
Adjusted R Square *	**0.056**		
Weighted N	**103,161,122**		

Source: Parsons Brinckerhoff Quade and Douglas, Inc.
Note: * Adjusted R Square is within the range found in other national studies of travel behavior, particularly those using the NTPS.

Table 11.6
Descriptive Statistics, Transit Only Model

	Mean	Standard Deviation
log pmttran	2.32	1.23
suburb	0.13	0.34
second city	0.11	0.31
mid inc1	0.38	0.49
inc 40+	0.27	0.45
sex	0.43	0.50
kids	0.32	0.47

Source: Parsons Brinckerhoff Quade and Douglas, Inc.

urban portion of Transit Only trips is only 13 percent. Instead, it probably indicates that suburban transit trips are longer than are urban transit trips. It is interesting to note that the higher income groups are associated with progressively increasing miles traveled relative to the lowest income group (the base variable), even in the Transit Only model. This result is contrary to expectations that the higher income categories would have negative coefficients, relative to low income.

Used Both Modes

POV

Table 11.8 reports the descriptive statistics from the POV portion of the Used Both Modes models. In terms of demographics, the individuals in this model fall squarely between the previous two mode groups.

Table 11.9 reports the results from the POV portion of the Used Both Modes model. In this model, the urban place type variables *suburb* and *second city* both indicate a large increase in miles traveled relative to the *urban* base variable. Although the *kids* variable in the previous two models appeared to be meaningfully and positively associated with a greater number of miles traveled, in this model it does not.

Transit

Table 11.10 reports the results from the transit portion of the Used Both Modes model (this being the same group of individuals, the descriptive statistics

Courtesy of C. Galley

Table 11.7
Results of the Transit Only Model

Dependent Variable: log pmttran			
	Coefficients	Standardized Beta Coefficients	t
(constant)	1.70		1249.25
suburb	0.64	0.17	320.00
second city	0.20	0.05	94.25
mid inc1	0.33	0.13	219.80
inc 40+	0.46	0.17	268.49
sex	0.37	0.15	285.41
kids	0.29	0.11	207.96
Adjusted R Square	**0.099**		
Weighted N	**3,338,127**		

Source: Parsons Brinckerhoff Quade and Douglas, Inc.

Table 11.8
Descriptive Statistics, Used Both Modes: POV

	Mean	Standard Deviation
log pmtpov	2.08	1.26
suburb	0.24	0.43
second city	0.21	0.40
mid inc1	0.39	0.49
inc 40+	0.38	0.48
sex	0.44	0.50
kids	0.39	0.49

Source: Parsons Brinckerhoff Quade and Douglas, Inc.

are the same as for the POV portion of this mode group).

This final model estimates the transit portion of daily miles traveled for individuals who used POV and transit. In this model, *second city* is negative relative to the base variable, *urban.* This indicates that those in second cities are predicted to travel fewer miles by transit when using both modes compared to those in urban areas.

Predicted Miles Traveled

By undoing the log transformations of the preceding models, the number of miles traveled according to urban classification and mode group can be calculated.[3] The examples below (Table 11.11) all assume that the person traveling is female, has one child, and lives at the mean density within her model group (each model has a different mean density). The predicted miles would increase, across all places, mode, and income groups, for a male. They would also increase with increased number of children in the household, although by a smaller amount than with gender. The last three rows are the total miles traveled, by POV and by transit, summed for both modes.

As would be expected from the coefficients from the model results, the effect of income within groups is slightly more powerful than the differences between urban form groups. That said, there are a number of interesting conclusions to be drawn. First, of all groups, those who travel by POV only are predicted to travel the greatest number of daily miles, ranging from 13 miles for a low-income, urban female to 40 miles for a high-income, rural female. Second, it is not surprising that those who travel by transit only

Courtesy of C. Galley

[3] Undoing the log transformations requires taking the exponent of the equation, thus making the relationships between each variable multiplicative. The general form of the equation is: exp(pmt) = exp(const) * exp(UPT) * exp(income) * exp(kids * #kids).

Table 11.9
Results of the Used Both Modes: POV Model

Dependent Variable: log pmtpov			
	Coefficients	**Standardized Beta Coefficients**	**t**
(Constant)	1.66		796.68
suburb	0.43	0.15	194.77
second city	0.58	0.19	253.95
mid inc1	0.09	0.04	38.03
inc 40+	0.35	0.14	145.58
sex	0.14	0.06	78.76
kids	-0.09	-0.03	-48.01
Adjusted R Square	**0.063**		
Weighted N	**1,918,745**		

Source: Parsons Brinckerhoff Quade and Douglas, Inc.

Table 11.10
Results of the Used Both Modes: Transit Model

Dependent Variable: log pmttran			
	Coefficients	**Standardized Beta Coefficients**	**t**
(Constant)	1.99		1033.81
suburb	0.29	0.11	142.68
second city	-0.30	-0.10	-143.01
mid inc1	-0.21	-0.09	-97.97
inc 40+	0.34	0.14	150.12
sex	0.36	0.15	215.90
kids	0.06	0.02	34.64
Adjusted R Square	**0.105**		
Weighted N	**1,918,745**		

Source: Parsons Brinckerhoff Quade and Douglas, Inc.

are predicted to travel, on average, the fewest number of daily miles. Clearly, an additional component of these individuals' travel takes place on foot or by bicycle, although the distances are likely to be relatively short. Finally, for those females using both modes (the majority of which are likely to be users of park-and-ride facilities), the total predicted miles traveled are close to those for the POV Only group within each income category.

Turning to differences between the UPT groups, while POV Only miles peak in the rural areas, Transit Only miles peak in the suburbs, as do transit miles for those who used both modes. In the POV Only group, the differences between urban, suburban, and second-city areas are small, but increase noticeably in exurban and town areas. The exurban case is interesting, as it may be that this is the current location of rapid population increases as the urban edges continue to expand outward.

In all cases, daily miles traveled for a person in a second city are more than in urban areas, except for the transit portion of the Used Both Modes group. An interesting extension to this study would be further investigation into the differences between these places.

TIME VARIABLES

A full accounting of the cost of travel must include estimates for the value of time, as this factor often comprises a large portion of such costs. The NPTS data set includes variables describing the number of minutes spent traveling for each trip taken. At the time the research team was completing the study, the NPTS

Table 11.11
Predicted Average Daily Miles of Travel by Mode Group, Urban Classification, and Income

Income Group	Urban	Suburban	Second City	Exurban	Rural
POV Only					
<$15,000	13	15	14	18	22
$15,000 to $39,999	18	22	21	27	31
$40,000 to $59,999	22	26	25	32	38
$60,000+	23	28	26	34	40
Transit Only					
<$15,000	7	14	9	-	-
$15,000 to $39,999	10	19	12	-	-
$40,000+	12	22	14	-	-
Used Both Modes: POV					
<$15,000	5	7	9	-	-
$15,000 to $39,999	5	8	9	-	-
$40,000+	7	11	12	-	-
Used Both Modes: Transit					
<$15,000	8	10	6	-	-
$15,000 to $39,999	6	8	5	-	-
$40,000+	11	14	8	-	-
Used Both Modes: TOTAL*					
<$15,000	13	17	15	-	-
$15,000 to $39,999	11	16	14	-	-
$40,000+	18	25	20	-	-

Source: Parsons Brinckerhoff Quade and Douglas, Inc.
Note: *"Total" is the sum of the POV and Transit portions from the Used Both models.

data on wait times appeared to be incomplete and the team elected not to include it. There is no reported walk time in the NPTS data.

Time Spent Traveling

In the same way that miles traveled by mode were summed to the person level, so too were the minutes spent traveling summed, with observations greater than the 99th percentile recoded as missing. Table 11.12 contains weighted descriptive statistics for the total minutes traveled per person by POV (POVMIN) and by transit (TRANMIN), from the raw data file (including non-MSAs and observations for all persons five years and older).

Ideally, time spent traveling would be predicted using an analysis that controls for key socioeconomic variables in addition to urban form. A set of models was specified and tested, but the results were quite unsatisfactory. The limitations of theory and time prevented exploring these relationships further, leading to the adoption of a simpler approach. Using the same mode groups as the person-miles traveled models (POV Only, Transit Only, and Used Both Modes), cross-tabulations were used to summarize the median values of POVMIN and TRANMIN by mode group and by urban classification, as shown in Table 11.13. The median values appear to exhibit enough variability to warrant stratification by place type.[4]

Regarding the median travel times above, the POV Only mode group minutes exhibit a slight U-shape, being the highest in rural areas and lowest in second cities. The Transit Only mode group as a whole has

[4] As would be expected, the very large sample size has the same effect on tests for differences of means as it does on t-scores and F-statistics. A difference of means test run on travel times between urban place types for each mode group resulted in all differences testing as significant at the 0.001 level. The decision to stratify travel time by place type did not rest on this result, however, as much as on an observation of the median differences.

Table 11.12
Descriptive Statistics (weighted) for Minutes Traveled by Mode

		POVMIN	TRANMIN
N	*Valid*	190,637,830	7,729,633
	Missing	51,037,171	233,945,368
Mean		76.68	77.18
Median		58	60
Minimum		1	1
Maximum		1,920	920
Percentiles	*25*	30	34
	50	58	60
	75	97	104
	95	202	180
	99	390	315

Source: Parsons Brinckerhoff Quade and Douglas, Inc.

Table 11.13
Median Travel Time in Minutes by Mode Group and by Urban Place Type

Urban Place Type	Median
POV Only	
Urban	62
Suburb	61
Second City	59
Exurban	65
Rural	67
Transit Only	
Urban	66
Suburb	80
Second City	70
Used Both: Pov	
Urban	25
Suburb	31
Second City	35
Used Both: Transit	
Urban	58
Suburb	60
Second City	36
Used Both: Total*	
Urban	83
Suburb	91
Second City	71

Source: Parsons Brinckerhoff Quade and Douglas, Inc.
Note: *"Total" is the sum of the POV and Transit portions from the Used Both models.

longer travel times than does the POV Only group, but the longest median travel times are for those in the Used Both Modes group. The time estimates are useful only if they are converted to costs in order to provide an estimate of the value of time spent traveling. The literature on the value of time is extensive. A recent study for the California Department of Transportation (Caltrans 1999) summarizes the research and notes that the values of time may vary according to numerous factors, including wage rates, trip purpose, mode, and travel conditions. Observing that "there is not a market for buying and selling time" (pp. 2-4), the researchers note that the derivation of the value of time must rely on indirect methods. Most frequently, the value of time is estimated using some percentage of the wage rate, with half the hourly wage applied to most types of trips. This study will use the reported household income to construct an approximate value-of-time estimate, as described in the next section.

Value of Time

The 1995 NPTS includes a variable for household income, which is reported in 18 ranges (this is the same variable that was used to create the four income categories used in the miles-traveled regressions). Each range was assigned its midpoint value, which was then divided by the number of workers in the household. This figure is a rough approximation of each person's annual income (households with no workers are not assigned a value). An assumption of the average number of hours worked per year is needed to bring this figure to an hourly wage estimate. This was provided by the Bureau of Labor Statistics, which reports that in 1995, the average number of hours worked per week was 34.4.[5] Multiplied by 52 weeks, the average number of hours worked per year was 1788.8. This was divided into the estimated annual income per person. All resulting values that were less than the minimum wage in 1995 ($4.25)[6] were recoded to the minimum wage. Finally, these values were summarized by income category and halved in order to multiply them by the estimated minutes traveled. Table 11.14 contains the estimates of hourly wages by income group, prior to halving.

[5] Information obtained from the Bureau's Web site, April 6, 2000. <http://146.142.4.24/cgi-bin/surveymost>.

[6] Information on the minimum wage was obtained from the Department of Labor Web site, April 6, 2000. <http://www.dol.gov/dol/esa/public/minwage/chart.htm>.

Table 11.14
Estimated Hourly Wages by Income Group

POV Only Group		All Others	
Income Group	**Estimated Hourly Wage**	**Income Group**	**Estimated Hourly Wage**
<$15,000	$5.26	<$15,000	$5.26
$15,000 to $39,999	$11.74	$15,000 to 39,999	$11.74
$40,000 to $59,000	$18.29	$40,000+	$23.48
$60,000+	$28.67		

Source: Parsons Brinckerhoff Quade and Douglas, Inc.

Table 11.15
Value of Time Traveled: By Urban Place Type, Income, and Mode Group

Income Group	Urban	Suburb	Second City	Exurban	Rural
POV Only					
<$15,000	$2.72	$2.67	$2.59	$2.85	$2.94
$15,000 to $39,999	$6.07	$5.97	$5.77	$6.36	$6.55
$40,000 to $59,999	$9.45	$9.30	$8.99	$9.91	$10.21
$60,000+	$14.81	$14.57	$14.10	$15.53	$16.01
Transit Only					
<$15,000	$2.89	$3.51	$3.07	-	-
$15,000 to $39,999	$6.46	$7.83	$6.85	-	-
$40,000+	$12.91	$15.65	$13.70	-	-
Used Both Modes: POV					
<$15,000	$1.10	$1.36	$1.53	-	-
$15,000 to $39,999	$2.45	$3.03	$3.42	-	-
$40,000+	$4.89	$6.07	$6.85	-	-
Used Both Modes: Transit					
<$15,000	$2.54	$2.63	$1.58	-	-
$15,000 to $39,999	$5.67	$5.87	$3.52	-	-
$40,000+	$11.35	$11.74	$7.04	-	-
Used Both Modes: TOTAL*					
<$15,000	$3.64	$3.99	$3.11	-	-
$15,000 to $39,999	$8.12	$8.90	$6.94	-	-
$40,000+	$16.24	$17.81	$13.89	-	-

Source: Parsons Brinckerhoff Quade and Douglas, Inc.
Note: *"Total" is the sum of the POV and Transit portions from the Used Both models.

Total Value of Time Traveled

The estimated number of minutes traveled by urban place type and income group, from Table 11.13, was converted to equivalent hours and multiplied by one-half of the estimated hourly wage from Table 11.14. This yields the following estimates of the value of time spent traveling according to income group and urban place type (Table 11.15).

The values in the above table highlight the effect of assuming that the value of time is linked to one's hourly earnings. It creates quite a steep gradient between income groups. The value-of-time estimates will be added to the other costs of miles traveled later in this chapter. The estimation of the number of miles traveled was described in the Travel Model Results section. The costs that will be attached to those miles are discussed in the next two sections. All of these estimates are brought together in the final section.

PRIVATE VEHICLE COSTS

There are many factors that contribute to the cost of travel in private vehicles. For the purposes of this discussion, these factors have been grouped into five categories:

- Direct Fixed Costs of Vehicle Ownership
- Direct Variable Costs of Vehicle Ownership
- Value of Travel Time
- Governmental Costs
- Social/Environmental Costs

This section describes these factors. The next section derives estimates for them.

Direct Fixed Costs of Vehicle Ownership

The direct fixed costs of vehicle ownership are those that an individual or household incur simply by owning a private vehicle. These include the costs of financing or purchase, vehicle depreciation, and the insurance that is required in order to operate a vehicle. While there is, in fact, some variation in depreciation and insurance based on the daily or annual vehicle-miles traveled and the location of the vehicle, the majority of these costs are fixed.

Courtesy of C. Galley

There are two other fixed costs of ownership—registration and licensing, and storage or home parking costs. Registration and licensing costs paid by an individual or household can vary substantially based on the number of vehicles registered or licensed and the fee structure of the local government. Nevertheless, under normal driving conditions these costs are less than a penny per passenger mile. Regarding vehicle storage or parking, for most vehicle owners this is the cost of a garage or an off-street parking space at the vehicle owners' residence. Parking spaces have a long functional life and therefore produce relatively small costs when considered on an annual basis.

Direct Variable Costs of Vehicle Ownership

The direct variable costs of vehicle ownership are those associated with the operation of a vehicle, and it is these expenses that are the largest component of the total cost of travel in any urban setting. These costs include fuel costs, other consumable costs such as oil and tires, and normal vehicle repair and maintenance. Many factors affect these costs from the perspective of the individual vehicle user. For example, the consumption of fuel during travel is directly related to the type, age, and mechanical condition of a vehicle.

There are numerous changes in exterior conditions that can affect the cost of travel during a single vehicle trip. These include vehicle speed, which initially decreases cost as vehicle speed increases, and then increases cost as vehicle speeds reach those of free-flow freeway traffic. Other exterior environmental factors include road gradient, curvature, and the condition of the road surface. On an annual basis, the impact of these individual trip environment factors is offset by the large number of miles traveled.

Value of Travel Time

The value of travel time is a major component in any estimate of travel costs. Numerous studies and transportation planning guidance documents provide estimates of the value of travel time. It is sometimes split into two categories: on-the-clock (i.e., working time) and off-the-clock time. On-the-clock time is normally assumed to be equal to the full wage of the driver. Off-the-clock time is commonly estimated to be half the prevailing wage for commuting trips.

Courtesy of C. Galley

Commuting time has traditionally been considered to be more valuable than travel time used for personal or social trips. Recent research casts doubt on this assumption. In addition, it is commonly assumed that higher-income individuals place a higher value on their travel time than lower-income individuals. An estimation of time costs was derived in the previous section and will not be addressed further here.

Governmental Costs

The government costs of travel are primarily associated with the expense of enforcing traffic laws, police and court costs, and that portion of the public cost of accidents not covered by insurance. These costs are relatively modest for most areas and are predominantly the responsibility of local government.

The cost associated with the construction and maintenance of the road system is not necessarily a governmental cost of travel. Most publicly built road facilities are constructed using money collected as part of a fuel tax (Federal Highway Administration 1999). This cost has already been accounted for in the variable direct cost of travel. Most of the local road system is constructed as part of the land development process. The cost of this capital infrastructure is included in the cost of home and commercial structures. It is paid as part of the mortgage, lease, or purchase price of buildings.

Social/Environmental Costs

The social costs and/or environmental costs of travel have been the subject of much debate and discussion. These external costs normally are borne by society as a whole rather than the people who generate them. The social costs of transportation include those associated with noise, air pollution, and water pollution from road runoff, to name a few. Air pollution costs generally comprise the largest portion of these. The role of air pollution as a source of health problems and property damage has been extensively documented during the last quarter-century. Estimates of this cost are usually made in the aggregate for the nation as a whole. When these costs are translated to a person-mile basis, they total several cents per mile.

Costs Used in This Study

Most of the cost estimates used in this analysis are averages derived from national databases or national case studies. They are grouped in three general categories: User Costs, Governmental Costs, and Societal Costs.


Courtesy of G. Lowenstein

Although automobile cost estimates are most frequently measured in dollars per vehicle-mile traveled ($/VMT), the cost-of-travel estimates used in this analysis are denominated in dollars per passenger-mile traveled ($/PMT) in order to facilitate the comparison between private vehicle costs and transit costs. The conversion of VMT to PMT is done by dividing the costs of travel expressed in VMT by the average occupancy for all trips, 1.59 persons per vehicle, as derived from the 1995 NPTS data. This occupancy is higher than the occupancy for work trips, 1.14 persons per vehicle.

User Costs

As described previously, user costs are those paid directly by the traveler, such as the cost of gasoline, oil, tires, and parking. These costs also include indirect costs, such as vehicle depreciation and the cost of insurance. The largest portion of the user costs is the direct cost of vehicle ownership, which has two components—fixed costs and variable costs.

The fixed costs of ownership are costs that do not vary on an annual basis, such as the cost of vehicle purchase or financing, the cost of vehicle depreciation, the cost of vehicle insurance, and the cost of vehicle storage or parking at the owner's residence. A vehicle owner incurs these costs whether the vehicle is driven one mile per year, 10,000 miles per year, or 25,000 miles per year. Obviously, the fixed cost per vehicle-mile traveled varies substantially depending on the number of miles traveled during a year.

The American Automobile Association (AAA) estimated that in 1995 the fixed costs of vehicle ownership for a private automobile were $0.410 per VMT, assuming 10,000 miles of driving per year. This estimate was derived for AAA by Runzheimer International and is based on a composite cost estimate using the cost for three types of cars driven 15,000 miles per year in stop-and-go traffic. The present study will use this estimate of the fixed costs of vehicle ownership. Converting it to a cost per PMT in 1995 dollars results in an estimated cost of $0.258 per PMT for all trips.[7]

The variable cost of vehicle ownership is directly related to the number of miles driven each year as well as to the type and condition of the vehicle(s) used by a household. Variable costs include the cost of fuel, oil, tires, maintenance and repairs, and short-term parking. AAA estimates that in 1995 the variable cost of vehicle ownership was $0.096 per VMT based on information supplied to them by Runzheimer International. Once again, this cost is a composite based on the cost of operating three different classes of vehicles driven 15,000 miles per year in stop-and-go traffic. The AAA estimate of the variable cost of vehicle ownership will be used. Transforming this cost to a per PMT basis in 1995 dollars yields an estimate of $0.060 for all trips.

Internal accident costs are those borne by individuals and not reimbursed by insurance payments. These costs include pain and suffering, lost time at work, disabilities, and other costs to individual vehicle users that are not recoverable from insurance companies or other responsible individuals. Litman (1995) estimates that the costs in this category total $0.060 per PMT, on average.

Internal parking costs are the costs of providing parking for a vehicle at an individual's place of residence. These include the cost of facilities such as garages, carports, or other off-street parking spaces. The cost estimates are based on the annualized cost of this parking infrastructure. Litman (1995) provides a best estimate of this cost as $0.027 per PMT.

Governmental Costs

The governmental cost of travel includes both direct governmental costs, such as police and court system costs for traffic enforcement, and indirect costs, such as the cost of accidents that are picked up by the government for those unable to pay.

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[7] All costs are summarized in a table at the end of this section.

Table 11.16
External Environmental Costs per VMT
($1995)

	Delucchi			
	Low Estimate	High Estimate	"Best" Estimate	Litman
Air Pollution	$0.018	$0.271	$0.046	$0.051
Water Pollution	$0.000	$0.001	$0.001	$0.010
Noise Pollution	$0.000	$0.008	$0.001	$0.010
Climate Change	$0.002	$0.020	$0.007	N/A
Total	**$0.021**	**$0.301**	**$0.055**	**$0.072**

Source: Delucchi (2000) modified by Parsons Brinckerhoff; Litman (1995)

Table 11.17
Adjusted External Environmental Costs per PMT ($1995)

	Delucchi Best Estimate	Litman
Air Pollution	$0.029	$0.032
Water Pollution	$0.001	$0.006
Noise Pollution	$0.001	$0.006
Climate Change	$0.004	N/A
Total	$0.036	$0.045

Source: Delucchi (2000) modified by Parsons Brinckerhoff; Litman (1995)

Municipal costs include a variety of governmental administrative functions that are not paid for by gas taxes but are directly related to traffic and travel. These include police and court services used for the enforcement of traffic laws and fire services that are provided for traffic-related problems. These costs can also include corrections costs. Litman estimates these at $0.006 per PMT.

External accident costs are unrecoverable accident costs that are predominantly picked up by government. These costs include medical and emergency services costs that are not reimbursed by insurance, disability costs that become the responsibility of the government and are not recoverable from insurance companies or individuals, and other similar costs that fall to the government because there is no one else to pay. Litman estimates these costs at $0.023 per PMT.

External parking costs are the value of off-street parking spaces that are provided free to employees and customers of business. This is a subsidy that raises the cost of goods and services. The amount of parking required at commercial facilities is a matter of local government regulation, and at times local governments are directly involved in the provision of parking lots in retail areas. Therefore, external parking costs are classified as governmental costs. Litman estimates these costs to be $0.031 per PMT.

Societal Costs

Societal costs are, by definition, external costs of vehicle travel. They reflect the cost of consuming common goods such as air or water, or the cost related to air, land, or water pollution. These costs are the subject of much discussion, debate, and some disagreement on the accuracy of the estimated values and on their place in the public policy process.

Delucchi (2000) provides a set of environmental cost estimates that can be converted to a cost per PMT (Table 11.16). These estimates produce a range of costs and include a best estimate for four classes of environmental costs that are directly applicable to this modeling process. Delucchi's method of producing a cost estimate is similar to the one used by Litman (1995). For the sake of comparison, Delucchi and

Courtesy of C. Galley


Courtesy of C. Galley

Litman's cost estimates are shown together in the following tables. The estimates are adjusted to 1995 dollars using the Consumer Price Index for All Urban Consumers to correspond to the same time frame as the NPTS data.

Table 11.17 shows the same cost estimates converted from VMT costs to PMT costs using 1.59 persons per vehicle, as described previously. Delucchi's estimates are used in this study as they are the most recently estimated. Air pollution costs, estimated at $0.029 per PMT, are one of the most obvious external costs associated with the use of vehicles powered by internal combustion engines. It is possible to estimate the amount of air pollution produced per year, measured in tons or kilograms, for any vehicle fleet with a known distribution of vehicle types. The result is an aggregate estimation of the amount of air pollution produced. Since air pollution from motor vehicles tends to be most heavily concentrated in urban areas, the health impacts of air pollution will generally be greatest in or near urban areas and along heavily traveled rural highways.

Water pollution costs are estimated to be $0.0006 per PMT. These costs are attributed to a variety of sources including leaking underground fuel tanks, large oil spills, contaminated urban runoff, and nitrogen deposition (nitrogen oxide). Each of these costs was estimated individually, and an aggregate cost was developed as a sum of these estimates.

Noise pollution costs are estimated at $0.0006 per PMT. These costs are somewhat harder to quantify than those of air pollution costs. In addition, noise impacts are quite localized. The highest levels of noise pollution from vehicles in an urban area are normally found on heavily traveled arterial streets and freeways. Higher-speed traffic also generates more noise than does lower-speed traffic. Delucchi's approach to estimating the cost of noise pollution is to estimate the impact from a 10 percent increase in vehicle-miles traveled for different types of vehicles and different types of roads.

Climate change costs are an estimate of the costs associated with increases in the concentration of greenhouse gases and motor vehicle travel in the United States. It is estimated that these produce as much as 30 percent of the total United States production of carbon dioxide. Delucchi's estimate of $0.004 per PMT is based on a life cycle emissions model (1991 and 1997) that considers variables such as fuel economy, gasoline quality, grams-per-mile emission

Table 11.18
Summary of Private Vehicle Travel Costs

Cost of Private Vehicle Travel $/PMT (1995 $)	$/PMT for All Trips	$/PMT for Work Trips
User Cost		
Fixed Costs of Ownership	$0.258	$0.360
Variable Costs of Ownership	$0.060	$0.084
Internal Parking Costs	$0.027	$0.038
Internal Accident Costs	$0.032	$0.045
Subtotal	***$0.378***	***$0.527***
Governmental Costs		
Municipal Costs	$0.006	$0.008
External Parking Costs	$0.031	$0.043
External Accident Costs	$0.023	$0.032
Subtotal	***$0.059***	***$0.083***
Social Costs		
Air Pollution	$0.029	$0.040
Water Pollution	$0.001	$0.001
Noise Pollution	$0.001	$0.001
Climate Change	$0.004	$0.006
Subtotal	***$0.035***	***$0.048***
Total Cost per PMT	**$0.473**	**$0.658**

Source: Parsons Brinckerhoff Quade and Douglas, Inc.

factors for vehicles, energy use at refineries, and other similar factors.

Summary of Private Vehicle Costs

All of the costs of vehicle travel discussed above are shown in Table 11.18. For purposes of comparison, costs are shown for all trips and for work trips. The cost of all trips will be used to estimate the cost of travel in this analysis.

The cost of work trips is included in this summary because this class of trips produces the highest demand on the transportation system. Work trips are also the most heavily studied and frequently modeled portion of the trips made in any area. It is interesting to note that the estimated cost of work trips by private vehicles is nearly the same as the estimated cost of transit trips described in the next section of this report. Since transit trips are predominantly work trips, this suggests that the cost of travel to work may be approximately the same regardless of mode when measured on a PMT basis (Table 11.18).

Source of Uncertainty in Estimates

There are numerous sources of uncertainty in the estimates of private vehicle costs. It is important to illustrate a few of them here, although these differences will not be expressed in the full cost estimates in this study.

Variation by Geography

Travel costs vary by geography as a function of the different mix of vehicles in the fleet for each geographic area. Litman (1995) estimated that fixed costs for private vehicles ranged from $0.18 per VMT for a fuel-efficient automobile to $0.27 per VMT for a van or light truck.

The automobile share of the vehicle fleet ranges from 76 percent in the urban areas to 52 percent in rural areas, while the percentage of light trucks and sport utility vehicles ranges from 14 percent in urban areas to 37 percent in rural areas. This variation has probably shifted somewhat in the last five years with the increase in market share of SUVs and light trucks.

Table 11.19
Total Social Cost per Vehicle-Mile Traveled
($1991)

Cost Item	Low Estimate	High Estimate
Environmental external cost of motor vehicle use	0.016	0.246
Other nonmonetary external cost: pain and suffering in motor vehicle accidents, nonmarket costs of travel delay, nonmonetary cost of crimes and fire related to using or having motor vehicle goods, services, or infrastructure	0.019	0.099
Monetary externalities (e.g. monetary costs of accidents and travel delay, "energy security" costs of using oil)	0.021	0.046
Government infrastructure and service related to motor vehicle use (highways, highway patrol, etc.)	0.061	0.115
Goods and services bundled in the private sector (e.g. "free parking")	0.035	0.130
Goods and services provided in the private sector (vehicle fuel, etc.)	0.383	0.452
Personal nonmarket costs (e.g., own risk in accidents, travel time when not subject to delay)	0.246	0.451
Total Costs, ($/VMT)	**0.781**	**1.686**
Total Costs, ($/PMT)	**0.491**	**1.060**

Sources: Delucchi (2000) modified by Parsons Brinckerhoff.

Finally, driving conditions will vary across urban and rural areas. In rural environments, vehicles are more likely to be operated under free traffic-flow conditions. This means that the VMT variable operating cost should be lower for each vehicle type, given similar road and terrain conditions. Urban and suburban vehicles can be expected to spend more time operating in congested traffic and, as a result, should expect to experience higher variable operating costs per mile.

Range of Variance in Cost Estimates

Table 11.19 from Delucchi (2000) shows the social costs of automobiles, derived from a national data set from 1990 and expressed in 1991 dollars. The costs have been converted into a cost per vehicle-mile traveled.

Because these cost estimates are not organized in a manner that is directly transferable to the modeling process used in this study, they are not used further in this report. However, the estimates illustrate the very wide range of costs within each category, which is a major source of uncertainty in a full cost framework analysis.

TRANSIT COSTS

All of the costs described in this section were derived from the 1995 National Transit Database compiled by the Federal Transit Administration (U.S. Department of Transportation 1997). For the purposes of this study, rail transit includes commuter-rail, heavy-rail, and light-rail. Bus transit includes motor bus and trolleybus. Collectively, these modes of transportation are consistent with the transit modes reported in the NPTS.[8]

All of the costs described in this section are long-run average costs, reflecting transit-capital investments, transit-route development, regional housing and employment locational decisions, and transit ridership patterns that have occurred over many years. Although travelers base their trip-making behavior (including mode choice) on marginal costs, it is more appropriate to report long-run average costs in a study that measures travel behavior at the national scale, where travel decisions are influenced by many years of accumulated transportation investment. It is worth not-

[8] Costs were not developed for the following transit modes, although they are reported in the National Transit Database: automated guideways, cable cars, demand-response, ferryboats, inclined planes, jitneys, monorails, publicos (Puerto Rico), and vanpools.

ing that marginal transit costs tend to be significantly lower than average costs (Litman 1999). The following conditions explain this tendency:

- Transit vehicles typically have excess capacity (i.e., the cost of filling an empty seat is small). Only about one-fifth of transit trips occur under fully loaded conditions when increased demand would require added service.
- Transit-vehicle capacity can often be increased at lower-than-average cost if larger vehicles are used.
- Frequent transit service reduces wait times and costs.

Operating Costs

Operating costs are derived from the National Transit Database (Transit Operating Expenses by Mode and Function: Details by Transit Agency). Operating costs for the following are paid from federal, state, and local funds (e.g., taxes):

- vehicle operations
- vehicle maintenance
- non–vehicle maintenance
- general administration
- purchased transportation

For the purpose of this study, funds that are distributed to transit agencies by governments are considered to be government-incurred costs, regardless of the original source of the funding (e.g., business or resident taxes). For 1995, total government operating costs for rail and bus transit were $6.1 billion and $9.3 billion, respectively.

In addition, transit users pay fares that are used to defray operating costs. As the National Transit Database does not tabulate fare revenue by transit mode, this information was obtained from the American Public Transportation Association's (APTA) Web site. Passenger fares are comprised of the following:

- base fares
- zone and express service premiums
- extra cost transfers
- revenues earned but paid for by an organization, not the rider
- special routes for which revenues are guaranteed by beneficiaries of the service

For 1995, total passenger fares (i.e., user costs) for rail and bus transit were $3.22 billion and $3.34 billion, respectively.

Capital Costs

Capital costs were derived from the National Transit Database (Capital Funds Applied by Type of Expenditure). Capital costs for the following are paid from federal, state, and local sources:

- rolling stock
- facilities
- other expenses

For the purposes of this study, funds that are distributed to transit agencies by governments are considered to be government-incurred costs, regardless of the original source of the funding (e.g., business or resident taxes). For 1995, total government capital costs for rail and bus transit were $4.9 billion and $1.8 billion, respectively. It is important to note that capital costs reflect actual cash expenditures for capital assets in the reporting year. While some transit agencies do record depreciation using various methods, many agencies do not because they are not required to do so. Because of these discrepancies, depreciation is not published in the National Transit Database.

To assess the "lumpiness" of the capital costs reported in 1995, these costs were compared with capital costs reported from 1992 to 1997. Table 11.20 shows capital-cost trends by transit mode for this time period. The figures reveal that capital costs for 1995 do not vary significantly from the six-year average. One can conclude that the cash outlays reported in 1995 are representative of recent actual capital expenses.

Societal Costs

Societal costs are costs that are incurred by the general public. These costs are not paid by the users who generate them. The following social costs are typically associated with transit use:

- accident costs
- air pollution
- water pollution
- noise

Based on the findings of previous research (Parsons Brinckerhoff Quade & Douglas, Inc. 1996a), only air pollution is estimated to amount to more than one-half cent per passenger-mile (for motor bus transit). Air pollution costs, for instance, were estimated to equal $.01 and $.03 per passenger-mile for peak and off-peak transit usage, respectively. Most light-rail

Table 11.20
Capital Cost Trends 1992 to 1997 by Transit Mode*

Year	Bus	Rail	Total
1992	$1,443,636,000	$4,168,260,000	$5,611,896,000
1993	$1,668,100,921	$4,243,503,187	$5,911,604,108
1994	$1,566,736,533	$4,154,102,901	$5,720,839,434
1995	$1,855,629,610	$4,935,321,572	$6,790,951,182
1996	$1,996,975,131	$4,633,821,990	$6,630,797,120
1997	$2,228,825,893	$4,715,348,533	$6,944,174,426
Average	$1,793,317,348	$4,475,059,697	$6,268,377,045

Source: Parsons Brinckerhoff Quade and Douglas, Inc.
Note: * Indexed to 1995 based on CPI for All Urban Consumers.

Table 11.21
Average Operating Costs and Total Cost per Passenger-Mile by Transit Mode

1995 Annual Figures	Bus	Rail	Total
Operating Costs ($)	9,385,888,550	6,109,245,681	15,495,134,231
Capital Costs ($)	1,855,629,610	4,935,321,572	6,790,951,182
Total Costs ($)	11,241,518,160	11,044,567,253	22,286,085,413
Passenger Fares ($)	3,341,200,000	3,222,200,000	6,563,400,000
Agency Passenger-Miles	16,146,608,521	18,998,778,689	35,145,387,210
Purchased Passenger-Miles	1,064,893,855	662,768,545	1,727,662,400
Total Passenger-Miles	17,211,502,376	19,661,547,234	36,873,049,610
Operating Cost per Passenger-Mile			
Users ($)	0.19	0.16	
Government ($)	0.36	0.15	
Social* ($)	0.01	N/A	
Total Operating Cost per Passenger-Mile ($)	0.56	0.31	
Capital Cost per Passenger-Mile (Gov't) ($)	0.10	0.25	**Weighted Average ($)**
Total Cost per Passenger-Mile ($)	**0.66**	**0.56**	**0.60**

Source: Parsons Brinckerhoff Quade and Douglas, Inc.
Note: * Based on peak-hour emissions.

systems use electric power generated from remote sources and do not directly produce exhaust or emissions. To measure the relevant air pollution impacts, it would be necessary to measure the emissions of the power plants that generate the electricity that power the light-rail vehicles.

Passenger-Miles

Passenger-miles by transit mode were derived from the National Transit Database (Transit Operating Statistics: Service Supplied and Consumed: Details by Transit Agency). For 1995, total passenger-miles were 19.6 billion for rail transit and 17.2 billion for bus transit.

Findings

Table 11.21 shows the average operating cost and average total cost per passenger-mile by transit mode for 1995. These costs are national long-run average costs. This study uses the weighted average estimate of $0.60 per person-mile.[9]

Based on the actual 1995 data, capital costs account for a relatively high share (45 percent) of total costs for rail transit. These costs are probably overstated, however, as many rail lines probably remained in-

[9] Person-mile and passenger-mile are used interchangeably in this study.

complete at the year-end despite substantial capital expenditures. Thus, while capital costs were recognized and tabulated, these facilities would not yet be generating transit ridership.

The goal of this study is to determine how transportation costs per person-mile vary depending on urban form. Due to the aggregate nature of the transit data (tabulated at the transit agency level), however, it was not possible to account for the effects of urban form upon transit ridership. To account for these relationships, route-level ridership at the local-jurisdiction level would need to be analyzed.

It is important to note that the cost-per-person-mile data developed for this study reflects *actual* transit provision and usage, which is a function of transit pricing (fare policy) and transit availability, among many other factors. Because urban environments with high population and employment densities generally produce higher transit ridership, costs per person-mile in these areas would generally be lower than costs in areas with more dispersed development patterns (Parsons Brinckerhoff Quade & Douglas, Inc. 1996b). This cost differential, however, might not be as pronounced

Courtesy of T. Delcorso

if actual marginal-cost pricing were implemented for transit. According to some researchers, in addition to charging higher fares for longer trips, marginal-cost pricing would, for example, require transit riders to pay higher fares when bus use is heavier (i.e., in dense areas, during peak periods, and/or traveling in the inbound direction). The rationale behind marginal-cost pricing is that transit riders under these conditions

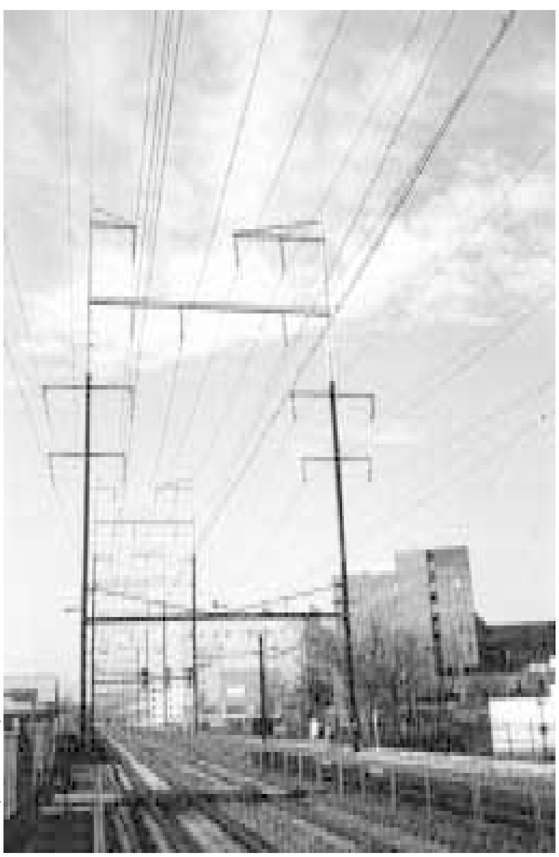
- impose more boarding time delay on more passengers;
- increase the likelihood that the vehicle fleet would need to be increased to accommodate riders that get passed up when transit vehicles are full.

Thus, if full marginal-cost pricing were implemented, costs (i.e., fares) for some urban riders would increase and transit ridership could decrease (or remain about the same) depending on the fare elasticity of demand for these riders. This could result in higher costs per person-mile if service levels were held constant.

In addition, some researchers contend that from an economic efficiency standpoint, many transit systems are overcapitalized, particularly with regard to suburban service (Karlaftis, McCarthy, and Sinha 1999). These researchers contend that

- too much service is directed to low-density areas (i.e., higher-income suburban residents value transit service much less than do lower-income residents);
- overly large vehicles are used to provide this service (transit managers counter that large vehicles are required to serve peak-period loads).

If these allegations are true, actual costs for transit service in low-density areas may be inefficiently high; reduced capital investment would result in more uniform costs per passenger-mile within a given metro-



Courtesy of C. Galley

Table 11.22
Full Travel Costs by Place Type, Income, and Mode Group without Time Costs

Income Group	Urban	Suburban	Second City	Exurban	Rural
POV Only					
<$15,000	$5.95	$7.05	$6.76	$8.64	$10.22
$15,000 to $39,999	$8.64	$10.24	$9.82	$12.54	$14.83
$40,000 to $59,999	$10.36	$12.28	$11.77	$15.04	$17.80
$60,000+	$10.97	$13.00	$12.47	$15.93	$18.84
Transit Only					
<$15,000	$4.40	$8.32	$5.37	-	-
$15,000 to $39,999	$6.15	$11.63	$7.49	-	-
$40,000+	$6.97	$13.17	$8.49	-	-
Used Both, POV					
<$15,000	$2.28	$3.51	$4.08	-	-
$15,000 to $39,999	$2.50	$3.84	$4.46	-	-
$40,000+	$3.25	$4.99	$5.81	-	-
Used Both, Transit					
<$15,000	$4.64	$6.20	$3.44	-	-
$15,000 to $39,999	$3.75	$5.01	$2.78	-	-
$40,000+	$6.50	$8.68	$4.81	-	-
Used Both: TOTAL*					
<$15,000	$6.92	$9.71	$7.52	-	-
$15,000 to $39,999	$6.25	$8.85	$7.24	-	-
$40,000+	$9.75	$13.67	$10.62	-	-

Source: Parsons Brinckerhoff Quade and Douglas, Inc.
Note: *"Total" is the sum of the POV and Transit portions from the Used Both models.

politan area. This would cause average and marginal costs to converge as seats are used more efficiently.

To conclude, in addition to economic efficiency, transit agencies must take into account many other factors (e.g., social equity and environmental, technological, and political issues) in designing their transit services. It is beyond the scope of this chapter to discuss optimal transit fare and fleet-composition policies and to speculate on their potential impacts on transit costs and ridership at the local or national levels. Thus, the methods discussed above provide the most reasonable option.

FULL COSTS OF TRAVEL

Table 11.22 shows the estimated cost of travel by income group, mode group, and urban place type; it does not include the value of time. This table was created by multiplying the predicted miles in Table 11.11 by the estimated per-mile cost of travel for POVs ($0.47) and transit ($0.60). The last three rows sum the estimates for the POV portion and transit portion of daily travel for the "used both" mode group.

The estimated costs of travel, above, are for one person's daily miles of travel according to his or her income group and urban place type. On a daily, per-person basis, the differences in cost by place are not inconsequential. A person in the suburbs, traveling by POV only, is responsible for travel costs that are 19 percent higher on average than a person of similar characteristics in an urban area. The difference between costs in urban and exurban areas is more pronounced; there is a 45 percent increase in the exurban areas.

Table 11.23 shows the full cost of travel including the value of time. This table was created by adding the estimated values of time from Table 11.15 to the costs in Table 11.22, according to income, mode group, and place type.

Table 11.23
Full Travel Costs by Urban Area, Income, and Mode Group with Time Costs

Income Group	Urban	Suburban	Second City	Exurban	Rural
POV Only					
<$15,000	$8.67	$9.72	$9.35	$11.49	$13.15
$15,000 to $39,999	$14.70	$16.20	$15.59	$18.90	$21.39
$40,000 to 59,999	$19.81	$21.58	$20.77	$24.95	$28.01
$60,000+	$25.78	$27.57	$26.56	$31.46	$34.85
Transit Only					
<$15,000	$7.30	$11.83	$8.43	-	-
$15,000 to $39,999	$12.61	$19.45	$14.34	-	-
$40,000+	$19.88	$28.83	$22.19	-	-
Used Both, POV					
<$15,000	$3.38	$4.86	$5.61	-	-
$15,000 to $39,999	$4.94	$6.87	$7.88	-	-
$40,000+	$8.14	$11.06	$12.66	-	-
Used Both, Transit					
<$15,000	$7.18	$8.83	$5.01	-	-
$15,000 to $39,999	$9.43	$10.88	$6.30	-	-
$40,000+	$17.84	$20.42	$11.85	-	-
Used Both: TOTAL*					
<$15,000	$10.56	$13.70	$10.62	-	-
$15,000 to $39,999	$14.37	$17.75	$14.18	-	-
$40,000+	$25.99	$31.48	$24.51	-	-

Source: Parsons Brinckerhoff Quade and Douglas, Inc.
Note: *"Total" is the sum of the POV and Transit portions from the Used Both models.

With the inclusion of time costs, the differences between place are decreased somewhat in percentage terms, and there are now, as would be expected, relative differences between income groups. The increase in daily travel costs for a person using a POV only ranges from 7 percent to 12 percent when comparing an urban area to a suburban one, depending on one's income group; the increase in costs ranges from 22 percent to 33 percent when comparing an urban area to an exurban one. It is important to note that those who experience the greatest percentage increases in travel costs are those in the lowest income group—for all mode groups (referring to the user portion of costs). Thus, although the value of time, as constructed for this study, increases with income, the effect of including this measure in the analysis indicates that those in the lower-income groups experience the highest percentage increases in travel costs, regardless of mode, when comparing urban areas with the other place types.

RESULTS OF THE ASSESSMENT

The Pairing of the Regression and Population Allocation Models

The purpose of this section is to view savings in travel miles and costs associated with two alternative-growth futures in the United States. These costs include the costs of time saved in travel. The regression coefficients discussed earlier in this chapter are applied to population locating to urban, suburban, rural, and undeveloped counties (see Chapter 2 of this study for definitions of these county types by geographic area of the country). This is done in the following way.

In order to use the results of the regression model in the population allocation model, the increment of 2000-2025 population 16 years or older (48.5 million people) is generated as individual cases with information on socioeconomic variables matching the characteristics used in the regression equation. If the county is not rural or undeveloped, a share of the cases (varying from 82 percent in urban to 97 percent in suburban) is identified as POV Only cases, with the rest of the cases identified either as Transit Only cases or Both Mode cases. All cases in undeveloped and rural counties are identified as POV Only cases.

The 2025 income distribution of the county is then used to divide the cases into four income ranges. In addition, one-half of the cases are considered to be male and one-half female. A share of all cases, reflecting the ratio of children to households in a county, are identified as having children in the household. This is repeated for all counties under both uncontrolled and controlled scenarios to create two data sets corresponding to the populations added between 2000 and 2025. These populations then contain the characteristics necessary to apply the coefficients developed in the regression model (mode of travel, area type, income group, sex, presence of children). The total population and personal incomes of each scenario are maintained the same within each EA.

For the regression's urban areas, this study's developed areas of urban and urban center counties are viewed as similar. For the regression's suburban areas, this study's developed areas of suburban counties are viewed as similar. For the regression's exurban areas, this study's developed areas of rural, rural center, and undeveloped counties and the less-developed areas of suburban counties are viewed as similar. For the regression's second-city areas, this study's less-developed areas of urban and urban center counties are viewed as similar. For the regression's rural areas, this study's undeveloped areas of rural center, rural, and undeveloped counties are viewed as similar.

The coefficients of the four different travel models (POV Only; Transit Only; Both Modes, POV; and Both Modes, transit) are applied to the appropriate cases of the data sets to develop travel-miles by mode.

Courtesy of C. Galley

Courtesy of G. Lowenstein

Cost factors are then applied to the different modes. In addition, a time cost, which varies by income level and county type, is added to develop the total costs of travel including time.

Strengths and Weaknesses of the Pairing Procedure

The strength of this analysis is that travel characteristics have been developed for different areas or county location types that exist nationally and that are differently occupied under the two growth scenarios. To the greatest degree possible, these definitions parallel the place definitions discussed earlier in this chapter. Populations locating to counties are then assigned the travel time and travel costs associated with the location types determined from the regression analysis. There are some obvious inconsistencies between the subcategories of metropolitan areas for which regressions are run and the categories of counties and their subareas to which the results are applied. This cannot be avoided. There is also the question of scale. For the most part, the areas for which regression analyses are run are smaller and more homogeneous than the individual counties and the developed and undeveloped areas within them. This is not as limiting a factor as it may appear. The vast preponderance of the 3,100 counties in the United States are rural counties receiving very little growth (2,125). The entire area of most of these counties is rural. On the other hand, 225 counties are mostly developed urban and suburban counties, which may or may not be receiving significant growth but whose areas are relatively evenly developed. The remaining 750 counties are the significant-sprawl locations, which have mostly rural areas but urban and suburban pockets. These are the separately differentiated areas that may prove to be the most problematical. Notwithstanding the differences between the regression analyses' locations and this study's counties, the following exercise allows the analyses in this chapter

Table 11.24
Population in Urban/Suburban/Rural-Center Counties versus Rural/Undeveloped Counties—Uncontrolled- and Controlled-Growth Scenarios: 2000 to 2025

Region	Uncontrolled-Growth Scenario: Urban/ Suburban/ Rural Center	Rural/Un-developed	Total	Controlled-Growth Scenario: Urban/ Suburban/ Rural Center	Rural/Un-developed	Total	Difference in Urban/ Suburban/ Rural Center
Northeast	1,809,856	1,395,252	3,205,108	1,878,245	1,226,287	3,104,532	68,389
Midwest	3,912,127	3,040,529	6,952,655	4,142,550	2,786,972	6,929,522	230,424
South	13,783,357	8,371,645	22,155,001	14,620,750	7,481,196	22,101,946	837,393
West	10,493,288	5,666,584	16,159,872	11,976,576	4,360,059	16,336,636	1,483,289
United States	29,998,627	18,474,009	48,472,636	32,618,121	15,854,515	48,472,636	2,619,495

Source: Woods & Poole (1998); Center for Urban Policy Research, Rutgers University.

Table 11.25
Population in Developed and Undeveloped Areas—Uncontrolled- and Controlled-Growth Scenarios: 2000 to 2025

Region	Uncontrolled-Growth Scenario: Developed Areas	Undeveloped Areas	Total Areas	Controlled-Growth Scenario: Developed Areas	Undeveloped Areas	Total Areas	Difference in Developed Areas
Northeast	1,950,308	1,254,800	3,205,108	1,999,785	1,104,747	3,104,532	49,477
Midwest	4,174,928	2,777,727	6,952,655	4,338,013	2,591,508	6,929,522	163,085
South	14,343,522	7,811,479	22,155,001	15,251,088	6,850,858	22,101,946	907,566
West	12,286,892	3,872,980	16,159,872	13,032,673	3,303,963	16,336,636	745,781
United States	32,755,651	15,716,985	48,472,636	34,621,559	13,851,077	48,472,636	1,865,909

Source: Woods & Poole (1998); Center for Urban Policy Research, Rutgers University.

to parallel the analyses undertaken in the other impact chapters. The analysis begins with the impacts of land-development patterns on travel miles and costs at the national and regional levels.

THE UNITED STATES AND ITS REGIONS

Over the period 2000 to 2025, the population of the United States will grow from 281.2 million to 341.9 million—an increase of 60.7 million. Of this, the population growth of those age 16 and over will be 48.5 million. Seventy-nine percent of this growth of 48.5 million people will take place in the South (22.2 million) and in the West (16.2 million). The remainder will take place in the Midwest (7.0 million) and in the Northeast (3.2 million) (Tables 11.24 and 11.25).

Under the uncontrolled-growth scenario, approximately 62 percent of the 48.5 million, or 30.0 million, new residents aged 16 and over will live in urban, suburban, and rural-center counties; 18.5 million new residents will live in rural and undeveloped counties. Under the controlled-growth scenario, approximately 67 percent of the 48.5 million, or 32.6 million, new residents aged 16 and over will live in urban, suburban, and rural-center counties; 15.9 million will live in rural and undeveloped counties (Table 11.24). This amounts to a shift of approximately 2.6 million people of driving age out of less-developed to more-developed counties under the controlled-growth scenario. This is an intercounty locational change often achieved through the establishment of a regional growth boundary.

In the uncontrolled-growth scenario, slightly more than 67 percent of 48.5 million new residents aged 16 and over (32.8 million) will reside in the developed

Table 11.26
Population Increment 16 Years and Older by Region and Mode of Travel
Uncontrolled-Growth Scenario: 2000 to 2025

Region	POV	Transit	Used Both	All
Northeast	3,092,866	71,135	41,107	3,205,108
Midwest	6,562,904	262,971	126,780	6,952,655
South	20,751,535	948,985	454,480	22,155,001
West	15,009,964	782,918	366,990	16,159,872
United States	45,417,270	2,066,009	989,357	48,472,636

Source: Woods & Poole, 1998. Center for Urban Policy Research, Rutgers University.

Table 11.27
Population Increment 16 Years and Older by Region and Mode of Travel
Controlled-Growth Scenario: 2000 to 2025

Region	POV	Transit	Used Both	All
Northeast	2,960,726	94,103	49,703	3,104,532
Midwest	6,478,354	307,007	144,161	6,929,522
South	20,460,838	1,119,741	521,368	22,101,946
West	14,887,068	995,359	454,209	16,336,636
United States	44,786,986	2,516,210	1,169,440	48,472,636

Source: Woods & Poole, 1998. Center for Urban Policy Research, Rutgers University.

areas of the counties; the remainder (15.7 million) will live in the undeveloped portions. In the controlled-growth scenario the share residing in the developed portions of the counties will rise to 71.4 percent (34.6 million) and the remainder (13.9 million) will live in the undeveloped portions (Table 11.25). This amounts to a shift of approximately 1.8 million people to the developed portions of the counties. This is an intracounty locational change often achieved through the designation of county urban service areas.

Courtesy of T. Delcorso

Avoiding overlap, some share in excess of 70 percent of 4.4 million people of driving age (3.16 million people) will experience a change in density and other locational attributes that will cause a change in their travel behavior. This will amount to approximately 6.5 percent of all future residents of driving age over the 25-year projection period. Tables 11.26 and 11.27 show those of driving age by transit mode under the two scenarios.

Uncontrolled Growth

Travel Distance

Under the uncontrolled-growth scenario, over the period 2000 to 2025, daily miles traveled in privately owned vehicles will increase by 1.19 billion miles, or approximately 26 miles per person per day (Table 11.28). Transit miles traveled daily will amount to 34.84 million miles or 10 miles per person per day. This is a total of 1.23 billion travel miles per day. Of these aggregate daily travel miles, 45.4 percent (0.56 billion miles) will occur in the South; 32.5 percent (0.40 billion miles) will occur in the West; 14.9 percent (0.18 billion miles) will occur in the

Table 11.28
Additional Daily Travel Miles in Privately Owned Vehicles (POV) and Transit by Region
Uncontrolled- and Controlled-Growth Scenarios: 2000 to 2025
(in Thousands of Miles)

	Uncontrolled-Growth Scenario			Controlled-Growth Scenario			Difference—Savings		
Region	POV Miles	Transit Miles	Total Travel Miles	POV Miles	Transit Miles	Total Travel Miles	POV Miles	Transit Miles	Total Travel Miles
Northeast	87,229	1,373	88,601	80,956	1,718	82,674	6,273	-345	5,928
Midwest	178,110	4,571	182,681	171,484	5,180	176,664	6,627	-609	6,018
South	541,339	15,672	557,010	517,354	18,178	535,533	23,984	-2,506	21,478
West	386,849	13,226	400,075	367,536	16,403	383,939	19,313	-3,177	16,136
United States	**1,193,526**	**34,842**	**1,228,368**	**1,137,329**	**41,479**	**1,178,809**	**56,197**	**-6,637**	**49,559**

Source: Woods & Poole, 1998. Center for Urban Policy Research, Rutgers University.

Table 11.29
Additional Daily Travel Costs in Privately Owned Vehicles (POV) and Transit by Region
Uncontrolled- and Controlled-Growth Scenarios: 2000 to 2025
(in $Thousands)

	Uncontrolled-Growth Scenario			Controlled-Growth Scenario			Difference—Savings		
Region	POV Costs	Transit Costs	Total Travel Costs	POV Costs	Transit Costs	Total Travel Costs	POV Costs	Transit Costs	Total Travel Costs
Northeast	69,229	1,812	71,041	64,701	2,330	67,031	4,527	-517	4,010
Midwest	138,670	6,364	145,034	134,428	7,244	141,673	4,242	-881	3,361
South	421,409	21,296	442,704	406,586	24,788	431,374	14,823	-3,492	11,330
West	309,554	18,275	327,829	299,565	22,895	322,460	9,989	-4,619	5,369
United States	**938,861**	**47,746**	**986,608**	**905,281**	**57,256**	**962,537**	**33,581**	**-9,510**	**24,071**

Source: Woods & Poole, 1998. Center for Urban Policy Research, Rutgers University.

Midwest; and 7.2 percent (0.09 billion miles) will occur in the Northeast. Daily miles traveled will increase in the South at a level of 1.4 times that of the West, three times that of the Midwest, and six times that of the Northeast.

Travel Costs

Daily travel costs under the uncontrolled-growth scenario will increase nationally by $986.61 million or by $0.803 per person-mile traveled (PMT) (Table 11.29). This is composed of the following: (1) costs of travel miles, using privately owned vehicles, of $563.34 million daily at $0.472 per person-mile traveled (PMT) including the cost of travel time of $375.52 million daily at $0.315 per person-mile traveled times 97 percent (incidence of POV travelers); and (2) the costs of travel miles, using transit, of $20.91 million at $0.600 per person-mile traveled (PMT) including the cost of travel time of $26.84 million daily at $0.770 per person-mile traveled times 3 percent (incidence of transit travelers). Travel time thus adds an average of $0.32 to a $0.47 POV per person-mile cost and $0.77 to a $0.60 transit per person-mile cost.

Relative total daily travel costs incurred by region follow directly from relative travel miles and will amount to 44.9 percent of the total national travel costs in the South ($442.7 million); 33.3 percent of total travel costs in the West ($327.8 million); 14.7 percent of total travel costs in the Midwest ($145.0 million); and 7.2 percent of total travel costs in the Northeast ($71.0 million).

Controlled Growth

Travel Distance

Under the controlled-growth scenario, over the period 2000 to 2025, daily miles traveled in privately owned vehicles will increase by 1.14 billion miles, or approximately 24.84 miles per person per day (Table 11.28). Transit miles traveled will amount to 41.48 million miles daily, or 11.3 miles per person per day. This amounts to a total of 1.18 billion travel miles per day. Of these aggregate daily travel miles, 45.4 percent (0.54 billion miles) will occur in the South; 32.6 percent (0.38 billion miles) will occur in the West; 15 percent (0.177 billion miles) will occur in the Midwest; and 7 percent (0.08 billion miles) will occur in the Northeast. As was the case for the uncontrolled-growth scenario, over the period 2000 to 2025, the increase in total miles traveled in the South will be 1.4 times that of the West, three times that of the Midwest, and seven times that of the Northeast.

Overall, there is a decrease in daily privately owned vehicle travel miles of nearly 56 million (or 4.7 percent) when the controlled-growth scenario is applied. On the other hand, there is an increase in daily transit travel miles of 6.6 million (or 19 percent). Overall, counting the decrease in daily privately owned vehicle travel miles (56 million) and the increase in daily transit miles (6.6 million), there is a 49.6 million savings or 4.0 percent in daily travel miles under the controlled-growth scenario.

Travel Costs

Daily travel costs under the controlled-growth scenario will increase nationally by $962.54 million or $0.817 per person-mile traveled (PMT) (Table 11.29). This is composed of the following: (1) costs of travel miles, using privately owned vehicles (including travel time) of $905.28 million daily; and (2) costs of travel miles, using transit (including travel time) of $57.26 million. Relative total daily travel costs by region divide the $962.54 million as follows: 44.8 percent ($431.4 million) in the South; 33.5 percent ($322.5 million) in the West; 14.7 percent ($141.7 million) in the Midwest; and 7.0 percent ($67.0 million) in the Northeast.

Privately owned vehicle daily travel costs are decreased by $33.6 million when the controlled-growth scenario is applied—a reduction of 3.6 percent. Transit daily travel costs are increased by $9.51 million, or 19.9 percent. Overall, counting the privately owned vehicle decrease ($33.6 million) and the transit increase ($9.51 million), daily travel costs are reduced by $24.07 million nationally, or 2.4 percent, under the controlled-growth scenario.

STATES

Uncontrolled Growth

Travel Distance

The top 20 states in future daily travel demand will experience 78 percent of all nationally projected daily travel in privately owned vehicles and transit (Table 11.30). The total daily travel increase of these states is 953 million miles. Of this, travel in privately owned vehicles will amount to 926 million miles and transit travel 34.8 million miles. Eighteen of 20 of these states are growing significantly in the number of new households; they are also undergoing the most land conversion. Except for Illinois and Pennsylvania replacing Nevada and Utah on the list of most significant travel-demand states, the lists of most significant growth states and most significant travel-demand states would be identical. The three fastest-growing states are also the three states with the largest number of daily travel miles added. These are California, Florida, and Texas, which have two to three times (111 to 164 million miles each) the level of travel miles added of the next-fastest-growing states—Arizona, Georgia, and North Carolina (45 to 50 million miles each).

Travel Costs

The top 20 states in future travel costs will also incur 78 percent of all future daily travel costs (Table 11.31). The total future daily travel costs in these states amount to $769.2 million. Of this, future daily travel costs incurred in privately owned vehicles are $731.7 million; future travel via transit incurs $37.5 million daily. The three fastest-growing states (California, Florida, and Texas) incur future daily travel costs of $143 million, $107 million, and $97 million, respectively. Their combined costs are 35 percent of national future daily travel costs.

Table 11.30
Additional Daily Travel Miles in Privately Owned Vehicles (POV) and Transit by State Uncontrolled- and Controlled-Growth Scenarios: 2000 to 2025

	Uncontrolled-Growth Scenario			Controlled-Growth Scenario			Difference—Savings		
State	POV Miles	Transit Miles	Total Travel Miles	POV Miles	Transit Miles	Total Travel Miles	POV Miles	Transit Miles	Total Travel Miles
California	163,957	5,857	169,814	151,582	8,157	159,740	12,375	-2,300	10,075
Florida	131,868	2,636	134,504	129,593	2,900	132,492	2,276	-264	2,012
Texas	111,291	6,017	117,307	107,719	6,669	114,387	3,572	-652	2,920
Arizona	50,369	582	50,951	49,983	582	50,565	386	0	386
Georgia	48,856	1,634	50,490	46,084	2,133	48,217	2,772	-499	2,273
North Carolina	45,894	1,220	47,114	45,862	1,227	47,089	31	-6	25
Washington	39,813	1,419	41,231	38,213	1,504	39,716	1,600	-85	1,515
Tennessee	34,463	521	34,984	32,487	768	33,255	1,976	-248	1,728
Virginia	32,469	1,443	33,912	28,384	1,643	30,027	4,085	-200	3,885
Colorado	31,280	1,010	32,290	29,230	1,310	30,540	2,050	-301	1,750
Ohio	27,201	503	27,705	26,201	657	26,858	1,000	-154	847
South Carolina	27,076	131	27,207	26,236	136	26,373	840	-5	835
Michigan	25,431	585	26,016	24,402	608	25,010	1,029	-23	1,006
Maryland	25,054	648	25,702	19,545	843	20,387	5,510	-195	5,315
Indiana	25,005	222	25,227	23,909	309	24,219	1,096	-87	1,008
Illinois	22,047	880	22,927	21,527	1,028	22,555	520	-148	372
Pennsylvania	22,340	204	22,544	20,395	224	20,619	1,945	-20	1,925
Oregon	21,350	577	21,927	20,623	823	21,445	727	-246	481
Alabama	20,505	192	20,696	19,584	319	19,903	921	-128	793
Minnesota	19,510	963	20,473	18,830	1,138	19,968	680	-175	504
Wisconsin	19,439	353	19,792	18,492	293	18,785	947	60	1,007
New York	19,296	413	19,709	18,982	447	19,428	314	-34	281
Nevada	17,517	1,422	18,938	17,285	1,441	18,726	232	-19	213
Missouri	18,305	222	18,527	17,056	303	17,359	1,249	-82	1,167
Utah	16,806	1,220	18,026	17,258	1,117	18,375	-453	103	-350
New Jersey	16,405	416	16,821	14,337	445	14,782	2,068	-29	2,039
Louisiana	13,895	527	14,422	13,034	515	13,549	860	12	873
New Mexico	13,945	317	14,262	13,280	438	13,718	665	-122	543
Kentucky	12,285	263	12,549	11,787	306	12,093	498	-43	455
Oklahoma	10,734	344	11,078	10,284	401	10,684	451	-57	394
Arkansas	10,733	16	10,749	10,221	48	10,269	512	-32	480
Massachusetts	9,890	236	10,126	10,123	484	10,607	-232	-248	-480
Mississippi	9,809	54	9,863	9,709	61	9,770	100	-7	93
Hawaii	9,350	310	9,660	7,658	518	8,176	1,691	-207	1,484
Idaho	9,026	252	9,278	8,988	252	9,240	38	0	38
New Hampshire	6,443	23	6,466	4,147	17	4,164	2,296	6	2,302
Kansas	6,119	262	6,382	6,024	261	6,284	96	1	97
Iowa	5,823	134	5,957	5,823	134	5,957	0	0	0
Alaska	5,471	250	5,721	5,471	250	5,721	0	0	0
Montana	5,156	12	5,168	5,156	12	5,168	0	0	0
Maine	4,802	21	4,823	4,788	22	4,810	14	-1	13
Nebraska	4,327	342	4,669	4,317	344	4,661	10	-2	8
South Dakota	3,286	83	3,369	3,286	83	3,369	0	0	0
Delaware	3,198	25	3,223	2,921	29	2,950	277	-5	273
West Virginia	3,207	3	3,210	2,343	4	2,348	863	-1	863
Vermont	2,824	12	2,836	2,824	12	2,836	0	0	0
Wyoming	2,810	0	2,810	2,809	0	2,809	2	0	2
Rhode Island	2,693	32	2,725	2,658	47	2,705	36	-16	20
Connecticut	2,535	16	2,551	2,703	19	2,722	-168	-3	-171
North Dakota	1,618	21	1,639	1,618	21	1,639	0	0	0
Top 20 States	**925,779**	**27,244**	**953,021**	**880,389**	**32,978**	**913,365**	**45,391**	**-5,736**	**39,655**
United States	**1,193,526**	**34,842**	**1,228,368**	**1,137,329**	**41,479**	**1,178,809**	**56,197**	**-6,637**	**49,559**

Source: Woods & Poole, 1998. Center for Urban Policy Research, Rutgers University.

Table 11.31
Additional Daily Travel Costs in Privately Owned Vehicles (POV) and Transit by State Uncontrolled- and Controlled-Growth Scenarios: 2000 to 2025

	Uncontrolled-Growth Scenario			Controlled-Growth Scenario			Difference—Savings		
State	POV Costs	Transit Costs	Total Travel Costs	POV Costs	Transit Costs	Total Travel Costs	POV Costs	Transit Costs	Total Travel Costs
California	134,973	8,327	143,301	128,644	11,683	140,327	6,329	-3,356	2,973
Florida	103,722	3,416	107,138	102,530	3,780	106,310	1,192	-364	828
Texas	88,899	8,151	97,050	87,079	9,054	96,133	1,821	-903	918
Arizona	38,595	658	39,253	38,337	658	38,995	258	0	258
Georgia	38,751	2,370	41,120	37,253	3,086	40,339	1,498	-716	781
North Carolina	35,009	1,691	36,699	35,017	1,698	36,715	-8	-7	-16
Washington	31,718	1,949	33,667	30,780	2,087	32,867	938	-138	800
Tennessee	25,303	685	25,988	24,261	1,014	25,275	1,043	-330	713
Virginia	26,908	2,107	29,015	23,992	2,403	26,395	2,916	-296	2,620
Colorado	25,135	1,413	26,548	23,859	1,833	25,691	1,277	-420	856
Ohio	20,655	663	21,318	20,088	874	20,962	567	-211	356
South Carolina	20,051	146	20,197	19,455	152	19,607	596	-6	590
Michigan	19,836	838	20,675	19,116	868	19,984	720	-29	691
Maryland	20,632	913	21,545	16,438	1,194	17,632	4,193	-281	3,912
Indiana	18,692	282	18,973	18,020	401	18,421	672	-119	553
Illinois	18,613	1,280	19,893	18,284	1,499	19,783	329	-219	110
Pennsylvania	17,264	259	17,523	15,753	295	16,048	1,511	-37	1,475
Oregon	16,206	771	16,977	15,930	1,105	17,035	275	-334	-58
Alabama	14,993	226	15,219	14,468	399	14,867	525	-174	352
Minnesota	15,698	1,384	17,081	15,477	1,642	17,119	221	-258	-37
Wisconsin	14,889	476	15,365	14,064	390	14,455	825	85	910
New York	15,127	546	15,674	14,950	590	15,540	177	-44	133
Nevada	14,679	1,943	16,621	14,580	1,966	16,546	99	-23	76
Missouri	13,631	284	13,915	12,799	412	13,211	832	-128	704
Utah	13,504	1,612	15,116	13,877	1,487	15,364	-373	125	-248
New Jersey	13,876	572	14,449	12,253	617	12,870	1,624	-44	1,579
Louisiana	10,574	688	11,262	9,879	676	10,554	695	12	707
New Mexico	10,391	434	10,825	10,127	607	10,734	264	-173	91
Kentucky	9,022	350	9,372	8,708	412	9,119	314	-62	252
Oklahoma	7,967	445	8,412	7,698	520	8,219	269	-76	193
Arkansas	7,684	18	7,702	7,413	52	7,466	271	-35	236
Massachusetts	8,098	312	8,410	8,606	688	9,294	-508	-376	-884
Mississippi	7,162	59	7,222	7,110	67	7,177	52	-8	45
Hawaii	7,360	449	7,808	6,465	749	7,214	895	-300	595
Idaho	6,841	344	7,185	6,815	344	7,159	26	0	26
New Hampshire	5,082	27	5,108	3,209	20	3,229	1,872	7	1,879
Kansas	5,003	381	5,384	4,931	379	5,310	72	1	73
Iowa	4,502	185	4,687	4,502	185	4,687	0	0	0
Alaska	4,514	364	4,878	4,514	364	4,878	0	0	0
Montana	3,641	13	3,653	3,641	13	3,653	0	0	0
Maine	3,563	24	3,587	3,556	25	3,582	6	-1	5
Nebraska	3,506	457	3,963	3,501	460	3,961	5	-3	2
South Dakota	2,426	111	2,537	2,426	111	2,537	0	0	0
Delaware	2,418	29	2,446	2,234	34	2,268	184	-5	179
West Virginia	2,314	4	2,318	1,671	4	1,675	643	-1	642
Vermont	2,061	14	2,074	2,061	14	2,074	0	0	0
Wyoming	1,997	0	1,997	1,997	0	1,997	1	0	1
Rhode Island	2,107	39	2,146	2,118	58	2,175	-11	-18	-29
Connecticut	2,050	19	2,069	2,195	23	2,218	-145	-4	-148
North Dakota	1,219	24	1,243	1,219	24	1,243	0	0	0
Top 20 States	**731,653**	**37,529**	**769,180**	**704,781**	**45,725**	**750,505**	**26,873**	**-8,198**	**18,675**
United States	**938,861**	**47,746**	**986,608**	**905,281**	**57,256**	**962,537**	**33,581**	**-9,510**	**24,071**

Source: Woods & Poole, 1998. Center for Urban Policy Research, Rutgers University.

Controlled Growth

Travel Distance

Under the controlled-growth scenario, daily travel miles for the top 20 states are reduced from 953 million to 913 million daily—a saving of 40 million miles per day or 4.2 percent (Table 11.30). Travel miles in privately owned vehicles are decreased from 925.8 million miles to 880.4 million miles, a saving of 45.4 million miles daily, or 4.9 percent. Travel miles via transit are increased from 27.2 million miles to 33.0 million miles, an increase of 5.8 million miles daily or 21.3 percent. Daily travel miles under controlled growth are reduced by 1.5 percent in Florida (2 million miles), 2.5 percent in Texas (3 million miles), and by nearly 6 percent in California (10 million miles). California as a state is able to experience the largest amount of intercounty growth redirection. Sixty-six percent of sprawling households are controlled in this state. In Texas, only 25 percent of sprawling households are controlled; in Florida, only 18 percent are controlled.

Travel Costs

Under controlled growth, the costs of daily travel in the top 20 travel-demand states are reduced from $769.2 million to $750.5 million (Table 11.31). This is an overall saving of $18.7 million daily or 2.4 percent. This saving is comprised of a $26.9 million decrease in privately owned vehicle daily travel costs and an $8.2 million increase in transit daily travel costs. The overall daily travel costs decrease achieved by the controlled-growth scenario includes a 22 percent increase in the daily travel costs of transit. Travel costs in Florida and Texas decrease by approximately $1 million daily; California's daily travel costs decrease by $3 million daily.

Courtesy of C. Galley

Courtesy of C. Galley

EAs

Uncontrolled Growth

Travel Distance and Travel Costs

Under uncontrolled growth, the top 30 travel-demand EAs incur a future growth of 766.4 million daily travel miles of which POV occupants contribute 738.7 million miles daily and transit users 27.7 million miles daily (Table 11.32). Travel costs for the top 30 EAs amount to $636.7 million daily of which POV occupant costs are $598.4 million and transit users costs $38.3 million (Table 11.33). The top 30 EAs, representing 17.4 percent of the EAs nationally, incur 62.4 percent of future daily travel miles and 64.5 percent of future daily travel costs. The small difference between these two percentages is that these EAs will have a slightly larger share of future travel miles in transit, which is the more expensive of the two modes per travel mile.

Individual EAs' future travel miles and costs under uncontrolled growth do not distinguish themselves noticeably except for the Los Angeles-Riverside-Orange, CA-AZ EA, which has an increase in future daily travel miles and costs of 1.5 times to 2.5 times any of the next 10 highest future travel demand EAs. Other exceptions to general trends include: (1) the Orlando, FL, and Phoenix, AZ EAs, which have significantly lower future transit daily travel miles and costs than other EAs with similar levels of future travel demand; and (2) the Las Vegas, NV-AZ-UT, and Salt Lake City-Ogden, UT-ID EAs, which have significantly higher future transit daily travel miles and costs than other EAs with similar levels of future travel demand.

Table 11.32
Additional Daily Travel Miles in Privately Owned Vehicles (POV) and Transit by EA Uncontrolled- and Controlled-Growth Scenarios: 2000 to 2025

	Uncontrolled-Growth Scenario			Controlled-Growth Scenario			Difference—Savings		
EA	POV Miles	Transit Miles	Total Travel Miles	POV Miles	Transit Miles	Total Travel Miles	POV Miles	Transit Miles	Total Travel Miles
Los Angeles-River.-Orange, CA-AZ	65,836	2,616	68,453	56,954	4,132	61,086	8,882	-1,516	7,366
Washington-Balti., DC-MD-VA-WV-PA	41,756	1,579	43,335	34,577	2,064	36,641	7,179	-486	6,694
San Francisco-Oak.-San Jose, CA	39,767	1,990	41,757	36,111	2,744	38,856	3,656	-754	2,902
Dallas-Fort Worth, TX-AR-OK	36,055	2,562	38,617	35,060	2,704	37,764	995	-141	853
Atlanta, GA-AL-NC	36,832	1,562	38,394	33,890	2,050	35,940	2,942	-488	2,454
Orlando, FL	34,086	726	34,813	34,086	726	34,813	0	0	0
Miami-Fort Lauderdale, FL	33,098	1,293	34,391	32,154	1,368	33,522	944	-75	869
Houston-Galveston-Brazoria, TX	31,831	1,479	33,310	30,456	1,707	32,163	1,374	-228	1,147
Phoenix-Mesa, AZ-NM	32,406	582	32,987	32,406	582	32,987	0	0	0
Denver-Boulder-Greeley, CO-KS-NE	29,682	1,010	30,692	27,632	1,310	28,942	2,050	-301	1,750
Seattle-Tacoma-Bremerton, WA	29,501	1,114	30,614	28,463	1,264	29,727	1,038	-151	888
San Diego, CA	28,109	599	28,708	28,109	599	28,708	0	0	0
New York-North NJ-Long Isl., NY-NJ-CT-PA-MA-VT	24,379	731	25,110	23,617	757	24,375	761	-26	735
Chicago-Gary-Kenosha, IL-IN-WI	20,565	958	21,523	19,963	1,083	21,046	601	-124	477
Minneapolis-St. Paul, MN-WI-IA	19,157	960	20,117	18,221	1,123	19,345	936	-164	772
Tampa-St. Peters.-Clearwater, FL	19,314	365	19,679	18,169	540	18,709	1,145	-175	970
Boston-Worcester-Law.-Low.-Brocktn, MA-NH-RI-VT	19,120	291	19,410	17,020	549	17,569	2,099	-258	1,841
Portland-Salem, OR-WA	17,792	856	18,648	16,478	1,036	17,514	1,314	-180	1,134
Philadelphia-Wil.-Atlantic City, PA-NJ-DE-MD	18,160	238	18,398	14,460	291	14,751	3,700	-54	3,647
Sacramento-Yolo, CA	17,678	651	18,329	17,409	681	18,090	269	-30	239
Las Vegas, NV-AZ-UT	16,775	1,355	18,130	16,775	1,355	18,130	0	0	0
Nashville, TN-KY	18,002	107	18,110	16,231	337	16,569	1,771	-230	1,541
Jacksonville, FL-GA	17,886	80	17,966	16,976	129	17,106	910	-50	860
San Antonio, TX	16,624	940	17,564	16,016	1,067	17,083	608	-127	481
Indianapolis, IN-IL	15,379	180	15,559	14,697	263	14,959	683	-83	600
Salt Lake City-Ogden, UT-ID	13,712	1,220	14,932	14,164	1,117	15,281	-453	103	-350
Raleigh-Durham-Chapel Hill, NC	12,213	576	12,789	12,116	581	12,698	97	-6	91
Detroit-Ann Arbor-Flint, MI	11,140	493	11,633	10,252	509	10,760	888	-16	872
Charlotte-Gastonia-Rock Hill, NC-SC	10,995	543	11,538	10,974	544	11,518	21	-1	20
Fresno, CA	10,873	0	10,873	10,873	0	10,873	0	0	0
Top 30 EAs	**738,723**	**27,656**	**766,379**	**694,309**	**33,212**	**727,525**	**44,410**	**-5,561**	**38,853**
United States	**1,193,526**	**34,842**	**1,228,368**	**1,137,329**	**41,479**	**1,178,809**	**56,197**	**-6,637**	**49,559**

Source: Woods & Poole, 1998. Center for Urban Policy Research, Rutgers University.

Table 11.33
Additional Daily Travel Costs in Privately Owned Vehicles (POV) and Transit by EA Uncontrolled- and Controlled-Growth Scenarios: 2000 to 2025

EA	Uncontrolled-Growth Scenario POV Costs	Uncontrolled-Growth Scenario Transit Costs	Uncontrolled-Growth Scenario Total Travel Costs	Controlled-Growth Scenario POV Costs	Controlled-Growth Scenario Transit Costs	Controlled-Growth Scenario Total Travel Costs	Difference—Savings POV Costs	Difference—Savings Transit Costs	Difference—Savings Total Travel Costs
Los Angeles-River.-Orange, CA-AZ	54,321	3,772	58,093	49,405	5,944	55,349	4,916	-2,171	2,744
Washington-Balti., DC-MD-VA-WV-PA	35,106	2,324	37,430	30,049	3,021	33,070	5,057	-697	4,359
San Francisco-Oak.-San Jose, CA	33,776	2,921	36,697	32,205	4,063	36,268	1,571	-1,142	429
Dallas-Fort Worth, TX-AR-OK	29,803	3,582	33,385	29,303	3,777	33,080	500	-195	305
Atlanta, GA-AL-NC	29,967	2,290	32,257	28,289	2,994	31,284	1,678	-704	974
Orlando, FL	26,552	987	27,539	26,552	987	27,539	0	0	0
Miami-Fort Lauderdale, FL	27,113	1,696	28,809	26,448	1,792	28,239	666	-96	570
Houston-Galveston-Brazoria, TX	25,450	1,983	27,433	24,684	2,295	26,979	766	-312	454
Phoenix-Mesa, AZ-NM	25,721	658	26,379	25,721	658	26,379	0	0	0
Denver-Boulder-Greeley, CO-KS-NE	24,013	1,413	25,426	22,737	1,833	24,569	1,277	-420	856
Seattle-Tacoma-Bremerton, WA	23,975	1,553	25,528	23,511	1,778	25,289	464	-225	240
San Diego, CA	23,783	709	24,491	23,783	709	24,491	0	0	0
New York-North NJ-Long Isl., NY-NJ-CT-PA-MA-VT	20,322	986	21,308	19,821	1,023	20,844	501	-37	464
Chicago-Gary-Kenosha, IL-IN-WI	17,752	1,385	19,136	17,301	1,572	18,873	451	-188	263
Minneapolis-St. Paul, MN-WI-IA	15,410	1,379	16,789	14,986	1,625	16,611	423	-246	177
Tampa-St. Peters.-Clearwater, FL	15,368	443	15,811	14,803	695	15,497	566	-252	314
Boston-Worcester-Law.-Low.-Brocktn, MA-NH-RI-VT	15,346	378	15,724	13,992	766	14,758	1,354	-388	966
Portland-Salem, OR-WA	13,951	1,139	15,090	13,182	1,385	14,567	768	-246	522
Philadelphia-Wil.-Atlantic City, PA-NJ-DE-MD	14,748	300	15,048	11,853	385	12,238	2,895	-84	2,810
Sacramento-Yolo,CA	14,043	925	14,968	13,892	968	14,860	151	-43	108
Las Vegas,NV-AZ-UT	13,920	1,861	15,781	13,920	1,861	15,781	0	0	0
Nashville, TN-KY	13,119	145	13,263	12,144	455	12,599	975	-310	665
Jacksonville,FL-GA	13,334	91	13,425	12,831	147	12,978	503	-56	447
San Antonio, TX	13,005	1,260	14,265	12,699	1,431	14,130	305	-171	134
Indianapolis, IN-IL	11,543	234	11,777	11,163	348	11,512	380	-114	266
Salt Lake City-Ogden, UT-ID	11,260	1,612	12,872	11,633	1,487	13,120	-373	125	-248
Raleigh-Durham-Chapel Hill, NC	9,764	822	10,586	9,715	828	10,543	49	-6	42
Detroit-Ann Arbor-Flint, MI	9,330	734	10,064	8,689	755	9,444	641	-21	619
Charlotte-Gastonia-Rock Hill, NC-SC	8,747	756	9,503	8,736	757	9,492	11	-1	10
Fresno, CA	7,822	0	7,822	7,822	0	7,822	0	0	0
Top 30 EAs	**598,364**	**38,338**	**636,699**	**571,869**	**46,339**	**618,205**	**26,495**	**-8,000**	**18,490**
United States	**938,861**	**47,746**	**986,608**	**905,281**	**57,256**	**962,537**	**33,581**	**-9,510**	**24,071**

Source: Woods & Poole, 1998. Center for Urban Policy Research, Rutgers University.

Courtesy of C. Galley

Controlled Growth

Travel Distance and Travel Costs

Under controlled growth, the top 30 travel-demand EAs incur a future growth of 727.5 million travel miles, of which occupants of POVs contribute 694.3 million miles and transit users 33.2 million miles (Table 11.32). The future increase in daily travel costs for the top 30 EAs under controlled growth is $618 million, of which POV occupants contribute $571.9 million and transit users $46.3 million (Table 11.33). The difference in daily travel miles due to the controlled-growth scenario is 38.9 million miles; the difference in daily travel costs is $18.5 million. Both of these aggregate savings include larger savings in POV daily travel miles and costs being somewhat diminished by increases in transit daily travel miles and costs. EAs that distinguish themselves in daily travel mile savings are the Los Angeles-Riverside-Orange, CA-AZ and the Washington-Baltimore, DC-MD-VA-WV-PA EAs, with travel distance savings at levels twice those of the next closest EAs. These same EAs, joined by the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD EA, also distinguish themselves in daily travel cost savings, which are three to four times the level of savings of the next closest EAs.

COUNTIES

Uncontrolled Growth

Travel Distance and Travel Costs

In the uncontrolled-growth scenario, the top 50 travel-demand counties incur 390.5 million miles in future daily travel and $340 million in future daily travel costs (Tables 11.34 and 11.35). Both travel miles and costs are dominated by the contributions of POV versus transit users. The top 50 of 3,100 counties incur approximately one-third of future national daily travel miles and costs. Actually, the share of travel costs is two percentage points higher than travel miles due to more growth and higher costs of transit in these counties. The top 50 future travel-demand counties contain close to 60 percent of future transit daily travel miles and costs. Individual counties that stand out are Maricopa County, AZ, and San Diego County, CA, which have future daily travel miles and costs of two

Table 11.34
Additional Daily Travel Miles in Privately Owned Vehicles (POV) and Transit by County
Uncontrolled- and Controlled-Growth Scenarios: 2000 to 2025

	Uncontrolled-Growth Scenario			Controlled-Growth Scenario			Difference—Savings		
County	POV Miles	Transit Miles	Total Travel Miles	POV Miles	Transit Miles	Total Travel Miles	POV Miles	Transit Miles	Total Travel Miles
Maricopa, AZ	28,599	582	29,181	28,599	582	29,181	0	0	0
San Diego, CA	28,109	599	28,708	28,109	599	28,708	0	0	0
Riverside, CA	15,803	0	15,803	5,835	0	5,835	9,969	0	9,969
San Bernardino,CA	14,150	0	14,150	5,481	0	5,481	8,668	0	8,668
Clark, NV	12,001	1,355	13,356	12,001	1,355	13,356	0	0	0
Orange, CA	11,715	1,311	13,026	12,903	1,444	14,348	-1,188	-133	-1,321
Harris, TX	11,025	1,257	12,282	13,032	1,486	14,517	-2,007	-229	-2,235
Los Angeles, CA	10,708	1,216	11,924	23,677	2,688	26,365	-12,968	-1,472	-14,441
Palm Beach, FL	11,112	238	11,349	8,581	183	8,764	2,531	54	2,585
Hillsborough, FL	10,315	202	10,517	11,942	234	12,176	-1,627	-32	-1,659
Orange, FL	9,448	194	9,642	9,448	194	9,642	0	0	0
Tarrant, TX	8,533	969	9,502	8,533	969	9,502	0	0	0
Bexar, TX	8,268	940	9,208	9,390	1,067	10,457	-1,122	-128	-1,249
Pima, AZ	9,009	0	9,009	9,009	0	9,009	0	0	0
Broward, FL	7,898	892	8,789	8,321	939	9,260	-423	-48	-471
Dade, FL	7,624	164	7,788	11,393	245	11,638	-3,770	-81	-3,851
King, WA	6,593	735	7,328	7,906	881	8,787	-1,313	-146	-1,459
Contra Costa, CA	6,444	722	7,166	6,444	722	7,166	0	0	0
Fairfax, VA	6,157	679	6,836	6,157	679	6,836	0	0	0
Sacramento, CA	5,758	651	6,409	6,024	681	6,706	-267	-30	-297
Santa Clara, CA	5,627	622	6,250	8,289	917	9,206	-2,662	-294	-2,956
Pierce, WA	6,019	122	6,141	6,081	123	6,205	-62	-1	-64
Snohomish, WA	5,828	99	5,927	5,847	99	5,946	-19	0	-19
Cobb, GA	5,206	581	5,786	5,206	581	5,786	0	0	0
Collin, TX	5,208	576	5,784	5,208	576	5,784	0	0	0
Fort Bend, TX	5,503	91	5,595	5,503	91	5,595	0	0	0
Wake, NC	4,995	554	5,549	4,995	554	5,549	0	0	0
Montgomery, TX	5,519	0	5,519	4,537	0	4,537	982	0	982
Arapahoe, CO	4,872	545	5,417	4,872	545	5,417	0	0	0
Salt Lake, UT	4,841	556	5,396	5,571	640	6,211	-731	-84	-814
Fresno, CA	5,357	0	5,357	5,357	0	5,357	0	0	0
Dallas, TX	4,806	545	5,351	6,110	693	6,802	-1,304	-148	-1,452
Gwinnett, GA	4,771	530	5,302	4,771	530	5,302	0	0	0
Seminole, FL	4,724	532	5,257	4,724	532	5,257	0	0	0
Mecklenburg, NC	4,650	523	5,173	4,650	523	5,173	0	0	0
Pasco, FL	4,986	70	5,055	2,540	35	2,576	2,446	34	2,480
Solano, CA	4,526	97	4,623	1,137	24	1,161	3,389	72	3,462
Manatee, FL	4,497	83	4,580	4,013	0	4,013	483	83	566
Lee, FL	4,414	52	4,466	4,414	52	4,466	0	0	0
Ventura, CA	4,288	89	4,377	2,706	0	2,706	1,581	89	1,671
El Paso, TX	3,908	455	4,364	3,908	455	4,364	0	0	0
Placer, CA	4,264	0	4,264	4,264	0	4,264	0	0	0
El Paso, CO	4,148	78	4,226	4,158	79	4,236	-10	0	-10
Sonoma, CA	4,185	0	4,185	1,680	0	1,680	2,505	0	2,505
Kern, CA	4,145	0	4,145	2,320	0	2,320	1,825	0	1,825
Washington, OR	3,722	423	4,144	3,722	423	4,144	0	0	0
Denton, TX	3,711	420	4,130	3,711	420	4,130	0	0	0
Hidalgo, TX	4,033	90	4,123	3,897	87	3,984	136	3	139
Lexington, SC	4,042	35	4,077	4,042	35	4,077	0	0	0
Williamson, TX	3,880	40	3,919	2,309	24	2,333	1,571	16	1,587
Top 50 Counties	**369,944**	**20,514**	**390,455**	**363,327**	**22,986**	**386,315**	**6,613**	**-2,475**	**4,141**
United States	**1,193,526**	**34,842**	**1,228,368**	**1,137,329**	**41,479**	**1,178,809**	**56,197**	**-6,637**	**49,559**

Source: Woods & Poole, 1998. Center for Urban Policy Research, Rutgers University.

Table 11.35
Additional Daily Travel Costs in Privately Owned Vehicles (POV) and Transit by County Uncontrolled- and Controlled-Growth Scenarios: 2000 to 2025

	Uncontrolled-Growth Scenario			Controlled-Growth Scenario			Difference—Savings		
County	POV Costs	Transit Costs	Total Travel Costs	POV Costs	Transit Costs	Total Travel Costs	POV Costs	Transit Costs	Total Travel Costs
Maricopa, AZ	23,053	658	23,711	23,053	658	23,711	0	0	0
San Diego, CA	23,783	709	24,491	23,783	709	24,491	0	0	0
Riverside, CA	12,022	0	12,022	4,439	0	4,439	7,584	0	7,584
San Bernardino,CA	10,879	0	10,879	4,214	0	4,214	6,665	0	6,665
Clark, NV	10,474	1,861	12,335	10,474	1,861	12,335	0	0	0
Orange, CA	11,175	1,944	13,120	12,309	2,142	14,451	-1,134	-197	-1,331
Harris, TX	9,639	1,708	11,348	11,394	2,019	13,413	-1,754	-311	-2,065
Los Angeles, CA	9,730	1,719	11,449	21,513	3,802	25,314	-11,783	-2,082	-13,865
Palm Beach, FL	9,089	269	9,358	7,019	208	7,227	2,070	61	2,132
Hillsborough, FL	8,390	232	8,622	9,714	268	9,982	-1,323	-37	-1,360
Orange, FL	7,668	222	7,890	7,668	222	7,890	0	0	0
Tarrant, TX	7,477	1,335	8,812	7,477	1,335	8,812	0	0	0
Bexar, TX	7,095	1,260	8,355	8,058	1,431	9,489	-963	-171	-1,134
Pima, AZ	6,634	0	6,634	6,634	0	6,634	0	0	0
Broward, FL	7,007	1,244	8,252	7,383	1,311	8,694	-375	-67	-442
Dade, FL	6,127	182	6,310	9,157	273	9,429	-3,030	-90	-3,120
King, WA	6,182	1,094	7,276	7,413	1,312	8,725	-1,231	-218	-1,449
Contra Costa, CA	6,048	1,061	7,109	6,048	1,061	7,109	0	0	0
Fairfax, VA	6,092	1,033	7,125	6,092	1,033	7,125	0	0	0
Sacramento, CA	5,158	925	6,083	5,397	968	6,365	-239	-43	-282
Santa Clara, CA	5,481	936	6,417	8,073	1,379	9,452	-2,592	-443	-3,035
Pierce, WA	4,788	137	4,925	4,837	139	4,976	-50	-1	-51
Snohomish, WA	4,733	115	4,848	4,749	115	4,864	-15	0	-16
Cobb, GA	4,938	868	5,806	4,938	868	5,806	0	0	0
Collin, TX	4,894	845	5,739	4,894	845	5,739	0	0	0
Fort Bend, TX	4,479	105	4,584	4,479	105	4,584	0	0	0
Wake, NC	4,509	797	5,307	4,509	797	5,307	0	0	0
Montgomery, TX	4,171	0	4,171	3,429	0	3,429	742	0	742
Arapahoe, CO	4,506	799	5,304	4,506	799	5,304	0	0	0
Salt Lake, UT	4,120	734	4,855	4,742	845	5,587	-622	-111	-733
Fresno, CA	3,921	0	3,921	3,921	0	3,921	0	0	0
Dallas, TX	4,223	746	4,969	5,368	949	6,317	-1,146	-202	-1,348
Gwinnett, GA	4,582	804	5,387	4,582	804	5,387	0	0	0
Seminole, FL	4,277	765	5,042	4,277	765	5,042	0	0	0
Mecklenburg, NC	4,135	733	4,867	4,135	733	4,867	0	0	0
Pasco, FL	3,845	77	3,922	1,959	39	1,998	1,886	38	1,924
Solano, CA	3,830	116	3,946	962	29	991	2,869	87	2,955
Manatee, FL	3,690	97	3,787	3,114	0	3,114	576	97	673
Lee, FL	3,574	60	3,634	3,574	60	3,634	0	0	0
Ventura, CA	3,770	108	3,878	2,239	0	2,239	1,532	108	1,640
El Paso, TX	3,225	575	3,800	3,225	575	3,800	0	0	0
Placer, CA	3,219	0	3,219	3,219	0	3,219	0	0	0
El Paso, CO	3,290	88	3,377	3,298	88	3,386	-8	0	-8
Sonoma, CA	3,237	0	3,237	1,299	0	1,299	1,937	0	1,937
Kern, CA	2,996	0	2,996	1,677	0	1,677	1,319	0	1,319
Washington, OR	3,239	579	3,818	3,239	579	3,818	0	0	0
Denton, TX	3,339	599	3,938	3,339	599	3,938	0	0	0
Hidalgo, TX	2,997	91	3,087	2,895	88	2,983	101	3	104
Lexington, SC	3,136	39	3,175	3,136	39	3,175	0	0	0
Williamson, TX	2,992	44	3,036	1,781	26	1,807	1,211	18	1,229
Top 50 Counties	**311,858**	**28,313**	**340,173**	**309,634**	**31,878**	**341,509**	**2,227**	**-3,561**	**-1,335**
United States	**938,861**	**47,746**	**986,608**	**905,281**	**57,256**	**962,537**	**33,581**	**-9,510**	**24,071**

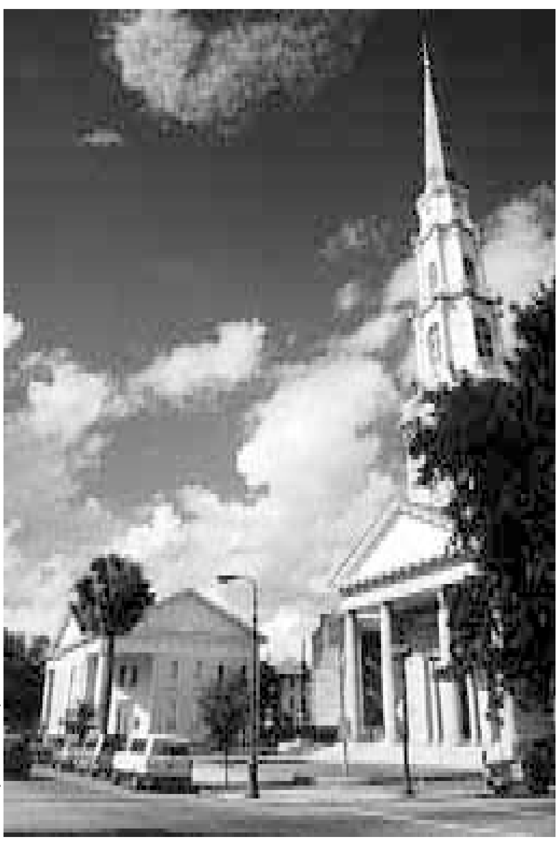
Source: Woods & Poole, 1998. Center for Urban Policy Research, Rutgers University.

to three times the levels of the next 10 highest travel-demand counties.

Controlled Growth

Travel Distance and Travel Costs

In the controlled-growth scenario, the top 50 travel-demand counties experience a 386.3 million increase in daily travel miles and $341.5 million increase in daily travel costs (Tables 11.34 and 11.35). This amounts to approximately a 4.1 million daily travel mile decrease and a $1.3 million daily travel cost increase. These 50 of 3,100 counties represent 8 percent of the overall national saving in daily travel miles (49.6 million). This grouping of counties represents an increase in overall daily travel costs even though nationally, daily travel costs decrease by $24.1 million. This is true because this group of 50 counties contains numerous counties whose costs actually increase since they are receiving counties under the controlled-growth regimen (Los Angeles County, CA; Dade County, FL; Santa Clara County, CA; Alameda County, CA; and so on). In addition, within this group of counties is found 37 percent of the increase in national transit daily travel miles.



Courtesy of C. Galley

Courtesy of C. Galley

Standouts at the county level in travel miles and costs saved are Riverside County, CA, and San Bernardino County, CA. A county significantly increasing in travel miles and costs in the controlled-growth scenario is Los Angeles County, CA.

CONCLUSION

In this chapter a regression-based travel model is developed to predict person-miles of travel as a function of urban form. The results of the regression model are paired with a population allocation model to provide estimates of miles and costs of travel under two alternative development futures. The results of this pairing show a national decrease of 49.6 million in daily travel miles and an associated decrease of $24.1 million in daily travel costs. Both of these figures include increases in the transit component of overall travel costs under a controlled-growth scenario.

The controlled-growth scenario decreases overall daily travel miles by 4 percent and daily travel costs by 2.4 percent. In the process of achieving these savings, daily travel miles emanating from POVs are decreased by 4.7 percent and those coming from transit are increased by 19 percent.

By growing more in urban/suburban counties as opposed to rural/undeveloped counties and closer-in in all counties, future transit daily travel miles are increased by one-fifth. The costs of these increases, combined with POV decreases, serve to decrease overall daily travel costs. This occurs in a context of 2,200 of 3,100 counties in the United States not involved in the intercounty population shifts that make possible much of the difference that occurs between the two growth alternatives.

Courtesy of R. Ewing

XII

Quality of Life in the United States

Quality of Life for New Residents under Sprawl and Alternative Conditions

INTRODUCTION

The purpose of this chapter is to provide estimates of the value of changes in the quality of life experienced by new residents of counties under two alternative development futures for the United States. One future is uncontrolled growth, or sprawl; the other is controlled growth to reduce sprawl.

This chapter first describes a procedure for estimating a value for the quality of life associated with a particular county in the United States. The data sources and methods used to apply this procedure at the county level are then described in detail. The chapter concludes with the application of the quality-of-life index to each county in the United States and the estimation of differences in the value of quality of life for new residents under the two alternative development futures.

An earlier part of this research effort reviewed the literature on quality of life. That review was organized to address several alleged impacts of sprawl on variables roughly categorized as quality of life (Burchell et al. 1998).

Alleged Negative Impacts
- Aesthetically displeasing
- Weakened sense of community
- Greater stress
- Higher energy consumption
- More air pollution
- Less historical preservation

Alleged Positive Impacts
- Low-density living
- Lower crime rates
- Better-quality schools
- Greater variety of tax rates and public services
- More local democracy

It was not the purpose of the original literature review to find a single index that could be used to determine whether, in the aggregate, the quality of life in one area was greater than that in another. The list of variables ultimately used in this analysis suggests why such measures are rarely reported in the professional literature. Most attempts to measure local quality of life end up relying on a whole host of indicators (air quality, student/teacher ratios, park acres per 1,000 residents, and so on), comparing performance to either adopted standards or the performance of other jurisdictions, ranking relative performance, and adding performance on all variables to obtain an aggregate score. In these analyses, weighting of different variables may occur explicitly, but weighting is often implicit, with each variable getting equal weight (thus giving more weight to aspects of quality of life that are measured with multiple indicators).

This type of analysis may be useful in focusing policy debates in individual jurisdictions, but it is less useful when its only purpose is to rank these jurisdictions for promotional purposes. Chapter 6 of TCRP Report 39 included a literature synthesis based upon the impacts shown above; a full presentation of the literature review would have included a discussion of the problems with quality-of-life index methods found in the literature (Burchell et al. 1998). Quality of life is subjective. Not only do researchers define it differently, but people experience it differently, i.e., different people value locational attributes differently. Therefore, efforts to provide a standardized measure are of dubious reliability.

Nonetheless, the national scope of this research effort meant that the research team either had to adopt or alter a set of standardized indicators of quality of life or leave this analysis out of the evaluation. The choice made by the research team was to alter a set of standardized indicators of quality of life and use it to evaluate two different development futures for the United States. The key research question this analysis attempts to address is:

If one had the power to move a household from the county it was assigned to by a long-run population forecast to a different county, would that household experience a change in its quality of life? Specifically, if the household could be moved from a "sprawl" (uncontrolled growth) county to a "nonsprawl" (controlled growth) county (as defined in other chapters of this report), would its quality of life change, and what is the societal significance of this change in quality of life once all households have been moved?

QUALITY-OF-LIFE MODEL

Several studies have attempted to identify those attributes of a residential location that cause people to prefer it over alternatives and to rate places on the basis of those attributes. Such studies face considerable challenges:

- It is not easy to determine which variables should be considered in a measurement of quality of life. For example, it is clear that income probably has a significant impact on the quality of life of most people. Does that mean that income should be included as a component of a quality-of-life index? People may accept lower incomes and con-


Courtesy of C. Galley

sider themselves better off if they live in an area with a lower cost of living and more natural and/or cultural amenities. Moreover, the value of those amenities will be partly—perhaps significantly—capitalized in land values and, therefore, in housing prices. Should higher housing prices be considered a negative or a positive indicator of quality of life?

- Tastes and preferences vary considerably. Some people are comfortable in an urban setting, while others will go to great lengths to avoid urban areas. Some people prefer warm weather all the time; others prefer seasonal changes.

- Some attributes are valued in conjunction with others. People may prefer to be near the seashore, but only if the area is not too crowded and the weather allows them to enjoy it.

- Many attributes cannot be measured in a consistent, objective manner. The quality of cultural events and performances available to residents of a particular area, for example, is not easily measured in an objective way. Such qualitative attributes are difficult to incorporate into a quantitative study.

- Consistent, reliable, and available data on many locational amenities are difficult to find. The larger the area and the finer the grain of a study, the less available are useful data. Even such a seemingly simple indicator as the student-to-teacher ratio is measured somewhat differently in various states' school districts.

- Many attributes are strongly correlated. When combined with the lack of available data for other attributes, this leads to seemingly inconsistent findings. For example, people might say they dislike certain attributes, but those same undesirable attributes prevail in the places where they prefer to live. The reason for the apparent inconsistency is that the undesirable attributes are correlated with desirable attributes for which data are not available, and so the undesirable attributes pick up the effects that should be ascribed to the omitted variables.

- Making locational comparisons requires more than identifying and measuring the attributes that influence people's locational decisions. Weights must be assigned to the various attributes; small differences in weightings can lead to large changes in ranking.

One of the most widely used models for estimating the value of the quality of life associated with regional location was developed and estimated by Stuart Gabriel of USC, Joe Mattey of the Federal Reserve Bank of San Francisco, and William Wascher of the Federal Reserve Board of Governors (Gabriel et al. 1996). Gabriel et al.'s model is used to compare quality of life in one state versus another. It is an econometric model whose regression coefficients and signs predict housing expenditures and wages related to the amenity of location. The goal of this section of the analysis is to employ a modified Gabriel et al.'s model in the comparison of quality of life at the county level. The variables from Gabriel et al.'s model were retained, altered, and supplemented to achieve "recognizable" indicators. The procedures for determining each of these quality-of-life measures are explained below.

GABRIEL'S INITIAL VARIABLES

Gabriel et al.'s study measured quality of life at the statewide level. In this study, their variables and others are applied at the county level. Two sets of issues arise in the development of county-level data. First, much of their data are not available for every county. This problem was partially circumvented by applying regional or statewide averages to counties missing particular data elements. Second, the scale of the variable must be relatively consistent. Because states differ in size, Gabriel et al. in most cases used variables that were relatively independent of scale, for example, taxes per $1,000 of personal income. The definition of "coast" was changed from "having a coast" at the state level to "being within 100 miles of a coast" at the county level. Ultimately, each variable was placed on a scale of 1 to 6 and given a sign that comported with the research team's view of better quality of life.

All variables, except for the population- and employment-growth scores and cost of living, which were scored individually, were standardized so the mean of the variable was zero and the standard deviation was one. Values lower than (-)1.5 were made equal to (-)1.5, and values above 1.5 were capped at 1.5. A value of 1.5 was then added to the original score to allow all scores to be positive and it was doubled to arrive at a range of 0 to 6, with 6 as the best score. The data were thus standardized to a mean of 3 and a standard deviation of 2. Results were truncated to be between 0 and 6. A number of the signs of Gabriel's original variables were reversed (as discussed below) so 6 was always the best score. The variables for a county were then averaged to arrive at a quality-of-life score, with eight of the overall 24 variables counted as one-quarter of their original value; this will be discussed in a subsequent section.

Precipitation

Precipitation is measured as annual rainfall in inches. The data came from the National Climatic Data Cen-

Courtesy of C. Galley

ter, National Oceanic and Atmospheric Administration (NOAA). The data were reported for 6,712 weather stations around the country. Weather stations were assigned to counties based on their reported latitude and longitude. For counties with more than one weather station, precipitation measures were averaged. For counties with no weather stations, the statewide average was used.

Humidity

Humidity is measured as the average of afternoon humidity and morning humidity. The data came from the NOAA. These data were reported for 284 cities. The cities were matched to their respective counties. For counties with more than one reported city, the humidity was averaged. For counties that did not have a reported city, the statewide average was used.

Heating Degree Days

Heating degree days are based on temperatures under 65 degrees. For each day in a year, every degree under 65 is added. These data came from the NOAA and were reported by weather station. Weather stations were assigned to counties based on their reported latitude and longitude. For counties with more than one weather station, measures were averaged. For counties with no weather stations, the statewide average was used.

Cooling Degree Days

Cooling degree days are based on temperatures over 65 degrees. For each day in a year, every degree over 65 is added. These data came from the NOAA and were reported by weather station. Weather stations were assigned to counties based on their reported latitude and longitude. For counties with more than one weather station, measures were averaged. For counties with no weather stations, the statewide average was used.

Courtesy of C. Galley

Wind Speed

Wind speed is measured in miles per hour. These data came from the NOAA and were reported for 284 cities. For counties with more than one reported city, wind speed measurements were averaged. For counties that did not have a reported city, the statewide average was used.

Sunshine

Sunshine is measured as the proportion of sunny days out of all the days in a year. These data came from the NOAA and were reported for 284 cities. For counties with more than one reported city, proportions were averaged. For counties that did not have a reported city, the statewide average was used.

Coast

The coast variable is equal to 1 if most or all of the county is within 100 miles of the coast and zero otherwise. The data were developed with maps and a ruler. Coastline on one of the Great Lakes counted as a coast.

Inland Water

Inland water is measured by dividing water area for a county by the sum of water area and land area for that county. The data came from the Census Bureau by county.

Federal Land

Federal land measures the percent of land area statewide that is owned by the government. The data came from the General Services Administration and the Census Bureau, U.S. Department of Commerce.

Visitors to National Parks

Visitors to national parks measures the number of visitors to national parks statewide per 100 people in the state. The data came from the Department of Interior, National Park Service, Public Use Statistics Office.

Courtesy of T. Delcorso

Visitors to State Parks

Visitors to state parks measures the number of visitors to state parks statewide per 100 people in the state. The data came from the National Association of State Park Directors' *Annual Information Exchange*.

Number of Hazardous Waste Sites

Number of hazardous waste sites measures the number of identified hazardous waste sites in each county. The data came from the Environmental Protection Agency's Envirofacts Warehouse (http://www.epa.gov/enviro/html/efovw.html).

Environmental Regulation Leniency

Environmental regulation leniency is measured by the Green Policies Index, a state-by-state guide to the nation's environmental health from 1991–1992. Each county was supplied with its state's score. Note that unlike the measures of environmental quality, this variable turned out to have a coefficient of zero in the quality-of-life model, implying that people value the effectiveness rather than the stringency of environmental regulation.

Commuting Times

Commuting times are measured as the average number of minutes taken to travel one way to work. The data came from the Census Bureau by county.

Violent Crime Rate

Violent crime rate is measured as the number of violent crimes, as defined by the FBI, per 100,000 people in a county. The data came from the FBI. All data (except for that pertaining to Illinois and Kansas) are from 1995. The data for Illinois and Kansas are from 1989; this was the latest year in which those states reported violent crimes.

Air Quality–Ozone

Air quality–ozone is measured in parts per million and reported as the highest average observed in a one-hour period. The data are from the Environmental Protection Agency's AIRSData database (http://www.epa.gov/airsdata/) and are reported for 1,365 air-quality monitoring stations. The stations were matched to counties using their reported latitude and longitude. For counties with no station, the region average, also found on the EPA AIRSData database, was used.


Courtesy of C. Galley

Air Quality–Carbon Monoxide

Air quality-carbon monoxide is measured in parts per million and reported as the highest average observed in an eight-hour period. The data are from the Environmental Protection Agency's AIRSData database (http://www.epa.gov/airsdata/) and are reported for 1,365 air-quality monitoring stations. The stations were matched to counties using their reported latitude and longitude. For counties with no station, the region average, also found on the EPA AIRSData database, was used.

Student–Teacher Ratios

The student–teacher ratio measures the ratio of students to teachers in public schools. All the data, except for that pertaining to Virginia and Minnesota, are from the U.S. Department of Education, National Center for Education Statistics. Virginia's data is from the Virginia Department of Education, and Minnesota's data is from the Minnesota Department of Children, Families, and Learning. These data were reported by county.

Taxes: State and Local Income Taxes per $1,000 of Personal Income

The annual amount of local income tax collected in each county, as reported by the Census Bureau, was divided by that county's annual personal income, as reported by the Bureau of Economic Analysis, and the result was multiplied by 1,000. Because data on state income tax collections by county are not uniformly available, the annual amount of state income tax collected in each state was divided by the annual personal income in each state, multiplied by 1,000, and added to the local rate to estimate the combined state and local rate.

Taxes: State and Local Property Taxes per $1,000 of Personal Income

The annual amount of local property tax collected in each county, as reported by the Census Bureau, was divided by that county's annual personal income, as reported by the Bureau of Economic Analysis, and the result was multiplied by 1,000. Because data on state property tax collections by county are not uniformly available, the annual amount of state property tax collected in each state was divided by the annual personal income in each state, multiplied by 1,000, and added to the local rate to estimate the combined state and local rate.

Taxes: State and Local Sales Taxes per $1,000 of Personal Income

The annual amount of local sales tax collected in each county, as reported by the Census Bureau, was divided by that county's annual personal income, as reported by the Bureau of Economic Analysis, and the result was multiplied by 1,000. Because data on state sales tax collections by county are not uniformly available, the annual amount of state sales tax collected in each state was divided by the annual personal income in each state, multiplied by 1,000, and added to the local rate to estimate the combined state and local rate.

Expenditures: Higher-Education Expenditures as Percent of Total

Local government education expenditures for each county were multiplied by the statewide ratio of higher education expenditures by local governments to total education expenditures by local governments and added to (state expenditures on higher education divided by the number of counties in the state). The result was divided by the sum of total local government expenditures in the county and (total state expenditures divided by the number of counties in the state). While imperfect, this measure seemed superior to the alternatives possible with the data available.

Expenditures: Public-Welfare Expenditures as Percent of Total

Local government public-welfare expenditures for each county were added to (state expenditures on public welfare divided by the number of counties in the state). The result was divided by the sum of total local government expenditures in the county and (total state expenditures divided by the number of counties in the state). While imperfect, this measure seemed superior to the alternatives possible with the data available.

Expenditures: Highway Expenditures as Percent of Total

Local government highway expenditures for each county were added to (state expenditures on highways divided by the number of counties in the state). The result was divided by the sum of total local government expenditures in the county and (total state expenditures divided by the number of counties in the state). While imperfect, this measure seemed superior to the alternatives possible with the data available.

MANIPULATIONS OF THE GABRIEL VARIABLES

The following changes were made to Gabriel et al.'s variables before they were used in the county quality-of-life rating. The signs of the regression coefficients for five of the 24 variables were changed. States with (1) less sunshine, (2) higher rates of violent crime, (3) higher state and local property taxes, (4) more expenditures on higher education, and (5) more expenditures on welfare were associated with *higher* quality of life in Gabriel et al.'s regression equation. The signs of these variables were reversed when used in this analysis. Further, the influence of some variables (regardless of sign) on counties appeared to be too strong: the presence of a coast (within 100 miles), better air quality (particularly low levels of carbon monoxide), a low number of hazardous waste sites, low student-to-teacher ratios, and significant funding for higher education and highways. The effects of these variables were reduced to one-quarter of their original influence.

In addition, the following variables seemed to have inconsistent effects because the data were usually not reported at the county level: (1) the amount of federal land that existed statewide, (2) whether or not

Courtesy of T. Delcorso

the state environmental protection laws were lenient, (3) the number of visits to national parks per 100 people in the state, and (4) the number of visits to state parks per 100 people in the state. These four variables were eliminated from the analysis.

Other key variables were missing from Gabriel et al.'s list of variables because they were accounted for in the structure of the regression. The following variables needed to be added: wealth of the county; share of the population, aged 25 and older, with a graduate degree; a cost-of-living index for the county; future population growth; and employment growth in the county. These additional variables, with the deduction of the four above, expanded the original variable set to 26. Population growth and employment growth were found to exert too much influence and were reduced to one-quarter of their original effects. The additional variables are shown below:

Wealth

Woods and Poole Economics Wealth Index estimated wealth to 2025. The Wealth Index is the weighted average of county income per capita divided by U.S. income per capita (80 percent of the index); plus the county proportion of income from dividends/ interest/rent divided by the U.S. proportion (10 percent of the index); plus the U.S. proportion of income from transfers divided by the county proportion (10 percent of the index).

Percentage of People Aged 20 to 64

Percentage of total population in the age group 20 to 64 was derived from Woods and Poole Economics data taken to 2025. This is an indicator of the proportion of the population that contributes wealth to a jurisdiction, as opposed to the population that must be provided for by the earned wealth of others.

Courtesy of T. Delcorso

Percentage of People 25 and Older with a Graduate Degree

Percentage of people with a master's or higher degree was taken from the 1990 U.S. Census. Education and personal achievement are highly correlated. Graduate degrees are also associated with greater wealth of a jurisdiction.

Estimated Cost-of-Living Index

This index was developed from the ratio of household income in 1990 to the median value of a single-family unit. Counties with low ratios of income to value were given low scores, and counties with high ratios were given high scores on cost of living. Lower costs of living, other things remaining equal, are usually regarded as contributing to higher qualities of life.

Population-Growth Score

This score was developed from population growth 1970 to 2025 as a percent of population 1970. Counties were given a score, with major decreasers given the lowest value (1), followed by moderate decreasers with the next lowest value (2). Minor decreasers were given a 3, followed by major increasers with a 4. Minor increasers were given a 5, and moderate increasers were given the best score (6). This index correlates locations of moderate and minor population growth with the highest qualities of life.

Employment-Growth Score

This score was developed from employment growth 1970 to 2025 as a percent of employment 1970. Counties were given a score, with major decreasers given the lowest value (1), followed by moderate decreasers with the next lowest value (2). Minor decreasers were given a 3, followed by major increasers with a 4. Minor increasers were given a 5, and moderate increasers were given the best score (6). This index correlates location of moderate and minor employment growth with the highest qualities of life.

The 26 variables presented in Table 12.1 were scored 0 to 6 and associated with a sign and weight relating to their quality-of-life impact in a county.

The indicators that appear here are course grain, moment in time, and often subjective. Yet the arithmetic (not even mathematics) of their employment

Table 12.1
Variables Used in the Quality-of-Life Ranking of Counties

Variable		Developed (D) or Undeveloped (U) Areas	Correlation between Variable and Quality of Life	Weighting
1.	Average annual rainfall	U	-	1
2.	Morning and evening humidity	U	-	1
3.	Heating degree days	U	-	1
4.	Cooling degree days	U	-	1
5.	Wind speed	U	-	1
6.	Sunshine days	U	+	1
7.	Coast location	U	+	¼
8.	Inland water bodies	U	+	1
9.	Hazardous waste sites	D	-	¼
10.	Commuting time	D	-	1
11.	Violent crime rate	D	-	1
12.	Air content—ozone	D	-	1
13.	Air content—carbon monoxide	D	-	¼
14.	Student–teacher ratio	U	-	¼
15.	State and local income taxes	D	-	1
16.	State and local property taxes	U	-	1
17.	State and local sales taxes	D	-	1
18.	Expenditures on higher education	D	+	¼
19.	Expenditures on public welfare	D	-	1
20.	Expenditures on highways	D	+	¼
21.	Wealth index	U	+	1
22.	Working age population	D	+	1
23.	Population with a graduate degree	D	+	1
24.	Cost-of-living index	U	-	1
25.	Population growth	U	≈+	¼
26.	Employment growth	D	≈+	¼

Source: Center for Urban Policy Research, Rutgers University.

Notes: a (+) sign indicates a positive correlation between the variable and quality of life; a (-) sign indicates a negative correlation between the variable and quality of life; a (≈+) sign indicates that for population growth and employment growth there is a positive correlation between the variable and quality of life except for extreme high growth, which is given a middle rating.

In counties that are typified by either all undeveloped areas (2,450 counties) or all developed areas (160 counties), all 26 variables are used for quality of life. In counties that contain both developed and undeveloped areas (490 counties), 13 variables are used for their developed areas and 13 variables are used for their undeveloped areas. Again, all 26 variables are used to define quality of life in a county.

gets very precise. It is the purpose of this exercise to show the relative impact of different places on people subject to controlled- versus uncontrolled-growth development scenarios. In each scenario the quality of life is the same; the difference is the numbers of people who experience it. It is not meant to be an exercise in extreme precision or classification but rather a comparison of impacts under different growth scenarios.

RESULTS OF THE ASSESSMENT

Experiencing Quality of Life

What is the quality of life for new residents of a nation, state, or EA? Is it what a group of states, EAs, or counties equally weighted average to, or is it a summation of these component parts weighted by who experiences one versus another quality of life? The research team believes it to be the latter. The quality of life for the increment of new residents of a county

Table 12.2
Quality-of-Life Scores for New Residents: Uncontrolled-Growth Scenario
(The Top 50 Counties and Bottom 50 Counties)

Top 50 Counties	Quality-of-Life Score (Uncontrolled Growth)	Bottom 50 Counties	Quality-of-Life Score (Uncontrolled Growth)
Lincoln, SD	4.29	Beauregard, LA	2.33
San Mateo, CA	4.17	Gallia, OH	2.33
Douglas, CO	4.13	Clay, WV	2.33
Pitkin, CO	4.09	Monroe, WV	2.33
Santa Barbara, CA	4.02	Polk, MN	2.33
Marin, CA	3.92	Mille Lacs, MN	2.33
Coconino, AZ	3.87	Harrison, IA	2.33
Somerset, NJ	3.84	Tyler, WV	2.32
Kiowa, CO	3.84	Muskogee, OK	2.32
Routt, CO	3.82	Pushmataha, OK	2.32
Santa Cruz, CA	3.81	Monroe, AL	2.32
Anchorage Borough, AK	3.79	St. Francis, AR	2.32
Douglas, NV	3.79	Wayne, WV	2.31
Grand, CO	3.76	Lawrence, MS	2.31
Fairbanks North Star, AK	3.75	Newton, AR	2.31
Albemarle + Charlottesville, VA	3.74	Madison, IN	2.31
White Pine, NV	3.74	Madison, LA	2.31
Teton, WY	3.73	Crisp, GA	2.30
Monterey, CA	3.73	Person, NC	2.30
Centre, PA	3.72	Orange, NY	2.29
Eagle, CO	3.72	Chester, SC	2.29
Kit Carson, CO	3.72	Rapides, LA	2.28
Larimer, CO	3.71	Marshall, WV	2.28
Arapahoe, CO	3.70	Tangipahoa, LA	2.26
Summit, CO	3.69	Lake, MI	2.26
Tompkins, NY	3.68	Jackson, OK	2.26
Los Alamos, NM	3.68	Hawaii, HI	2.25
Gunnison, CO	3.68	Jackson, MO	2.25
Fairfax, VA	3.67	Mahoning, OH	2.25
Albany, WY	3.67	Richland, WI	2.24
Jefferson, CO	3.66	Pointe Coupee, LA	2.24
San Luis Obispo, CA	3.66	Merced, CA	2.22
Washington, CO	3.66	Jasper, SC	2.22
Ventura, CA	3.65	Iberville, LA	2.22
Washoe, NV	3.64	St. Louis, MN	2.21
Lincoln, CO	3.64	Doddridge, WV	2.21
Crowley, CO	3.64	Edgecombe, NC	2.20
Okaloosa, FL	3.63	Chisago, MN	2.20
Merrimack, NH	3.63	Crittenden, AR	2.18
Cache, UT	3.63	Adams, OH	2.18
Ouray, CO	3.62	Lake, IN	2.16
Baca, CO	3.62	Douglas, WI	2.14
Ulster, NY	3.61	St. James, LA	2.14
Phillips, CO	3.61	Burke, GA	2.13
Cochise, AZ	3.61	Hancock, GA	2.09
Apache, AZ	3.61	Macon, IL	2.08
Cheyenne, CO	3.61	Peoria, IL	1.94
Champaign, IL	3.60	Rock Island, IL	1.91
York + Poquoson, VA	3.54	Buchanan, MO	1.84
Greene, OH	3.51	Black Hawk, IA	1.82
Top 50 Counties	3.74	Bottom 50 Counties	2.23
United States	3.00		

Source: Center for Urban Policy Research, Rutgers University.

is determined by who will live in its component developed or undeveloped areas, weighted appropriately; the quality of life of an EA is who will live in its component counties, weighted appropriately; the quality of life of a nation is who will live in its states, weighted appropriately. Thus, quality of life for new residents in any area under scrutiny is determined by who will live in the various component parts times the individual measures of quality of life found there. For example, if the United States were a two-state nation made up of California and New York, and the quality of life currently averaged 5.0 in California and 2.5 in New York, and 200 people were moving to California and 100 people were moving to New York, the quality of life for new residents of the United States would be determined as the sum of the quality of life of its component parts, calculated as follows:

U.S. QoL (new residents) = (QoL in California * California-Bound Population) + QoL in New York * New York-Bound Population)

QoL of the U.S. = [5.0(200) + 2.5(100)]/300
= 1250/300
= 4.167

A jurisdiction's quality of life is the summation of the quality of life experienced by new residents to the various components of that jurisdiction. More people moving to the more central or urban areas of a jurisdiction under one or the other development alternative contribute to a different overall quality of life in that jurisdiction as a result of more urban residence there. These differences in quality of life are then indicative of the overall change in a jurisdiction due to the effects of residence patterns there.

The smallest jurisdictions for which quality of life is calculated are the developed and undeveloped areas of counties. Most counties (2,450) contain only undeveloped areas, 160 counties contain only developed areas, and the remaining 490 counties contain a combination of developed and undeveloped areas. For those counties that contain only undeveloped or developed areas, all 26 variables are used to determine the quality of life in that jurisdiction. Due to the absence of below-county-level data for the developed and undeveloped areas of counties, for those counties that contain both developed and undeveloped areas, 13 variables are used to describe the quality of life in developed areas and 13 variables are used to describe the quality of life in undeveloped areas. These average scores are weighted by existing relative populations to derive a new combined score for the county. The new combined score is divided into the aggregate original score for the county and the resulting ratio is used to multiply the developed and undeveloped area scores so they sum to the original combined score as weighted individual scores. The 13 variables that apply to either developed areas or undeveloped areas in the 490 counties containing a combination of areas are shown in Table 12.1. All of the variables shown in this table are used to calculate the quality of life in counties that are either wholly

Courtesy of C. Galley

undeveloped or developed counties. These produce ratings of counties like those shown in Table 12.2 for the highest- and lowest-rated counties in the United States. Information on quality of life at the county level will be discussed in a later section. The analysis begins with the quality of life in the United States and its regions.

THE UNITED STATES AND ITS REGIONS

Uncontrolled Growth

Quality of life for new residents in the United States averages 3.00 on a scale of 0 to 6, right at the middle of the scale. For developed areas, quality of life averages 8 percent higher (3.11) than for undeveloped areas (2.85) (see Table 12.3). As indicated above, ratings for counties are derived from 26 variables to develop an overall quality-of-life rating for the county and from subsets of these variables to determine quality of life for developed and undeveloped areas within a county. These quality-of-life scores multiplied by the number of people moving to a jurisdiction represent the quality of life of that jurisdiction. Subcounty areas sum to counties, counties sum to EAs, EAs sum to states, states sum to regions, and regions sum to the United States. The average quality-of-life figure for the United States is composed of lower values for all census regions except for the West region of the United States (Table 12.3). The lowest overall value of quality of life is found for the Midwest (2.87), followed by the South (2.92) and Northeast (2.95). The quality-of-life rating for the West is 3.20; this is 9 percent higher than the rating for the Northeast and South and 11 percent higher than that in the Midwest. Western locations typically get high marks for quality of life due to the wealth of their areas, education of their

Table 12.3
Quality-of-Life Index for New Residents:
Uncontrolled- and Controlled-Growth Scenarios, by Region

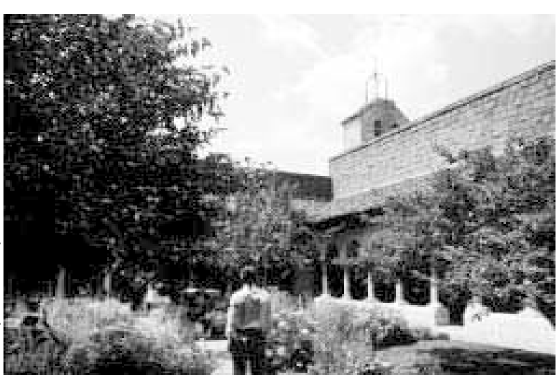
	Uncontrolled Growth			Controlled Growth			Difference between Controlled and Uncontrolled Growth		
Region	Developed	Un-developed	All	Developed	Un-developed	All	Developed	Un-developed	All
Northeast	3.15	2.75	2.95	3.11	2.79	2.94	-0.04	0.03	-0.01
Midwest	3.12	2.65	2.87	3.09	2.67	2.86	-0.03	0.02	0.00
South	3.02	2.78	2.92	3.00	2.79	2.91	-0.02	0.01	0.00
West	3.19	3.15	3.20	3.21	3.14	3.21	0.02	-0.01	0.01
United States	3.11	2.85	3.00	3.10	2.85	3.01	-0.01	0.00	0.00

Source: Center for Urban Policy Research, Rutgers University.

population, nonextreme weather conditions, lower crime rates, lower taxes, and manageable levels of population and job growth. Midwestern locations get lower marks due to more extreme weather conditions, higher taxes and crime rates, and very slow growth or decline. Northeastern locations get lower marks than the West for similar reasons as the Midwest but do slightly better in both the growth and weather categories. The South gets lower marks than the West primarily due to lower wealth and education levels; hot, arid weather; and, in some cases, extreme levels of population and employment growth.

Controlled Growth

Under the controlled-growth scenario, the quality-of-life score for the nation as a whole is also approximately 3.0 (Table 12.3). The obvious conclusion is that there is virtually no change in overall quality of life for new residents at the national level resulting from the pursuit of a more centrally oriented development pattern in metropolitan areas to channel growth. However, there are changes at the regional level. This is particularly true of developed areas in the four U.S. regions (Table 12.3). Those who will live in the *developed* areas of the Northeast, Midwest, and South under the controlled-growth regimen will experience a slight decrease in their quality of life; those who will live in the developed areas of the West will experience a slight increase in their quality of life. For *undeveloped* areas, there will be a slight increase in quality of life for those who move to these locations in the Northeast, Midwest, and South. There will be a very slight decrease in quality of life in undeveloped areas for those who move to these areas in the West.



Courtesy of C. Galley

Again, the *developed* areas to be occupied in the Northeast, Midwest, and South regions under the controlled-growth scenario have a lower quality of life for new residents than developed areas that would be occupied under the uncontrolled-growth scenario. Those going to developed areas would be fewer in number and headed to the better areas under uncontrolled growth. In the West, going to more intensely developed areas increases quality of life because developed areas in this region are strong economically and otherwise. The primary and secondary cities of the Western and Mountain divisions are much healthier than their southern, midwestern, and northeastern counterparts.

Quality of life in *undeveloped* areas actually increases in the Northeast, Midwest, and South under the controlled-growth scenario because those going to these locations are fewer and are locating in the more desirable undeveloped areas. The most extreme areas, with lowest populations and less-sophisticated services and infrastructure, are being avoided under the controlled-growth scenario. These are the areas where follow-up land preservation may be possible. The quality of life in *undeveloped* areas of the West actually decreases slightly, because some of the undeveloped areas of the West are closer in and less desirable than the extreme and more pristine outer areas no longer targeted under alternative development.

The basic message is that, in the aggregate, overall quality of life experienced by new residents in the United States is unaltered as a result of the applied controlled-growth regimen. The very small changes that do occur represent a small decrease in quality of life in regions other than the West and a small increase in quality of life in the West. These slight changes are due to the relative health of central cities in these regions.

STATES

Uncontrolled Growth

Quality of life for new residents in the United States varies at the state level from a high of 3.56 in Colorado to a low of 2.63 in Louisiana (Table 12.4). Under the controlled-growth scenario, the top 20 states in the United States exhibit a quality of life that averages 10 percent higher than the average quality of life for the nation as a whole. The state with the highest quality-of-life rating for new residents is Colorado, followed by Alaska, Montana, Virginia, Nevada, Wyoming, Utah, Idaho, California, and New Mexico (Table 12.4). These states range from 3.56 (Colorado) to 3.20 (New Mexico) in their overall quality-of-life rating. New Jersey is the 14th state in quality of life, Florida is the 22nd state, and Georgia the 32nd. The fast-growing, suburbanizing states (Arizona, Nevada, and California) appear to have a higher quality of life in their less-developed versus more-developed areas of counties. Other states have a quality of life almost equal in developed and undeveloped areas. Examples of these are Tennessee, Utah, Florida, Connecticut, and Rhode Island. All the remaining states have a higher quality of life in their more-developed versus less-developed areas of counties (Table 12.4). Of the top 10 states in quality of life, nine are in the West and one is in the South (Virginia). Of the top 20 states, 11 are in the West, five are in the Midwest, three are in the Northeast, and two are in the South.

Controlled Growth

For the top 20 states in terms of quality of life, as was the case with the regional finding, on average there is no overall change in quality of life for new residents due to the implementation of a controlled-growth regimen. On the other hand, there are some changes in four out of the top 30 states and five out of the remaining 20 states. Of the top 20 states, two increase somewhat in their quality of life—California and New Mexico; two states decrease somewhat—Colorado and Maryland (Table 12.4). In California and New Mexico, the increase is due to increases in quality of life in developed areas—more people going to higher-quality, existing developed areas under alternative development. In Colorado, the decrease is due to a lower quality of life being experienced in both undeveloped and developed areas. Under the controlled-growth scenario, people in Colorado are moving to developed and undeveloped areas with a slightly lower quality of life. In Maryland, the decrease is due to the quality-of-life decreases being experienced in its developed areas (more people are experiencing a lower quality of life in the central areas). In the remaining 30 states, there are also relatively few changes in quality of life. Quality of life for new residents under controlled growth is likely to decrease somewhat in Alabama and Rhode Island—the former due to decreases in quality of life in developed areas, the latter due to decreases in quality of life in unde-

Courtesy of C. Galley

Table 12.4
Quality-of-Life Index for New Residents:
Uncontrolled- and Controlled-Growth Scenario, by State

	Uncontrolled Growth			Controlled Growth			Difference between Controlled and Uncontrolled Growth		
State	Developed	Un-developed	All	Developed	Un-developed	All	Developed	Un-developed	All
Colorado	3.60	3.53	3.56	3.54	3.50	3.51	-0.06	-0.03	-0.05
Alaska	3.80	3.11	3.50	3.80	3.11	3.50	0.00	0.00	0.00
Montana	3.61	3.22	3.37	3.61	3.23	3.37	0.00	0.01	0.00
Virginia	3.47	3.08	3.34	3.45	3.11	3.35	-0.02	0.03	0.01
Nevada	3.29	3.45	3.32	3.30	3.47	3.33	0.01	0.02	0.01
Wyoming	3.44	3.28	3.31	3.45	3.28	3.31	0.01	0.00	0.00
Utah	3.24	3.23	3.24	3.22	3.21	3.23	-0.02	-0.02	-0.01
Idaho	3.44	3.03	3.21	3.43	3.03	3.21	-0.01	0.00	0.00
California	3.15	3.30	3.21	3.21	3.23	3.24	0.06	-0.07	0.03
New Mexico	3.28	3.10	3.20	3.34	3.09	3.24	0.06	-0.01	0.04
Arizona	3.05	3.52	3.17	3.05	3.48	3.18	0.00	-0.04	0.01
North Dakota	3.44	3.02	3.16	3.44	3.03	3.16	0.00	0.01	0.00
Kansas	3.29	2.86	3.12	3.29	2.89	3.12	0.00	0.03	0.00
New Jersey	3.19	2.97	3.11	3.17	3.03	3.11	-0.02	0.06	0.00
New Hampshire	3.93	2.70	3.09	3.88	2.74	3.09	-0.05	0.04	0.00
Vermont	3.90	2.83	3.09	3.90	2.85	3.09	0.00	0.02	0.00
Illinois	3.23	2.68	3.05	3.19	2.73	3.04	-0.04	0.05	-0.01
South Dakota	3.32	2.95	3.05	3.33	3.00	3.05	0.01	0.05	0.00
Nebraska	3.16	2.70	3.03	3.16	2.80	3.04	0.00	0.10	0.01
Maryland	3.09	2.88	3.03	3.01	2.90	3.00	-0.08	0.02	-0.03
Pennsylvania	3.30	2.72	2.99	3.24	2.78	3.00	-0.06	0.06	0.01
Florida	2.99	2.93	2.97	2.99	2.95	2.96	0.00	0.02	-0.01
Oregon	3.20	2.72	2.96	3.11	2.71	2.94	-0.09	-0.01	-0.02
Washington	3.09	2.74	2.94	3.08	2.79	2.94	-0.01	0.05	0.00
South Carolina	3.04	2.87	2.94	3.03	2.87	2.94	-0.01	0.00	0.00
Massachusetts	3.00	2.78	2.94	3.03	2.76	2.97	0.03	-0.02	0.03
North Carolina	3.09	2.77	2.92	3.09	2.77	2.92	0.00	0.00	0.00
Connecticut	2.97	2.90	2.90	2.95	2.92	2.88	-0.02	0.02	-0.02
Maine	3.25	2.74	2.89	3.23	2.74	2.89	-0.02	0.00	0.00
Indiana	3.23	2.72	2.89	3.16	2.70	2.87	-0.07	-0.02	-0.02
Delaware	3.02	2.65	2.88	3.03	2.66	2.88	0.01	0.01	0.00
Georgia	3.01	2.75	2.87	2.97	2.76	2.88	-0.04	0.01	0.01
Michigan	3.09	2.70	2.87	3.07	2.71	2.86	-0.02	0.01	-0.01
Iowa	3.16	2.50	2.87	3.16	2.56	2.87	0.00	0.06	0.00
Texas	2.98	2.68	2.86	2.96	2.71	2.87	-0.02	0.03	0.01
Tennessee	2.86	2.86	2.85	2.84	2.89	2.85	-0.02	0.03	0.00
Kentucky	2.95	2.80	2.84	2.93	2.81	2.84	-0.02	0.01	0.00
Wisconsin	3.14	2.60	2.83	3.14	2.61	2.82	0.00	0.01	-0.01
Alabama	3.07	2.67	2.82	2.93	2.68	2.77	-0.14	0.01	-0.05
Arkansas	2.94	2.79	2.82	2.96	2.78	2.83	0.02	-0.01	0.01
Minnesota	3.12	2.40	2.77	3.05	2.43	2.78	-0.07	0.03	0.01
Ohio	2.97	2.68	2.76	2.92	2.69	2.75	-0.05	0.01	-0.01
Mississippi	2.91	2.69	2.76	2.85	2.69	2.74	-0.06	0.00	-0.02
West Virginia	3.11	2.72	2.74	3.03	2.70	2.73	-0.08	-0.02	-0.01
New York	2.96	2.73	2.74	2.92	2.76	2.74	-0.04	0.03	0.00
Rhode Island	2.63	2.64	2.69	2.64	2.55	2.62	0.01	-0.09	-0.07
Oklahoma	2.80	2.61	2.68	2.75	2.61	2.66	-0.05	0.00	-0.02
Hawaii	2.89	2.54	2.68	2.89	2.55	2.80	0.00	0.01	0.12
Missouri	2.82	2.62	2.66	2.87	2.65	2.70	0.05	0.03	0.04
Louisiana	2.72	2.48	2.63	2.70	2.49	2.61	-0.02	0.01	-0.02
Top 20 States	3.40	3.07	3.21	3.39	3.09	3.21	-0.01	0.01	0.00
United States	3.11	2.85	3.00	3.10	2.85	3.01	-0.01	0.00	0.00

Source: Center for Urban Policy Research, Rutgers University.

veloped areas (Table 12.4). Quality of life is likely to increase noticeably in Massachusetts and Missouri and, most of all, Hawaii. In the former cases, this is due to increases in quality of life in developed areas (movement to better developed areas); in the latter case, it is due to increases in quality of life in unde-

Courtesy of C. Galley

veloped areas (less movement to the least-desirable undeveloped areas). Overall, less than 20 percent of the states (nine states) experience an observable change in their quality of life due to the controlled-growth regimen. Of those states that do experience a change, more go up (five), than go down (four). Most of those that increase in quality of life are home to strong and interesting cities; most of those states that decrease are diminished by having cities that are less desirable as residences.

EAs

Uncontrolled Growth

The top 30 EAs nationwide have an average quality of life for new residents of 3.29, approximately 10 percent above the national average of 3.00 (Table 12.5). Developed areas are 0.32, or 10 percent, better than the national average; undeveloped areas are 0.33, or 11 percent, better than the national average.[1] Of these top 30 EAs, nine of the first 10 are in the West region of the United States (Table 12.5). Of the top 30 EAs, 19 are in the West, seven are in the South, three in the Midwest, and one is in the Northeast. The Denver-Boulder-Greeley, CO-KS-NE EA is the top EA in the country, followed by the (2) Anchorage, AK EA; (3) Reno, NV-CA EA; (4) Flagstaff, AZ-UT EA; (5) Boise City, ID-OR EA; (6) Missoula, MT EA; (7) San Francisco-Oakland-San Jose, CA EA; (8) Billings, MT-WY EA; (9) Farmington, NM-CO EA; and (10) Staunton, VA-WV EA (Table 12.5). In the top 30 EAs, the quality of life in developed areas exceeds the quality of life in undeveloped areas, except for the Tucson, AZ and Pueblo, CO-NM EAs, where the reverse is true. In the San Francisco-Oakland-San Jose, CA EA; the Salt Lake City-Ogden, UT-ID EA; and the Las Vegas, NV-AZ-UT EA, the quality of life in developed areas is approximately the same as the quality of life in undeveloped areas.

Controlled Growth

Under the controlled-growth scenario, the 30 top EAs nationwide show virtually no change in quality of life for new residents. A very slight decrease in quality of life in developed areas (-0.01) is made up by the very slight increase in quality of life in undeveloped areas (+0.01) (Table 12.5). EAs that decrease somewhat in quality of life are the Roanoke, VA-NC-WV EA and the Denver-Boulder-Greeley, CO-KS-NE EA. EAs wherein quality of life increases are the San Francisco-Oakland-San Jose, CA EA; Albuquerque, NM-AZ EA; Flagstaff, AZ-UT EA; and Reno, NV-CA EA. In the first case of decreasing quality of life in EAs (i.e., Roanoke, VA-NC-WV EA and Denver-Boulder-Greeley, CO-KS-NE EA) it is due to decreases taking place in developed areas. More people move to urban locations where the quality of life is lower. In

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[1] Missing data impacts on the overall average of individual columns.

Table 12.5
Quality-of-Life Index for New Residents:
Uncontrolled- and Controlled-Growth Scenario, by EA

	Uncontrolled Growth			Controlled Growth			Difference between Controlled and Uncontrolled Growth		
EA	Developed	Un-developed	All	Developed	Un-developed	All	Developed	Un-developed	All
Denver-Boulder-Gree., CO-KS-NE	3.60	3.54	3.57	3.55	3.50	3.51	-0.05	-0.04	-0.06
Anchorage, AK	3.80	3.11	3.50	3.80	3.11	3.50	-	-	-
Reno, NV-CA	3.60	3.45	3.49	3.60	3.47	3.54	-	0.02	0.05
Flagstaff, AZ-UT	-	3.45	3.45	-	3.49	3.49	-	0.04	0.04
Boise City, ID-OR	3.58	3.03	3.43	3.58	3.03	3.43	-	-	-
Missoula, MT	3.93	3.16	3.39	3.93	3.17	3.39	-	0.01	-
San Francisco-Oakland-San Jose, CA	3.31	3.34	3.38	3.44	3.25	3.47	0.13	-0.09	0.09
Billings, MT-WY	3.45	3.33	3.36	3.45	3.35	3.36	-	0.02	-
Farmington, NM-CO	-	3.32	3.32	-	3.32	3.32	-	-	-
Staunton, VA-WV	-	3.30	3.30	-	3.29	3.29	-	-0.01	-0.01
Tallahassee, FL-GA	3.49	2.98	3.30	3.49	2.99	3.30	-	0.01	-
Albuquerque, NM-AZ	3.34	3.19	3.28	3.42	3.18	3.34	0.08	-0.01	0.06
Roanoke, VA-NC-WV	3.48	3.15	3.28	3.29	3.16	3.21	-0.19	0.01	-0.07
Casper, WY-ID-UT	3.44	3.20	3.26	3.45	3.20	3.26	0.01	-	-
Santa Fe, NM	3.34	3.21	3.26	3.34	3.22	3.27	-	0.01	0.01
San Diego, CA	3.25	-	3.26	3.25	-	3.26	-	-	-
Las Vegas, NV-AZ-UT	3.26	3.24	3.26	3.26	3.22	3.26	-	-0.02	-
Norfolk-Virginia Beach-Newport News, VA-NC	3.30	2.93	3.25	3.29	2.95	3.24	-0.01	0.02	-0.01
Salt Lake City-Ogden, UT-ID	3.24	3.25	3.24	3.22	3.20	3.23	-0.02	-0.05	-0.01
Richmond-Petersburg, VA	3.38	3.01	3.22	3.38	3.04	3.24	-	0.03	0.02
State College, PA	3.89	2.86	3.21	3.89	2.88	3.21	-	0.02	-
Twin Falls, ID	-	3.21	3.21	-	3.21	3.21	-	-	-
Pensacola, FL	3.35	3.01	3.21	3.35	3.02	3.21	-	0.01	-
Rapid City, SD-MT-NE-ND	3.48	3.03	3.19	3.48	3.09	3.19	-	0.06	-
Washington-Baltimore, DC-MD-VA-WV-PA	3.32	2.92	3.19	3.22	2.96	3.17	-0.10	0.04	-0.02
Pueblo, CO-NM	3.04	3.52	3.17	3.04	3.50	3.17	-	-0.02	-
Great Falls, MT	-	2.92	3.16	-	2.92	3.16	-	-	-
Minot, ND	-	3.15	3.15	-	3.15	3.15	-	-	-
Bismarck, ND-MT-SD	3.39	2.97	3.15	3.39	2.97	3.15	-	-	-
Tucson, AZ	3.03	3.55	3.14	3.03	3.54	3.14	-	-0.01	-
Top 30 EAs	3.43	3.18	3.29	3.42	3.19	3.29	-0.01	-	-
United States	3.11	2.85	3.00	3.10	2.85	3.01	-0.01	-	-

Source: Center for Urban Policy Research, Rutgers University.

the second case of increasing quality of life in EAs (i.e., San Francisco-Oakland-San Jose, CA EA; Albuquerque, NM-AZ EA; Flagstaff, AZ-UT EA; and Reno, NV-CA EA), in the first two instances it is due to movement closer to strong developed areas; in the second two, it is due to movement away from weak


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undeveloped areas. Overall, the magnitude of change in decreasing locations is approximately equal to the changes in the increasing locations (Table 12.5). The end result for the top 30 EAs is no change in overall quality of life due to the adoption of a controlled-growth regimen.

COUNTIES

Uncontrolled Growth

The quality-of-life rating for counties does not vary for developed and undeveloped areas under the two future development alternatives. These are the same averaged values from the 13 variables that apply to undeveloped areas and the 13 variables that apply to developed areas. The difference between the uncontrolled- and controlled-growth scenarios in the quality-of-life rating at the county level is the *number of people* who will be subjected to a different quality of life in developed and undeveloped areas under the two growth scenarios.

The top 50 counties in the United States have a high quality of life for new residents under uncontrolled growth that averages 3.74 and varies from a high of 4.17 (San Mateo, CA)[2] to a low of slightly more than 3.60 (Cheyenne County, CO) (Table 12.6). The quality of life in these counties is nearly 25 percent higher than the average quality of life in the United States as a whole. Of the top 50 counties, 38 are in the West region, five are in the Northeast, four are in the South, and three are in the Midwest. Three-quarters of the top 50 counties in quality of life are found in the West region of the United States (Table 12.6). On average, the quality of life of the developed areas of the top 50 counties (3.91) is 12 percent higher than the quality of life in undeveloped areas of those counties (3.50).

Controlled Growth

Under controlled growth in the top 50 counties, there is virtually no change in aggregate quality of life for new residents due to the adopted regimen. Quality of life in the top 50 counties (average 3.74) for the con-

[2] The first county on the list (Lincoln, SD) is a very small county that is being influenced in its urban portion by spillover from the city of Sioux Falls in a neighboring county. This influence may be having greater statistical than actual effect.

Table 12.6
Quality-of-Life Index (for New Residents)
Uncontrolled- and Controlled-Growth Scenario, by County

	Uncontrolled Growth			Controlled Growth			Difference between Controlled and Uncontrolled Growth
County	Developed	Un-developed	All	Developed	Un-developed	All	All
Lincoln, SD	4.58	2.63	4.29	4.58	2.63	4.44	0.15
San Mateo, CA	4.17	4.70	4.17	4.17	4.70	4.17	-
Douglas, CO	4.40	3.89	4.13	4.40	3.89	4.15	0.02
Pitkin, CO	-	4.09	4.09	-	4.09	4.09	-
Santa Barbara, CA	4.02	4.07	4.02	4.02	4.07	4.02	-
Marin, CA	3.91	4.07	3.92	3.91	4.07	3.91	-0.01
Coconino, AZ	-	3.87	3.87	-	3.87	3.87	-
Somerset, NJ	3.86	2.82	3.84	3.86	2.82	3.85	0.01
Kiowa, CO	-	3.84	3.84	-	3.84	3.84	-
Routt, CO	-	3.82	3.82	-	3.82	3.82	-
Santa Cruz, CA	3.81	4.01	3.81	3.81	4.01	3.81	-
Anchorage Boro., AK	3.80	2.89	3.79	3.80	2.89	3.79	-
Douglas, NV	-	3.79	3.79	-	3.79	3.79	-
Grand, CO	-	3.76	3.76	-	3.76	3.76	-
Fairbanks N. Star, AK	-	3.75	3.75	-	3.75	3.75	-
Albemarle + Charlo., VA	4.07	3.07	3.74	4.07	3.07	3.81	0.07
White Pine, NV	-	3.74	3.74	-	3.74	3.74	-
Teton, WY	-	3.73	3.73	-	3.73	3.73	-
Monterey, CA	3.73	3.98	3.73	3.73	3.98	3.73	-
Centre, PA	4.07	2.71	3.72	4.07	2.71	3.83	0.11
Eagle, CO	-	3.72	3.72	-	3.72	3.72	-
Kit Carson, CO	-	3.72	3.72	-	3.72	3.72	-
Larimer, CO	3.82	3.33	3.71	3.82	3.33	3.75	0.04
Arapahoe, CO	3.70	3.44	3.70	3.70	3.44	3.70	-
Summit, CO	-	3.69	3.69	-	3.69	3.69	-
Tompkins, NY	3.68	2.49	3.68	3.68	2.49	3.68	-
Los Alamos, NM	-	3.68	3.68	-	3.68	3.68	-
Gunnison, CO	-	3.68	3.68	-	3.68	3.68	-
Fairfax, VA	3.67	3.20	3.67	3.67	3.20	3.67	-
Albany, WY	-	3.67	3.67	-	3.67	3.67	-
Jefferson, CO	3.67	3.61	3.66	3.67	3.61	3.67	0.01
San Luis Obispo, CA	3.67	3.62	3.66	3.67	3.62	3.66	-
Washington, CO	-	3.66	3.66	-	3.66	3.66	-
Ventura, CA	3.64	3.96	3.65	3.64	3.96	3.65	-
Washoe, NV	3.60	3.87	3.64	3.60	3.87	3.62	-0.02
Lincoln, CO	-	3.64	3.64	-	3.64	3.64	-
Crowley, CO	-	3.64	3.64	-	3.64	3.64	-
Okaloosa, FL	3.71	3.03	3.63	3.71	3.03	3.67	0.04
Merrimack, NH	5.17	3.53	3.63	5.17	3.53	3.64	0.01
Cache, UT	3.63	3.22	3.63	3.63	3.22	3.63	-
Ouray, CO	-	3.62	3.62	-	3.62	3.62	-
Baca, CO	-	3.62	3.62	-	3.62	3.62	-
Ulster, NY	3.89	2.63	3.61	3.89	2.63	3.71	0.10
Phillips, CO	-	3.61	3.61	-	3.61	3.61	-
Cochise, AZ	-	3.61	3.61	-	3.61	3.61	-
Apache, AZ	-	3.61	3.61	-	3.61	3.61	-
Cheyenne, CO	-	3.61	3.61	-	3.61	3.61	-
Champaign, IL	3.80	1.89	3.60	3.80	1.89	3.70	0.10
York + Poquoson, VA	3.69	2.78	3.54	3.69	2.78	3.61	0.07
Greene, OH	3.81	2.24	3.51	3.81	2.24	3.64	0.13
Top 50 Counties	3.91	3.50	3.74	3.91	3.50	3.75	0.02
United States	3.11	2.85	3.00	3.10	2.85	3.01	0.00

Source: Center for Urban Policy Research, Rutgers University.

trolled-growth scenario remains approximately 25 percent higher than the quality of life in the nation as a whole (3.01) (Table 12.6). There are several counties that do increase in quality of life under a controlled-growth future. These are Lincoln County, SD (+0.15); Greene County, OH (+0.13); Centre County, PA (+0.11); Ulster County, NY (+0.10); Champaign County, IL (+0.10); Albermarle and Charlottesville County, VA (+0.07); York and Poquoson County, VA (+0.07); Larimer County, CO (+0.04); and Okaloosa

County, FL (+0.04) (Table 12.6). In each of these examples of increase in quality of life under the controlled-growth scenario, the increase is due to movement closer to strong growth centers in the county. No county in the top 50 quality-of-life counties experiences significant decreases in quality of life under the controlled-growth regimen. The overall finding for the top 50 counties is very little, if any, change in aggregate quality of life due to the controlled-growth regimen. This is in keeping with our findings vis-à-vis the other subsets of quality-of-life analysis.


Courtesy of T. Delcorso

CONCLUSION

Quality of life is almost impossible to quantify. To allow quality of life to be understood and measured, a "places-rated" method generally must be used. If one can select variables that meaningfully separate places, and those places, once distinguished, are recognizable as different by a judging population, then a places-rated scheme can be used for more rigorous analysis. This is what is attempted here. Variables from a recognized econometric procedure to rate quality of life are augmented and altered to attain an acceptable ordering of counties in five states: New Jersey, South Carolina, Florida, Arizona, and Oregon. These variables are then applied to all counties of the United States to develop an initial rating for each county. For those counties with both developed and undeveloped areas, approximately 490, or 15 percent of all counties, the 26 variables are divided into two sets of 13 variables each to describe the counties' developed and undeveloped portions. Counties, EAs, states, regions, and the United States as a whole can have a quality of life altered by the number of people moving to a county and its developed and undeveloped areas under the two alternative growth scenarios.

The finding of this analysis is that, overall, movement to central places by new residents under a controlled-growth regimen does not appreciably alter quality of life at any level of jurisdiction. Neither the top 50 counties nor all counties, the top 30 EAs or all EAS, the top 20 states or all states, show significant variations in quality of life for new residents as a result of the controlled-growth regimen. In individual instances, there may be some changes in quality of life experienced. This is true at the county, EA, state, and regional levels. On the whole, however, any increases in quality of life balance out the decreases. In general there is no shift in quality of life because in approximately 2,610 of the total 3,100 counties there is no intracounty shift—most shifts are intercounty. The increased population in receiving locations incurs the same quality of life under both scenarios. For those locations where there is a change in quality of life, the change may occur in either direction. Thus, at least at the county scale, it cannot be said that controlled growth will lead to either increasing or decreasing quality of life. This is an important finding, because literature in the field is full of unsubstantiated claims favoring both positions. While the above analysis is far from the last word on controlled growth and quality of life, the findings do shed some light on the complexity of the issue and the percentage of jurisdictions involved in quality-of-life changes under a controlled-growth scenario.

Courtesy of R. Ewing

XIII

Relating Sprawl to Urban Decline:

Effects of Suburban Sprawl on the Decline of Metropolitan Areas

INTRODUCTION

This chapter explores fundamental social issues raised by sprawl development. It shifts the focus from the comparison of the two potential futures—uncontrolled- or controlled-growth—to the analysis of the relationships between sprawl and urban decline.

Many of those who follow urban issues believe that losses of population and fiscal strength in large, older American cities have been aggravated by the particular form of suburban growth that has occurred around those cities: so-called suburban sprawl. Until now, little attempt has been made to establish an empirically verified connection between suburban sprawl and the urban decline of large American cities. This chapter explores empirical linkages between suburban sprawl and urban decline and seeks to determine (1) whether these are statistically significant and (2) whether they confirm that sprawl aggravates urban decline. The empirical exploration is preceded by a conceptual discussion of possible relationships between suburban sprawl and urban decline.

Two different statistical approaches are employed here. In the section following basic concepts, the empirical measures of both suburban sprawl and urban decline are derived specifically for the analysis, and are not directly related to the empirical variables used in the other chapters of this report. In the final sections, empirical measures of both sprawl and decline derived from the data in the other chapters of this study are used. Findings from both sections are then compared.

THE RELATIONSHIP BETWEEN SPRAWL AND URBAN DECLINE

Peripheral Growth in U.S. Metropolitan Areas after 1950

After 1950, some type of large-scale, peripheral residential development around the central cities of most United States metropolitan areas was inevitable, for two reasons. First, housing in most large American cities was severely overcrowded by 1950. Thousands of residents had been imported from rural areas during World War II to participate in war production, yet very little new housing had been built in or near those cities since the 1920s, thanks to the depression of the 1930s and the curtailment of civilian production during World War II. Second, there was a huge influx of population to metropolitan areas containing these cities, starting around 1950 and lasting through the late 1960s, caused by: (1) the displacement of rural workers by mechanization—especially from Southern cotton-growing areas; (2) a general desire among young people raised in rural areas to seek broader economic opportunities than were available in those areas; (3) unexpectedly fast population growth in the late 1950s and 1960s because of the postwar baby boom; and (4) the rapid expansion of job opportunities in metropolitan areas during the postwar economic boom.

These forces generated an enormous demand for additional housing in most metropolitan areas that could not be met within the existing boundaries of central cities unless housing densities there were greatly increased. At the same time, rising real incomes in all economic groups, coupled with the increasing availability of automobile transportation, stimulated the demand for lower-density housing, precluding increasing densities within big cities. Thus, peripheral population expansion around those cities after 1950 was both inescapable and socially desirable.

However, suburban sprawl, the particular form of peripheral growth that became dominant in almost all American metropolitan areas, was certainly not inescapable and had many socially undesirable aspects.

Defining Suburban Sprawl

Large-scale peripheral growth in United States metropolitan areas conceivably could have occurred without suburban sprawl. Many nations around the world, both economically developed and less developed, have been able to support such growth without significant sprawl. Nonetheless, sprawl has been dominant in nearly all United States metropolitan areas for half a century, for reasons discussed below. First, however, it is important to define suburban sprawl precisely in order to study it empirically.

An earlier study by similar participants to this study (Burchell et al. 1998) developed a specific definition of suburban sprawl that contained multiple elements. These elements were arrived at through an acknowledgement of the basic characteristics and impacts of sprawl found in the extensive literature on that subject. For example, one common criticism of sprawl is that it involves too much dependence on the automobile to navigate the distances between work and residence. The dependence on private vehicles causes significant traffic congestion, excessive air pollution, hardship for people who cannot afford private vehicles, and fosters very low density settlement patterns. This criticism led to the conclusion by the research team that sprawl is characterized by both the dominance of the automobile and low-density development. Some critics of sprawl claim that the extensive commercial strip developments in sprawled communities lead to excessive travel and undermine existing central-city and suburban "downtown" districts. From this criticism, it was further concluded that two defining elements of sprawl are significant commercial strip development and the segregation of the land uses into separate spatial zones. The additional defining elements of sprawl were similarly formulated by determining the traits that accounted for the negative and positive outcomes attributed to sprawl. The 10 elements that are used to define suburban sprawl in this chapter are as follows:

- Relatively low residential and nonresidential density in peripheral areas
- Unlimited outward extension of new settlements
- Leapfrog development of new subdivisions not contiguous to existing built-up areas
- Segregation of land uses by types, into separate zones or territories
- Dominance of surface transportation by private automobiles
- Fragmented governmental control over land use among many relatively small localities
- No centralized ownership of land or planning or regulation of new development
- Great disparities in the fiscal capacities of local governments across each metropolitan area
- Widespread emergence of commercial strip mall development along major arteries
- No direct provision of new low-priced housing. Reliance on the filtering or "trickle-down" process to provide housing for low-income households

This approach to defining sprawl is responsive to most of the major concerns about sprawl expressed by the public and in the literature. However, the 10 defining elements do not form a single coherent "bundle" of interrelated attributes. Some of the elements are interrelated, for example, relatively low densities in peripheral areas, unlimited outward extension, and leapfrog development. Other elements have no intrinsic or necessary relationship to these three: examples are fragmentation of governance over land use and reliance on the trickle-down or filtering process to provide housing for low-income households. Consequently, it is difficult using these 10 elements to create a cohesive *index of suburban sprawl* that can be applied to each urbanized area or metropolitan area. Since the variables from which the index is to be cre-


Courtesy of G. Lowenstein

ated do not form a homogeneous or coherent set of traits, the index itself does not represent measurement of a coherent, closely integrated, underlying reality. This will become clearer in later sections of this chapter.

The Metropolitan Growth Process and the Concentration of Poverty in Core Areas

For at least four decades, households and businesses have been moving from central cities and inner-ring suburbs to low-density, outer-ring suburbs in the process of suburban sprawl described above. Most urban economists believe the decentralizing process has been caused by rising real incomes, which motivate households to seek larger homes and lots, and by improved means of transportation and communications, which reduce the costs of traveling and communicating over greater distances. These forces have been crucial influences in "pulling" firms and households—especially high-income households—outward from the central parts of metropolitan areas to their edges. Consequently, such outward movement would surely have occurred to some degree in the absence of other factors.

Nevertheless, a second set of factors consisting of poverty, crime, and racial concentrations has greatly increased and accelerated the movement of viable firms and households away from older core areas and toward the periphery of the metropolitan areas. *A central hypothesis of this analysis is that these push factors have been generated for the most part by the disproportionate concentration of poor households in older core areas—a result of the American metropolitan growth process*. Therefore, understanding how that concentration occurs is crucial to exploring how suburban sprawl might be linked to urban decline.

In 1990, approximately 10 million people lived in census tracts in which 40 percent or more of the residents had incomes below the poverty line. About 7.5 million of the 10 million were located in central cities, comprising 10 percent of the total center-city population. This percentage varied greatly among cities: 36.5 percent in Detroit; 23 percent in Atlanta; 13.7 percent in Chicago; and only 3.4 percent in Washington, D.C. Similar census tracts are now expected in the 2000 Census in many older, inner-ring suburbs too. In 1990, more than 30 percent of all poor African Americans in America lived in such high-poverty census tracts, compared with 21 percent of all poor

Hispanics and only 7 percent of all poor whites.[1] In 1990, more than 19 percent of all central-city residents were poor, compared with approximately 8.4 percent of all suburban residents.

This American concentration of poor households within older, central-city core neighborhoods is not an inevitable result of overall population growth, the laws of nature, or free-market forces. In fact, it is not found in most other nations. *Concentration of the poor—especially poor minority-group households—in older core areas is a peculiarly American condition caused by specific public policies that are designed to spatially segregate poor households from nonpoor households, which form a majority in each metropolitan area.*

A metropolitan area—anywhere in the world—must include for its economic success a significant percentage of low-income households, because these residents perform vital economic roles. Low-income residents cannot afford to live in market-value housing (i.e., new standard-quality units as defined by American housing laws) without receiving public subsidies, which are costly, or spending high proportions of their income. Therefore, large metropolitan areas must have housing units that are considered "substandard." This is a reality that few public officials or urban planners are willing to acknowledge; nevertheless, it exists, even in the wealthy United States. Substandard units are either new units built to very low quality standards or older, better-quality units that have deteriorated or become overcrowded. Such "slums" provide housing that many poor households can afford to occupy without subsidies.

As the total population of any U. S. metropolitan area rises, the number of poor people there also rises as long as the United States continues to receive millions of poor immigrants from abroad. However, the presence of low-income households is regarded by most local public officials and many residents as a fiscal drawback. Compared to more affluent households, poor residents tend to generate high public-service costs but provide low revenues from property taxes and sales taxes. Moreover, low-income neighborhoods are associated with higher-than-average crime rates and other social maladies. Consequently, nearly every locality wants to minimize the number of its poor residents. Furthermore, no community can use local taxes to significantly redistribute income to benefit its poor residents without driving many of its nonpoor residents and firms somewhere else.[2]

A key hypothesis of this analysis is that the metropolitan development process in the United States contains six basic elements that generate high concentrations of minority-group poverty in inner-core areas.

First, American zoning and building codes universally require all new housing units to meet high-quality standards that are unaffordable to poor households without public subsidies. In contrast, in most developing nations, poor people can and do occupy brand new unsubsidized units—most of which they have built themselves. But these units are constructed to low-quality standards. They are usually little more than shacks to begin with, though many are upgraded over time. Such units are often built on once-vacant land expropriated by the residents through "squatting," without purchase or the obtainment of legal title. This permits poor people to build new units at the growth periphery in concentrations of slums known as ghettos or barrios. Over time, as the new-growth periphery moves outward from the historic center, concentrations of poor households are found at all distances from that center—neither just in the center itself (as in the United States) nor mainly on the edges (as in much of Western Europe). This outcome is prevented in the United States by legally requiring all newly built dwellings to meet high-quality standards and by rigorously enforcing those requirements.

Second, governments—federal, state, and local—do not provide enough housing or income subsidies to enable most low-income households to live in newly constructed units, which are costly because of the

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[1] Data from Ronald B. Mincy and Susan J. Wiener, *The Underclass in the 1980s: Changing Concept, Constant Reality*, (Washington, D.C.: The Urban Institute, July 1993); Paul A. Jargowsky and Mary Jo Bane, "Ghetto Poverty in the United States: 1970-1980," in Christopher Jencks and Paul A. Peterson, eds., *The Urban Underclass* (Washington, D.C.: The Brookings Institution, 1991), 251-270; and John D. Kasarda, "Inner-City Concentrated Poverty and Neighborhood Distress," *Housing Policy Debate*, 4, 3 (Fall 1993): 253-302.

[2] For a discussion of why significant income redistribution within most cities is politically impossible, see Paul E. Peterson, *City Limits,* Chicago, IL: Chicago University Press, 1981.

high standards they are required to meet. In Western Europe, many poor households live in standard-quality units that are publicly subsidized and located in new suburban areas. In the United States, governments provide only enough housing subsidies to shelter about 20 percent of the poor in standard-quality housing. Local opposition prevents most of those subsidized units from being placed in suburbs, so they are concentrated in older inner-city areas. There is nothing inherently wrong with having most low-income households occupy older housing units that have "trickled down" from former occupancy by nonpoor people unless those units are deteriorated, as they often are. The older housing in each metropolitan area is concentrated in close-in areas. Thus, in the United States, high-quality standards for all new housing and the limited availability of public subsidies preclude most poor households from living in new-growth regions on the periphery of each metropolitan area.

The third factor that helps generate high concentrations of poverty in metropolitan areas consists of exclusionary zoning codes and other local policies adopted by suburban communities whose residents do not want poor people living nearby. Many suburbs have adopted zoning codes that minimize the land availability for construction of multifamily housing, which is less costly than single-family units. Other suburbs have adopted large-lot and other rules that prevent lower-cost single-family housing. Such spatial segregation by income is not a burden to the upper- and middle-income groups, but it compels low-income people to live in older areas containing a concentration of poverty-level households. The widespread nature of such regulatory barriers was documented by the United States Department of Housing and Urban Development's Advisory Commission on Regulatory Barriers to Affordable Housing.[3]

The fourth factor that helps generate high concentrated poverty in inner-city areas is racial segregation in housing markets. Studies of recent behavior by white real estate brokers, homeowners, and mortgage lenders reveal a high incidence of discrimination against African American households. One reason African Americans live in areas of concentrated poverty is the high fraction of all African Americans who are poor. In 1997, six years into the greatest peacetime economic expansion in American history, 26.5 percent of all African Americans had incomes below the poverty level, compared to 27.1 percent of all Hispanics, and 11.0 percent of non-Hispanic whites.

Neighborhood racial segregation is not caused solely by widespread unwillingness on the part of white Americans to live near African Americans or other "persons of color." Such segregation also arises from a combination of differences in the way African Americans and white Americans typically define "desirably integrated neighborhood," and the resulting processes of self-selection in the housing choices made by members of both groups. Poll results show that African Americans typically consider a neighborhood to be "desirably integrated by race" when about half the residents are African American and half are white. In contrast, polls also show that most white Americans consider a neighborhood to be "desirably integrated by race" when no more than 25 percent to 33 percent of the residents are African Americans, and the rest are white. (A discussion of these views is presented later.) In light of these views, if all the members of both groups want a given neighborhood to be "desirably integrated," it will not remain so over time. For example, if the neighborhood has only a few African American residents, other African Americans will continue to move in as long as their group accounts for less than half of the residents, since many prefer an integrated area. However, when the percentage of African Americans exceeds approximately 33 percent of all residents, most white Americans will stop moving in because they believe that the neighborhood is no longer "desirably integrated." Yet, residential neighborhoods in the United States have an annual housing turnover rate of at least 10 percent (and often higher) for reasons unrelated to racial composition. Therefore, 10 percent of the existing residents must be replaced each year by newcomers to keep the population constant. If all the newcomers are African Americans, their percentage of the total population will inevitably rise beyond 33 percent. Eventually, the neighborhood will become almost entirely African American, even if all residents of both groups would prefer living in a racially integrated neighborhood and no initial white residents "flee" from racial change. This outcome results from the differential willingness of members of each of the two groups to live with varying proportions of members of the other group. As long as most whites are less

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[3] Advisory Commission on Regulatory Barriers to Affordable Housing, *Not in My Backyard* (Washington D.C.: United States Department of Housing and Urban Development, 1991).


Courtesy of A. Nelessen

willing than African Americans to share neighborhoods with high proportions of members of the other racial group, it will be difficult to achieve stable racial integration in many neighborhoods.

Moreover, many whites do not want to live in neighborhoods in which even low percentages of African Americans are present. Therefore, they engage in explicit racial discrimination when buying homes for themselves and when selling or renting homes to others. This attitude is also a key factor sustaining residential racial segregation.

A fifth element in the U.S. metropolitan development process that helps generate spatial concentration of the poor in older core areas is the presence of many more obstacles to building new housing in such areas, and in older cities generally, than on vacant land at the metropolitan periphery. These additional obstacles include higher land costs; a greater incidence of previously polluted sites that must be cleaned before redevelopment can occur; more restrictive local regulations and much more bureaucratic red tape that must be overcome; legal or political requirements to use costlier union labor; union resistance to lower-cost building methods and materials; a greater likelihood of neighborhood opposition; a greater difficulty obtaining financing in older neighborhoods; and higher crime rates. Such difficulties lead real estate developers to prefer building new projects on vacant peripheral sites to putting similar projects on infill sites within large cities or older suburbs.

The final factor that helps generate concentration of poverty in older core areas is the pattern of expressing upward social and economic mobility by moving to "better" neighborhoods rather than by upgrading one's existing accommodations without moving. This dynamic behavior pattern may be part of the "frontier mentality," which encourages people to move farther outward from established settlements whenever their circumstances change for the better. Whatever its ultimate cause, this behavior pattern tends to drain the most successful households out of poor inner-city neighborhoods, leaving the remaining households with a higher concentration of poor neighbors. Thus, as individual household upward mobility is achieved, the proportion of middle- and upper-income households left in inner-city neighborhoods decreases. This dynamic occurs among all racial and ethnic groups, and it is a key factor in keeping the percentage of children from poor households quite high in public schools serving inner-city neighborhoods.

Concentration of Poverty and Urban Decline

The next set of hypotheses underlying this analysis concerns the impacts of concentrated poverty. When concentrations of poverty arise in older central-city and inner-ring suburban neighborhoods, destructive local environments are often created. Such environments are marked by high rates of crime, out-of-wedlock births, single-parent households with no father present, unemployment, drug abuse, inadequate nutrition for babies, lack of interest in education, and school truancy.

In particular, five negative conditions have caused millions of households and many business firms to move out of older central-city and inner-ring suburban neighborhoods. These same five conditions have also inhibited middle-income households of all ethnic types and viable firms from moving back into such neighborhoods. The first condition is fear of crime and violence. The second is the poor quality of public schools, a problem created by both the burden of educating high proportions of children from poor households with nonsupportive attitudes toward education and the presence of dysfunctional public school systems. The third condition is the unwillingness of most white households to live in neighborhoods where more than one-third of the residents are minority-group households, as noted above.[4] The fourth condition is the dysfunctional nature of many large-city bureaucracies, such as schools, welfare systems, housing authorities, and the police. The fifth condition is the inability of local governments in many cities to provide high-quality public services to their citizens because of lack of fiscal resources.

The out-migration of middle- and upper-income households and viable businesses caused by the five conditions described continues to drain fiscal resources from older cities that are saddled with the costs of serving the poor. As a result, the ability of local governments to overcome or offset these negative conditions is further weakened. Thus, the concentration of the poor in these core areas leads to a self-aggravating downward spiral in their fiscal strength and environmental quality.

The process described above creates tremendous social inequities in the quality of environments in different parts of each metropolitan area. Central cities, inner-ring suburbs, and some outer-ring suburbs have low fiscal resources and high costs compared with many affluent suburbs. This situation makes a mockery out of the cherished American value of "equality of opportunity." The growth process is not the only cause of these problems, but it is a crucial and major cause.

Sprawl and the Spiral of Urban Decline

The next key hypothesis is that the entire process of urban decline is aggravated by several of the basic characteristics of suburban sprawl:

- Very low density residential and nonresidential development spreads the entire metropolitan area out over a much larger total territory than it would have to occupy if average densities were higher. This separates many low-income households and

Courtesy of G. Lowenstein

[4] Recent survey evidence confirming that this view is still strong among whites is cited in Douglas S. Massey and Nancy A. Denton, *American Apartheid: Segregation and the Making of the Underclass* (Cambridge, MA: Harvard University Press, 1993), chapter 4.

unemployed workers living in the core areas from job opportunities in the peripheral areas, adds to total infrastructure and travel costs, makes widespread use of public transit impractical, and may aggravate regional air pollution.

- Fragmented government controls over land use permit many communities to engage in exclusionary zoning, and inhibit the emergence of any incentives for local government officials to take account of the impacts of their parochial actions on the region as a whole. This prevents many low-income households from relocating near the new-growth suburbs where job opportunities are being created. Poor residents are concentrated in inner-city neighborhoods, as explained above. This condition also causes the metropolitan area to spread out over a larger territory, further separating low-income workers from job opportunities.

- Fragmented control over the fiscal tax base inherent in fragmented general government powers causes older-city governments and some inner-ring suburban governments to lose any access to taxable resources that move outside their boundaries, even if the households and firms involved continue to use services provided by those city governments. Fragmented control also motivates officials in each local government to discourage creation of land uses within its borders that its officials regard as “fiscal losers;” that is, uses that generate more local government expenditures than revenues. Conversely, local officials are motivated to encourage creation of land uses they regard as “fiscal winners.” This usually means that they favor more offices and retailing centers rather than low-cost housing (especially rental apartments). So, households seeking low-cost housing find it available mainly in the form of older units in central cities and older suburbs, near the location of other low-income households.

- Unlimited outward expansion of new growth and leapfrog development permit the construction of new subdivisions on vacant land in more distant locations. This eventually draws new places of employment into areas similarly distant from the historic center. Such peripheral development adds unnecessarily to the social costs of creating the infrastructure to serve these settlements and locates many new jobs beyond the knowledge or commuting range of most unemployed residents.

Courtesy of R. Ewing

- Almost total reliance on private automobile transportation means that low-income residents who cannot afford to own a car or truck cannot easily find or commute to most of the areas where new jobs are being created. The areas either are not served by public transportation or, if they are served by public transportation, the trip is extremely long and costly. This aggravates the negative effects of unlimited outward extension, low-density peripheral settlements, and leapfrog development.

- The complete absence of any centralized planning or regulation of land use means that public officials have no incentives to take into account the effects of local government planning decisions on the operation of the entire region, or the tendency of the growth process to undermine the fiscal health of large older cities.

- Creation of widespread commercial strip developments outside existing downtown areas of the central-city and suburban communities undermines the fiscal health of older established communities because newer retail facilities drain business—and therefore property values—from existing establishments in the downtown areas. This aggravates the fiscal decline of governments in cities closer to the metropolitan center while benefiting governments in cities at the periphery.

- Physical segregation of land uses by type into separate zones makes walking impractical, thereby creating the need for more driving trips by residents and, possibly, increasing air pollution.

These are some of the major disadvantages of suburban sprawl, as alleged by its critics where it is compared with alternative, higher-density forms of suburbanization. However, merely asserting that these causal relationships exist does not prove either that they actually exist or if they do exist, that they have significant negative effects that aggravate urban decline.

STATISTICAL ANALYSIS BASED ON AN INITIAL DEFINITION OF SPRAWL AND URBAN DECLINE

Statistical Relationship between Sprawl and Urban Decline

How can the importance of such alleged disadvantages be analyzed statistically? The first of two methods used in this chapter entails the development of a generalized quantitative measure of suburban sprawl followed by an examination of the relationship between that measure and measures of each of the negative outcomes described above. But suburban sprawl is a complex phenomenon, as indicated by the 10-trait definition set forth earlier. Therefore, no one empirical variable can capture all of its dimensions. One way to at least partially overcome this difficulty is to develop separate variables to measure different aspects of sprawl and then create a *sprawl index* from all of those variables to estimate sprawl's overall presence in each metropolitan area. The goal is to determine whether sprawl in general seems to have an important causal role in generating any of its alleged negative effects. This method is employed later in this analysis.

A second method of relating sprawl and urban decline involves the development of a similar generalized quantitative measure of urban decline followed by an examination of the relationship of that measure to (1) the sprawl index and (2) specific measures of several individual characteristics of sprawl. The object would be to determine whether sprawl in general, or any of its specific traits, seems to have an important causal role in generating urban decline. The analysis employs this method using two different measures of urban decline. The first measure consists of *the percentage change in central-city population from 1980 to 1990.* This variable really encompasses *overall city growth*, rather than urban decline alone, since it measures positive population expansion as well as decline. Urban decline, however, is also a complex phenomenon encompassing more than just central-city population changes. Therefore, this analysis also develops an *urban decline-distress index* computed from measurements of several components of urban decline and distress. These components include crime rates, unemployment rates, high school drop-out rates, percentage changes in city population from 1980 to 1990, and several other variables.


Courtesy of T. Delcorso

These two major measures of urban decline—population change and the urban decline-distress index—are used as dependent variables in separate regressions in which the sprawl index and many other traits are used as independent variables. In addition, a third set of regressions uses these two dependent variables versus the individual components of the sprawl index as independent variables (but not the index itself) to see whether any particular elements of sprawl are especially significant causes of urban decline.

Developing a Generalized Measure of Sprawl

What Areas Should Be Used?

The first issue in developing a generalized measure of sprawl is, to what geographic and jurisdictional areas or entities should the measure be applied? The Census Bureau has developed a measure it refers to as *urbanized areas*. These are territories immediately surrounding a major city or other urbanized center that exhibit enough density and enough contiguity to some major built-up area to be considered part of its hinterland. Urbanized areas are usually parts of metropolitan areas; however, some metropolitan areas may exist outside urbanized areas, and urbanized areas occasionally extend outside the boundaries of metropolitan areas. The Census Bureau published 1990 urbanized area population and area data for 396 urbanized areas. Separate population and area data were published for the central places and urban fringes of each urbanized area, thereby permitting calculations of population densities in both the central places and the surrounding urban fringes. This information is much more appropriate for measuring suburban sprawl than densities that could be gleaned from metropolitan-area data, which often cover large, relatively sparsely inhabited territories far from central places. Therefore, much of the analysis in this chapter deals with urbanized-area data rather than metropolitan-area data.

Among the 396 urbanized areas enumerated by the Census Bureau in 1990, 220 had populations of less than 150,000. The average territory encompassed by these smaller areas was 51.4 square miles. Such small areas would surely not suffer most of the adverse impacts of suburban sprawl alleged by its critics, because new settlements at their periphery would not be very far from their centers. Therefore, this initial analysis focuses on only the 162 urbanized areas that had 1990 populations of 150,000 or more.[5] These 162 urbanized areas, and some basic data concerning each, are listed in alphabetical order in Appendix D.[6]

What Variables Should Be Measured?

Not all of the 10 characteristics identified earlier as defining suburban sprawl can be quantitatively measured. Two traits are immeasurable even in theory: leapfrog development and no centralized planning or regulation. Among the remaining eight, there are three (namely, segregation of land uses by type, disparities in the fiscal capacities of local governments across each metropolitan area, and emergence of commercial strip development along major arteries) for which it would be very difficult to obtain the required data. That leaves five traits of sprawl that are measurable in theory and for which adequate data are available: population density, unlimited outward extension, transportation dominated by the use of automobiles (shown by commuting data), fragmentation of governments, and the concentration of low-income households within central cities relative to their suburbs. (The last is not part of the specific definition of sprawl used herein, but is closely related to the "trickle down" process and to exclusionary zoning, as discussed later in the chapter.)

However, more than five measures of sprawl can be derived from these five defining traits of sprawl. The following nine measures have been developed:

1. *An urbanized area's total land area* (URBLND90). The larger the population of an urbanized area or metropolitan area, the more likely its population is to "sprawl" over a large territory, and therefore the more likely the area is to suffer from the alleged drawbacks of suburban sprawl. There is a 78 percent correlation between the physical size of urbanized areas and their total populations. Therefore, the bigger the

Courtesy of C. Galley

[5] One small urbanized area—the Hesperia-Apple Valley area in California—had such a low population in 1980 that its percentage increase in population from 1980 to 1990 was so enormous as to distort statistical analysis using that increase as a major element. Therefore, the Hesperia-Apple Valley urbanized area has been excluded from the entire analysis, leaving 162 urbanized areas in the sample.

[6] One additional problem emerged in analyzing the 162 areas: nine are smaller parts of large metropolitan statistical areas (MSAs), rather than the central portions of those metropolitan areas. Yet it is necessary to use some territories as equivalent metropolitan areas for several of the key variables in the analysis. Therefore, individual counties surrounding these smaller urbanized areas were used in some instances as smaller metropolitan areas while their larger metropolitan areas were used in other cases.


Courtesy of C. Galley

physical territory encompassed by an urbanized area, the greater its degree of sprawl.

2. *The population density of that portion of an urbanized area outside its central city or cities* (OUTDEN90). Low density is in itself a key defining trait of sprawl. But sprawl refers to low density at the periphery of a built-up territory. Therefore, the density of population in portions of an area outside its central city (or cities) — its urbanized fringe — is an appropriate measure of sprawl. The lower that density, the greater the sprawl.

3. *The ratio of the central city's population density to the density of the urbanized fringe* (DENRATIO). If the central city (or cities) has a much higher density than its surrounding urbanized fringe, there is a greater likelihood that people and firms will move out of the central city to the fringe than if both have similar densities. The former circumstance is most prevalent in older urbanized areas with central cities originally built when transportation facilities were not adequate to support low population densities. These older cities tend to have obsolete street layouts that cause congestion, as well as older housing that residents with rising incomes consider less desirable than newer outlying housing. Those aspects contribute to the greater tendency of households and firms to move out of the central areas, especially as household incomes rise. Consequently, the higher the ratio of the central city's population density to the urbanized fringe's density, the greater the degree of sprawl within an urbanized area.

4. *The percentage of a metropolitan area's total population living outside the boundaries of the urbanized area around the metropolitan area's center (%MSAOUTS).* The urbanized area lying in and around the center of each metropolitan area normally encompasses most of the higher-density portions of that entire metropolitan area. If a significant percentage of the metropolitan area's residents live outside the boundaries of that urbanized area, they probably live at densities too low to have been considered "urbanized" by the Census Bureau (normally, fewer than 1,000 residents per square mile). These "outer fringe" residents might be considered the vanguard of suburban sprawl. Therefore, the higher the proportion of a metropolitan area's total population that resides outside the boundaries of its central urbanized area, the greater the degree of sprawl.

5. *The percentage of a metropolitan area's total population living within its central city (or cities)* (%MSACENC). The central city of each metropolitan area normally contains the highest-density portions of settlement within that area, partly because it usually contains the earliest-developed portions. If the central city encompasses only a small percentage of the metropolitan area's total population, most of that population lives in relatively lower density outlying suburbs. Moreover, in such cases, the central city is likely to suffer more fiscal and other adverse consequences from outward movement of households and firms to the suburbs than when the central city contains a relatively high percentage of the metropolitan area's total population. Therefore, the smaller the percentage of a metropolitan area's total population residing within its central city (or cities), the greater the degree of sprawl there.

6/7. *The percentage of commuters within the urbanized area who commute either by driving alone or in car pools* (DRIVALON and %CARPOOL). The higher this combined percentage, the more dominant are automotive vehicles in the transportation life of the urbanized area.

8. *The number of separate local jurisdictions controlling land use per 100,000 metropolitan-area residents* (LOCP100K). Fragmented jurisdiction over land uses is a key trait of sprawl as defined in this study. Therefore, the larger the number of separate jurisdictions with control over land uses per 100,000 residents of a metropolitan area, the greater the degree of sprawl within that area.

These political jurisdictions include counties, cities, townships, and villages.

9. *The ratio of the percentage of central-city residents who are poor to the percentage of suburban residents who are poor (that is, the former divided by the latter)* (CITSUBPV). This ratio measures the relative degree to which poverty within the metropolitan area is concentrated within its central city, compared to its suburbs. Ratios larger than 1.0 indicate that the central city has a higher percentage of poor residents than all of the outlying portions of the metropolitan area combined (the suburbs). To some degree, this variable can be interpreted as measuring the extent of exclusionary zoning by outlying areas, since a high ratio indicates that the suburbs have much lower fractions of poor residents than the central city. True, many factors other than exclusionary zoning may influence this ratio. This ratio is not the same as the overall extent of poverty within the city or the metropolitan area. Rather it compares poverty within these two subregions, and may be either high or low in either quite poor or quite affluent metropolitan areas.

Data for measuring all nine of these possible indicators of sprawl are available from the United States Census Bureau. Therefore, all nine have been included in the statistical analysis described below.

How Should Measurements of the Indicator Variables Be Translated into a "Sprawl Index"?

There are many ways to develop a single "sprawl index" from the nine measurements described above. Admittedly, choosing from among these methods is quite arbitrary. This analysis has used an approach that is easy to understand and therefore could be varied by someone wishing to use the same data but in a different manner. For each of the nine measurements described above, the following procedure was used:

- All 162 urbanized areas were sorted in descending order of the key variable concerned, with the area having the value indicating the highest degree of sprawl at the top of the list and the area having the value indicating the lowest degree of sprawl at the bottom of the list. Thus, New York City has the highest degree of sprawl based on the physical size of its urbanized area, which is 2,966.4 square miles—the largest of all 162. In contrast, the Santa Barbara urbanized area has the lowest degree of sprawl with respect to that variable, since it contains only 48.8 square miles.

- The area with the greatest degree of sprawl by this definition is assigned a *sprawl index score* of 100 for that trait; the area with the lowest degree, a score of zero.

- The value of this variable with the lowest degree of sprawl is subtracted from the value of this variable with the highest score. The difference is then divided by 100 to determine what change in the value of this variable should be equivalent to a one-point change in the sprawl index score of the area concerned. In this case, 2,966.4 minus 48.8 equals 2,917.6. Divided by 100, that equals 29.176. Therefore, every difference of 29.176 square miles in total area should equal a one-point difference in the sprawl score of an urbanized area with respect to this variable. To put it another way, the sprawl score for this variable can be computed with the formula:

  SPRAWL INDEX SCORE =
  (URBANIZED LAND AREA - 48.8) X (1/29.176)

  or

  SPRAWL INDEX SCORE =
  [(THIS URBANIZED AREA'S VALUE—LEAST HIGHLY SPRAWL ORIENTED VALUE)] X [1/((MOST HIGHLY SPRAWL ORIENTED VALUE—LEAST HIGHLY SPRAWL ORIENTED VALUE)/100)]

  This amounts to considering the difference between the most-favorable-to-sprawl value and the least-favorable-to-sprawl value as equal to 100 points.

- Similar scores are computed for all nine variables. These nine values are then added and divided by nine to obtain the *composite sprawl index score*. This amounts to weighting each of the nine measures as equal in relative importance to each of the others. It is also possible to weight some of these variables more heavily by multiplying them by some factor before engaging in this averaging. This variation is discussed further below.

Results of Computing the Sprawl Index

The overall sprawl index scores for all 162 urbanized areas, plus their scores for each of the nine components of the index, are provided in Appendix E to this report.[7] Table 13.1 is the ranked tabulation of the 162 urbanized areas by their overall sprawl index scores (calculated with equal weight on each element). Table 13.2 is a tabulation of the 20 urbanized areas with the highest sprawl ranking. At first glance, the overall ranking is surprising, because several older northeastern and midwestern cities are ranked among those with the highest sprawl index scores. Among the 20 most sprawling urbanized areas are 16 located in the Midwest or Northeast. Several of these older cities—such as Hartford, Scranton, and Harrisburg—get high component scores because they have very low percentages of their total metropolitan-area populations within the central-city boundaries. Several other midwestern cities get high sprawl scores because they have so many local governments per 100,000 residents.

In contrast, many urbanized areas commonly thought of as "sprawling" receive low sprawl index ratings. Los Angeles ranks 150th out of 162, and Phoenix, Tucson, San Diego, and Denver are all near the bottom of the list. Los Angeles gets a low composite score because it has the highest fringe-area population density of all these urbanized areas.

What most people think of as "suburban sprawl" is low fringe-area population density. If that component of the index is used as the sole measure of sprawl, then the following 20 urbanized areas would have the greatest degree of sprawl, in the order shown (excluding Anchorage, Alaska, which has no fringe area):

Lubbock, TX
Lincoln, NE
Lexington-Fayette, KY
Corpus Christi, TX
Savannah, GA
Huntsville, AL
Nashville, TN
Winston-Salem, NC
Jackson, MS
Greensboro, NC
Charlotte, NC
Tulsa, OK
Lorain-Elyria, OH
Mobile, AL
El Paso, TX-NM
Knoxville, TN
Norfolk-Virginia Beach, VA
Chattanooga, TN-GA
Little Rock, AR
Montgomery, AL

Another approach would be weighting land size and outlying population density more heavily in computing the composite sprawl index. The results of quadruple weighting these two elements are shown in another column of the sprawl index summary table in

[7] One statistical difficulty arose from this process: for three of the variables, the New York urbanized area had values that constituted distant "outliers" in the statistical sense. That is, these values were much greater than the analogous variable values for any other urbanized area. This outcome arose because the Census Bureau treats the New York City and northern New Jersey environs as a single urbanized area whereas it divides most of the other very large urban concentrations (e.g., the Los Angeles and Chicago areas) into several separate urbanized areas. This makes the New York urbanized area much larger than any other in terms of both spatial territory and population. In addition, the gross population density of New York City is much higher than that of any other U.S. city, and New York City has a much more extensive public transit system than any other U.S. city. Therefore, concerning the ratio of central-city density to outlying urban-fringe density, the total land area within the urbanized area, and the percentage of locally resident commuters who use automotive vehicles or public transit, New York City had values far more than three standard deviations away from the mean. Including these extreme values in regressions concerning the variables would tend to distort the results. Consequently, in all regressions using these variables (including the variables DRIVALON, %CARPOOL, and %PUBTRAN), New York was omitted as a case.

One other statistical problem was caused by the high population growth rate—102 percent—of the Lancaster, California urbanized area from 1980 to 1990. This value was also an extreme outlier, since the median growth rate was 8.26 percent and the standard deviation was 17.88 percent. Therefore, the Lancaster area was omitted from all regressions using the percentage rate of population growth from 1980 to 1990 as the dependent variable. In the cases of several other variables, outliers were eliminated if they were more than three standard deviations from the mean in using those variables in regressions.

Table 13.1
Ranked Urban Decline-Distress Index Scores for 162 Urbanized Areas
Decline Index with Equal Weight on Each Element

Rank	Area	Index	Rank	Area	Index	Rank	Area	Index
1	Atlantic City, NJ	75.62	55	Lansing-East Lansing, MI	52.85	109	Columbus, OH	42.96
2	Detroit, MI	75.35	56	Kalamazoo, MI	52.55	110	Montgomery, AL	42.73
3	Lawrence-Haver., MA-NH	75.09	57	Kansas City, MO-KS	52.55	111	Columbus, GA-AL	42.56
4	St. Louis, MO-IL	74.70	58	Akron, OH	52.51	112	Amarillo, TX	42.55
5	Youngstown-Warren, OH	73.15	59	Dayton, OH	52.15	113	Nashville, TN	41.87
6	Miami-Hialeah, FL	72.98	60	Mobile, AL	51.98	114	Riverside-San Ber., CA	40.96
7	Flint, MI	71.01	61	Memphis, TN-AR-MS	51.35	115	Des Moines, IA	40.62
8	Cleveland, OH	70.84	62	Joliet, IL	51.34	116	Springfield, MO	40.60
9	Hartford-Middletown, CT	70.32	63	South Bend-Misha., IN-MI	50.71	117	Tulsa, OK	40.52
10	Trenton, NJ-PA	69.98	64	Shreveport, LA	50.66	118	Santa Barbara, CA	40.06
11	Baltimore, MD	67.69	65	Worcester, MA-CT	50.51	119	Jackson, MS	39.76
12	Buffalo-Niagara F., NY	67.09	66	Roanoke, VA	50.24	120	Lubbock, TX	39.65
13	Harrisburg, PA	66.34	67	Stockton, CA	50.24	121	Fayetteville, NC	39.63
14	Reading, PA	65.99	68	El Paso, TX-NM	50.14	122	Pensacola, FL	39.38
15	Augusta, GA-SC	65.05	69	Savannah, GA	49.99	123	Provo-Orem, UT	39.38
16	Bridgeport-Milford, CT	63.38	70	Minneapolis-St. Paul, MN	49.95	124	Winston-Salem, NC	39.35
17	Providence-Paw., RI-MA	62.95	71	Dallas-Fort Worth, TX	49.82	125	Tucson, AZ	39.33
18	Daytona Beach, FL	62.71	72	Ogden, UT	49.69	126	Modesto, CA	39.11
19	Springfield, MA-CT	62.27	73	Norfolk-Virginia B., VA	49.27	127	Seattle, WA	39.06
20	New Orleans, LA	61.98	74	Oxnard-Ventura, CA	49.20	128	Phoenix, AZ	38.97
21	Lancaster, PA	61.48	75	Allentown-Bethlehem, PA	49.20	129	Santa Cruz, CA	38.97
22	Lowell, MA-NH	60.94	76	Jacksonville, FL	49.11	130	Omaha, NE-IA	38.60
23	Philadelphia, PA-NJ	60.86	77	Knoxville, TN	49.10	131	Orlando, FL	38.53
24	Utica-Rome, NY	60.78	78	Baton Rouge, LA	48.89	132	Salem, OR	38.39
25	Rochester, NY	60.29	79	Tacoma, WA	48.86	133	Wichita, KS	38.16
26	Canton, OH	59.95	80	Albany-Schenectady, NY	48.47	134	Green Bay, WI	38.06
27	New Haven-Meriden, CT	59.71	81	Houston, TX	48.31	135	Charlotte, NC	36.31
28	Atlanta, GA	59.29	82	Fort Myers-Cape Co., FL	47.81	136	Albuquerque, NM	36.13
29	Birmingham, AL	57.90	83	Rockford, IL	47.71	137	Lexington-Fayette, KY	35.93
30	Wilmington, DE-NJ	57.59	84	Charleston, WV	47.67	138	Bakersfield, CA	35.79
31	Cincinnati, OH-KY	57.47	85	Fresno, CA	47.19	139	Durham, NC	35.31
32	Syracuse, NY	56.61	86	Evansville, IN-KY	47.04	140	Greensboro, NC	35.28
33	Brockton, MA	56.54	87	San Antonio, TX	46.55	141	San Diego, CA	35.17
34	Chicago, IL-North. IN	56.50	88	West Palm Beach-Boca, FL	45.50	142	Tallahassee, FL	35.07
35	Binghamton, NY	56.28	89	Greenville, SC	45.32	143	Melbourne-Palm B., FL	34.64
36	Louisville, KY-IN	56.08	90	San Francisco-Oakland, CA	45.21	144	San Jose, CA	34.64
37	Tampa-St. Peters., FL	55.46	91	Portland-Vancou., OR-WA	45.13	145	Huntsville, AL	34.31
38	Erie, PA	55.14	92	Peoria, IL	45.12	146	Eugene-Springfield, OR	34.09
39	McAllen-Edinburg, TX	55.09	93	Denver, CO	44.98	147	Austin, TX	33.46
40	Boston, MA	54.97	94	Columbia, SC	44.95	148	Reno, NV	32.63
41	Los Angeles, CA	54.85	95	Corpus Christi, TX	44.75	149	Madison, WI	31.38
42	Pittsburgh, PA	54.69	96	Indianapolis, IN	44.71	150	Lincoln, NE	31.15
43	Lorain-Elyria, OH	54.65	97	Fort Wayne, IN	44.70	151	Appleton-Neenah, WI	30.74
44	New York, NY-North. NJ	54.57	98	Spokane, WA	44.40	152	Ann Arbor, MI	30.71
45	Scranton-Wilkes-B., PA	54.45	99	Charleston, SC	44.32	153	Colorado Springs, CO	29.46
46	Grand Rapids, MI	54.21	100	Davenport-Rock Isl., IA-IL	44.29	154	Las Vegas, NV	29.35
47	New London-Nor., CT	53.97	101	Biloxi-Gulfport, MS	44.12	155	Santa Rosa, CA	29.15
48	Richmond, VA	53.96	102	Aurora, IL	44.07	156	Honolulu, HI	28.76
49	Milwaukee, WI	53.80	103	Little Rock-North Lit., AR	43.55	157	Antioch-Pittsburg, CA	28.38
50	Waterbury, CT	53.71	104	Oklahoma City, OK	43.36	158	Lancaster-Palmdale, CA	28.36
51	Washington, DC-MD-VA	53.64	105	Sacramento, CA	43.36	159	Raleigh, NC	27.63
52	Toledo, OH-MI	53.43	106	Salt Lake City, UT	43.36	160	Boise City, ID	26.68
53	Huntington, WV-KY-OH	53.38	107	Sarasota-Bradenton, FL	43.30	161	Stamford, CT-NY	26.22
54	Chattanooga, TN-GA	53.37	108	Fort Lauderdale-Holly., FL	43.26	162	Anchorage, AK	24.45

Source: The Brookings Institution

the appendix and the top 20 from such a weighting are set forth in column 2 of Table 13.2. The results of these two weightings are quite similar. Fourteen of the 20 most sprawling areas with equal weighting of all variables remain in the top 20 with this particular unequal weighting; six are different in the two groupings.

Table 13.2
Cities of Highest Sprawl Ranking

Ranking by Sprawl Index	Cities of Highest Sprawl Ranking Using Sprawl Index with Equal Weights for All Nine Variables	Cities of Highest Sprawl Ranking Using Sprawl Index with Quadruple Weighting of Total Area and Outlying Density
1	Harrisburg, PA – 59.24	Anchorage, AK – 53.71
2	Antioch-Pittsburgh, CA – 56.41	Dallas-Fort Worth, TX – 51.77
3	Utica-Rome, NY – 55.91	New York – N.E. NJ – 50.05
4	Reading, PA – 54.87	Harrisburg, PA – 49.46
5	Lancaster, PA – 54.34	Utica-Rome, NY – 49.06
6	Joliet, IL – 54.04	Minneapolis-St. Paul, MN – 48.86
7	Lowell, MA – 54.00	Milwaukee, WI – 47.76
8	Hartford, CT – 53.67	Antioch-Pittsburgh, CA – 47.69
9	Scranton, PA – 53.10	Winston Salem, NC – 47.59
10	Kalamazoo, MI – 51.40	Greensboro, NC – 47.25
11	Lawrence, MA – 51.37	Atlanta, GA – 47.04
12	Grand Rapids, MI – 50.88	Lorain-Elyria, OH – 46.86
13	Greensboro, NC – 50.82	Lowell, MA – 46.67
14	Winston-Salem, NC – 50.76	Hartford, CT – 46.28
15	Milwaukee, WI – 50.54	Grand Rapids, MI – 46.21
16	Dallas-Forth Worth, TX – 50.27	Pittsburgh, PA – 46.01
17	Lorain-Elyria, OH – 49.83	Lancaster, PA – 45.97
18	Syracuse, NY – 49.35	Scranton, PA – 45.96
19	Peoria, IL – 49.24	Joliet, IL – 45.93
20	Fort Wayne, IN – 48.79	Charlotte, NC – 45.71

Source: The Brookings Institution

Figure 13.1 shows the distribution of all 162 equally weighted scores by five point ranges. This graph indicates that the index approach used in the analysis generates a roughly normal distribution of urbanized areas, shown by the bell-shaped graphic outcome. However, many areas have very similar scores; hence, differences in rank between areas with quite similar scores are probably not very meaningful. Thus, 52 areas have scores ranging from 40.0 to 44.99; they probably do not differ meaningfully in their true "degrees of sprawl."

Measures of Urban Decline-Distress

Which Areas Should Be Considered?

A key question in analyzing urban decline is: on which geographic areas should the analysis focus? This analysis uses the major central cities within each of the 162 urbanized areas used in the analysis of suburban sprawl described above. Within each urbanized area, the largest central city was selected (sometimes such areas contain more than one), and it was assumed that city would experience urban decline. This sometimes results in sizable cities being excluded from the analysis if they were incorporated into an urbanized area along with another, larger central city. However, the list of cities included in this analysis encompasses all of the 27 largest cities in the nation in 1990, and 46 of the 50 largest cities—omitting only Fort Worth (part of the Dallas-Forth Worth urbanized area), Long Beach (part of the Los Angeles-Long Beach urbanized area), Virginia Beach (part of the Norfolk urbanized area), and Oakland (part of the San Francisco-Oakland urbanized area). Among the 100 largest cities in the United States in 1990, 81 are specifically included in this analysis as central cities possibly subject to decline (or expansion).

What Should Be Measured?

Urban decline has been extensively analyzed in the past, notably by Katharine Bradbury, Anthony Downs, and Kenneth Small in *Urban Decline and the Future of American Cities*, The Brookings Institution (Bradbury 1982). Their analysis distinguishes be-

Figure 13.1
Distribution of Sprawl Index Scores for 162 Urbanized Areas

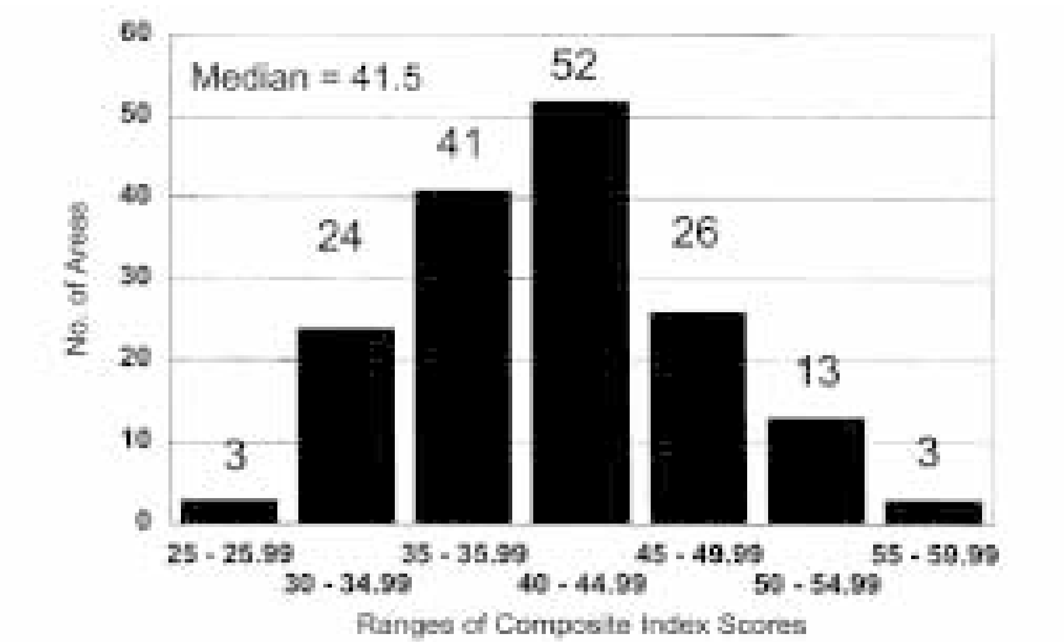
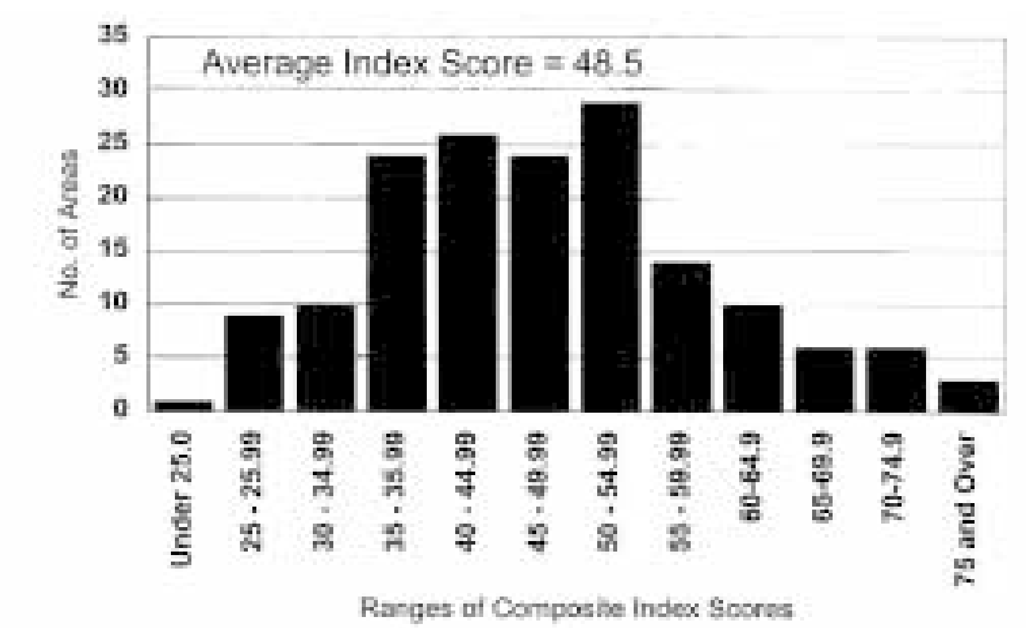


Figure 13.2
Distribution of Decline-Distress Index Scores for 162 Urbanized Areas



tween urban *decline* and urban *distress*. The first encompasses dynamic measures of *adverse changes in conditions* over time, and the second encompasses static measures of *adverse levels of certain conditions* in time. As noted above, we are using two measures of urban decline and distress. The first is the *percentage change in a central city's population from 1980 to 1990.* This is the single most important piece of evidence concerning whether a city was growing or declining. Hence it has been used as the dependent variable in a number of regressions designated to analyze the nature of urban decline. Once those regressions identified which factors are most significant in contributing to population change, those factors were examined to see whether they also contributed to urban decline.

Population changes in central cities are greatly affected by the cities' annexation of surrounding territories. To account for this factor, it is necessary to examine changes in the areas of central cities over the period of population change being considered. Data on the area of central cities within urbanized areas are available for both 1980 and 1990—the two dates spanning the period of population change considered in this analysis. Therefore, the percentage change in each central city's geographic area in square miles from 1980 to 1990 was used as an independent variable in all regressions concerning central-city growth rates to account for such annexation. Where the raw data indicated a change of less than 5 percent, the change was set equal to zero in the regressions, the assumption being that such small changes resulted from measurement or reporting errors.

However, focusing on a single variable as the measure of urban decline (and growth) precludes the greater richness of an approach with multiple dimensions. Hence a second approach that measures several different indicators of both decline and distress and combines them into a single *urban decline-distress index* was also used. This index was developed from measures of nine variables in the same way that the sprawl index was developed from measures of nine other variables, as described earlier. The nine variables on which the urban decline-distress index has been built are shown in Table 13.3. It sets forth the most and least declining-distressed cities for each variable, and their scores. (No data on violent crime rates were available for eight cities, so this variable was omitted from their index scores and the overall averages for those cities were computed on eight variables rather than nine.)

Results of Computing the Urban Decline-Distress Index

The results of computing the urban decline-distress index are shown in an accompanying table, with cities listed in descending order of their index scores (highest scores indicate the greatest decline-distress). Scores range from a high of 75.62 (Atlantic City) to a low of 24.45 (Anchorage). The average score is 48.5 and the median is 49.11. The five most declining-distressed cities were Atlantic City, Detroit, Lawrence, St. Louis, and Youngstown, in that order. The five least declining-distressed cities were Anchorage, Stamford, Boise City, Raleigh, and Lancaster-Palmdale, in that order. Among the 25 cities scoring highest on this index, 15 are in the Northeast, 5 in the Midwest, 5 in the South, and none in the West. Among the 25 cities scoring lowest on this index, 13 are in the West, 7 in the south, 4 in the Midwest, and only 1 is in the Northeast (Stamford). These results correspond approximately to what a priori intuition would indicate, as follows:

Courtesy of C. Galley

- The most declining-distressed cities are large ones in the Midwest and Northeast.
- The "usual suspects" are near the top of the list: Detroit, St. Louis, Cleveland, Flint, Youngstown, Buffalo, New Orleans, Philadelphia.
- Most western cities have very low decline-distress index scores, and a high percentage of all cities with low such scores are in the West.
- Index scores are distributed in a roughly bell-shaped curve, with most clustered in the middle and fewer at each extreme. This distribution is shown in Figure 13.2.

Comparing City Population Decline Rates and the Urban Decline-Distress Index

The two measures of urban decline calculated above produce different rankings of individual cities regarding their relative degrees of population gain or loss on the one hand, and urban decline-distress on the other. These rankings are shown in Tables 13.4 and 13.5.

Table 13.3 shows the 20 most-declining or distressed cities by both measures. Only six cities—Youngstown,

Table 13.3
Urban Decline-Distress Index Component Variables

Urban Decline-Distress Index Component Variable	Most Seriously Declining or Distressed Area and Value	Least Seriously Declining or Distressed Area and Value	Difference Between Extremes = 100 points
1. Percentage change in central-city population from 1980 to 1990 (CHG8090%)	Youngstown, OH -17.12%	Lancaster-Palmdale, CA +102.58%	119.7%
2. Number of violent crimes per 100,000 central-city residents in 1991 (VIOCPCAP)	Miami, FL 4,252 crimes	Appleton, WI 38 crimes	4,214 crimes
3. Percentage of 1990 residents over 25 who had graduated from high school (PCTGRAD)	Miami, FL 47.6% graduates	Ann Arbor, MI 93.9% graduates	46.3% graduates
4. Percentage of central-city workforce unemployed in 1991 (UNEMPLY%)	Flint, MI 16.7% unemployed	Lincoln, NE 2.3% unemployed	14.4% unemployed
5. Central-city income per capita in 1989 (INPCAP89)	Provo-Orem, UT $8,408 per capita	Stamford, CT $27,092 per capita	$18,684 per capita
6. Percentage of 1990 central-city population with 1989 incomes below the official poverty level (%POVPERS)	Augusta, GA 33.3% poor	Stamford, CT 6.3% poor	27.0% poor
7. Percentage 1990 housing units built before 1940 (PRE1940%)	Reading, PA 70.1% of units	Anchorage, AK 0.6% of units	69.5% of housing units
8. Percentage change in central-city population from 1990 to 1994 (%CHG9094)	New London, CT -20.14%	Las Vegas, NV +27.0%	47.14% population change
9. Percentage of 1990 residents aged 16 to 19 neither in school nor high school graduates (hence high school dropouts) (HS%DRPOT)	Atlantic City, NJ 27.93% est. high school dropouts	Ann Arbor, MI 2.19% est. high school dropouts	25.74% est. high school dropouts

Source: The Brookings Institution

St. Louis, Cleveland, Flint, New Orleans, and Buffalo—are on both of these "bottom 20" lists. Thus, severe population declines are not concentrated mainly in cities showing broader signs of urban decline or distress. The 20 least-declining cities by each measure are shown in Table 13.4.

Nine cities are on both of these "10 best" lists—Lancaster, Santa Rosa, and Antioch in California; Las Vegas and Reno in Nevada; Austin, Texas; Colorado Springs, Colorado; Anchorage, Alaska; and Melbourne, Florida. California cities dominate both lists. In fact, 10 of the 20 cities that grew fastest in population from 1980 to 1990 are in California. Only four of the 40 cities on these two lists are in the Midwest (three of them are the sites of state universities), and only one is in the Northeast—Stamford, Connecticut, is a "least distressed" city because of the high income of its residents.

Regression Analysis Methods

What Regression Methods Should Be Used?

In order to ensure the reliability of the conclusions drawn from analyzing these variables, this study uses two different multiple regression methods. One is a form of step-wise regression, in which independent variables are introduced—or removed—from the analysis one at a time. This method starts by using a set of many independent variables that might affect the dependent variables and gradually removes those that have low beta values and, especially, t-scores below 2.0. Different combinations of variables are tried until some are found that meet two criteria: (1) all independent variables have t-scores above 2.0, and (2) the resulting adjusted R-squared is larger than for

Table 13.4
Most-Declining Cities by Population Change and by Urban Decline-Distress Index

Rank	Most-Declining Cities by Population Change	Most-Declining Cities by Index Value
1	Youngstown, Ohio	Atlantic City, New Jersey
2	Huntington, West Virginia	Detroit, Michigan
3	Pittsburgh, Pennsylvania	Lawrence-Haverhill, Massachusetts
4	St. Louis, Missouri	St. Louis, Missouri
5	Cleveland, Ohio	Youngstown, Ohio
6	Flint, Michigan	Miami-Hialeah, Florida
7	New Orleans, Louisiana	Flint, Michigan
8	Charleston, West Virginia	Cleveland, Ohio
9	Chattanooga, Tennessee	Hartford, Connecticut
10	Louisville, Kentucky	Trenton, New Jersey
11	Canton, Ohio	Baltimore, Maryland
12	Utica, New York	Buffalo, New York
13	Erie, Pennsylvania	Harrisburg, Pennsylvania
14	Peoria, Illinois	Reading, Pennsylvania
15	Buffalo, New York	Augusta, Georgia
16	Davenport, Iowa	Bridgeport, Connecticut
17	Chicago, Illinois	Providence, Rhode Island
18	Atlanta, Georgia	Daytona Beach, Florida
19	Scranton, Pennsylvania	Springfield, Massachusetts
20	Birmingham, Alabama	New Orleans, Louisiana

Source: The Brookings Institution

Table 13.5
Least-Declining Cities by Population Change and by Urban Decline-Distress Index

Rank	Least-Declining Cities by Population Change	Least-Declining Cities by Index Value
1	Lancaster, California	Anchorage, Alaska
2	Bakersfield, California	Stamford, Connecticut
3	Fresno, California	Boise City, Idaho
4	Las Vegas, Nevada	Raleigh, North Carolina
5	Modesto, California	Lancaster, California
6	Tallahassee, Florida	Antioch, California
7	Antioch, California	Honolulu, Hawaii
8	Stockton, California	Santa Rosa, California
9	Raleigh, North Carolina	Las Vegas, Nevada
10	Santa Rosa, California	Colorado Springs, Colorado
11	Durham, North Carolina	Ann Arbor, Michigan
12	Austin, Texas	Appleton, Wisconsin
13	Sacramento, California	Lincoln, Nebraska
14	Reno, Nevada	Madison, Wisconsin
15	Riverside, California	Reno, Nevada
16	Oxnard, California	Austin, Texas
17	Colorado Springs, Colorado	Eugene, Oregon
18	Anchorage, Alaska	Huntsville, Alabama
19	Orlando, Florida	San Jose, California
20	Melbourne, Florida	Melbourne, Florida

Source: The Brookings Institution

Table 13.6
Correlation of Causal Variables with Percent Change in Central-City Population (CHG8090%) and The Urban Decline-Distress Index (DECLINDX)

	Simple Correlation With:			Simple Correlation With:	
Variable Name	**CHG8090%**	**DECLINDX**	**Variable Name**	**CHG8090%**	**DECLINDX**
PCTHISPN	0.363229	0.084013	STATCAPL	0.025457	-0.132705
PCTMINOR	-0.050233	0.473330	POVFEMFM	-0.387819	0.679683
PCTBLACK	-0.428270	0.539534	EXP%POLC	0.250309	0.003070
PCTGRAD (D)	0.338488	-0.848019	***%MSAOUTS*** (S)	0.090418	-0.099377
PCTBACH	0.198570	-0.636185	***SPRLSCR6*** (S)	-0.306033	0.473691
UNEMPLY% (D)	-0.066538	0.671956	UAINCRAT	0.508299	0.634670
AGE18T24	0.205941	-0.136619	UAEDGMED	-0.117403	0.041406
AGE5TO17	0.037533	0.182651	***LOCP100K*** (S)	-0.375833	0.157946
MEDINAGE	-0.327201	-0.633378	AFROSEG	-0.530732	0.586992
%POVPERS (D)	-0.388103	0.745825	HISPNSEG	-0.031887	0.410406
FEMFAM%	-0.532473	0.838674	MSA8090%	0.756686	-0.390347
MEDINC89	0.465999	-0.633378	MSASUB%	0.447438	-.0218574
INCOV74K	0.283340	-0.484004	MSANPA80	0.002198	0.093059
INCUND5K	-0.573473	0.663483	MSACPA80	-0.168046	0.229002
PRE1940% (D)	-0.584837	0.649713	MSANSA80	-0.255127	0.104826
PCT1UNIT	0.157022	-0.410795	***HS%DRPOT*** (D)	-0.133541	0.576885
PCT5PLUS	0.091339	-0.113566	***%CHG9094*** (D)	0.616369	-0.596046
PCTVAC90	-0.285731	-0.342828	AREA	0.135968	-0.184510
JANTEMP	0.427348	-0.236600	POPUL80	-0.064832	0.123801
JULYTEMP	0.217580	-0.110001	***INPCAP89*** (D)	0.267750	-0.601605
EMP10000	-0.310886	0.358433	MSAPOP90	-.090982	0.187765
TAXPCAP	-0.197986	0.194132	MSAINC89	0.005479	-0.003598
GOVXPCAP	-0.202960	0.250798	***CHG8090%*** (D)	1.000000	-0.573729
REVPCAP	**-0.212734**	0.258724	***%MSACENC*** (S)	0.200218	-0.377712
DRIVALON **(S)**	***0.251574***	*-0.382966*	***CITSUBPV*** (S)	-0.384937	0.668233
%CARPOOL (S)	0.051001	0.399088	***URBLND90*** (S)	-0.131639	0.208706
AUTOCOM%	0.267439	-0.298317	***DENRATIO*** (S)	-0.304341	0.367143
COMUTMIN	0.030596	0.179057	PRECIPIN	-0.518685	0.317336
OUTDEN90 (S)	0.175526	0.066714	***VIOCPCAP*** (D)	-0.187762	0.541539
CRIMPCAP	-0.044178	0.367468	DENS90	-0.233754	0.503340
AREA%CHG	0.176156	-0.151588			

Source: The Brookings Institution

any other set of independent variables that met the first criterion.

The drawback of this approach is that influences exerted by the variables initially thought plausible causes but then removed might have an important bearing on both the overall R-squared result and the beta values and t-scores of those variables that remain. This could distort the results of what might be called the "best" regression, containing only the remaining statistically significant independent variables. In order to check against this possibility, a second "block" regression approach was also used. This approach identified all the independent variables that appeared to have some reasonable probability of acting as causal factors influencing the dependent variable, then carried out a regression using all those variables. Those variables with t-scores above 2.0 were selected for more intensive analysis, but none of those with lower t-scores were removed from the regression. This produced quite a different "final" regression from the step-wise approach described above. The implications of this "final" regression were then analyzed to see whether they differed from those derived from the "best" step-wise regression.

What Independent Variables Should Be Used?

In order to determine which other variables might affect urban growth and urban decline-distress, key variables were identified based on information available from the 1990 United States Census about each of these 162 cities. Also used were 36 variables developed by Paul Jargowsky in his book *Poverty and Place*.[8] In all, data on 190 variables were compiled for each of 162 urbanized areas. Then this massive list was narrowed down to 69 variables that might have some causal impact upon the two dependent variables: (1) the extent to which a central city's population rose or fell during the 1980s and (2) the index of urban decline-distress calculated for each central city. These 69 variables are set forth in Appendix F.

All of the above variables classified as C (possible causes) are set forth in Table 13.6 by their abbreviations. Those underlined, in boldface and italics, are part of either the sprawl index or the urban decline-distress index. The table also shows the simple correlation between each of these independent variables and the two key dependent variables CHG8090% and DECLINDX. (Most of these correlations are based upon a set of 139 out of 162 cases, and may differ fractionally from correlations based upon larger or smaller case sets.) These variables were used in the first "block" regression, described below.

Regression Analysis Using Percentage Change in Population as the Dependent Variable

Step-Wise Regression Analysis

Regression analyses were carried out using these independent variables in relation to the dependent variable of the percentage population change from 1980 to 1990 in each major central city within the 162 urbanized areas included in this analysis. This procedure was less than perfect in that it was necessary to use data almost entirely from the year 1990 to "explain" changes in a variable that took place from 1980 to 1990, because detailed data for 1980—which would have been methodologically preferable—were not readily available. Hence the analysis tried to "explain" what caused something to happen in a given period by referring to conditions prevailing at the end of that period, rather than those prevailing at the beginning. However, 1980 levels for most of these independent variables were not terribly different from their levels in 1990. Hence it is likely—though not certain—that use of 1980 data would not have caused greatly different results.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The "best" final regression emerging from this process is set forth in Table 13.7. It contains 23 independent variables, all of which have t-scores above 2.0. Thus, all 23 independent variables are statistically significant at the .05 level, and 15 are significant at the .001 level. The adjusted R-squared for this regression is 0.83485486—a relatively high figure. Most independent variables had signs as predicted above, but there were several surprising exceptions, as follows:

- The *number of serious crimes per 100,000 residents* had a positive sign, although the simple correlation of this variable with the dependent variable was -0.0213.
- The *percentage of workers residing in the city who commute by public transit* had a positive sign and a very high beta value of 0.67—the highest of any variable except median income, even though New York City was omitted from this regression. This was true even though the simple correlation between this variable and the dependent variable was -0.305. This implies that greater availability of public transit encourages faster

[8] Paul A. Jargowsky, *Poverty and Place: Ghettos, Barrios, and the American City* (New York Russell Sage Foundation, 1997), chapter 6 and tables B-1 to B-3.

Table 13.7
"Best" Step-Wise Regression of Central-City Population Change, 1980-1990

Statistical Multiple Regression	Regression Summary for Dependent Variable: CHG8O90% R= 0.92676587; R-Squared = 0.85889497; Adjusted R-Squared = 0.83485486 F-Statistic(23,135)=35.728; p = <0.0000; Standard Error of estimate: 6.5473					
N=159	**BETA Coefficient**	**Standard Error of BETA**	**B Coefficient**	**Standard Error of B**	**t-Score (135)**	**p-level**
Intercpt			-84.2689	23.47607	-3.58957	.000462
PCTMINOR	-.437894	.070956	-.3813	.06179	-6.17132	.000000
REVPCAP	-.569725	.216663	-.0117	.00444	-2.62954	.009542
CRIMPCAP	.131653	.048287	.0005	.00017	2.72645	.007252
PCTBACH	.224237	.077628	.4511	.15616	2.88860	.004509
DRIVALON	.493141	.106213	.8180	.17618	4.64295	.000008
%CARPOOL	.235147	.056281	1.6282	.38971	4.17811	.000052
%PUBTRAN	.670300	.125870	1.6280	.30571	5.32534	.000000
COMUTMIN	-.29383B	.067841	-1.4753	.34062	-4.33131	.000029
WRK%POP	-.251201	046395	.4789	.08B45	-5.41434	.000000
INCOV74K	-.58LIbb/	.106530	-2.5619	.46662	-5.49034	.000000
PCTSOCSC	-.291585	.068301	-.8779	.20564	-4.26912	.000037
PCTPUBAS	.327886	.072669	1.1809	.26171	4.51207	.000014
MEDINC89	.738690	.134648	.0022	.00041	5.48607	.000000
INCCHG79	.170801	.062939	.1310	.04827	2.71378	.007520
GOVXPCAP	.467038	.205845	.0094	.00416	2.26888	.024862
JANTEMP	.437379	.067087	.5388	.08264	6.51954	.000000
JULYTEMP	.160857	.052459	.4573	.14913	3.06636	.002618
PRECIPIN	-.321388	.043013	-.3725	.04985	-7.47193	.000000
PCTLUNIT	-.282100	.071597	-.2779	.07054	-3.94011	.000130
PRE1940%	-.321487	.087712	-.2856	.07792	-3.66527	.000354
DENRATIO	-.157336	.044091	-2.5409	.71205	-3.56844	.000498
%MSAOUTS	.108004	.036896	.1088	.03716	2.92727	.004014
STATCAPL	-.078905	.036533	-3.1607	1.46339	-2.15985	.032550

Source: The Brookings Institution

population growth, even though most cities with high transit usage are also older cities and therefore more likely to experience decline. (The simple correlation between this variable and the percentage of housing units built before 1940 was 0.493.) The statistical significance of this factor was much lower if the percentage of all workers residing *throughout the urbanized area* who used public transit was substituted for this narrower measure.

- The *percentage of the total city population working* had a negative sign. The simple correlation between this variable and the dependent variable was -0.02.
- The *percentage of households with 1989 incomes of $75,000 or more* had a negative sign and a high beta, even though the simple correlation between this variable and the dependent variable was 0.3367.
- The *percentage of residents receiving public assistance* had a positive sign, although it had a relatively low beta value, and a simple correlation between this variable and the independent variable was -0.294.
- *Government expenditures per capita* had a positive sign and a relatively high beta value, although this variable had a simple correlation with the dependent variable of -0.183. Moreover, govern-

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ment expenditures per capita had a simple correlation with government revenues per capita of 0.9838, even though the latter variable had a high beta value and a negative sign.

- The *percentage of housing units consisting of single-family detached units* had a negative sign, even though the simple correlation of this variable with the dependent variable was a positive 0.148. This implies that a city with a variety of housing types will grow faster than one that contains predominantly single-family detached dwellings if other things are equal.

Implications of the Step-Wise Regression of City Population Change from 1980-1990

The results of this regression and the others carried out along with it imply the following notable conclusions:

- *Older cities were more likely to experience population declines than younger ones*, based upon the negative influence of the variable showing the percentage of housing units built before 1940.

- *Citywide crime rates had very little measurable influence on city population growth.* Four different measures of crimes were used: total serious crimes, total serious violent crimes, serious crimes per 100,000 residents, and serious violent crimes per 100,000 residents. None showed any significant negative statistical relationship to central-city population changes between 1980 and 1990. In fact, the regression coefficient for serious crimes per 100,000 residents—the only one of these crime measures that was statistically significant—had a positive beta of 0.13 and a t-score of 2.7.

This finding is not consistent with the widely held view that many residents move out of central cities to escape relatively high crime rates there. The implication that high crime rates have a *positive impact* on city growth is surprising: the impact is relatively weak, though statistically significant at the .01 level. It is more reasonable to conclude that crime rates do not notably affect city growth one way or the other.

One possible explanation of this finding is that citywide crime rates—the ones used in this regression—are not nearly as important as local neighborhood crime rates in motivating people to leave central cities. It is well known that neighborhood crime rates are much higher in low-income neighborhoods than high-income ones, other things being equal. People who leave cities because of high crime rates may be reacting to crime in or near their neighborhoods, rather than to citywide rates. This would not show up in the regression analysis performed herein.

- *Southern locations (warmer weather) exerted a significant positive effect on central-city growth in the 1980s.* Average January temperature in particular had a beta value of 0.437 and a t-score of 6.5. Average July temperature also exerted a positive and statistically significant impact upon city growth. (July and January temperatures have a simple correlation of 0.478.) In contrast, rainy weather apparently had a notable negative influence on city growth.

- *Neither central-city size and population density nor suburban size and population density had much impact on central-city growth rates.* This was true of city size in both 1980 and 1990.

- *Level of educational attainment had a positive impact on city growth rates,* as indicated by the regression coefficient and t-score of the variable showing the percentage of 1990 residents over the age of 25 who had received bachelor's degrees. On the other hand, the variables indicating the percentage who had graduated from high school and high school drop-out rates had no statistically significant impact on city growth.

- *The percentage of a city's population receiving public assistance was positively related to its population growth rate*. Why this was so is not obvious. It may be that cities with high levels of public benefits attract immigrants seeking welfare, and that contributes to their population growth. But that conclusion is certainly not established by this analysis.

- *Diversity of housing types—as opposed to a prevalence of single-family detached units—appeared to increase central-city growth rates*. This conclusion implied that a high percentage of housing units consisting of single-family detached homes had a *negative* impact on city growth rates.

- *Measures of both local government spending and local government revenues had significant but opposite relationships to central-city population growth rates*. Local government revenues per capita had a very high negative beta of -0.5697, whereas local government spending per capita had a positive beta of 0.4670. Yet these two independent variables have a simple correlation with each other of 0.9838! Eliminating one or the other from the regression dropped its adjusted R-squared by several points. Therefore, both were left in, in spite of this confusing result. Three seemingly inconsistent conclusions appear to be supported by these results: (1) more local government spending improves the quality of local services and therefore attracts more growth; (2) higher local revenues put greater burdens on local taxpayers and therefore reduce growth; and (3) more spending and higher revenues are closely associated with each other.

- *High percentages of the two major minority groups were significantly associated with lower city population growth rates.* This finding held true when using a single independent variable for all minority groups combined or using separate independent variables for percentage African American and percentage Hispanic. In the latter case, the signs of both variables were negative; their beta values were -0.3526 and -0.2634, respectively, and their t-scores were well above 4.4. These findings support the view that white racial attitudes are still strong factors influencing metropolitan housing markets. Also, members of these two minority groups increasingly are moving to the suburbs; hence, high fractions of them in a city may make it vulnerable to population losses. Yet the simple correlation of percentage Hispanic and percentage population growth was a positive 0.3438.

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- *Measures of local poverty were not significantly related to central-city growth rates, although cities with higher median household incomes—or faster growing median household incomes—grew faster, all else being equal*. Several measures of city poverty were used in these regressions, but none were consistently statistically significant in relationship to city population growth. The most prominent was the percentage of female-headed households living in poverty, which had a negative relationship to city growth. The overall percentage of persons in the city with incomes below the poverty level was not significantly related to city growth. Yet the percentage of households with 1989 incomes of $75,000 or higher was negatively related to population growth, with a notable beta value and a high t-score. In contrast, the percentage of households with incomes below $5,000 was not statistically significant.

- *The ratio of city resident median income to fringe-area resident median income had no significant impact on city population growth rates*. This finding is not consistent with those of earlier studies showing that cities with residents whose incomes are similar to the incomes of residents of their suburbs tend to do better than those with resident incomes far below the incomes of suburban residents. The level of fringe-area incomes itself was statistically significant at the 0.05 p-level, although its t-score was slightly below 2.0 (so it was not included in the "best" regression, even though its inclusion raised the overall R-squared fractionally to 0.8383).

- *Suburban sprawl within an urbanized area as measured by the sprawl index computed above appears to have no significant impact upon the population growth rate of that area's central city.* An independent variable consisting of the composite sprawl index for each urbanized area was substituted in the "best" regression for other sprawl variables to determine the possible impact of sprawl upon city growth—and therefore upon city decline as well. This variable had a beta score of 0.067438 and a t-score of 1.29906. Its use dropped the overall R-squared to 0.7835. This indicates that sprawl has neither a sizable nor a statistically significant effect upon city population growth or decline.

Further Analysis of the Relationship between Sprawl and City Population Change

The final conclusion above concerning sprawl's lack of influence on central-city population growth and decline was tested by trying many combinations of independent variables, with and without the sprawl index. Generally, using that index did not improve R-squares and often reduced them.

Table 13.8
Impacts of Changes in Sprawl-Indicator Variables upon Urban Decline

Variable	Definition	BETA Value	Mean Value	If Variable Value Rises		More Sprawl from this Variable Causes Central-City Growth to	One Percent Change in Mean Value of the Independent Variable	Percentage Impact on Mean City Growth Rate of One Percent Rise in Independent Variable Mean Value	Percentage Changes in Median Value of Independent Variable Needed to Raise Mean City Growth Rate of From 7.56% to 8.56% (by 13.2%)	Absolute Changes in Median Value of Independent Variable Needed to Raise Mean City Growth Rate of From 7.56% to 8.56% (by 13.2%)
				Sprawl Becomes	Growth Becomes					
DRIVALON	Percentage of resident commuters who drive to work alone	0.487623	70 82	Greater	Larger	Increase	0.7082 Percent of all commuters	7.448	1.77	1.26 Percent of all commuters
%CARPOOL	Percentage of resident commuters who go to work in carpools	0.217685	13 69	Greater	Larger	Increase	0.1369 Percent of all commuters	2.713	4.87	0.67 Percent of all commuters
OUTDEN90	Population density of urbanized-area fringe	0.10039	1848.03	Less	Larger	Decline	18.48 persons per sq. mile	0.507	26.04	481.14
DENRATIO	Ratio of central-city density	0099982	217	Greater	Larger	Increase	0.022	0.465	28.39	0.62
%MSAOUTS	Percentage of total MSA population outside of entire urbanized area	00137788	29.23	Greater	Larger	Increase	0.289 percent	0.535	24.67	7.21 Percent of MSA residents
UROLND90	Size of urbanized area in square miles	-0.067322	304 16	Greater	Smaller	Decline	3.042 sq. miles	-0.116	-104.37	-317.44 square miles
%MSACENC	Percentage of total MSA population residing in its major central city	0. 042937	37 28	Less	Larger	Decline	0.373 percent	0.19	63.72	23.75 percent

However, the "best" regression already contained several components of the sprawl index as independent variables separate from that index: %MSAOUTS (the percentage of each metropolitan area's population that lives outside the urbanized area); DENRATIO (the ratio of the central city's density to the urbanized fringe's density); DRIVALON (the percentage of city residents who commute by driving alone); and %CARPOOL (the percentage of city residents who commute in car pools). So another way to analyze the impact of sprawl upon city population growth is to enter each of the sprawl index's different parts into this "best" regression separately and examine its specific impact. This approach has proved more fruitful than trying to compute a single sprawl index from all of these components and test its composite effects.

Therefore, all nine of the component variables used in computing the sprawl index were entered into the "best" regression simultaneously. This produces an R-squared of 0.8308—slightly lower than the R-squared of the "best" regression above. Repeated variations showed that *several different combinations of sprawl-related variables and other variables produce almost identical R-squared results*.

Consequently, it is worthwhile quantifying the likely impacts of *changes in sprawl-component variables* upon the percentage change in central-city population from 1980 to 1990. Table 13.8 shows the increase in each of the nine sprawl-related variables required to raise the average rate of city growth by one percentage point—that is, from 7.54 percent to 8.54 percent (an increase of 13.26 percent in that variable). This calculation is based on the fact that the beta value of any variable shows the impact of a one-standard-deviation change in the independent variable upon one standard deviation of the dependent variable, assuming both have values close to their respective means. This relationship can be converted into the percentage or absolute change in each independent variable necessary to produce any given change in the dependent variable. The second-to-last column in this table indicates that relatively small percentage changes in the two automobile commuting variables could raise a city's growth rate by the indicated amount, but only much larger percentage changes in the other five sprawl-related variables could do so. The changes in each sprawl-related variable needed to raise central-city growth rates by one percentage point are as follows:

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- A rise in the fraction of commuters who drive alone from 70.83 percent to 72.05 percent. This implies that greater sprawl (more commuters driving alone) would increase city population growth, rather than causing greater city population decline. Hence this finding is inconsistent with the hypothesis that greater sprawl aggravates urban decline.

- A rise in the fraction of commuters who carpool from 13.69 percent to 14.3 percent. This finding could mean that greater sprawl (more commuters using automobiles) would increase city population growth, rather than causing greater city population decline. But it could also mean that more riders per car (less auto usage) would be associated with faster growth, which means fewer riders per car would be associated with slower growth. So the meaning of this result is ambiguous.

- A decline in the ratio of the density of the central city's population to the density of the outlying fringe's population from 2.15 to 1.76. This finding implies that less sprawl (a lower ratio) would increase city population growth. Hence it is con-

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sistent with the hypothesis that greater sprawl aggravates urban decline.

- An increase in the percentage of the metropolitan area's population living outside the urbanized area from 29.06 percent to 38.25 percent. This finding implies that greater sprawl (a higher fraction of metropolitan-area residents living further out) would increase city population growth. Hence this finding is also inconsistent with the hypothesis that greater sprawl aggravates urban decline.

Surprisingly, the findings concerning two of the four sprawl-related variables in this "best" regression contradict the hypothesis that greater sprawl aggravates urban decline (that is, they have the wrong mathematical sign), and the finding concerning one other variable is ambiguous. Only the findings concerning the ratio of central-city densities to urbanized-fringe densities support this hypothesis. This outcome is shown in the eighth column of Table13.8, which indicates whether greater sprawl in each variable would *lessen* or *aggravate* central-city population declines. This finding reinforces the earlier conclusion drawn from analyzing the composite sprawl index. *There is no meaningful statistical evidence that greater suburban sprawl contributes to population decline in central cities.* In fact, concerning two and possibly three of these four dimensions of sprawl, greater suburban sprawl seems to *reduce* population decline, though not very powerfully.

The lower half of Table 13.8 analyzes the impacts of changes in the other five sprawl-related variables on central-city population growth rates. The impacts of four of these five variables—OUTDEN90, CITSUBPV, LOCP100K, and URBLND90—are consistent with the hypothesis that greater sprawl contributes to falling population growth rates in central cities. But these variables do not have statistically significant impacts upon central-city growth rates, so this finding does little to offset the more general conclusion stated in the previous paragraph.

Block Regression Analysis

As a check on the reliability of the step-wise regression described above, a block regression was also carried out, using the same dependent variable (CHG8090%). The independent variables were all 60 variables labeled in Table 13.6 as potential causes of central-city population change or urban decline-distress. They were all introduced into the regression simultaneously, and left in it throughout the analysis. The results of this regression are shown in Table 13.9. Because full information on all 60 variables was lacking for some cities, the total number of cases encompassed in this analysis was 139. The adjusted R-squared was 0.8604, somewhat higher than the 0.8400 produced by the "best" step-wise regression. Only 14 of the 60 independent variables had t-scores above 2.0, though two others (GOVXPCAP and MEDINAGE) had t-scores between 1.95 and 2.0.

The following conclusions can be derived from the block regression's results:

- *A southern location (warmer weather) is a significant stimulus to city population growth whereas heavy precipitation exerts a notable negative influence.*

- *Measures of income and economic status have conflicting relationships to city population growth*. Higher median incomes and lower percentages of households with incomes under $5,000 are associated with faster growth, as are higher levels of poverty among individuals and lower percentages of very high income households.

- *Annexation was responsible for a reasonable part of city growth in the 1980s*. About 54 percent of all the central cities in this group gained at least 5 percent in population during that decade by adding spatial territory. However, the beta value of the variable AREA%CHG is only .096—almost the same as the .092 in the step-wise regression analyzed previously. Thirty-three other independent variables (out of 59) have higher beta values.

- *Physical size, 1980 population size, and population density had relatively little impact on central-city growth rates in the 1980s*. These three variables had very low beta values and low t-scores.

- *Citywide crime rates had almost no effect on central-city growth rates*. The beta values and t-scores of both serious crimes per capita and violent crimes per capita were very low, and had positive signs rather than the predicted negative signs. Removing both of them from the regression only reduced the overall adjusted R-squared from 0.86044 to 0.84877. However, using just VIOCPCAP to measure crime's effects actually *raised* the overall R-squared slightly to 0.86217696. This indicates that violent crimes probably have more impact than property crimes on household movement behavior.

- *Education levels of residents had very little impact on central-city growth rates*. The three variables PCTBACH, PCTGRAD, and HS%DRPOT had relatively low beta values, and the last two had low t-scores.

- *Among transportation variables, only %PUBTRAN was significant, and it had a positive impact on city growth rates rather than the expected negative effect.* Public transit usage is not highly correlated with city area or 1980 city population, but it is with city population density. It also has a high negative correlation with driving alone to work. Commuting time in minutes also had little impact on city population growth rates.

- *Tight labor markets seem to inhibit central-city growth rates.* The higher the percentage of city residents employed, the lower the growth rate. And the higher the percentage of city workers unemployed, the higher the growth rate—though this conclusion is much less reliable, judging from its lower t-score. This seems to indicate that cities with ample labor supplies attract jobs, and those where labor markets are tight discourage potential firms from moving or staying there.

- *Older cities grow more slowly, but those with higher fractions of apartments grow faster.*

- *Higher city revenues per capita discourage population growth, but larger government spending per capita encourages it.* The former relationship appears to be statistically stronger

Courtesy of C. Galley

Table 13.9
Block Regression of Central-City Population Change, 1980-1990

Statistical Multiple Regression N=139	BETA Coefficient	Standard Error of BETA	B Coefficient	Standard Error of B	t-Score (78)	p-level
	Regression Summary for Dependent Variable: CHG8090% R = 0.95975005 R-squared = 0.92112016 Adjusted R-Squared = 0.86044336 F-Statistic (60,78) = 15.181 p-level<0.00000 Standard Error of estimate: 5.6705					
Intercept			44.1735	89.41791	.49401	.622607
ARFA	.033500	- 079152	.0043	.01017	.4.2323	.673290
POPUL80	-.086649	.154386	-.0000	.00001	-.5912.5	576238
DENS90	.093703	.115584	.0006	*.00069*	*.81069*	.420013
PCTBLACK	-.069207	.240305	-.0622	.21583	-.28800	.774113
PCTHISPN	-.190371	137104	-.2176	.15670	-1.38852	.168932
PCTMINOR	-.156766	.203620	-.1314	17067	-.76989	.443689
EMP10000	.023068	.083996	.0036	.01310	.27463	.784326
PEVPCAP	-.825486	.301868	-.0168	.00615	-2.73459	.007727
TAXPCAP	.090545	.125882	.0034	.00479	.71929	.474115
CRIMPAP	.014069	.103188	.0000	.00037	.13654	.891746
VIOCPCAP	.015551	.106504	.0003	.00185	.14602	.884284
PCTGRAD	-.179180	.175198	-.3510	.34325	-1.02273	.309598
PCTEACH	.185481	.120387	.3661	.23764	1.54070	.127436
DRIVALON	.340355	.220062	.5344	.34550	1.54663	.126000
%CARPOOL	.038373	.089576	.2684	.62657	.42838	.669554
%PUBTRAN	.595780	.217712	1.3589	.49653	2.73655	.007685
COMUTMIN	-.087983	.123698	-.4291	.60334	-.71127	.479037
WRK%POP	-.354619	.070684	-.6520	.12997	-5.01694	.000003
UNEMPLY%	.016096	.084020	.2024	.53456	.19157	.848577
INCUNDSK	-.258297	.145741	-1.2310	.69461	-1.77230	080250
INCOV74K	-.707911	.273013	-3.4469	1.19436	-2.88599	.005054
MEDINC89	.976724	.339896	.0030	.00105	2.87160	.005227
INPCAP89	.179209	.242919	.0011	.00150	.73773	.462893
POVFEMFM	-.223631	.137677	-.4.0851	.25148	-1.62432	.108342
FEMFAM%	.048664	.215120	.1056	.46678	.22622	.821624
%POVPERS	.702644	.234749	1.9634	.65597	2.99317	.003697
CITSUBPV	.127896	.117996	1.7984	1.65919	1.08391	.281746
GOVXPCAP	.465282	.237843	.0094	.00481	1.95626	.054015
EXP%POLC	-.091281	.076595	-.2921	.24506	-1.19173	.236981
EXP%HGWY	.062215	.046476	.1958	.15254	1.28336	.203165
JANTEMP	.331382	.116335	.3993	.14017	2.84851	.005614
JULYTEMP	.206463	.071222	.5740	.19802	2.89889	.004861
PRECIPIN	-.266568	.085154	-.3041	.09715	-3.13040	.002457
PCTVAC90	-.069798	.079533	-.3159	.35997	87760	.382858
PCT1UNIT	-.069561	.105830	-.0651	.09902	-.65729	.512932
PCT5PLUS	.190554	.092172	.3439	.16635	2.06738	.042015
PRE1940%	-.309539	.144231	-.2685	.12509	2.1'4614	.034971
URBLND90	-.134199	.156344	-.0064	.00749	-.65836	.393326
OUTDEN90	.027946	.094118	.0005	.00164	.29692	.767316
DENRATIO	-.158451	.067916	-2.5271	1.08316	2.33305	.022224
MSAPOP90	-044217	.198839	.0000	.00000	.22238	.824602
%MSAOUTS	.085857	.066319	.0891	.06880	1.29461	.199276
%MSACENC	-.090198	.086718	-.0625	.07933	-1.04014	.301490
AGE5TO17	-.155455	.181080	-.9729	1.13327	-.85849	.393254
AGEI8T24	-.285173	.206858	-1.1830	.85809	-1.37859	.171962
MEDINAGE,	-.320931	.162348	-2.2492	1.13780	-1.97682	.051597
STATCAPL	-.022497	.047819	-.8669	1.84270	-.47046	.639340
IJAEDGMED	.081278	.185101	.0002	.00042	.43910	.661804
UAINCRAT	-.105742	.150883	-6.1873	8.82871	-.70082	.485502
AFROSEG	-.024420	.072733	-3,0462	9.07312	-.33574	.737967
HISPNSEG	.061050	.063300	.0224	.02319	.96446	.337795
LOCP100K	-.104030	.067261	-.2513	.16243	-1.54689	125938
MSAINC89	-.191263	.158253	-.0006	.00046	-1.20859	.230473
MSASUB%	.101218	058663	.0747	.04329	1.72483	.088518
MSANPA80	.144292	.119834	51.3819	42.67220	1.20411	.232190
MSACPA80	-.275994	.121350	-46.8767	20.61089	-2.27437	.025692
MSANSA80	-.092558	.076889	-23.3730	19.41628	-1.20378	.232314
SUB%PV90	-.045785	.113735	-.1296	.32189	-.40255	.688377
HS%DRPOT	-.065992	.07589a	-.2227	.25617	-.86948	.387251
AREA%CHG	.096445	.044907	.0354	.01649	2.14768	.034844

Source: The Brookings Institution

than the latter. And these results are puzzling, because higher revenues per capita are 98 percent correlated with higher government spending per capita.

- *Cities where high percentages of the MSA's poor residents live in concentrated-poverty neighborhoods grow more slowly than those where this condition is not as strongly present.* This finding concerning the variable MSACPA80 indicates that concentrated poverty does indeed have a negative impact on city growth—or a positive impact on decline. *This finding confirms one of the central hypotheses of this study*.

- *Racial and ethnic composition and racial segregation seem to have little impact upon central-city population growth or decline*. Five variables in this regression measure aspects of these conditions, and only one has a t-score above 1.0. All five also have relatively low beta values. If all five are removed from the regression, the adjusted R-squared drops from .086044 to 0.82006.

- *Only one of the nine sprawl-related variables—DENRATIO—has a statistically significant effect upon city population growth or decline*. Six of the nine have the appropriate mathematical signs (indicating that greater sprawl implies slower city growth), but three do not. They are CITSUBPV, URBLND90, and %MSAOUTS. When all nine are removed from the regression, the R-squared declines from 0.86044 to 0.834431. If the sprawl index is substituted for these nine variables, the R-squared becomes 0.831698 and its t-score is only -0.47405. Thus, the sprawl index itself has almost no impact upon the regression results, though it has the correct mathematical sign. Even DENRATIO has a relatively low beta value (-0.158451); 12 of the other 13 variables with t-scores over 2.0 have higher beta values.

Analysis of the two sets of conclusions, drawn from the two different regressions, leads to the following general conclusions:

- *The two regressions have very similar implications with respect to the effects change of crime rates (no effects), city age (negative), southern locations (warm weather) (positive), precipitation (negative), poverty and wealth measures (mixed), city area and population (no effects), government revenues and spending (mixed), and diversity of housing types (positive) on central-city ratio of population changes.*

Courtesy of C. Galley

- *The "best" step-wise regression implies stronger causal roles for education levels (positive), minority race and ethnic composition (negative), and solo commuter driving (positive) on rates of city population change. None of these variables appear significant in the block regression.*

- *Both regressions indicate that suburban sprawl and sprawl-related variables have very little impact on central-city population growth or decline.*

In conclusion, using the block regression approach rather than the reverse step-wise approach does not notably change the results of using the reverse step-wise approach.

Regression Analysis Using the Urban Decline-Distress Index as the Dependent Variable

Regression analyses were also carried out using the independent variables listed earlier in relation to the dependent variable of the urban decline-distress index for each major central city within each of 162 urbanized areas included in this analysis. This procedure, too, was handicapped by having to rely mostly on data from the year 1990 to "explain" changes that occurred in a variable from 1980 to 1990, because detailed data for 1980—which would have been methodologically preferable—were not readily available. In addition, these regressions could not use as independent variables any of the nine specific factors encompassed within the urban decline-distress index itself. Doing so would put the same variables on both

Table 13.10
"Best" Step-Wise Regression of Urban Decline-Distress Index

Statistical Multiple Regression N=139	Regression Summary for Dependent Variable: DECLINDX R = 0. 95484692 R-squared = 0. 91173264 Adjusted R-Squared = 0. 00422052 F-Statistic(12,141) = 121.37 p-level < 0.00000 Standard Error of estimate: 3.5216					
	BETA Coefficient	Standard Error of BETA	B Coefficient	Standard Error of B	t- score (78)	p-level
Intercpt			54.51626	5.354931	10.18057	.000000
DENS90	.105997	.037497	.00040	.000140	2.82661	.005365
PCTHISPN	.208603	.030372	.17120	.024926	6.86939	.000000
PCTBACH	-.246688	.034452	-.35202	.049122	-7.16622	.000000
INCUND5K	.245864	.042075	.86439	.147925	5.84342	.000000
FEMFAM%	.337523	.055857	.52428	.086764	6.04266	.000000
CITSUBPV	142858	.039516	1.43361	.396610	3.61516	.000417
JULYTEMP	-.183742	.034173	-.37634	.069992	-5.37686	.000000
PCTVAC90	.120165	.036442	.40143	.121744	3.29737	.001235
PCT5PLUS	-.095428	.035729	-.11860	.044404	-2.67087	.008455
%MSACENC	-.070745	.030778	-.04642	.020196	-2.29852	.023002
AFROSEG	.074842	.034B24	6.86071	3.192260	2.14917	.033328
LOCP100K	.074277	.029270	.12071	.047567	2.53766	.012247

Source: The Brookings Institution

sides of the regression equation, thereby creating falsely high R-squared results. This limitation excluded many key variables normally thought to be causes of urban decline, such as crime rates, poverty rates, high fractions of older housing in the city, measures of educational attainment, and so on. Therefore, the regressions seeking to "explain" the urban decline-distress index were limited to other factors, though some of these were quite highly correlated with variables used in creating that index. (For example, the variable FEMFAM% measures the percentage of households in a city that are headed by females with no male head present; it has a 0.69 correlation with the variable %POVPERS—the percentage of city residents with 1989 incomes below the poverty line—which is a component of the urban decline-distress index. As discussed below, FEMFAM% is an important independent variable used in regressions employing the index as the dependent variable.)

Courtesy of C. Galley

Using a Step-Wise Regression to Analyze the Urban Decline-Distress Index

An initial regression was run using all of the earlier-described independent variables, plus several others—but excluding the nine components of the urban decline-distress index—as a single block of independent variables against that index. The initial results were altered by removing those independent variables with low betas and t-scores from the set of independent variables and rerunning the regression. This process was repeated until it generated a remaining set of independent variables, all of which had t-scores above 2.0.

The "best" final regression emerging from this process is set forth in Table 13.10. It contains 12 independent variables, all of which have t-scores above 2.0. Thus, all 12 independent variables are statisti-

Courtesy of A. Nelessen

cally significant at the .05 level, and six are significant at the .001 level. The adjusted R-squared for this regression is 0.9042—a very high figure. All but one of the independent variables had signs as predicted earlier; the one surprise was that the percentage of housing units in buildings with five or more units was negatively related to the severity of a city's decline or distress. This implies that the higher the proportion of rental apartments in a city in large structures, the lower its urban decline or distress – the opposite of what might be expected.

To extend the analysis, the "best" regression was supplemented with respect to the urban decline-distress index by adding the other six sprawl-related variables not included in the original list and running a second regression with all nine such variables. This regression has an R-squared slightly higher than the "best" regression above (0.90552 vs. 0.90422), but 10 of its 18 variables have T-scores less than 2.0 – including seven of the nine sprawl-related variables (all but CITSUBPV and LOCP100K). However, *all nine sprawl-related variables have mathematical signs consistent with the hypothesis that greater sprawl would contribute to more urban decline and distress.* This regression is also presented on Table 13.10. This provides further evidence that this hypothesis is fundamentally correct, though it is rather weak substantiation.

Regression Analysis of the Urban Decline-Distress Index

Step-Wise Regression Analysis

Results of the above step-wise regression and others carried out along with it imply the following notable conclusions:

- *Race and ethnicity are important influences on urban decline-distress*. The higher the percentage of Hispanics in a city's population, the greater its index of decline-distress, all else being equal. If either PCTMINOR or PCTBLACK is substituted for PCTHISPN in this regression, ethnic factors remain significant but the overall R-squared falls by several points. Also, the greater the index of spatial separation between African Americans and whites in the metropolitan area as a whole, the greater the central city's index of decline-distress. The latter variable had a much smaller beta value than the first, and a smaller t-score.

- *Increases in the overall suburban sprawl index have a positive and statistically significant impact on the urban decline-distress index.* If the variable SPRLSCR6—the final version of the sprawl index—is substituted for the three sprawl-related variables in the above regression, that variable is statistically significant with a t-score of 3.64 and a beta value of 0.118795. The overall R-squared of the regression declines from 0.90422 to 0.871816, and two other variables—AFROSEG and PCT5PLUS—become statistically insignificant at the .05 p-level. (Their removal reduces the overall R-squared further.) This implies that cities with higher sprawl indices are likely to exhibit more urban decline-distress. However, this overall impact of suburban sprawl can be broken down further, as discussed below.

- *The greater the intensity of three measures of suburban sprawl in an urbanized area or metropolitan area, the greater the urban decline or distress of its central city.* The "best" regression set forth above contains three measures of suburban sprawl as independent variables: CITSUBPV (the ratio of central-city poverty to suburban poverty), %MSACENC (the percentage of the metropolitan area's population residing in its central city), and LOCP100K (the number of local governments with zoning power per 100,000 residents in the metropolitan area). All three are statistically significant and have the correct signs indicating that greater sprawl (as indicated by these variables) contributes to greater urban decline or distress.

  Other specific sprawl-related variables have no significant impact on the urban decline-distress index. These include DRIVALON, %CARPOOL, %MSAOUTS, URBLND90, OUTDEN90, and DENRATIO. When individual variables measuring these attributes of suburban sprawl are included in this regression, they neither raise its overall R-squared notably or show any statistically significant contribution to it. *This implies that the three attributes of suburban sprawl included in the "best" regression, rather than all sprawl's attributes combined or any of its other attributes individually, form the real linkages between suburban sprawl and urban decline-distress.*

- *The particular suburban-sprawl-related variables affecting urban decline–distress are those that could be considered most closely linked to exclusionary zoning against low-income housing by local governments in metropolitan suburbs.* One is the number of local governments with zoning powers per 100,000 metropolitan-area residents—the measure of governmental fragmentation. The other is the ratio of the percentage of poor residents in the central city to the same percentage in the metropolitan area's suburbs. The higher this ratio, the greater the disparity in percentage poverty populations between these two subareas. That disparity is likely to rise if suburban governments engage in exclusionary zoning against low-income households, or suburban markets engage in racial segregation against African American households—since the latter have lower average incomes than whites. Therefore, the existence of high ratios of this type can be taken as de facto evidence of past exclusionary zoning. Admittedly, other factors could be contributing to these high ratios; therefore, this evidence is not conclusive, only suggestive.

Courtesy of T. Delcorso

- *The higher the education level of a city's population, the lower the city's propensity to decline or distress.* True, this conclusion is based on only one variable—CTBACH, the percentage of city residents over 24 years old with bachelor's degrees. But that variable has a relatively high beta score and a very high t-score. This finding partly reflects inclusion of two other educational variables in the decline-distress index itself: the percentage of those over 24 years old who are high school graduates, and the percentage of those 16 to 19 neither in school nor working (hence high school dropouts). The former variable has a correlation with PCTBACH of 0.734, so this conclusion must be considered not very strongly supported by this regression result.

- *Urban decline-distress is more likely to result in the emptying out of inner-city neighborhoods than their overcrowding.* This is shown by the positive sign on PCTVAC90—the percentage of city housing units vacant in 1990. This result occurs partly because the index of decline-distress contains two variables based on population changes within each city, and both of them count falling population as causing more decline or distress.

- *Southern locations (warmer weather) tend to reduce urban decline-distress*. This may reflect the fact that the nation's fastest-growing cities are in the South, Southwest, and West, where July temperatures are higher than in the Midwest and the Northeast, on the average.

- *High density within cities tends to increase urban decline-distress*. This result may also reflect regional factors, since the cities with the highest density tend to be in the oldest parts of the nation—the Northeast and Midwest. Newer cities in the South and West were built mostly after the advent of the automobile; so they have more and broader streets and lower housing density patterns.

- *Larger percentages of relatively low income households (INCUND5K) and higher percentages of female-headed families (FEMFAM%) are positively associated with higher urban decline-distress index scores and both are statistically significant*. (These two variables also have a 0.70 correlation with each other.) Moreover, FEMFAM% has the highest beta value of any statistically significant variable, and INCUND5K has the third highest. This result stems partly from the high correlations of both these variables with key components of the index itself, especially %POVPERS. *Thus, central cities with relatively poor populations are more likely to exhibit urban decline or distress than those with economically better-off populations.* This is hardly surprising.

- *City government fiscal behavior—revenue raising, taxing, employment, and spending—seems to have little impact on a city's urban decline-distress index.* None of the variables concerning such behavior (EMP10000, REVPCAP, TAXPCAP, and GOVXPCAP) is statistically significant, so none has survived into the final "best" regression. Only the number of local governments in the metropolitan area per 100,000 persons is statistically significant. But that variable reflects the underlying institutional structure of the area's governments more than their fiscal behavior.

Table 13.8 has been constructed to show the specific impacts of each sprawl-related variable upon the urban decline-distress index, as was done earlier with respect to the impacts of these variables on central-city population growth rates. True, the urban decline-distress index is itself a composite based upon nine other variables, not a direct descriptor of some clearly identifiable condition. Therefore, index changes are not easily interpreted in any meaningful way. Nevertheless, this table is useful in showing the strength of the impacts that sprawl-related variables have upon the urban decline-distress index. The changes in the means of sprawl-related variables necessary to produce a rise in the mean urban decline-distress index by the arbitrarily chosen amount of three percentage points (from 48.965 percent to 51.965 percent—a rise of 6.15 percent), are as follows:

- A rise in the mean ratio of poor city residents to poor suburban residents from 2.24 to 4.31 (an increase in that ratio of 92.6 percent).

- A decline in the mean percentage of metropolitan-area residents living in the central city from 36.88 percent to -27.42 percent—which is clearly impossible. In other words, no possible change in this variable could increase the urban decline-distress index by three percentage points. And only an increase in this percentage to almost 100 percent of all residents living in the central city would decrease the urban decline-distress index by three percentage points.

- A rise in the mean number of local governments with zoning-power within the metropolitan area from 8.13 to 32.85 (an increase in that number of 304.06 percent).

These findings clearly show that *relative and absolute changes in these three statistically significant sprawl-related variables would have to be immense in order to produce any notable change in the urban decline-distress index.* Parallel findings emerge from a similar analysis of the other six sprawl-related variables, as shown on Table 13.8. But some of the other nonsprawl-related variables in the "best" regression—those with the highest beta values—also have very low leverage impacts on this index, as revealed by a similar analysis concerning them. Thus, in order to raise the urban decline-distress index by three percentage points while all other things remain the same, the following changes would have to occur in other variables.

- The mean percentage of central-city residents who are Hispanic would have to rise from 10.473 percent to 27.963 percent (an increase of 167.03 percent).

- The mean percentage of central-city households headed by females with no adult male present would have to rise from 24.156 percent to 29.866 percent (an increase of 23.65 percent). This rise appears at least plausible, if not probable.

- The residential density of the central city would have to rise from a mean of 4,070 persons per square mile to 11,617 persons per square mile (an increase of 185.4 percent). This change is at least conceivable, since a few American cities do have densities above 11,000 persons per square mile. The percentage of central-city households with incomes under $5,000 per year would have to rise from a mean of 8.348 percent to 11.80 percent (an increase of 41.51 percent). This change is probably the most plausible of any discussed in this section.


Courtesy of C. Galley

The foregoing analysis shows that although three sprawl-related variables have statistically significant relationships to the urban decline-distress index, none of them have a very powerful mathematical influence upon that index compared to other, nonsprawl factors. In other words, although increases in suburban sprawl undoubtedly aggravate urban decline and distress, they do not do so very strongly.

Another way to illustrate this point is to use the mean values of all the variables in the "best" regression to "predict" the resultant urban decline-distress index. Each mean value is multiplied by its B-weight to obtain a B-weighted value, and the sum of those values, plus the intercept, equals the predicted index value. This procedure is shown in Table 13.11, which indicates that the predicted index value is 48.652—the mean value for the index. Subtracting the intercept of 54.516 shows that the B-weighted values of all the independent variables sum to -5.865 algebraically, but in absolute terms (disregarding minus signs) to 76.083. The three sprawl-related variables contribute only 5.921 of that total, or 7.78 percent. In other words, the three sprawl-related variables combined exert, on the average, less than 8 percent of the influence on the urban decline-distress index within this regression. In fact, simultaneously changing the values of each of these three variables by 10 percent in the directions that would increase sprawl, while leaving all other variable values the same, and calculating another predicted index value only raises the lat-

Courtesy of T. Delcorso

ter from 48.562 to 49.244, or by 1.22 percent! This is also shown in Table 13.11. In contrast, raising the variable FEMFAM% by just 10 percent increases the predicted index value by 2.6 percent, and lowering the variable JULYTEMP by just 10 percent increases that index by 5.89 percent. If *all* the variables in this regression are simultaneously changed by 10 percent, each in the direction that would raise the index the most, the overall index rises by 15.6 percent.

Using a Block Regression to Analyze the Urban Decline-Distress Index

As a check on the reliability of the step-wise regression described above, a block regression was conducted, using the same dependent variable (DECLINDX). The 60 variables in Table 13.6 were used as potential causes of central-city population change or urban decline-distress. They were used as independent variables—excluding the seven variables used to calculate the urban decline-distress index itself. These 53 variables were introduced into the regression simultaneously; they were left in it throughout the analysis. The results of this regression are shown in Table 13.12. Because full information on all 53 variables for all 162 cities was lacking, the total number of cases encompassed in this analysis was 139. The adjusted R-squared was 0.9458, notably higher than the 0.9042 produced by the "best" step-wise regression. Only 15 of the 60 independent variables had t-scores above 2.0.

An adjusted R-squared of 0.945 is extremely high for any regression analysis in the social sciences. A major reason for the high R-squared is that several of the independent variables remaining in this regression, after all the variables used to compute the urban decline-distress index have been eliminated, are highly correlated with those component variables. For example, VIOCPCAP (violent crimes per 100,000 residents) is an element in computing the urban decline-distress index. This variable has a positive correlation of 0.802 with CRIMPCAP (serious crimes per 100,000 residents), which is in this block regression. Similarly, INPCAP89 (income per capita in 1989) is an element in this index; it has a positive correlation of 0.879 with INCOV74K (percent of households with 1989 incomes $75,000 and over), which is in this regression. And %POVPERS (percent of residents with 1989 incomes below the poverty level) is part of computing the index; it has positive correlations of 0.850 and 0.831 with INCUND5K and POVFEMFM respectively. Both of the latter are in this regression. Consequently, it could be argued that several key elements of the urban decline-distress index in effect appear on both sides of this regression, which would help explain why it has such a high adjusted R-squared.

However, if these highly correlated independent variables were eliminated from the regression, it would be transformed from a block regression into a form of reverse step-wise regression. Instead, the analysis focused on the correlations between (1) the nine variables on which the urban decline-distress index was based, and (2) the 15 independent variables that are statistically significant in the block regression using the index as the dependent variable (that is, these 15 variables have t-scores above 2.0). This analysis indicates that four of the 15 statistically significant independent variables are so highly correlated with components of the index (they have correlations of above 0.70) that conclusions concerning their importance in causing urban decline should be viewed with great caution. These four independent variables are CRIMPCAP, PCTBACH, MEDINC89, and

Table 13.11
Predicting Urban Decline-Distress Index from Assumed Values of Independent Variables Based upon "Best" Step-Wise Regression

Original "Best" Regression

Variable	B-Weight	Value	B-Weight Times Value
DENS90	0.000397	4,070,059	1,615.8
PCTHISPN	0.171200	10,473	1,793.0
PCTBACH	-0.352018	21,581	-7,596.9
INCUND5K	0.864389	8,348	7,215.9
FEMFAM%	0.524284	24,156	12,664.6
CITSUBPV	1.433812	2,247	3,221.8
JULYTEMP	-0.376339	76,088	-28,634.9
PCTVAC90	0.401434	8,806	3,535.0
PCT5PLUS	-0.118597	25,446	-3,017.8
%MSACENC	-0.046422	37,147	-1,724.4
AFROSEG	6.860713	596	4,089.0
LOCPLOOK	0.120709	8,073	974.5
Intercept			54,516.3

Predicted Value of Urban Decline-Distress Index **48,651.8**
(identical with the Mean Value of that Index)

Values of Sprawl-Related Variables Changed to Increase Their Sprawl-Raising Effects by 10 Percent

Variable	B-Weight	Value	B-Weight Times Value
DENS90	0.000397	4,070,059	1,615.8
PCTHISPN	0.171200	10,473	1,793.0
PCTBACH	-0.352018	21,581	-7,596.9
INCUND5K	0.864389	8,348	7,215.9
FEMFAM%	0.524284	24,156	12,664.6
CITSUBPV	1.433812	2,472	3,544.0
JULYTEMP	-0.376339	76,088	-28,634.9
PCTVAC90	0.401434	8,806	3,535.0
PCT5PLUS	-0.118597	25,446	-3,017.8
%MSACENC	-0.046422	33,432	-1,552.0
AFROSEG	6.860713	596	4,089.0
LOCP100K	0.120709	8,880	1,071.9
Intercept			54,516.3

Predicted Value of Urban Decline-Distress Index **49,243.9**

Absolute Difference in Predicted Values **592.1**
Difference as Percent of Original "Best" Prediction **1.2170**

Table 13.12
Variables in Regression on City Population Change, 1980 to 1990

Regression Summary for Dependent Variable: DECLINDX

R= 0.98309567 R-Squared = 0.96647711 Adjusted-R Squared = 0.94581765

F-Stistic (53,86) = 46.781 p-level = <.0.00000 Standard Error of estimate = 2.6986

Statistical Multiple Regression N=140	BETA	Standard Error of BETA	B Coefficient	Standard Error of B	t-Score (78)	p-level
Intercept			43.2543	27.24557	1.58757	.116053
AREA	.061450	.045602	.0058	.00433	1.34753	.181349
POPUL80	-.212866	.088019	-.0000	.00000	-2.41841	.017698
DENS90	.063204	.066828	.0003	.00029	.94577	.346916
PCTBLACK	-.263323	.126904	-.1751	.08438	2.07499	.040976
PCTHISPN	-.020896	.075195	-.0177	.06357	-.27789	.781765
PCTMINOR	.236440	.107831	.1466	.06687	2.19269	.031030
EMP10000	.021974	.047630	.0025	.00549	.46134	.645721
REVPCAP	.044480	.166368	.0007	.00250	.26736	.789831
TAXPCAP	.066801	.071346	.0019	.00201	.93629	.351745
CRIMPCAP	.114777	.038406	.0003	.00010	2.98852	.003654
PCTBACH	-.194692	.056110	-.2843	.08194	-3.46984	.000816
DRIVALON	.001779	.118460	.0021	.13768	.01502	.988051
%CARPOOL	.041440	.050703	.2145	.26241	.81730	.416013
%PU13TRAN	-.233530	.127943	-.3934	.21552	-1.82526	.071433
COMUTMIN	.158193	.072297	.5698	.26042	2.18811	031374
WRK%POP	-.027431	.040748	-.0367	.05458	-.67319	502631
INCUND5K	-.041775	.080597	.1472	.28390	-.51833	.605562
INCOV74K	.133421	.092!0!)4	.4305	.30003	1.43473	.154990
MEDINC89	-.418909	.162727	-.0010	.00037	-2.57431	.011756
POVFEMFM	-.020705	.069599	-.0279	.09385	-.29748	.766814
FEMFAM%	.295854	.114590	.4737	.18348	2.58185	.011520
CITSUBPV	.103632	.065179	1.0749	.67607	1.58996	.115513
GOVXPCAP	-.087762	.137505	-.0013	.00205	-.63824	.525011
EXP%POLC	-.005444	.043194	-.0129	.10229	-.12603	.900006
EXP%HGWY	-.030215	.029249	-.0702	.06799	-1.03304	.304483
JANTEMP	-.190085	.067002	-.1688	.05950	-2.83700	.005678
JULYTEMP	-.141523	.039667	-.2901	.08131	-3.56776	.000591
PRECIPIN	.124631	.046155	.1040	.03852	2.70029	.008342
PCTVAC90	.096630	.043391	.3230	.14504	2.22695	.028563
PCTLUNIT	.009326	.059847	.0065	.04145	.15583	.876528
PCT5PLUS	-.106146	.049815	-.1418	.06657	-2.13082	.035959
URBLND90	-.021527	.092511	-.0008	.00328	-.23270	.816549
OUTDEN90	.061619	.053609	.0009	.00077	1.14940	.253578
DENRATIO	.092299	.040479	1.0897	.47790	2.28020	.025069
MSAPOP90	.243757	.114937	.0000	.00000	2.12080	.036818
%MSAOUTS	-.004386	.038865	-.0034	.02976	-.11285	.910409
%MSACENC	-.063538	.048820	-.0430	.03303	-1.30149	.196567
AGE5TO17	.033977	.079987	.1574	.37064	.42478	.672058
AGE18T24	.064615	.076638	.1975	.23426	.84312	.401498
MEDINAGE	.045073	.083013	.2319	.42705	.54296	.588559
STATCAPL	-.031081	.026908	.8859	.76700	-1.15509	.251255
UAEDGMED	-.082453	.110884	-.0001	.00019	-.74360	.459145
UAINCRAT	.067987	.091846	2.9437	3.97672	.74023	.461174
AFROSEG	.067294	.040592	6.1912	3.73455	1.65783	.100996
HISPNSEG	.032495	.037303	.0088	.01005	.87110	.386126
LOCP100K	.062782	.038041	.1122	.06796	1.65038	.102512
MSAINC89	.140575	.093721	.0003	.00020	1.49993	.137294
MSASUB%-	-.022452	.034388	-.0123	.01876.1	-.65291	.515554
MSANPA80	-.084359	.067146	-22,2369	17,699651	-1,25635	212393
MSACPA80	.125499	.070445	15.7648	8.84902	1.78153	.078357
MSANSA80	-.003893	.045393	-.7184	8.37752	-.08575	.931862
SUB%PV90	.121514	.064615	.2519	.13396	1.88059	.063413
AREA%CHG	-.023266	.026632	-.0063	.00723	-.87364	.384749

Source: The Brookings Institution

Table 13.13
Statistics of the Key Variables Influencing Urban Decline-Distress Index

Sprawl-Related Variable	Mathematical Sign	Beta Coefficient	t-Score	Relation to Basic Hypothesis
DRIVALON	+	0.001779	0.01502	Consistent
CAR POOL	+	0.041440	0.81730	Consistent
CITSUBPV	+	0.10362	1.58996	Consistent
URBLND90	**-**	**-0.02157**	**-0.23270**	**Inconsistent**
OUTDEN90	**+**	**0.061619**	**1.14940**	**Inconsistent**
DENRATIO	+	0.092299	2.28020	Consistent
%MSAOUTS	**-**	**-0.004386**	**-0.11285**	**Inconsistent**
%MSACENC	-	-0.063538	-1.30149	Consistent
LOCP100K	+	0.062782	1.65038	Consistent

Source: The Brookings Institution

FEMFAM%. The other 11 statistically significant variables do not suffer from this limitation; hence conclusions about their causal roles can be viewed as more reliable.

Block Regression Analysis

The results of the above block regression and others carried out with it imply the following notable conclusions:

- *The influence of race and ethnicity upon the urban decline-distress index is ambiguous*. Higher percentages of black or Hispanic residents are associated with less decline, but higher percentages of all minority groups combined are associated with more decline. The influence of Hispanics has a low t-score, but the other two ethnic influences have similar t-scores above 2.0 and similar beta values—but with opposite signs. Greater overall residential segregation of African Americans at the metropolitan level (AFROSEG) is weakly associated with greater urban decline, but that is not statistically significant. No clear conclusion emerges.

- Only one of the nine measures of suburban sprawl (DENRATIO) has a statistically significant relationship to the urban decline-distress index, and it has a relatively low beta value. Six of the nine sprawl-measuring variables have mathematical signs consistent with the hypothesis that greater sprawl is associated with greater urban decline-distress. But three of those variables (URBLND90, OUTDEN90, and %MSAOUTS) have mathematical signs that are inconsistent with that hypothesis. The signs, beta values, and t-scores of all nine of these variables in this regression are shown in Table 13.13 (variables with signs not consistent with this hypothesis are shown in boldface).


Courtesy of C. Galley

A striking thing about the data in Table 13.13 is that the beta values of all nine sprawl-related variables are extremely low—only one (CITSUBPV) is above 0.093. This means that *all sprawl-related conditions—even including those that are not statistically significant—have relatively little influence upon the urban decline-distress index.*

Substituting SPRLSCR6 for all nine of the above sprawl-related variables in the block regression drops the overall adjusted R-squared slightly from 0.9458 to 0.9426. But SPRLSCR6 then has a beta value of only 0.047805 and a t-score of 1.29222. Thus, *the sprawl index has the correct sign for supporting this paper's basic hypothesis (more sprawl causes greater urban decline), but*

Courtesy of C. Galley

it is not statistically significant and has very little influence on the urban decline-distress index.

- *The higher the education level of a city's population, the lower the city's propensity to decline or distress.* As noted earlier, this conclusion is based on only one variable, and must be considered not very strongly supported by this regression result.

- *Urban decline-distress is more likely to result in the emptying out of inner-city neighborhoods than their overcrowding.* This is shown by the positive sign on the statistically significant variable PCTVAC90—the percentage of city housing units vacant in 1990.

- *Southern locations (warmer weather) are associated with lower decline index scores, but higher precipitation tends to increase decline.* This partly reflects the fact that the nation's fastest-growing cities are in the South, Southwest, and West, where January and July temperatures are higher than in the Midwest and the Northeast, on the average.

- *In 1990 relatively large cities suffered from less urban decline than those that were smaller, but this conclusion may be unreliable.* This finding is based on the negative sign of the statistically significant variable POPUL80. However, there is also a positive sign on the statistically significant variable COMUTMIN, which has a 0.6196 correlation with POPUL80. This would indicate that larger cities, which have longer average commuting times, would have *higher* urban decline-distress index scores. Moreover, the central cities in relatively large metropolitan areas experienced more urban decline than those in relatively smaller areas, based on the variable MSAPOP90. In addition, this variable has a very high correlation (0.943) with POPUL80. These data tend to reduce the reliability of the conclusion that larger cities experience less decline than smaller ones.

- *Cities with higher percentages of housing units in structures containing five or more units and higher vacancy rates tend to experience more decline than those with lower statistics in these areas.* This may result from the fact that most units in structures with five or more units are rental units, and occupants of rental units are, on

Table 13.14
Comparison of Full Block Regression and "Best" Step-Wise Regression for Dependent Variable = DECLINDX for All Independent Variables with t-Scores above 2.0

Twenty-two independent variables have t-scores over 2.0 in at least one of these two regressions; they are all shown below. All t-scores over 2.0 and the beta values associated with them are shown in boldface**.** Five independent variables have t-scores over 2.0 in both regressions; they are marked with asterisks. These five variables significant in both regressions have very similar beta values in both. Among the 12 variables that are found in both of these two regressions, 10 have the same mathematical sign in both. Only PCTHISPN and INCUND5K have different signs. Seventeen independent variables have a t-score above 2.0 in one regression but not in the other; ten of these are found only in one regression; seven are in both. Only two variables have signs opposite those predicted for the regression in which they have t-scores over 2.0; they are ***in bold and italics*** (POPUL80 and PCTBLACK).

Independent Variable Names, All 22 With t-Scores Over 2.0 in At Least One Regression	Block Regression, 53 Initial Independent Variables; 15 Are Significant; N = 140; Adjusted R-Squared = 0.94582		"Best" Step-Wise Regression, 12 Final Significant Independent Variables; N = 154; Adjusted R-Squared = 0.90422	
	Beta Coefficient	**t-Score**	**Beta Coefficient**	**t-Score**
POPUL80	**-0.212866**	**-2.41841**	xxxxxxx	xxxxxx
DENS90	0.063204	0.94577	**0.105997**	**2.82681**
PCTBLACK	**-0.263323**	**-2.07499**	xxxxxxx	xxxxxx
PCTHISPN	-0.020896	-0.27789	**0.208603**	**6.86839**
PCTMINOR	**0.236640**	**2.19269**	xxxxxxx	xxxxxx
CRIMPCAP	**0.114777**	**2.98852**	xxxxxxx	xxxxxx
PCTBACH*	**-0.194692**	**-3.46984**	**-0.24688**	**-7.16622**
COMUTMIN	**0.158193**	**2.18811**	xxxxxxx	xxxxxx
rNC@5K	-0.041775	-0.51833	**0.245964**	**5.84342**
MEDINC89	**-0.418090**	**-2.57431**	xxxxxxx	xxxxxx
FEMFAM%*	**0.295854**	**2.58185**	**0.337523**	**6.04266**
CITSUBPV	0.103632	1.58996	**0.142858**	**3.61516**
JANTEMP	**-0.190085**	**-2.83700**	xxxxxxx	xxxxxx
JULYTEMP*	**-0.141523**	**-3.56776**	**-0.183742**	**-5.37688**
PRECIPIN	0.124631	2.70029	xxxxxxx	xxxxxx
PCTVAC90*	**0.096630**	**2.22695**	**0.120165**	**3.29737**
PCT5PLUS*	**-0.106146**	**-2.13082**	**-0.095428**	**-2.67087**
DENRATIO	**0.09229**	**2.28020**	xxxxxxx	xxxxxx
MSAPOP90	**0.243757**	**2.12080**	xxxxxxx	xxxxxx
%MSACENC	-0.063538	-1.30149	**-0.070745**	**-2.29852**
AFROSEG	0.067294	1.65783	**0.074842**	**2.14917**
LOCPIOOK	0.062782	1.65038	**0.74277**	**2.53766**

Source: The Brookings Institution

average, poorer than homeowners. This view is strengthened by the vacancy rate finding, since vacancy rates are almost always higher in rental housing than ownership housing.

- *Cities with relatively low income levels (MEDINC89) and high percentages of female-headed households (FEMFAM%) tend to have higher urban decline-distress indexes than those with higher income levels*. The variable MEDINC89 has a very high negative beta value and a t-score of -2.57; the variable FEMFAM% also has a relatively high positive beta value and a t-score of 2.58. The income aspects of this conclusion are somewhat confirmed by the negative beta value of INCUND5K and the positive beta value of INCOV74K, though neither of these variables is statistically significant.

- *City government revenue raising, taxing, employment per capita, and spending seem to have very little influence on a city's urban decline-distress index*. The beta values of REVPCAP, TAXPCAP, EMP10000, and GOVXPCAP are all quite low—all below 0.09 (in absolute terms). None of these variables has a t-score as high as 1.0. The mathematical signs indicate that more taxing, revenue, and employees per capita increase the index of decline-distress, whereas more government spending per capita reduces this index. But none of these variables are statistically significant.

Comparing Results of the Step-Wise and Block Regressions

Table 13.14 compares the 15 statistically significant independent variables produced by the block regression with the 12 such variables produced by the "best" step-wise regression. Altogether, 22 different independent variables had t-scores of 2.0 or higher in at least one of these regressions, and five had such scores in both regressions. Most of those five have quite similar beta values in both regressions. Among the 12 variables found in both regressions, 10 have the same mathematical signs in both. Only two variables have mathematical signs opposite those predicted in the earlier table of variables. Examination of this table, plus analysis of the two sets of conclusions drawn above from the two different regressions, leads to the following conclusions (in these findings, a *positive* impact of an independent variable means higher values of that variable are associated with greater urban decline and distress):

- *The two regressions have similar implications with respect to the effects on central-city urban decline-distress index scores of southern location (negative), high fractions of poverty and relatively low incomes among residents (strongly positive), high fractions of female-headed families (strongly positive), higher resident education levels (negative), city population size (negative but unreliable), city density (slightly positive), city government revenues and spending (no effects), and high vacancy rates and diversity of housing types (positive).*

- *The impacts of ethnic factors on urban decline-distress index scores differ in the two regressions.* In the "best" step-wise regression, the percentage of Hispanic city residents has a strong positive impact upon such scores, and the degree of residential segregation of African American residents in the entire metropolitan area has a weak positive effect. In the block regression, the city's percentage of African American residents has a strong negative impact, and its percentage of Hispanic residents has a weak negative impact, but its overall percentage of minority residents has a strong positive impact. *Taken together, these results are ambiguous and inconclusive.*

- *The step-wise regression indicates that three specific sprawl-related variables have some impact on the urban decline-distress index consistent with the hypothesis that greater sprawl leads to greater decline. They are CITSUBPV, %MSACENC, and LOCP100K. However, the quantitative influence of these variables upon the index is very small. The latter finding is consistent with the block regression's finding that only one sprawl-related variable (DENRATIO) has a statistically significant impact upon the index, and none have any large influence on its value.*

- *Crime rates had a moderately positive impact on urban decline-distress index scores in the block regression, but no influence in the step-wise regression*.

STATISTICAL ANALYSIS BASED ON VARIABLES USED IN THE REMAINDER OF THE STUDY

The statistical analysis in the previous section concluded that suburban sprawl in itself has not been a major cause of urban decline. However, that analysis did not make use of the same definitions and empirical measures of sprawl used in most of the remainder of this study. The analysis in this section will determine, insofar as possible, whether using the same definitions and measures of sprawl employed in the rest of this study would lead to conclusions consistent with the conclusion of the previous section.

Measures of Urban Decline and Distress

The study uses individual counties and Economic Areas consisting of groups of counties as its basic statistical building blocks. In the analysis of the previous section, data on a large set of variables related to counties and EAs were assembled and will be used in this analysis as well. The following variables can be considered as possible measures of urban decline or distress *whenever their values are high* compared with the averages of all areas in the study (symbols for each used in the regression analysis are shown following its description):

%BELOPOV	Percent of all families in an EA below the poverty line in 1990
%FAMFEM	Percentage of all families in an EA headed by females in 1990
%HSPRE39	Percentage of all 1990 housing units in an EA built before 1939
UNEMPL%	Unemployment rate in 1990
COSTLIVE	An index of cost of living based upon 1990 county data
%VACHOUS	Percentage of all 1990 housing units that were vacant
VIOLCRIM	1995 rate of violent crimes per 100,000 county residents
PUBWELEX	Local government public welfare expenditures, 1995 to 1996

The following variables can be considered as possible measures of urban decline or distress *whenever their values are low* compared with the averages for all areas in the study:

%CHCCHSH	Percentage change in the number of households from 1980 to 1990 in central cities in the EAs
WEALTH	An index of wealth based upon 1989 personal incomes and types of personal income
MEDINC89	Median household income in 1989
GRADDEGR	Percent of 1990 residents 25 years and older with a graduate degree
MDHOUS$	Median 1990 value of owner-occupied housing

Single Variables as Measures of Urban Decline and Distress

For much of the analysis in this section, a single variable—percent change in households from 1980 to 1990 in central cities in the EA (%CHCCHSH)—is used as the primary measure of urban decline and distress. In essence, that variable measures the population growth rate of each central city in the 1980s. Cities that lost households are considered to be in decline; cities that gained households are not considered to be in decline. This will be the principal dependent variable in regressions used to analyze urban decline and distress. Other possible measures of central-city urban decline and distress will be considered independent conditions that may contribute to low levels of the main dependent variable.

Courtesy of G. Lowenstein

There is one significant drawback to using %CHCCHSH as the main measure of urban decline and distress: its value is heavily influenced by changes in the territorial extent of the central cities during the decade (%CHCCTER). If the cities expanded in area through annexation from 1980 to 1990, the percentage change in their household population would tend to increase without necessarily reflecting any alteration in other conditions within those cities. Of the 172 EAs covered by this study, 22 had no data available on territorial changes, 25 declined in size, 11 remained the same size, and 114—or 66 percent—increased in size. In fact, percentage changes in the number of central-city households from 1980 to 1990 in the Economic Areas studied have a 92 percent simple correlation with percentage changes in the territory occupied by those cities.

Therefore, using %CHCCTER (the percentage change in central-city territory) as an independent variable in regressions where %CHCCHSH (the percentage central-city household change from 1980 to 1990) is the dependent variable skews the results because the close correlation strongly dominates the regression. For example, in a regression with the 16 independent variables described above and %CHCCHSH as the dependent variable, the adjusted R-squared is only 0.0448, though two variables have t-scores above 2.0. However, if %CHCCTER is added into the regression as another independent variable, the adjusted R-squared jumps to 0.8649. A possible method of avoiding this problem is discussed later in this chapter.

Measures of Suburban Sprawl

The following variables can be considered as possible measures of suburban sprawl:

%SPRINEA	Population in counties designated by this study as sprawl counties as a percentage of total EA population (A relatively high value indicates more sprawl)
DRIVALON	Percentage of commuters driving alone in 1990 (A relatively high value indicates more sprawl)
EADENS	1990 density of population (persons per square mile) in the EA (A relatively low value indicates more sprawl)
EAAREA	Total land area (square miles) in the EA (A relatively large area might be associated with more sprawl)

%SPRINEA will be used as the principal measure of suburban sprawl.

Simple Correlations among the Variables

The principal measure of urban decline and distress—%CHCCHSH—has low simple correlations with all of the variables described above. The highest such correlation (-0.2155) is with percentage of housing units vacant in 1990 (%VACHOUS). This implies that higher degrees of vacancy in 1990 were weak symptoms of low household growth rate in the 1980s, all else being equal.

The principal measure of sprawl—%SPRINEA—also has low simple correlations with all of the other variables. Its direct correlation with %CHCCHSH is only -0.1616. This implies that a higher percentage of total EA population in sprawl counties is weakly associated with a lower percentage of central-city household change from 1980 to 1990. That result is consistent with the hypothesis that sprawl contributes to urban decline and distress, since lower central-city growth (or even decline) is associated with increased sprawl.

In fact, the principal sprawl measure (%SPRINEA) has low simple correlations with nearly all the possible measures of urban decline and distress. Table 13.15 indicates whether each variable has the sign that would be consistent with the basic hypothesis that greater urban decline is associated with more sprawl. Also included in the table below the gray bar are %SPRINEA's simple correlations with the other three variables identified as possible indicators of sprawl. Thus, judging from simple correlations alone, the evidence supporting the hypothesis that sprawl aggravates urban decline and distress is quite weak. The signs of eight of the 12 urban distress-decline variables shown in Table 13.15 are inconsistent with this hypothesis, and the correlations of those that are consistent with it are low.

Also of interest is the fact that the three other sprawl-related variables—DRIVALON, EADENS, and EAAREA—have low simple correlations with the principal measure of sprawl—%SPRINEA. Their mathematical signs are consistent with expectations, but the values of the correlations show very little direct connection between any of these proposed traits of sprawl and the overall sprawl measure. Simple correlations do not account for the influence of more

Courtesy of G. Lowenstein

Table 13.15
Correlation of the Causal Variables with the Principal Measure of Suburban Sprawl (%SPRINEA)

Variable	Simple Correlation with %SPRINEA	Expected Sign	Is Sign Consistent with or Inconsistent with Hypothesis?
%CHCCHSH	-0.161597	Negative	Consistent
VIOLCRIM	0.240146	Positive	Inconsistent
WEALTH	-0.065815	Positive	Inconsistent
GRADDEGR	0.103700	Negative	Inconsistent
COSTLIVE	-0.260669	Negative	Consistent
MEDINC89	0.023743	Negative	Inconsistent
%FAMFEM	-0.041643	Positive	Inconsistent
%BELOPOV	-0.019887	Positive	Inconsistent
%VACHOUS	0.087036	Positive	Consistent
%HSPRE39	-0.298497	Positive	Inconsistent
MDHOUS$	0.057255	Negative	Inconsistent
UNEMPLY%	0.078341	Positive	Consistent
DRIVALON	0.081786	Positive	Consistent
EADENS	-0.078759	Negative	Consistent
EAAREA	0.049514	Positive	Consistent

Source: The Brookings Institution

than one variable at a time; therefore, more complex multiple regressions are needed to arrive at more convincing conclusions about the plausibility of the hypothesis and the other relationships discussed above.

Multiple Regressions with Percentage Change of Central-City Household as the Measure of Urban Decline and Distress

To more thoroughly test that sprawl aggravates urban decline and distress, several multiple regressions were run using %CHCCHSH (the percentage change in central-city households from 1980 to 1990 within each EA) as the dependent variable. The first regression contained the 29 variables for which data were available from the 172 EAs studied and that seemed likely to exert influence upon the dependent variable. The 27 independent variables are among those listed in Table 13.16. This regression yielded an adjusted R-squared of 0.8666, but only four of the 29 variables had t-scores of 2.0 or higher. These were as follows:

- The percentage change in households from 1980 to 1990 in the entire area (%HSH8090)
- A measure of air pollution based upon ozone readings (AIRQUAL)
- The unemployment rate in 1990 (UNEMPLY%)
- The percentage change in the territorial extent of the central cities in the EA from 1980 to 1990 (%CHCCTER)

Three of these variables (%HSH8090, AIRQUAL, and %CHCCTER) had mathematical signs consistent with a priori judgments about how each variable would affect central-city growth. The mathematical sign for UNEMPLY%, was inconsistent: it indicated that higher unemployment rates were associated with faster central-city growth.

As noted earlier, the high R-squared of this regression was heavily dependent upon the influence of just one variable—%CHCCTER. If that variable is removed from the regression, the R-squared falls from 0.8666 to 0.1089, though the number of other variables with t-scores over 2.0 rises from three to five.

To further refine the analysis, the regression with the higher R-squared was modified by gradually removing variables with t-scores less than 2.0. This resulted in a regression containing %CHCCTER and five other

Table 13.16
Variables Used In Regression on
Percentage Change In Central-City Households, 1980-1990

Symbol for Variable	Meaning of Variable	Symbol for Variable	Meaning of Variable
%HSH8O90	Percent change in households, 1980 to 1990	MDHOUSS	Median value of owner-occupied housing units, 1989
%EMP8090	Percent change in employment, 1980 to 1990	DRIVALON	Percent of commuters who drove to work alone, 1990
QUALLIFE	Index of the quality of life	UNEMPL%	Percent of labor force unemployed in 1990
VIOLCRIM	Violent Crimes per 100,000 people in 1995	%CHCCTER	Percent change in territory of central cities, 1980 to 1990
PUBWELEX	Local government public welfare spending, 1995-96	%SPINEA	Percent of Economic Area residents in sprawl counties
WEALTH	Index of wealth based on personal income flows	%HSPRI&39	Percent of all 1990 housing units built before 1939
GRADDEGR	Percent of residents 25 and over with graduate degreees, 1990	COASTLIN	Equals 1.0 if county is within 100 miles of coastline; otherwise, zero
INCOMTAX	Annual income tax rate vs. personal income	%BELOPOV	Percent of residents with incomes below poverty level, 1989
AIRQUAL	Highest C02 parts per million in any 8-hr. period, 1999	%FAMFEM	Percent of all households headed by a single woman
RAINFALL	Annual rainfall in inches	%VACHOUS	Percent of all housing units vacant in 1990
SUNSHINE	Percent of sunny days out of all days in each year	%SFDETA	Percent of all housing units consisting of single family detached homes
HEATINDX	Heat degree days, based on days under 65 degrees	MEDINC89	Median household income in 1989
COSTLIVE	Ratio of household income to median home values	%POP5-17	Percent of population aged 5 to 17
HAZWASTE	Number of hazardous waste sites		
STUTEARA	Ratio of students to teachers in local schools		

Source: The Brookings Institution

independent variables with t-scores over 2.0, and an adjusted R-squared of 0.8672. The six independent variables are shown in Table 13.17.

The mathematical signs of COSTLIVE and UNEMPLY% are inconsistent with a priori expectations. Both a higher cost of living and a high unemployment rate are negative features, but they are associated with a faster rate of central-city growth in this regression. The remaining four independent variables have signs consistent with expectations about their impact upon the rate of change in the number of central-city households. Clearly, the percentage change in city territory is the dominant variable, with a Beta of 0.9258—which is eight times higher than that of the second highest variable, UNEMPLY%.

If the variable measuring sprawl—%SPRINEA—is added to the above regression, the overall adjusted R-squared rises slightly from 0.8672 to 0.8694. The t-score of %SPRINEA is -1.9264, so it almost qualifies as a statistically significant factor; however, its Beta is a small number (-0.05875). The SPRINEA variable's B-coefficient of -1.21 implies that a 10 percent increase in an EA's average percentage of residents living in sprawl counties (a gain of 1.423 percent from 14.123 percent to 15.500 percent) would be associated with a 1.71 percentage point fall (1.423 times -1.21) in the average percentage change in the number of central-city households (from 13.63 percent to 11.93 percent, which is a 12.50 percent drop). Thus, *there seems to be a negative relationship between the percentage of an EA's population living in*

Table 13.17
Multiple Regressions Using the Percentage Change in Central-City Households from 1980 to 1990 within Each EA (%CHCCHSH) as the Dependent Variable for All Independent Variables with T-Scores Above 2.0

Variable	Beta Coefficient	Standard Error of Beta	B Coefficient	Standard Error of B	t-score (165 cases)	p-level
Intercept			39.26	145.217	.27036	0.787220
%HSH8090	0.073837	0.035696	1848.00	893.414	2.06847	0.040156
AIRQUAL	-0.062870	0.030815	-2439.23	1195.560	-2.04024	0.042921
COSTLIVE	0.088411	0.038201	27.21	11.756	2.31437	0.021880
%VACHOUS	-0.087310	0.030330	-4.06	1.410	-2.87870	0.004522
UNEMPLY%	0.158387	0.031612	21.57	4.304	5.01041	0.000001
%CHCCTER	0.925830	0.028858	0.87	0.027	32.08275	0.000000

Source: The Brookings Institution

sprawl counties and the percentage rate of change in the number of households in its central cities. The higher the percentage of residents living in sprawl counties, the lower the growth rate in the number of central-city households. This relationship is not statistically significant at the .05 level—though it is close to being so.

Another approach to estimating the influence of sprawl-related traits upon urban decline also used %CHCCHSH as the dependent variable but deliberately omitted the territorial change variable, %CHCCTER. This approach began with as many variables as could be included from the available set and eliminated them one at a time until the adjusted R-squared was no longer raised. The result was a maximum adjusted R-squared of 0.2077 from 18 independent variables, though only 10 had t-scores larger than 2.0. Only two of the 18 independent variables are sprawl related. %DRIVALON (the percentage of commuters who drove to work alone) has a t-score of only 1.515; it is not statistically significant. %SPRINEA (the percentage of each EA's population in counties scored as sprawl counties) has a t-score of -2.097; it is significant at the 0.05 level. Its B-coefficient had a value of -3.5, implying that a change of one percentage point in an EA's average percentage of population residing in sprawl counties would produce a decline of 3.5 percentage points in the average percentage change in the number of central-city households from 1980 to 1990. That is, if the average percentage of the EA's population living in sprawl counties rose from 14.12 percent to 15.12 percent—a gain of 7.00 percent in that variable's average value—there would be a drop in the 1980 to 1990 percentage change in the number of central-city households within that EA from 13.79 percent to 10.29 percent—a decrease of 25.40 percent in that variable's value. *This conclusion seems to imply that the percentage of an EA's population living in counties experiencing sprawl had a significant impact on the percentage change in the number of households living in its central cities during the period 1980 to 1990*. However, the overall influence of all the variables included in the regression that produced this conclusion was relatively small, since its adjusted R-squared was only 0.2077.

How Is Sprawl Defined?

Whether the conclusion stated above implies that sprawl in some way causes or aggravates urban distress or decline depends, in part, on how the counties are designated as sprawling counties or nonsprawling counties. This designation process is described in chapter four. A county can be designated as sprawling for either of two time periods: 1980 to 2000, or 2000 to 2025. No county is designated as sprawling in either period if it is classified as an urban or urban

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center county. Those classifications are based upon density—that is, the number of households per square mile—and vary with groups of states of different densities. This latter designation process is described in chapter two. Since the average household contains about 2.65 persons, these standards are equivalent to counties with populations of greater than 225 persons per square mile in very low density states to populations of greater than 1,855 persons per square mile in high density states. One hundred of the nation's 3,091 counties have been placed in the two urban categories.

Other counties can be classified as undeveloped (2,083 counties), rural and rural center (689 counties), or suburban (219 counties). In *these 2,991 nonurban counties, sprawl is defined by this study as relatively rapid population or employment growth in undeveloped places*. A county is considered to be experiencing sprawl if (1) its growth rate is in the top quarter of its EA's annual household and employment growth; (2) its growth rate exceeds the average annual county growth rate (which was 1.36 percent from 1980 to 2000); and (3) the county's absolute level of growth exceeds 40 percent of the average absolute county growth (which was 357 households per year from 1980 to 2000), *or* (4) the county's absolute level of growth exceeds 160 percent of the average annual absolute county growth (which was 411 households per year from 1980 to 2000).

Table 13.18 shows that 742 counties were classified as sprawl counties. Of these, the 134 counties were classified as *growing sprawl counties*; that is, they did not experience sprawl, as defined above, from 1980 to 2000, but they will do so during the period 2000 to 2025. The 431 counties labeled *sustaining sprawl counties* experienced sprawl during the period 1980 to 2000 and will continue to do so during the period 2000 to 2025. The 177 *decreasing sprawl counties* experienced sprawl during the period 1980 to 2000 but will not continue to do so during the period 2000 to 2025. Hence 608 counties were experiencing sprawl during the period 1980 to 1990. The total population of these counties grew by 23.0 percent during the period, reaching 68.7 million in 1990 (27.6 percent of the nation's total population). In contrast, 2,249 counties (outside of urban and urban center counties) were labeled *nonsprawl counties*. Since the 134 *growing sprawl counties* were also actually in the *nonsprawl* category during the period 1980 to 1990, the total 1990 population of the counties that did not experience sprawl in the 1980s (excluding those in urban and urban center counties) was 99.0 million (39.7 percent of the nation's total population); these counties experienced a 3.5 percent growth in population during the period 1980 to 1990. The remaining 81.6 million residents of the nation in 1990 (32.7 percent of the total) lived in urban and urban center counties, the population of which grew by 8.7 percent during the 1980s. Clearly, counties that were defined as experiencing sprawl had much higher population growth rates during the 1980s than did those defined as nonsprawl.

Courtesy of G. Lowenstein

Multiple Regressions with the Ratio of City Change in Households to Change in Territory as the Measure of Urban Decline and Distress

As noted earlier, multiple regressions using %CHCCHSH (percentage change in central-city households from 1980 to 1990) as the dependent variable measuring urban distress or decline have relatively low adjusted R-squared ratings—*unless* they contain the independent variable %CHCCTER (percentage change in central-city territory from 1980 to 1990). Since the variables %CHCCHSH and %CHCCTER have a simple correlation of more than 92 percent, including %CHCCTER in a regression using %CHCCHSH as the dependent variable produces very high adjusted R-squareds. However, that does not help illuminate the causal roles of other factors—including those related to sprawl.

In order to avoid this problem, a composite measure of urban population growth and decline was also developed by combining %CHCCHSH and %CHCCTER. This composite variable was computed for each EA by dividing %CHCCHSH by %CHCCTER. The composite variable is referred to as the KEYRATIO.

Table 13.18
Demographics of Counties by County Development Type and by Sprawl Category: 1980-1990

			Population					
County Type	Count	Count	1980	1990	Percent Change	Total Area (Sq.mi.)	Overall Density	Average Density
ALL SPRAWL COUNTIES OF ALL TYPES								
Undeveloped	2,083	271	10,888,253	13,338,370	22.50	928,254	14.4	44.03
Rural	643	327	28,905,001	34,486,213	19.31	233,835	147.5	161.13
Rural Center	46	20	2,348,144	2,686,305	14.40	38,032	70.6	120.16
Suburban	219	124	25,069,004	30,059,541	19.91	107,778	278.9	379.04
Total	**2,991**	**742**	**67,210,402**	**80,570,429**	**19.88**	**1,307,899**	**61.6**	**153.67**
SUSTAINING SPRAWL COUNTIES								
Undeveloped	2,083	124	6,321,595	8,233,432	30.24	715,909	11.5	43.61
Rural	643	223	21,114,034	26,262,063	24.38	173,612	151.3	172.50
Rural Center	46	8	1,122,769	1,354,925	20.68	26,087	51.9	65.54
Suburban	219	76	11,779,867	14,802,368	25.66	63,186	234.3	311.30
Total	**2,991**	**431**	**40,338,265**	**50,652,788**	**25.57**	**978,794**	**51.8**	**157.91**
GROWING SPRAWL COUNTIES								
Undeveloped	2,083	67	2,075,913	2,211,762	6.54	116,414	19.0	36.81
Rural	643	39	3,754,819	3,696,228	-1.56	24,994	147.9	142.42
Rural Center	46	6	653,462	701,787	7.40	$7,409	94.7	140.42
Suburban	219	22	4,884,135	5,258,478	7.66	17,695	297.2	447.53
Total	**2,991**	**134**	**11,368,329**	**11,868,255**	**4.40**	**166,513**	**71.28**	**139.62**
DECREASING SPRAWL COUNTIES								
Undeveloped	2,083	80	2,490,745	2,893,176	16.16	95,931	30.2	50.73
Rural	643	65	4,036,148	4,527,922	12.18	35,228	128.5	133.36
Rural Center	46	6	571,913	629,593	10.09	4,536	138.8	172.73
Suburban	219	26	8,405,002	9,998,695	18.96	26,897	371.7	519.10
Total	**2,991**	**177**	**15,503,808**	**18,049,386**	**16.42**	**162,592**	**111.0**	**154.01**
NONSPRAWL COUNTIES (NOT IN URBAN OR URBAN CENTER AREAS)								
Undeveloped	2,083	1,812	30,827,245	30,644,031	-0.59	1,872,048	16.4	
Rural	643	316	18,073,779	17,958,489	-0.64	164,730	109.0	
Rural Center	46	26	3,804,038	4,001,162	5.18	75,905	52.7	
Suburban	219	95	31,591,158	34,510,199	9.24	66,096	522.1	
Total	**2,991**	**2,249**	**84,296,220**	**87,113,881**	**3.34**	**2,178,779**	**40.0**	
URBAN AND URBAN CENTER COUNTIES								
Urban	71	71	44,292,808	49,853,920	12.56	39,357	1,266.70	1,669.49
Urban Center	29	29	30,746,375	31,733,510	3.21	9,383	3,382.20	8,847.96
Total	**100**	**100**	**75,039,183**	**81,587,430**	**8.73**	**48,740**	**1,673.94**	**3,751.25**
ALL COUNTIES								
Undeveloped	2,083	2,083	41,715,498	43,982,401	5.43	2,800,302	15.71	28.80
Rural	643	643	46,978,780	52,444,702	11.63	398,565	131.58	139.08
Rural Center	46	46	6,152,182	6,687,467	8.70	113,937	58.69	124.86
Suburban	219	219	56,660,162	64,569,740	13.96	173,875	371.36	486.91
Urban	71	71	44,292,808	49,853,920	12.56	39,357	1,266.70	1,669.49
Urban Center	29	29	30,746,375	31,733,510	3.21	9,383	3,382.20	8,847.96
Total	**3,091**	**3,091**	**226,545,805**	**249,271,740**	**10.03**	**3,535,419**	**70.51**	**206.06**

Courtesy of C. Galley

If an EA's KEYRATIO is more than 1.0, then the number of households in the EA's central cities grew faster in percentage terms from 1980 to 1990 than the spatial territory of those cities. This means the *average household density of the central cities increased*. An increase in the average household density would imply that those cities did not suffer from urban decline—according to this population-based measure. If an EA's KEYRATIO is less than 1.0, then the number of households within its central cities grew more slowly in percentage terms from 1980 to 1990 than the spatial territory of those cities. This means the *average household density of the central cities decreased*. A decrease in average household density would imply that those cities did suffer from urban decline—according to this population-based measure. Twenty-two of the 172 EAs covered by this study had no data on central-city territorial change from 1980 to 1990. Data from the remaining areas showed the following: in 25 EAs, central cities declined in territory; in 11 EAs, there was no change in central-city territory; and in 114 EAs, central cities' territory expanded. Therefore, a KEYRATIO of less than 1.0 for an Economic Area usually implies that its central cities either actually lost households or would have lost households if their total area had not increased. This variable will be used as an alternative measure of urban growth or decline in regressions attempting to relate such growth or decline to suburban sprawl.

Twenty-two of the 172 EAs used in this study had no data on territorial change, and one additional area, Honolulu, was the same as its central city, therefore, the KEYRATIO variable could only be meaningfully computed for 149 of the 172 EAs. KEYRATIO had a value of less than 1.0 in 83 areas, a value of exactly 1.0 in 2 areas, and values of more than 1.0 in 64 areas. Thus, by this measure, central cities in more than half of all the Economic Areas for which relevant data were available would be considered to have experienced urban distress or decline from 1980 to 1990.

Unfortunately, attempts to create a meaningful regression with KEYRATIO as the dependent measure of urban decline and distress were not successful. The first attempt included 26 variables from the available data set as independent variables, since it seemed that each of the 26 might have some influence on central-city growth. However, the resulting adjusted R-squared was -0.0756, and none of the 26 variables had a t-score of more than 1.56. Subsequent attempts to raise the R-squared of the regression by removing variables with very low t-scores were not fruitful. Even when the number of independent variables was cut to six, several of which had t-scores over 2.0, the ad-

Table 13.19
Multiple Regressions Using the Percentage of the Total EA Population in Counties Designated as Sprawl (%SPRINEA) as the Dependent Variable

Variable	Beta Coefficient	Standard Error of Beta	B Coefficient	Standard Error of B	t-score (164 cases)	p-level
Intercept			21.9704	10.0200	2.19267	0.029740
%HSH8090	0.294650	0.089482	356.9963	108.4160	3.29284	0.001215
VIOLCRIM	0.216378	0.085454	0.0156	0.0061	2.53209	0.012278
MEDINC89	0.498552	0.130812	0.0018	0.0005	3.81122	0.000195
COSTLIVE	-0.471995	0.144195	-7.0314	2.1482	-3.27331	0.001296
MDHOUS$	-0.535231	0.177996	-0.0003	0.0001	-3.00699	0.003054
EADENSE	-0.216061	0.087754	-0.0239	0.0097	-2.46211	0.014847
POLICEPC	-0.402719	0.087248	-0.1942	0.0421	-4.61579	0.000080

Source: The Brookings Institution

justed R-squared remained well under 0.10, and none of the statistically significant variables were related to sprawl.

Multiple Regressions with Population in Sprawl Counties as a Percentage of Total EA Population as the Dependent Variable Measuring Sprawl

Another way to explore the relationship between sprawl and urban decline and distress is to use a measure of sprawl as the dependent variable and various measures of urban decline and distress as the independent variables. This approach seems to imply that urban decline and distress cause sprawl, rather than the reverse. However, any relationship between sprawl and urban decline and distress would be of interest, so this approach was also tested.

Initially, 26 independent variables were used against the dependent variable %SPRINEA, including all the variables related to urban decline and distress. The result was an adjusted R-squared of 0.2567, but only two of these variables had t-scores over 2.0. Gradual removal of the variables with low t-scores raised the adjusted R-squared to 0.3039 with seven independent variables. All seven had t-scores over 2.0, which indicates statistical significance at the p-level of .02. These variables are shown in Table 13.19.

Of the seven variables, five are possible indicators of urban decline and distress: VIOLCRIM, MEDINC89, COSTLIVE, MDHOUS$, and POLICEPC. VIOLCRIM has a positive sign, which implies that higher crime rates are associated with more sprawl. This result is consistent with *a priori* expectations because higher crime rates, which are normally concentrated in older cities, tend to motivate people to move outward, aggravating sprawl. MEDINC89 also has a positive sign, indicating that higher incomes in the Economic Area are associated with greater sprawl. This implies that people move out of central cities as their incomes increase—so it is consistent with the basic hypothesis that sprawl aggravates urban decline and distress. COSTLIVE, MDHOUS$, and POLICEPC have negative signs, implying that higher levels of these conditions—higher living costs, higher median housing prices, and higher per capita spending on police—would *reduce* the amount of sprawl in the Economic Area. That indicates that the more decline or distress is experienced in a central city, the less sprawl is associated with its EA—a result that is in opposition to the basic hypothesis. Yet, all seven of these variables have t-scores above 2.0, which indicates that they are statistically significant at the .05 level or above.

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Taken together, the data are too contradictory to either affirm or deny the basic hypothesis that sprawl aggravates urban decline and distress. The results are too inconsistent to support any definite conclusion.

Which Elements of the Growth Process Cause Urban Decline?

The reasoning presented above is consistent with the conclusion reached in the second section of this chapter about the relationship between suburban sprawl and urban decline and distress. After an exhaustive series of statistical analyses, that section concluded that urban decline was not significantly affected by the low-density aspects of the growth process—those most commonly meant by the term sprawl. However, the second section had already pointed out that urban decline and distress were significantly increased by the way the American metropolitan growth process occurred overall, mainly because that process clearly produces concentrations of poverty in older core areas. *Therefore, it is likely that other elements of the U.S. metropolitan growth process—other than its low-density elements—most aggravate urban decline and distress.* The first section of the chapter identified the following elements as fundamental aspects of the U.S. metropolitan growth process:

- The universal requirement that all new housing units in the United States be built to high-quality standards—standards that make these units too costly for low-income households to occupy without large public subsidies
- The political unwillingness of governments to provide enough housing or income subsidies to poor households to enable them to occupy new housing
- Exclusionary zoning by many suburban governments
- Continuing racial segregation in housing markets
- Major obstacles to development in older cities that make building on vacant peripheral land much more attractive to developers
- The dynamic nature of upward mobility in the United States that causes households to move to "better" neighborhoods, rather than upgrade existing accommodations without moving, when their incomes improve

These elements, in combination, are those most likely to concentrate low-income households—especially low-income minority households—in older core-area

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neighborhoods. That, in turn, leads to urban decline and distress because many viable households and firms become motivated to move out of central cities and older suburbs. The empirical evidence relevant to these conclusions is presented in the final section of this chapter.

The elements of metropolitan growth, perhaps with the exception of exclusionary zoning, are not inherently related to suburban sprawl, which is a particular low-density form of peripheral growth. If all peripheral growth in U.S. metropolitan areas occurred at relatively high densities (like such growth in most of Western Europe) but the growth process still exhibited these six elements, future urban decline would still be aggravated by peripheral growth. Hence, *policies aimed only at reducing the low-density aspects of American metropolitan growth—those aspects which cause such growth to be labeled as sprawl—would not affect the decline-aggravating nature of that growth if such changes did not affect the six key elements described above*.

This conclusion is hard for many observers of urban affairs to accept because they believe all American metropolitan growth is sprawl and, therefore, one cannot usefully distinguish between sprawl and the underlying growth and development process. This widespread belief is based on the fact that almost all U.S. metropolitan-area growth and development during the past 50 years has indeed exhibited all the four basic traits of sprawl. Growth has been at relatively low densities; it has involved leapfrog development and has had no outward limits; and it has featured the heavy dominance of ground transportation by private automobiles.

Future metropolitan growth does not have to exhibit the same low-density traits. In fact, many opponents of sprawl are now advocating higher-density and more spatially confined growth patterns that would not have the same traits as past sprawl growth. They contend that reducing the low-density elements of sprawl would reduce future urban decline and distress. Therefore, many of the policies they advocate—for example, urban growth boundaries, smaller lot sizes, greater use of public transit, and higher densities—are aimed at reducing the low-density aspects of future growth.

Would Policies That Reduce Sprawl Also Reduce Urban Decline and Distress?

A key study question is: Would such anti-low-density policies in fact help reduce future urban decline and distress if overall metropolitan population growth continued in some high-density manner without changing the other elements of the growth process mentioned above? The answer would be "Yes" only if there were strong linkages between the low-density aspects of past and present metropolitan growth and urban decline and distress. The analysis in this chapter indicates that strong linkages do not exist. Rather, it implies that urban decline and distress are aggravated by elements of the metropolitan growth process that would not be changed by shifting future growth from low-density to high-density patterns. This is a crucial conclusion because one of the key arguments for making such a growth-pattern shift is to reduce future urban decline and distress. However, if such policies do not alter the other elements of the growth process that are most likely to be aggravating decline, they will not affect future urban decline.

REEXAMINING THE LINKAGES BETWEEN SPRAWL AND URBAN DECLINE

What are the implications of the preceding analyses for the basic hypothesis that the metropolitan-area growth process helps cause—or at least aggravates—the decline of many older central cities? To answer that question, it is necessary to restate the argument in the form of seven related propositions or hypotheses. Following each proposition stated below is a discussion of the empirical evidence bearing upon its validity. This evidence has been taken both from this study and from other relevant sources.

1. The American urban development process concentrates poor households, especially poor minority households, in older central cities and inner-ring suburbs.

Empirical findings. The data clearly confirm this proposition:

- In 1990, the average fraction of poor residents in 157 cases was 12.2 percent for entire metropolitan areas, but 18.3 percent in the central cities and 10.0 percent in the suburbs.

- An average of 49.7 percent of all poor metropolitan-area residents lived in central cities in 1990, although those cities contained an average of only 37.0 percent of total metropolitan-area population.

- In the 83 metropolitan areas for which data were available for both central cities and their suburbs, an average of 84.3 percent of all people living in extreme-poverty census tracts resided in the central cities, 15.7 percent lived in the suburbs.

- Minority groups experience much greater concentration of poverty in high-poverty neighborhoods than do non-Hispanic whites. In 1990, according to calculations made by Paul Jargowsky (1997) and applied to the 162 metropolitan areas in this study, an average of only 4.5 percent of all metropolitan-area residents lived in neighborhoods where 40 percent or more of the residents had incomes below the poverty level. Breaking this down by group, 2.3 percent of all white metropolitan-area residents, 7.6 percent of all Hispanic metropolitan-area residents, and 15.3 percent of all African American metropolitan-area residents lived in high-poverty areas. Thus, *the high percentage of all African American residents living in such high-poverty areas was nearly seven times as high as the percentage of all non-Hispanic whites living in high-poverty areas.* Similarly, among all *poor* residents in these metropolitan areas, an average of 14.4 percent were concentrated in high-poverty neighborhoods. Breaking this down by groups, 7.3 percent of poor whites, 14.3 percent of poor Hispanics, and 24.9 percent of poor African Americans lived in high-poverty areas. Most high-poverty areas in metropolitan areas are located within central cities, as noted earlier. Thus, high-poverty inner-city neighborhoods contain much greater concentrations of minority-group poor people than of white poor people.[9] Apparently, *poverty in itself* is not nearly as much of a barrier to living outside of high-poverty concentrations as is *poverty combined with minority-group membership*.

2. A major cause of the concentration of poverty is the deliberately exclusionary behavior adopted by many suburban governments in order to keep low-income households out of their communities. The exclusionary behavior includes raising the costs of occupying housing in the suburban communities. This local government behavior is made possible by the fragmentation of suburban governance over land uses into separate powers held by many relatively small localities.

Empirical findings. The fragmentation of governmental powers had no significant relationship to city growth rates. In fact, governmental fragmentation is largely a regional phenomenon. It occurs to the greatest degree in the Midwest and the Northeast, and to the least degree in the West and the South. Hence, this proposition is neither confirmed nor refuted with respect to central-city population growth.

In the "best" step-wise regression concerning the index of urban decline-distress, however, the variable measuring local government fragmentation was statistically significant at the .012 p-level. This implies that the greater the fragmentation of local governments in a metropolitan area, the greater the urban decline-distress index in its central city. In addition, the variable CITSUBPV was also statistically significant at the .0004 p-level. This variable measures the disparity concerning the percentage of residents who are poor in the central city and those who are poor in the remainder of the metropolitan area—that is, in the suburbs. In short, it measures the relative concentration of poverty within the central city. Such concentration could result from many factors, but exclusionary suburban zoning is surely one of the major factors. Therefore, the significance of this variable can be interpreted as at least indirect evidence that past and present exclusionary zoning and other practices—including racial segregation—have produced greater urban decline and distress.

Furthermore, the variable AFROSEG was statistically significant at the .03 p-level in the "best" step-wise regression using the urban decline-distress index as the dependent variable. This indicates that racial segregation of whites vs. African Americans is a definite contributor to urban decline and distress. Such segregation is often a key motive for suburban adoption of exclusionary zoning, although residents rarely admit this to be the case. Hence, the significance of the AFROSEG variable is further indirect evidence of the truth of this proposition.

3. Additional causes of the concentration of minority poverty include certain other elements of suburban sprawl. These elements spread suburban population over large territories relatively distant from the central-city neighborhoods where poor minorities are concentrated. The elements are (1) unlimited outward extension of new development in space, (2) leapfrog development, (3) low-density residential and nonresidential development, and (4) extensive dominance of urban transportation by the automobile.

Empirical Findings. None of these sprawl-related variables had any significant impact on city growth or decline rates; levels of central-city poverty; or the urban decline-distress index. There is a statistically significant relationship between Economic Area density and the percentage of the area's total population living in counties classified as sprawling (%SPINEA). Moreover, as noted above, the variable's mathematical sign is consistent with the hypothesis that greater sprawl within an Economic Area is associated with lower population density in the area as a whole. But both rural and rural center counties classified as sprawl counties had higher densities than rural and rural center counties classified as nonsprawl counties. Thus, the preponderance of evidence concerning this proposition tends to reject rather than affirm it.

4. The resulting concentration of minority poverty generates certain social conditions within large parts of those central cities and inner-ring suburbs that are considered undesirable by many households living there and elsewhere. These conditions are (1) high crime rates, (2) poor-quality public schools, (3) the

[9] Paul A. Jargowsky supplied data concerning neighborhood poverty ratios and poverty concentration ratios for the areas studied in this analysis. The applications of his data to the areas covered in the study were carried out by Anthony Downs. Jargowsky's data can be found in Paul A. Jargowsky, *Poverty and Place: Ghettos, Barrios, and the American City* (New York: Russell Sage Foundation, 1997), tables B-1 to B-3.

low quality of other public services (a result of the fiscal weakness of local governments due to the loss of tax-paying households and firms to the suburbs), (4) inefficient city government bureaucracies that serve their own interests with higher priority than the interests of their clients, and (5) large minority neighborhoods segregated from whites by white behavior patterns, including the unwillingness of most white households to live there.

Empirical findings. The following data are relevant to the hypotheses stated above:

- *High crime rates*. In 1990, the average serious-crime rate in 159 central cities included in this analysis was 9,318 crimes per 100,000 residents, compared with the overall U.S. average rate in 1990 of 5,820 crimes per 100,000 residents. The average violent crime rate in these same cities in 1990 was 1,292 crimes per 100,000 residents, compared with the U.S. average rate of 732 crimes per 100,000 residents. Crime rates in these cities were 1.6 times higher than the U.S. average for all serious crimes and 1.77 times higher than the U.S. average for violent crimes. Moreover, crime rates *within* these cities were much higher in high-poverty areas than the city averages indicate.[10] The data tend to confirm the first hypothesis above.

- *Poor quality of public schools*. As of 1990, data from 161 cities showed that the average percentages of persons 25 years of age and older who had completed four years of high school and four years of college were 74.3 percent and 21.7 percent, respectively. For the entire U.S. in 1990, the figures were 77.8 percent and 21.3 percent for those who had completed four years of college. Thus, residents of these cities, on the average, did not have educational attainments much below national averages.[11] These data do not support the second hypothesis stated above. However, Jargowsky (1997) analyzed educational attainments within metropolitan-area neighborhoods with different levels of poverty in 1990. His findings, shown in Table 13.20, are for residents 25 years and older.[12]

  These data are for entire metropolitan areas, but most high-poverty neighborhoods within such areas are located in central cities, as noted above. Residents of high-poverty neighborhoods have educational attainment levels that are much lower than those of residents of low-poverty neighborhoods. This fact does not prove that public schools serving the former are worse than those serving the latter, since the cause of lower scores might be factors other than the schools. For example, other factors might be family support of education, hereditary abilities, peer-group attitudes, etc. However, these data are at least consistent with the hypothesis that the quality of education received in high-poverty areas within central cities is lower than that received elsewhere.


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- *Quality of other public services*. There are no readily available measures of the quality of other public services in different cities and suburban communities. Therefore, the third hypothesis above cannot be effectively tested.

- *Large bureaucracies in central cities*. In 1990, the average central city (156 cities were used in this analysis) contained 340,568 residents; the average metropolitan area contained 1,018,318 residents. Thus, 677,750 people lived in the sub-

[10] Crime rate data for the United States as a whole is from *Statistical Abstract of the United States: 1996*, p. 201.

[11] Educational attainment data for the the United States as a whole is from *Statistical Abstract of the United States: 1996*, p. 159.

[12] Paul A. Jargowsky, *Poverty and Place: Ghettos, Barrios, and the American City* (New York: Russell Sage Foundation, 1997), p. 111.

Table 13.20
1990 Metropolitan Areas' Level of Educational Attainment

1990 Educational Attainment	All Metropolitan Area Neighborhoods	Neighborhood Poverty Level in 1990		
		0%-19.9%	20%-39.9%	40%-100%
High school dropout	23.0%	19.2%	40.7%	51.7%
High school graduate	28.7%	29.1%	27.3%	23.9%
Some college	19.5%	20.4%	15.6%	12.7%
Two-year degree	6.4%	6.8%	4.6%	3.4%
Four-year degree	14.4%	15.8%	7.5%	5.0%
Graduate or professional degree	8.0%	8.8%	4.3%	3.2%

Source: The Brookings Institution

urban portions of the average metropolitan area. The average number of land-use-governing local governments in the metropolitan area was 7.76. The central-city government was one of those; the other 6.76 were in the suburbs. Hence, the average suburban community with land-use-governing powers contained about 100,258 residents. The average central-city government served 3.4 times as many constituents as the average suburban government did. These data imply that the central-city government was much more likely to become undesirably bureaucratic than were suburban governments because of sheer discrepancies in size. (Suburban governments in the Midwest and in the Northeast have far fewer residents on the average than do those in the South and the West. So this size discrepancy is more likely to be large in the former two regions than in the latter two.)

- *Concentration of minority groups in central cities*. Minority groups made up 35.8 percent of the average central city's population. African Americans made up 21.6 percent of the average central city's population. When the 1990 total and minority populations of all 162 cities together are calculated, 46.0 percent of the total consisted of minority-group members, 24.3 percent consisted of African Americans, and 16.2 percent were of Hispanic origin. Outside these cities, in the remainder of the U.S., 23.9 percent of all residents were minority-group members (including all persons of Hispanic origin). Of this amount, 8.7 percent were African Americans, and 7.0 percent were of Hispanic origin. Thus, the percentage of residents in the central cities consisting of all minority-group members and Hispanics were just about double the analogous percentage for the rest of the nation. For African Americans, the city percentage was three times as great as the percentage for the rest of the nation. This partially confirms the last hypothesis in the preceding analytic paragraph. There were far more, and larger, minority-group concentrations in these central cities than in other parts of the nation, including their suburbs.

5. The five inner-city social conditions described above have motivated, and still motivate, many economically viable households, including minority-group households, and many economically viable businesses to move out of central cities and inner-ring suburbs, or to refuse to move into them. Economically viable households and businesses move to farther-out suburbs or exurbs, or locate in the latter when they move into, or are founded in, the metropolitan area concerned. (This proposition refers to the *motivation* for people moving out of cities; the next proposition deals with the *magnitude* of such movements.)

Empirical findings. The following findings assess whether the five social conditions described above motivate people to move out of the older core areas:

Courtesy of A. Nelessen

- *High crime rates*. The basic regression concerning city population changes showed no negative relationship between 1990 city crime rates and rates of city population change from 1980 to 1990. In fact, there was a slight positive relationship, though it was not statistically significant. Therefore, although central cities indeed have higher crime rates than other places, their high crime rates do *not* appear to motivate people to move out of those cities, other things being equal. However, as noted earlier, this finding applies to citywide crime rates and may not apply to local neighborhood crime rates.

- *Poor-quality public schools*. The same basic regression showed a statistically positive relationship between the percentage of adults 25 years of age and older with bachelor's degrees and rates of city population change from 1980 to 1990. This relationship was significant at the .004 level. However, no significant relationship existed between rates of city population change from 1980 to 1990 or the urban decline-distress index and either (1) the percentage of adults 25 years of age and over who had graduated from high school or (2) the percentage of persons 16 to 19 years of age who were neither in school nor employed (and who could therefore be presumed to be high-school dropouts). Therefore, only weak statistical evidence of a connection between central-city public school quality and central-city population or other decline can be gleaned from this analysis. True, this can be supplemented by strong anecdotal evidence gathered from Realtors and other well-informed observers about the importance of public school quality in determining residential locations; however, clearer empirical testing of this motivational factor must await better measures of public school quality.

Courtesy of G. Lowenstein

- *Low quality of other public services*. The study has neither produced nor found any relevant empirical evidence capable of testing whether this motivational factor causes many people to move out of central cities.

- *Inefficient central-city public bureaucracies*. The study has neither produced nor found any relevant empirical evidence capable of testing whether this motivational factor causes many people to move out of central cities.

- *Unwillingness of whites to live in heavily minority-populated neighborhoods*. Studies of white households' attitudes toward living in racially integrated neighborhoods were conducted in 1976 and in 1992 by Reynolds Farley and several associates. In the 1976 study, only one-fourth of the white households interviewed said they would be willing to move into a neighborhood containing 33 percent African American households.[13] In the 1992 study, about 41 percent of the 636 white households interviewed said they would move into such a neighborhood, but only 27 percent were willing to move into a neighborhood containing 60 percent black households.[14] These are higher percentages than in the earlier survey, but they indicate that a majority of whites are still not willing to live in neighborhoods with more than one-fourth to one-third African American residents. Therefore, as the percentage of minority-group residents increases in many central-city neighborhoods, fewer and fewer whites are willing to remain in, or move into, those areas. Yet the central cities in the 162 urbanized areas in this analysis are heavily population by minority groups, especially African Americans, as noted above. In fact, 36 of the 162 central cities have majority-minority populations

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[13] Farley Reynolds, Howard Schuman, Suzanne Bianchi, Diane Colesanto, and Shirley Hatchett, "Chocolate City, Vanilla Suburbs: Will the Trend towards Racially Separate Communities Continue?" *Social Science Research,* 7; p. 319-344.

[14] Farley Reynolds and William H. Frey, "Changes in the Segregation of Whites from Blacks in the 1980s: "Small Steps towards a More Integrated Society," *American Sociological Review*, 59, 1: 23-45.

Courtesy of C. Galley

overall, and 23 others have populations that are more than 40 percent minority.

This conclusion is reinforced by the ethnic composition of the public schools in many of the 162 cities. Nearly all the largest cities in the United States have majority-minority enrollments in their public elementary and secondary schools, even if their total resident population is not majority-minority. In the 18 cities for which enrollment data by race and ethnicity were readily available, the average percentage of minority students in public schools in 1992 was 79.7 percent, although the average proportion of minorities in these cities' total populations was 58.7 percent.[15] Each of these 18 cities had majority-minority enrollments in its public schools. Many white parents are unwilling to send their children to majority-minority schools, as a result of the same attitudes that make them unwilling to move into majority-minority neighborhoods.

These findings confirm the hypothesis that racial attitudes among whites cause many to move out of central cities, or not to move into them, because those cities contain high proportions of minority-group households. As noted earlier, white attitudes concerning race are not the only cause of neighborhood residential segregation by race. A process of self-selection by both whites and African Americans is also an important contributing factor. Many African Americans prefer living in mainly black neighborhoods, just as many whites prefer living in mainly white ones. All these attitudinal factors make reducing residential segregation by race extremely difficult.

6. Many "declining cities" have lost population as middle-class residents and white residents of all classes move from the cities into the suburbs.

Empirical findings. In the decade from 1980 to 1990, 53 U.S. cities containing more than 100,000 residents lost population. These cities are listed on Table 13.21 along with data concerning their population changes from 1950 to 1990. Fifteen of the cities lost population in each of the four decades from 1950 to 1990. The 53 cities include those communities to which most people refer when they speak about America's "declining cities." Population changes from 1950 to 1990

[15] National Center for Education Statistics, *Digest of Educational Statistics, 1992* (U.S. Department of Education, 1994), 97-101.

Table 13.21
Population Changes from 1950 to 1992 in All 53 Large U.S. Cities That Declined in Population from 1980 To 1990
(Includes only cities with over 100,000 residents in 1990)

			Total City Populations on April First (in Thousands)						Percent Changes in Population of Cities by Periods				
NO	CITY	REG	1950	1960	1970	1980	1990	1992	1950-1960	1960-1970	1970-1980	1980-1990	1990-1992
1	Akron	MW	275	290	275	237	223	224	5.45	-5.17	-13.82	-5.91	0.45
2	Atlanta	S	331	487	495	425	394	395	47.13	1.64	-14.14	-7.29	0.25
3	Baltimore	S	950	939	905	787	736	726	-1.16	-3.62	-13.04	-6.48	-1.36
4	Beaumont	SW	94	119	118	118	114	115	26.60	-0.84	0.00	-3.39	0.88
5	Birmingham	S	326	341	301	284	266	265	4.60	-11.73	-5.65	-6.34	-0.38
6	Bridgeport	NE	159	157	157	143	142	137	-1.26	0.00	-8.92	-0.70	-3.52
7	Buffalo	NE	580	533	463	358	328	323	-8.10	-13.13	-22.68	-8.38	-1.52
8	Cedar Rapids	MW	72	92	ill	110	109	112	27.78	20.65	-0.90	-0.91	2.75
9	Chattanooga	S	131	130	120	170	152	153	-0.76	-7.69	41.67	-10.59	0.66
10	Chicago	MW	3,621	3,550	3,369	3,005	2,784	2,768	-1.96	-5.10	-10.80	-7.35	-0.57
11	Cincinnati	MW	504	503	454	385	364	364	-0.20	-9.74	-15.20	-5.45	0.00
12	Cleveland	MW	915	876	751	574	506	503	-4.26	-14.27	-23.57	-11.85	-0.59
13	Dayton	MW	244	262	243	194	182	183	7.38	-7.25	-20.16	-6.19	0.55
14	Denver	W	416	494	515	493	468	484	18.75	4.25	-4.27	-5.07	3.42
15	Detroit	MW	1,850	1,670	1,514	1,203	1,028	1,012	-9.73	-9.34	-20.54	-14.55	-1.56
16	Erie	NE	131	138	129	119	109	109	5.34	-6.52	-7.75	-8.40	0.00
17	Evansville	MW	129	149	139	130	126	128	15.50	-6.71	-6.47	-3.08	1.59
18	Flint	MW	163	197	193	160	141	139	20.86	-2.03	-17.10	-11.88	-1.42
19	Ft. Lauderdale	S	36	84	140	153	149	149	133.33	66.67	9.29	-2.61	0.00
20	Gary	MW	134	178	175	152	117	117	32.84	-1.69	-13.14	-23.03	0.00
21	Honolulu	W	248	294	325	365	365	371	18.55	10.54	12.31	0.00	1.64
22	Jackson	S	98	144	154	203	197	196	46.94	6.94	31.82	-2.96	-0.51
23	Kansas City KS	MW	130	122	168	161	150	147	-6.15	37.70	-4.17	-6.83	-2.00
24	Kansas City MO	MW	457	476	507	448	435	432	4.16	6.51	-11.64	-2.90	-0.69
25	Knoxville	S	125	112	175	175	165	167	-10.40	56.25	0.00	-5.71	1.21
26	Lansing	MW	92	108	131	130	127	127	17.39	21.30	-0.76	-2.31	0.00
27	Louisville	S	369	391	362	299	269	271	5.96	-7.42	-17.40	-10.03	0.74
28	Macon	S	70	70	122	117	107	107	0.00	74.29	-4.10	-8.55	0.00
29	Memphis	S	396	498	624	646	610	610	25.76	25.30	3.53	-5.57	0.00
30	Metairie	S	-	-	136	164	149	-	-	-	20.59	-9.15	-
31	Milwaukee	MW	637	741	717	636	628	617	16.33	-3.24	-11.30	-1.26	-1.75
32	Minneapolis	MW	522	483	434	371	368	363	-7.47	-10.14	-14.52	-0.81	-1.36
33	Mobile	S	129	203	190	200	196	202	57.36	-6.40	5.26	-2.00	3.06
34	New Orleans	S	570	628	593	558	497	490	10.18	-5.57	-5.90	-10.93	-1.41
35	Newark	NE	439	405	382	329	275	268	-7.74	-5.68	-13.87	-16.41	-2.55
36	Norfolk	S	214	306	308	267	261	254	42.99	0.65	-13.31	-2.25	-2.68
37	Peoria	MW	112	103	127	124	114	114	-8.04	23.30	-2.36	-8.06	0.00
38	Philadelphia	NE	2,071	2,003	1,949	1,688	1,586	1,553	-3.28	-2.70	-13.39	-6.04	-2.08
39	Pittsburgh	NE	677	604	520	424	370	367	-10.78	-13.91	-18.46	-12.74	-0.81
40	Richmond	S	230	220	249	219	203	202	-4.35	13.18	-12.05	-7.31	-0.49
41	Rochester	NE	332	319	295	242	232	234	-3.92	-7.52	-17.97	-4.13	0.86
42	Rockford	MW	93	127	147	140	139	142	36.56	15.75	-4.76	-0.71	2.16
43	Salt Lake City	W	182	189	176	163	160	166	3.85	-6.88	-7.39	-1.84	3.75
44	Savannah	S	120	149	118	142	138	139	24.17	-20.81	20.34	-2.82	0.72
45	Shreveport	S	127	164	182	206	199	197	29.13	10.98	13.19	-3.40	-1.01
46	South Bend	MW	116	132	126	110	106	106	13.79	-4.55	-12.70	-3.64	0.00
47	St. Louis	MW	857	750	622	453	397	384	-12.49	-17.07	-27.17	-12.36	-3.27
48	St. Petersburg	S	97	181	216	239	239	235	86.60	19-34	10.65	0.00	-1.67
49	Syracuse	NE	221	216	197	170	164	163	-2.26	-8.80	-13.71	-3.53	-0.61
50	Toledo	MW	304	318	383	355	333	329	4.61	20.44	-7.31	-6.20	-1.20
51	Warren	MW	1	89	179	161	145	142	8800.00	101.12	-10.06	-9.94	-2.07
52	Washington	S	802	764	757	638	607	585	-4.74	-0.92	-15.72	-4.86	-3.62
53	Yonkers	NE	153	191	204	195	188	186	24.84	6.81	-4.41	-3.59	-1.06
Total population			22,052	22,689	22,342	19,938	18,557	18,272	2.89	-1.53	-10.76	-6.93	-1.54
Number of Cities			52	52	53	53	53	52	Percentage changes in adjusted total population				
Adjusted total to same number of cities			22,052	22,689	22,206	19,774	18,408	18,272	2.89	-2.13	-10.95	-6.91	-0.74
									Numerical changes in adjusted total population (000)s				
									637	-483	-2,432	-1,366	-136

Source: The U.S. Department of Commerce, Bureau of the Census

Table 13.22
Summary Population Changes for 52 Declining Cities: 1960 to 1990

	Population Changes for 52 Declining Cities in Three Periods		
Population Group	**1960-1970**	**1970-1980**	**1980-1990**
Total population	-483,000 (-2.1%)	-2,432,000 (-11.0%)	-1,366,000 (-6.9%)
African American population	+623,571 (+10.0%)	+486,921 (+7.1%)	-13,960 (-0.2%)
Nonblack population	-1,106,571 (-6.7%)	-2,918,921 (-19.0%)	-1,352,040 (-10.9%)

Source: The Brookings Institution

Note: Nonblacks include all persons other than African Americans. This term is necessary because the Census Bureau changed its definitions of both blacks and other groups over time.

Table 13.23
Summary Population Changes for 48 Metropolitan Areas: 1960 to 1990

	Population Changes		
Geographic Area	**1960-1970**	**1970-1980**	**1980-1990**
Total area	+7,376,800 (+14.6%)	+5,681,400 (+9.8%)	+3,834,000 (+6.0%)
Total large cities	-483,000 (-2.1%)	-2,432,000 (-11.0%)	-1,366,000 (-6.9%)
Total other suburbs	+7,859,800 (+27.8%)	+8,113,400 (+22.4%)	+5,200,000 (+11.7%)

Source: The Brookings Institution

in 52 of these cities (Metairie, a suburb of New Orleans, was excluded because early data were not available) and from 1960 to 1990 in their 48 metropolitan areas confirm this hypothesis, though it is based upon a smaller set of cities than the set in this analysis. Table 13.16 summarizes the data.

Table 13.22 shows that the cities as a group experienced massive population losses from 1960 through 1990, especially after 1970. Part of the losses resulted from an expansion of the African American population that replaced former white residents. This part of the loss tends to confirm the hypothesis that the separatist racial attitudes of most whites combined with expanding minority populations in central cities caused many of the white residents to move out. However, nonblack population losses in each decade were much larger than black population increases. This is true even though the nonblack population includes Hispanics, who grew in numbers in most of the cities during these periods. So, non-Hispanic white losses in the cities were even larger than shown by this table. Thus, departures from these cities were not caused solely by "flight" from neighborhood racial change, though such "flight" was a key factor. Moreover, in the 1980s, the black populations of these cities also declined slightly because many black middle-class households moved to the suburbs.

Table 13.23 shows that suburban populations in the metropolitan areas of the 53 declining cities grew tremendously while populations of the large cities in them were shrinking. (The number of metropolitan areas in this table is smaller than the number of large cities in the preceding table because several cities over 100,000 that lost population in the 1980s were suburbs in metropolitan areas with other central cities.) Suburban growth in these MSAs in the 1950s was even larger than that in any of the decades shown above. Clearly, this suburban growth was also much larger than can be explained by people moving out of central cities. Its main cause was in-migration into these metropolitan areas from elsewhere.

These data confirm that many people were moving out of the central cities and into surrounding suburbs during the periods when poverty concentrations there were increasing. At least some of the population losses can surely be attributed to "flight" from adverse central-city conditions or racial minorities there. On the other hand, many other factors are also involved, since out-movements from central cities were much larger than can reasonably be attributed to moving away from concentrated poverty areas or conditions.

7. The departure of viable households and firms from the central city and from inner-ring suburbs reduces the fiscal resources available to the governments of those communities because the departing elements remove their taxable resources beyond the legal jurisdictions of those communities. This weakens the ability of those local governments to provide adequate public services to their citizens, who include a disproportionate share of households with low incomes and few economic resources.

Empirical findings. A regression analysis of the variable GOVXPCAP (city government expenditures per capita) was conducted as the dependent variable against other relevant variables in the set used in this analysis as independent variables. This is a partial test of the above hypothesis because it would detect whether cities with lower expenditures per capita were more likely to experience population declines. Lower expenditures per capita are not identical with lower-quality public services, but might be related. This regression produced an adjusted R-squared of .80725. However, the regression showed only a weak positive relationship between government spending per capita and the percentage change in city population from 1980 to 1990—a relationship not statistically significant at the 0.10 level. Thus, cities losing population in the 1980s did not have much lower government expenditures per capita than did those cities gaining population, all other things being equal.

The major regression analysis using the percentage change in city population from 1980 to 1990 as the dependent variable showed a stronger relationship to city government expenditures per capita, significant at the .004 level. Thus, increases in city government spending per capita did contribute to faster population growth to some degree. These findings do not, however, constitute any strong confirmation of this hypothesis, though they do not refute it either.

Courtesy of C. Galley

Courtesy of G. Lowenstein

The regression analysis using the urban decline-distress index as the dependent variable showed no statistically significant relationship between that index and government expenditures per capita, government revenues per capita, or taxes per capita.

8. The resulting poor quality of public services drives more viable households and firms out of the core communities, generating a self-aggravating, downward fiscal spiral therein. This downward spiral is a major cause of the urban decline witnessed in many large, older American cities.

Empirical findings. The cumulative nature of urban decline is shown by data in the Table 13.21 listing of all cities with populations over 100,000 (in 1990) that experienced decreasing populations in the 1980s. Of these 53 cities, 20 had decreasing populations in the 1950s. All 20 of those cities had subsequent decade-long declines in population in at least two of the subsequent three decades, and 15 of them had decreasing populations in all three of the subsequent decades. From 1960 to 1970, populations decreased in 30 of these cities (including most of the 20 just described). Twenty-six of the 30 cities had falling populations in both of the next two decades, and the other four had a population decline in one of those two decades. Thus, at least among these 53 cities, once population decline occurred over an entire decade, it was very likely to continue over most of the next several decades.

Declines in population are not the same as declines in a city's fiscal strength or the quality of services within it. However a declining population raises the per capita level of all the fixed costs in a city, including its debt service, and is certainly associated in the minds of most public officials with a general decline in quality of life. The exception is when a population decline follows a period of unusual population overcrowding, which was probably the case in the 1950s in many of these cities, for reasons discussed earlier.

Decreases in population after 1960 cannot reasonably be attributed to the relief of serious overcrowding.

Thus, the decline in city population used in this analysis as one measure of urban decline certainly appears to be a cumulative process. This finding is consistent with the hypothesis that urban decline contains self-aggravating elements that perpetuate it, once it has begun. Hence, the empirical evidence appears to confirm this hypothesis, though not with absolute certainty.

CONCLUSION

Findings

The following conclusions have emerged from the examination of hypotheses and empirical evidence presented above:

- The American development process does concentrate poor households—especially poor minority households—in central cities and older core portions of metropolitan areas.

Courtesy of C. Galley

- There is some indirect statistical evidence that exclusionary zoning is a key causal factor of such poverty concentration. That evidence consists of a positive association of the urban decline-distress index with (1) greater local government fragmentation, (2) greater overall metropolitan-area residential segregation of whites and African Americans, and (3) higher ratios of the percentage of poor residents in cities to the percentage in the suburbs. However, this indirect evidence cannot reasonably be construed as conclusive proof that exclusionary zoning causes urban decline or distress.

- Some of the major traits associated with suburban sprawl have no statistically significant relationship associated with declines in central-city population, or with the urban decline-distress index. These traits include (1) unlimited outward extension of new development, (2) leapfrog development, (3) low-density residential and nonresidential development, and (4) extensive dominance of urban transportation by automobiles. (The last is statistically significant in relation to city growth, but has the wrong sign to be evidence that more dominance by automobiles aggravates city population losses.) Therefore, urban decline cannot reasonably be attributed to the presence or absence of any of these traits, insofar as evidence from this study is concerned.

- The concentration of poverty within large central cities

— clearly produces higher crime rates, lower levels of educational attainment, and much higher proportions of minority-group households within those cities than elsewhere;

— does not clearly produce lower-quality public services than exist elsewhere, since there are no readily available means of testing the quality of public services in different communities;

— clearly creates larger public bureaucracies in large cities—however, whether those larger bureaucracies produce lower-quality and less-responsive services than are produced by smaller public organizations elsewhere cannot readily be tested.

- Whether these central-city conditions motivate residents to move out, or potential residents not to move in, varies depending on the traits concerned.

— Higher citywide crime rates appear to have no statistically significant effect on motivating households to move out of central cities.

— Large concentrations of minority-group households within central cities clearly motivate many non-Hispanic whites to move out of, or to avoid moving into, those cities. This results from the prevailing attitudes of most such whites toward living in ethnically or racially integrated neighborhoods.

— This study has not found reliable statistical evidence either confirming or refuting the hypothesis that poor-quality public schools cause many households of all ethnic groups to move out of central cities, or to refrain from moving into them. Anecdotal evidence supports that hypothesis, but it is not statistically verifiable.

— This study has also not found reliable statistical evidence either confirming or refuting the hypothesis that other poor-quality public services cause many households of all ethnic groups to move out of central cities, or to refrain from moving into them.

— There is inferential evidence that the racial and ethnic composition of public school systems in central cities—most of which have majority-minority enrollments—motivate many white households to move out of those cities, or not to move into them, because of the same attitudes that affect their behavior concerning housing choices. However, statistically significant proof of this view has not been found.


Courtesy of C. Galley


Courtesy of G. Lowenstein

- A notable number of large U.S. central cities—including 53 of the 189 cities that each contained 100,000 or more residents in 1990—lost population in the 1980s in what might reasonably be considered a process of urban decline. Of the 162 central cities included in this analysis, 63 lost population in that decade. A significant part of the population losses experienced by those cities occurred because households moved out of them into surrounding suburbs. Part of that movement was displacement of non-Hispanic white households by expanding numbers of African American and Hispanic and other minority households. However, the declines in non-Hispanic whites experienced by these cities were much larger than can reasonably be attributed to such racial or ethnic displacement.

- This study has produced no persuasive evidence that the population losses caused serious declines in government resources or in the quality of public services in the cities concerned. Hence, the hypothesis that makes that claim must be regarded as unproven.

- The urban decline process, as measured by city population changes, is clearly a cumulative one that—once started—tends to continue over time, even over many decades. This tends to confirm the hypothesis that urban decline contains self-aggravating elements that extend it for long periods of time. The clearest such element is the concentration of racial and ethnic minorities within central cities, because that concentration repels non-Hispanic whites in both housing markets and public schools. However, African Americans have also begun moving out of central cities in large numbers; so the future of this element is uncertain.

Implications of the Findings

What implications do the findings have concerning the relationship between suburban sprawl and urban decline?

First, *the American urban development and growth process does—by its very nature—produce conditions that generate urban decline in older core areas*. The most important of those conditions is the concentration of low-income households—especially low-income minority-group households—within the older core areas. *This concentration in itself* appears to be the single most important factor leading to the withdrawal of many viable households and firms from central cities and into outlying areas. That is true mainly because of the attitudes of many non-Hispanic white households against living in racially integrated neighborhoods or sending their children to racially integrated schools. In most commentaries about urban decline, the withdrawal of viable households from cities is attributed mainly to secondary conditions *produced by* concentrated poverty—high crime rates, poor-quality schools, and low levels of public services—not to the concentration of poverty in itself. However, the data from this analysis do not indicate that these secondary effects—insofar as they can be measured—have statistically significant relationships to city population growth rates. That is particularly true of high city crime rates, but also applies to educational attainments. Whether that finding means poor-quality public schools do or do not cause out-migration from cities cannot be determined from this analysis because no variables reliably measuring public school quality were available.

One significant factor is the racial and ethnic composition of concentrated poverty areas, and of central cities in general. The regression analyses showed that the percentage of city population consisting of minority groups had a major downward impact on city population growth rates from 1980 to 1990, and a significant impact aggravating urban decline and distress—although the latter impact was somewhat more ambiguous than the former. In terms of the logic of the American development process set forth at the beginning of this analysis, that factor stands out as having its importance confirmed more than any other factor contained in that logic. It is especially important because the U.S. growth process has concentrated poor minority-group households—especially African Americans—together in high-poverty neighborhoods to a much greater degree than poor whites. Thus, a second major conclusion from this analysis is that *the racial attitude of whites toward living with minorities—especially African Americans—is the single most important factor causing the concentration of poverty—and of minorities—in central cities to lead to urban decline*.[16] This conclusion must be qualified by the observation that other factors, including African American attitudes toward living with whites, are also important causes of residential segregation by race.

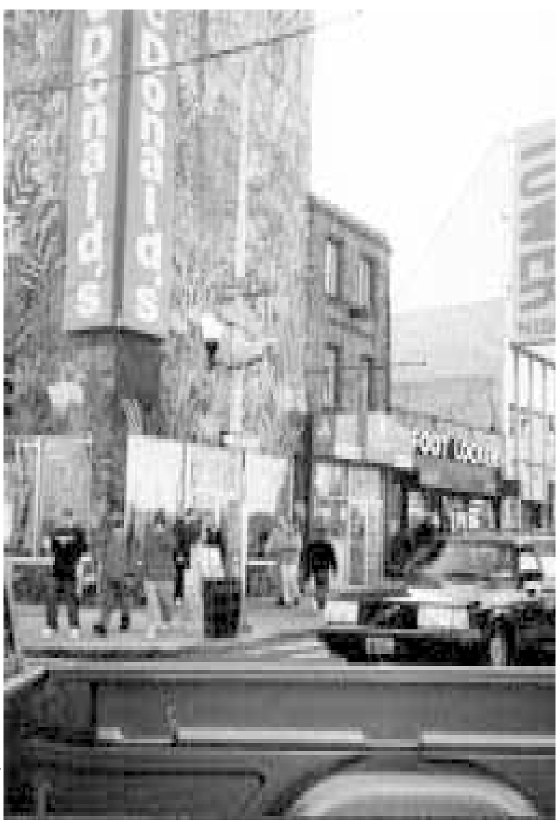
Courtesy of C. Galley

A third major conclusion from the analysis is that *three variables embodying aspects of suburban sprawl have a statistically significant relationship to greater urban decline and distress, as measured by the urban decline-distress index. The three variables are*

[16] This conclusion is similar to that reached by Douglas S. Massey and Nancy A. Denton in *American Apartheid: Segregation and the Making of the Underclass* (Cambridge, MA: Harvard University Press, 1993).

all indirectly related to exclusionary behavior in suburban housing markets. However, not one of these sprawl-related variables exerts a powerful influence on the index. The variables are the ratio of the percentage of poor persons living in the central city to the percentage of poor persons living in the suburbs within a metropolitan area; the number of local governments with land-use control powers per 100,000 metropolitan-area residents; and the percentage of a metropolitan area's population living within its central city.

A fourth key conclusion is that *several other factors closely associated with suburban sprawl seem to have no impact on city population growth rates or urban decline-distress*. If sprawl has some role in the decline of cities, that influence is not being exerted through (1) unlimited outward extension of new development, (2) leapfrog development, (3) low-density residential and nonresidential development, or (4) extensive dominance of urban transportation by automotive vehicles. Therefore, although these traits might be deemed undesirable on other grounds, public policies aimed at counteracting urban decline should not focus on trying to influence them. Rather, such policies should focus on other aspects of the U.S. metropolitan growth and development process that are more likely to be direct causes of urban decline.



Courtesy of G. Lowenstein

A fifth major conclusion is that *at least some conditions within central cities definitely affect metropolitan areawide conditions to a greater degree than conditions within suburbs affect central-city conditions.* The median income within central cities has a much greater impact on metropolitan areawide median income than does the median income within the urban fringes, even though central cities contain less than half of all metropolitan-area residents, on the average. City median incomes also influence metropolitan areawide population growth rates, and city population growth rates greatly affect those of entire metropolitan areas, for the obvious reason that cities contain a large percentage of metropolitan population.

The sixth major conclusion is that *urban decline as measured by losses of city population is indeed a cumulative process consistent with the hypothesis that it contains self-aggravating elements*.

The final major conclusion is that the *empirical validity of certain key steps in the logical argument linking the U.S. development process to urban decline remains to be tested conclusively.* These steps are (1) that exclusionary zoning by suburbs helps concentrate minority poverty within central cities and older inner-ring suburbs; (2) that central-city public schools offer a poorer-quality education than do suburban schools, on the average; (3) that central-city public services are of lower quality than those in the suburbs, on average, and (4) that both public schools and public services in central cities are low enough in quality to motivate many households to leave the central cities and move to the suburbs or to discourage additional households from moving into central cities. There is substantial anecdotal evidence and some quantitative evidence (including some evidence from this analysis) to support some of these propositions. Yet, because they cannot be confidently confirmed by the quantitative results of this analysis, additional research needs to be conducted.

Three Erroneous Conclusions That Should Not Be Drawn from This Analysis

The above analysis could easily lead to three erroneous conclusions, all of which should be avoided.

Courtesy of R. Ewing

The first error would be that sprawl has contributed nothing to urban decline in the past. That is what some defenders of sprawl may conclude, and in a purely technical sense, it may be true, if sprawl is interpreted as being only the low-density aspects of the growth process, as explained above. However, almost all U.S. metropolitan-area growth during the past 50 years has been in the form of sprawl integrally combined with the other elements analyzed above. Therefore, in an important sense, metropolitan-area growth has been identical with sprawl during the past half-century. Hence *the overall growth process, of which sprawl has been an integral part, has indeed contributed to, and aggravated, urban decline and distress*. True, it was not the low-density elements of that process that caused urban decline; however, the other elements that did cause urban decline have been linked closely enough to the sprawl elements so that past sprawl cannot escape totally unscathed from bearing responsibility for urban decline and distress.

The second erroneous conclusion would be that the past sprawl-dominated metropolitan growth process can be continued unchanged without any danger of aggravating urban decline in the future. This is false because the present sprawl-dominated growth process contained the other non-low-density elements that contributed to urban decline, and it would still contain those elements if not altered. To prevent future peripheral growth from aggravating urban decline, those other elements would have to be changed. Changes to the non-low-density elements might affect the low-density elements as well. For example, reduction of exclusionary zoning and changing building standards to permit lower-cost new construction might help create more housing affordable to low-income households in suburban areas, thereby raising densities there.

The third erroneous conclusion would be that there is nothing wrong with continuing the low-density elements of the growth process in the future, since those elements have not contributed to urban decline. The low-density elements that constitute sprawl contribute to other adverse outcomes that many citizens do not like. These include increasing traffic congestion, absorption of a lot of open land at the edges of metropolitan areas, higher taxes to pay for more infrastructure, and air pollution. Hence, there are good reasons to at least consider policies that alter the low-density elements of sprawl in the future, completely apart from the role of sprawl in aggravating urban decline and distress.

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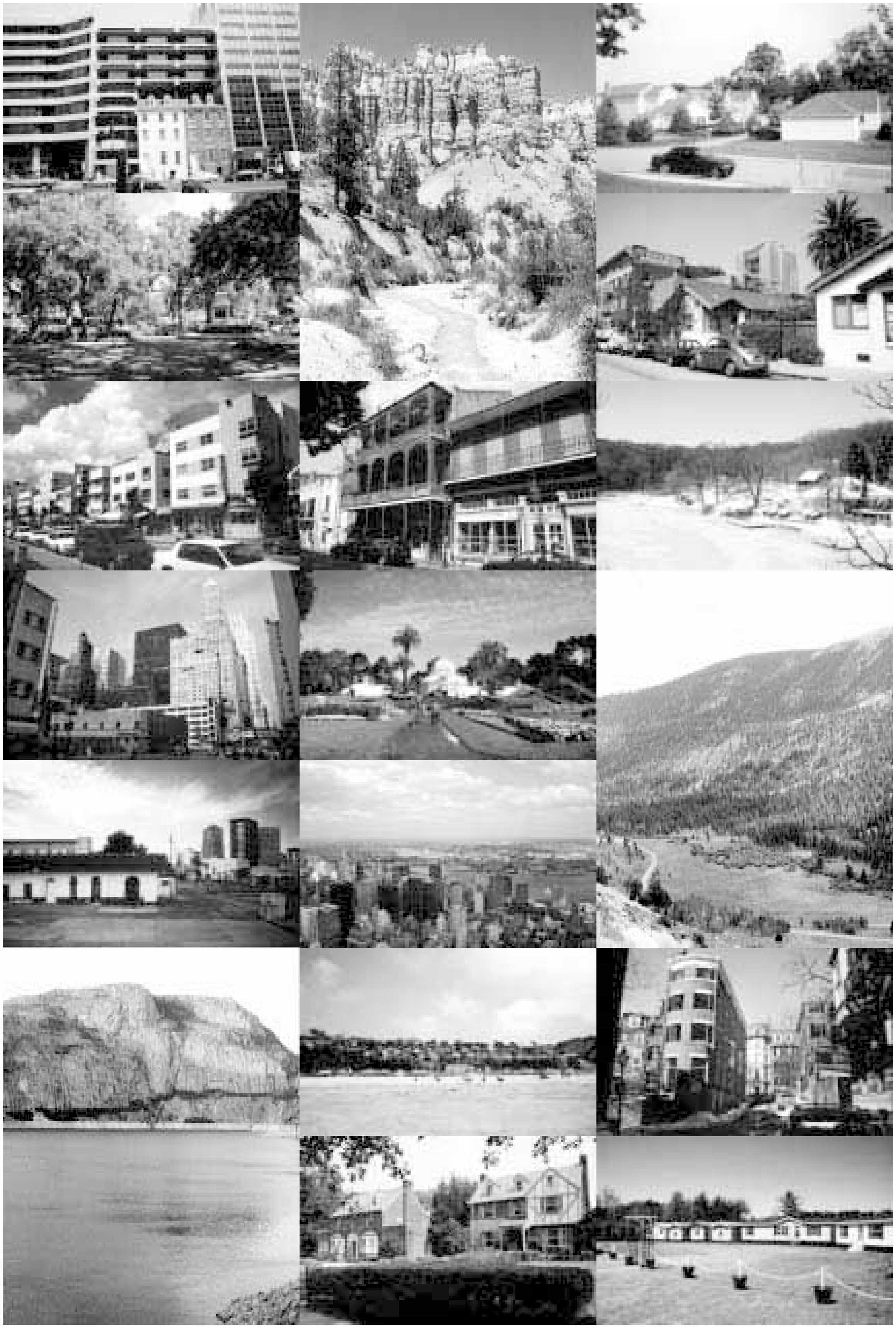
PART IV

DEALING WITH SPRAWL



Introduction to Part IV

The purpose of this part of the report is to deliberately set forth the positive effects of sprawl and suggest what can be done to cure its negative effects. The chapters present a discussion on the benefits of sprawl (chapter 14), ways to mitigate the negative effects of sprawl (chapter 15), and the need for future research on sprawl (chapter 16). The benefits of sprawl include the provision of housing at the periphery of the metropolitan area that is less expensive than housing closer in, a lessening of overall congestion, especially in the closer-in areas, and the opportunity to enjoy the low-density lifestyle that most Americans are satisfied with. This chapter collects empirical evidence on these benefits and identifies other alleged benefits for which empirical evidence is conflicting or cannot be found. This might include sprawl's supposed ability to reduce overall travel costs, provide more locational choices due to the number of smaller political jurisdictions, make land cheaper due to skipped-over development, and create homogeneous socioeconomic neighborhoods because of the variety of places one can live.

Chapter 15 sets forth the various techniques that can be used to mitigate the negative impacts of sprawl, including urban growth boundaries, public-service districts, revitalization techniques and subsidies, transit-oriented development, and new forms of regional governance. This chapter includes a rating scheme that determines which of these techniques might be more or less desirable based on effectiveness in accomplishing the task, ease of administration or implementation, costs to the public sector, absence of its own negative effects, and finally, general political acceptability. This is a very detailed chapter on strategies to mitigate sprawl and the facility with which they can be implemented.

The final substantive chapter of the report (chapter 16) investigates and prioritizes (by necessity and ease or cost of implementation) research on sprawl required for the future. The organization of this chapter follows the general organization of the study and proposes future research related to definition and incidence of sprawl, physical resources consumed, personal lives affected, and procedures to deal with sprawl. Recommended future research varies from studies of housing costs imposed by growth boundaries to ways in which community groups can be engaged to be part of the solution to the regional sprawl problem.

Courtesy of R. Ewing

XIV

The Benefits of Sprawl:
Individual and Societal

IDENTIFYING THE BENEFITS OF SPRAWL

The literature search on suburban sprawl (*TCRP Report 39, The Costs of Sprawl—Revisited*) revealed at least 13 possible benefits that various observers attributed to sprawl. These are listed in Table 14.1 grouped into several subsets, drawn from Table 7 of *TCRP Report 39* (Burchell et al. 1998). In the remainder of this analysis, it is assumed that all inclusive conditions exist to some degree and that some observers consider each one of them to be beneficial.

MEASURING AND VALUING THE BENEFITS OF SPRAWL

A fundamental problem in all cost–benefit analyses of social policies is that benefits of social actions are difficult to measure in terms that make their sizes comparable to the sizes of other benefits or of the costs of the same activities. Some benefits, such as those that are purely psychological, are rarely measurable empirically. In some cases, the *incidence* of a benefit is measurable—that is, the extent to which it occurs—but the *economic value* of that benefit cannot be quantified. For example, one benefit of sprawl derives from its fragmentation of governance, public services, and housing product among many relatively small localities. This fragmentation creates an array of choices about community and general lifestyles from which households can choose, choices predicated on such considerations as local taxes and the quality and quantity of public services. Society benefits from the ability to make these types of choices. In theory, whether or not such an array of choices exists can be measured by examining the specific combinations of tax rates, public services, and lifestyles found in each metropolitan area. It is more difficult, however, to quantify in dollar or other terms the economic value of these choices to each household, or how valuable to society as a whole the existing array of choices may be.

Similarly, in theory, fragmented government gives each citizen a stronger voice in influencing local affairs than would a smaller number of larger governments. Whether citizens participate more intensively in local government affairs in fragmented systems than in nonfragmented ones could be determined by polls that measure citizens' political activities. Still, it is not possible to quantify the economic or other value of resulting differences in participation. The analysis of the benefits of sprawl is organized to answer the following questions:

Table 14.1
The Alleged Benefits of Sprawl

Housing-related benefits.

- Land that is farther out from the center of a metropolitan area is less expensive; housing built on such land is priced lower and is more affordable than housing closer in.
- Average lot sizes are greater in farther-out areas, providing more outside space per household. This improves households' access to open space.
- Average housing sizes are greater in farther-out areas, providing more interior space per household.
- Low-density settlements more closely reflect the preferences of most Americans for detached single-family homes and sizable lots and backyards—key elements of the "American dream."

Transportation benefits.

- Commuting times may be lower for persons living farther out if they also work at a location distant from the center, because they can travel faster in less dense outlying areas.
- There is less intensive traffic congestion in low-density neighborhoods than in high-density ones.
- Because of its heavy reliance on the private automobile for transportation, sprawl generates lower total transportation costs—public and private—than would greater overall reliance on public transit, which is more costly to build and to operate than using automotive vehicles.

Land-planning benefits.

- Leapfrog development leaves vacant infill sites that can later be developed at higher densities more appropriate for later stages of urban development. In the long run, this is more efficient than building up all sites contiguous to the edge of previously settled areas at low densities, and then having to tear down many such structures later and develop them at more appropriate higher densities after further outward growth has occurred.

Quality of life and social benefits.

- Crime rates are lower and security is higher in farther-out areas than in highly urbanized areas.
- School quality is better, on the average, in farther-out areas than in closer-in areas.
- Fragmenting local government into many small units provides a greater variety of combinations of tax rates, local services, and housing choices from which citizens can choose than would more homogeneous government, thereby maximizing consumer sovereignty over life styles. This causes government service providers to adapt their services more closely to the desires of their local citizens.
- Rough segregation of income groups in space through exclusionary zoning practices adopted by fragmented governments permits members of each income group to live in neighborhoods populated mainly by others with similar incomes, and to avoid living with households much poorer than themselves—two goals held by most American households, in spite of their major societal implications.
- Fragmenting local government into many small units permits citizens to have stronger influence over conditions in their own localities, which matter most to them, than would much larger government units. Thus, sprawl fosters self-government, democratic participation, and citizen control over local affairs (significant argument exists in terms of whether sprawl "creates" this situation or is "created by" this situation).

Source: The Brookings Institution.

Table 14.2
Can the Benefits of Sprawl Be Quantified in the Real World?

Benefit of Sprawl	Is the Incidence of This Benefit Measurable?	Is Its Economic Value Quantifiable in Practice?	Has That Economic Value Been Reliably Quantified in Practice?	How Important Is This Benefit to Society?
Lower land and housing costs	Yes	Yes	A Few Times	**Very**
Larger average lot sizes	Yes	Yes	No	Not very
Larger home and room sizes	No	Yes	No	Not very
Reflects low-density preferences	Yes	No	No	**Very**
Shorter commuting times	Yes	Yes	Somewhat	**Very**
Less-intensive traffic congestion	Yes	No	No	**Very**
Lower overall transport costs	Yes	Probably	No	**Very**
More efficient use of infill sites	Yes	No	No	Slightly
Lower-crime neighborhoods	Yes	No	No	**Very**
Better-quality public schools	Yes	Yes	In Part	**Very**
Greater consumer lifestyle choices	Yes	No	No	Somewhat
Stronger citizen participation	Yes	No	No	Somewhat
Segregation by income groups	Yes	No	No	**Very**

Source: Anthony Downs, The Brookings Institution.
Note: Darkened rows indicate benefits that (1) can have their incidences measured, (2) can have the value of those benefits quantified in money terms, (3) have actually had the value of those benefits quantified in money terms by reliable investigators, and (4) are very important to society.

- Is the incidence of this benefit measurable, at least in theory?
- Is the economic value of this benefit quantifiable in practice?
- Has the economic value of this benefit been quantified in practice by one or more reliable investigators insofar as can be determined?
- How important to society as a whole is this benefit, if it could be quantified?

Answers to these four questions are set forth in an accompanying table entitled "Can the Benefits of Sprawl Be Quantified in the Real World?" (Table 14.2). The answers are based upon research team analysis, informed judgment, and the results of surveying the judgments of others in the literature on sprawl. Benefits that the authors believe are very significant to society are shown in boldface. Other observers might arrive at different answers, but this approach at least identifies appropriate questions that might be posed.

Table 14.2 shows that the *incidence* of all 13 benefits of sprawl is measurable, at least in theory; that is, there is some way to measure the extent to which each benefit actually exists among its potential recipients, including by direct polling. However, for a majority of these benefits, there is no practical way to convert such measurements into quantified estimates of economic value that would be useful in comparing relative benefits or benefits to costs. Moreover, for only three alleged benefits of sprawl have quantified measures of value actually been carried out by reliable investigators insofar as the authors' research could determine. The three alleged benefits, indicated by shaded rows in Table 14.2, are as follows:

- *Lower land and housing costs.* For this alleged benefit, which presumably is attributable to outlying land being less expensive than land closer in to the core, some econometric studies of the gradient of land and housing prices (i.e., the slope at which a graph of those prices declines with distance from the center of the metropolitan area) have been conducted. These are discussed in a later section of this analysis.

- *Shorter commuting times.* The value of shorter commuting times has been measured for different populations and attempts have been made by reliable investigators to value the costs in time savings. Aggregating the results to all of society is a complex process subject to significant error and interpretation.

- *Better-quality public schools.* Measures of student academic performance by schools are available in some but not all areas. Impacts of school district performance upon home values have been estimated by several relatively small-scale studies. Therefore, generalizing these results to the nation as a whole would be subject to challenge as going beyond the scope of area-specific studies.

Thus, even for those alleged benefits of sprawl for which economic values have been quantified, it is difficult to translate those estimates into national measures of the aggregate value of such benefits. And for a majority of the benefits of sprawl—including five that are regarded as potentially very important to society—there is no practical way to estimate their quantity for the nation as a whole. The present analysis, then, suffers from the same condition that characterizes other attempts to conduct cost–benefit studies of important policies actions: To determine whether the benefits of sprawl exceed its costs, many important but nonquantifiable benefits must be compared to many important and quantifiable costs. Consequently, the ultimate balancing of benefits versus costs can be accomplished only by subjective estimates of how important these nonquantifiable benefits are compared to quantifiable costs. Of course, those subjective judgments are colored by the values, views, and experiences of the persons making them. Nevertheless, this portion of the analysis attempts to quantify certain of these benefits in order to convey some order-of-magnitude comprehension about how they might compare to the detailed estimates of the costs of sprawl presented elsewhere in this study.

Courtesy of C. Galley

The Effect of Lower-Cost, Outlying Land on Housing Costs

One of the alleged benefits of sprawl is that land farther out from the center of any region is cheaper than land closer to the center; therefore, housing prices are believed to decrease with distance from the center. Two key numbers are needed: (1) the rate at which housing prices fall with distance from the center, and (2) the influence of the length of distance caused by sprawl compared to the distance attributable to other possible forms of growth.

In reality, housing prices are influenced by myriad factors other than the distance of each house from the center of the region. Therefore, without including other factors, simple measures of variations in housing prices with variations in distance from the center are not reliable indicators of the influence of distance-related price differences.

A Washington, D.C., Region Test

In the Washington, D.C., metropolitan area, average 1999 sales prices of housing units sold in each postal zip code have very low correlation (less than 0.05) with the distance of the center of each zip code from either downtown Washington, D.C., or from Tyson's Corner, a large outlying employment center in Fairfax

County, Virginia. In order to fully isolate the relationship between housing prices and distance from the center, it is necessary to conduct regression analyses of the traits of individual housing units (number of bedrooms and baths, size and type of structure, presence or absence of air conditioning, distance from the downtown, and so on) for a large sample of units in a single region or many regions. Such analysis has not been undertaken for the Washington, D.C., area insofar as the authors of this report could determine.

A San Francisco Bay Area Analysis

Kara Kockelman (1996) conducted a study of housing prices in the San Francisco Bay Area in which she regressed many variables against home prices per square foot for units throughout the area. One of the variables analyzed by Kockelman is distance from the San Francisco CBD in miles. The feasible generalized least-squares regression coefficient for this variable is -7.502e+4, which implies a $7,502 decrease in the price of a home for each additional mile from the San Francisco central business district (CBD) that the home is located. A similar coefficient for the San Jose CBD implies a decrease in price of $1,632 per mile from that location, but another regression coefficient implies that distance from the Oakland CBD *adds* to home value by $7,888 per mile. These calculations are based on 1990 census data employing 1989 housing prices. The relationships of distance from the CBD and housing prices are complex: Movement from the San Francisco CBD southward toward San Jose both decreases value because of greater distance from San Francisco but increases value because of greater proximity to San Jose. Movement in the direction of Oakland finds decreases in value from San Francisco but increases in value relative to Oakland.

Courtesy of C. Galley

A Los Angeles–Region Analysis

Another analysis of the relationship between distance from the CBD and home prices in various neighborhoods was undertaken by Denise DiPasquale and Matthew E. Kahn (1999), using 1990 data for the Los Angeles area. These researchers employed three different regressions that used home prices as the dependent variable and distance from the Los Angeles CBD as one of the independent variables. The database contained more than 70,000 home prices but included average distances to only 58 districts in which those 70,000 homes were located. The regression with the highest adjusted R-square (0.402) showed that a one-mile increase in distance from the CBD would reduce the price of a home by 6.04 percent—at least in the vicinity of the average distance from the CBD, which was 14.4 miles. Since the average home price in the sample was $239,986, that translates to a decrease of $20,879 per mile. Intuitively, this seems like a very high estimate, but there are no other studies to refute the findings. The lowest estimate in these three regressions was a one-mile price drop of 4.0 percent, or $13,679; this regression had an adjusted R-square of 0.389.

Another Los Angeles Regional Study

To test further whether distance from downtown has significant impact upon housing prices, this study analyzed the relationship between housing sales prices in January 2000 and distances from (1) downtown Los Angeles, and (2) the Pacific Ocean, for 107 municipalities in Los Angeles, Riverside, and San Bernardino counties in California. Distances were measured in straight-line miles between the center of each municipality and the two end points, regardless of the


Courtesy of C. Galley

terrain and topographical features separating the two ends of each line. Several regressions were run, with recent home sales prices as the dependent variable (data from the California Association of Realtors) and different sets of independent variables.[1] The simple correlation between home prices and distance of each municipality from the CBD is -0.3452, which implies that home prices decline with increasing distance from the center of Los Angeles. A regression run with distance from the CBD as the only independent variable showed that this variable was statistically significant, though the adjusted R-square was only 0.127. Its coefficient implied that an increase in distance from the CBD of one mile would reduce the price of the median-priced home ($227,353) by $3,054, or 1.35 percent.

However, adding more independent variables changes this implication enormously. If both 1999 municipal population and distance from the Pacific Ocean are added, the R-square increases to 0.270, but the distance to the CBD loses all of its statistical significance. Instead, the other two variables are statistically significant at the 0.05 level. Their coefficients imply that an increase in distance from the Pacific Ocean of one mile would reduce the median home price by $4,363, or 1.92 percent. However, these two distance variables are colinear (0.7244) because, in many cases, increasing distance from the ocean also means increasing distance from the CBD, which is at the ocean edge. Moreover, most of the new housing construction in the greater Los Angeles region is occurring east of downtown, which is also farther inland from the ocean. Thus, it could be true that moving farther away from the center of the region would enable households to reduce their housing costs somewhat.

[1] Home prices from the California Association of Realtors (2000b).

Adding still more independent variables increases the adjusted R-square. For example, including 1989 median household income in such a regression increases the adjusted R-square to 0.5866 even though the income data are 10 years old, because there is a 0.68 correlation between 1989 incomes and 2000 home prices. In that regression, 1989 median income, 1999 population, and distance from the Pacific Ocean are all statistically significant at the 0.05 level. The coefficients imply that moving one mile inland from the ocean reduces the median current home price by $3,537. However, moving one mile farther from the CBD in any direction increases that home price by $281, and this estimate is not statistically significant. This regression shows that, in the Los Angeles area, moving *inland* away from the CBD (that is, to the east, northeast, or southeast) definitely and significantly results in lower home prices. Moving west from downtown (toward the ocean) does not increase sprawl, because that area is already fully built up. Therefore, *this evidence tends to confirm the theory that sprawling farther out from the center of a region provides the benefit of lower housing prices.*

Extra costs of driving farther out. Are lower housing prices enough to more than offset the higher cost of increased commuting distance? A one-mile increase in daily commuting trips is two added miles per day on each of 240 working days, or 480 total miles traveled. If the commuter's car gets 20 miles per gallon and regular gasoline costs $1.50 per gallon, that is a marginal driving cost of 7.5 cents per mile for fuel, plus, say, 2.5 cents for other operating expenses, for a total of 10 cents per mile. So the marginal cost of driving another 480 miles over the course of a year is $48. At an average speed of 25 miles per hour, each mile would take 2.4 minutes; thus, the total time added over an entire year would amount to 19.2 hours. Personal income per capita in California was $27,503 in 1998. If that figure is translated into the commuter's annual wage for 240 working days of eight hours each day, it is equivalent to an hourly wage of $14.32. If the commuter values his or her commuting time at half the hourly wage, that would be $7.16 per hour, or $138 for the 19.2 hours of extra time per year; the total added driving cost, therefore, would be $186 per year. This annual figure, capitalized at an interest rate of 8 percent, amounts to a capital charge of $2,325—34 percent below the home price saving of $3,537 realized from driving that extra one mile twice each workday. These calculations indicate that it behooves the commuter to drive farther out for lower home prices—at least in the high-priced Southern California housing market.[2]

Moreover, this statistical analysis underestimates the benefits of moving farther out because it deals only with home sales prices, not with the specific amenities "purchased" with a given price in each different community. It is well known that a particular amount—say, \$200,000—will buy a much larger home, a bigger lot, and more on-site or in-house amenities in an inland city like Riverside than in a coastal city like Santa Monica. However, it is not possible to estimate the size of this additional benefit without a detailed hedonic analysis (standardizing for amenities) of all aspects of each home sold. Adequate data on these variables are not available.

How much savings is needed to offset higher driving costs? Another approach to this subject is calculating the amount of home-price savings that would be necessary to offset increased travel costs and time losses from commuting farther out. The preceding analysis indicates that the total cost of driving one additional mile each day to and from work equates to \$186 per year in California, of which \$138 is the cost allocated to the added time consumed by driving. The wage rate used in that computation should be adjusted downward by 4 percent to compensate for the fact that personal incomes per capita are slightly higher in California than in the nation as a whole. This adjustment reduces the annual time cost calculated in the preceding analysis by \$5.52 to \$132.48. With operating costs of \$48, the total annual cost derived is \$180.48. Capitalized at 8 percent, that equals a one-time capital cost of \$2,256. The median sales price of existing single-family homes in the United States in 1999 was \$133,300. Therefore, the price of the median home would have to decline more than 1.69 percent per mile as distance from the center of the region increased to make the extra costs of commuting worthwhile. This seems like a realistic possibility, based upon information presented in this study and other surveyed sources of information.

A Chicago-Region Analysis

As a further check of whether distance from the center of a region influences housing prices, a regression analysis was conducted relating the median 1990 home values in 117 suburbs of Chicago as the dependent variable with straight-line distance from the Sears Tower in downtown Chicago and median 1989 household incomes in the same suburbs as the dependent variables. The simple correlation between home values and household incomes was an extremely high 0.927, whereas the simple correlation between home values and straight-line distance from the Sears Tower was a very low -0.038. These relationships resulted in a regression with a high adjusted R-square of 0.8649, with both variables statistically significant at the 0.05 percent level. However, the coefficient of the distance-to-downtown-Chicago variable was very low: It implies that a one-mile increase in distance from downtown Chicago would cause a decline in home value of only \$697, or 0.54 percent of the median home value of \$128,695.

As a further refinement, variables denoting the suburban sectoral locations of the individual communities were added to the regression: one variable for being in the northern sector, away from downtown Chicago (north of Chicago and east of U.S. Route 12), and one for being in the southern sector (south of Chicago and east of Interstate 55). A value of one was assigned to all cities in each of these sectors and a value of zero to cities not in them. This increased the adjusted R-square slightly, to 0.8811. All four independent variables were statistically significant at the 0.05 level. The coefficients of the sectoral variables indicated that cities in the southern sector suf-

Courtesy of C. Galley

[2] These calculations further underestimate the savings from moving farther out, because the time costs of greater commuting do not require cash outlays, whereas paying more for a home does involve larger cash outlays in addition to interest over time. Further, the calculations illustrated in the text used a capitalization rate of 8 percent because of relatively low current interest rates. If a 10 percent rate is used instead, the savings of moving one mile farther out are increased because the costs of travel are then 48 percent below the lower cost of the home, as estimated from the regressions.

Courtesy of T. Delcorso

fered a home-value penalty of $16,257, or 12.6 percent of the mean home value in the entire set. Cities in the northern sector realized an increase in their home values of $16,007, or 12.4 percent of the median home value. In this regression, the loss of value for each mile of distance away from downtown Chicago was $845, or only 0.657 percent of the median home value. However, even this small coefficient shows that homebuyers willing to move 10 miles farther out from downtown could save $8,450, and those willing to move 20 miles farther out could save $16,900.[3]

These results reflect the fact that incomes in northern-sector communities surrounding Chicago are substantially higher than those in southern-sector communities. (Similar variables used for the northwestern, southwestern, and western sectors showed neither statistical significance nor sizable coefficients.) Differences in household incomes and home values for all five sectors included in this analysis are shown in Table 14.3. These results indicate that the impact upon home values of distance outward from the center of a region is heavily influenced by which sector of the region is involved. In nearly every metropolitan area, certain "most-favored sectors" contain disproportionately high shares of the wealthier households in the region, whereas other "least-favored sectors" contain disproportionately high shares of the poorer households in the region. The influence of such sectors upon home values is significant, regardless of a home's distance from the region's center.

The preceding analysis showed that the housing cost savings from moving farther out in the Chicago region would be less than offset by the capitalized value of the additional operating costs required to drive the extra distances commuting both ways each day. This conclusion assumes that those commuting distances would increase by the extra distance from the region's center necessary to reduce housing costs. Based upon these 1990 Chicago-area data, therefore, it would not be worthwhile to drive farther out to achieve housing-cost savings.

By 1999, the median value of single-family homes sold in the entire Chicago region rose to $171,000 (National Association of Realtors 2000). If the same percentages as applied in 1990 were used against this median value, the amount saved by moving one mile

[3] The variable for 1990 community population was also tested in several regressions, but it had a very low correlation with home values and was never statistically significant.

Table 14.3
Sector Results of Analysis of Distance from Downtown Chicago

Sector	Number of Cities	Average 1989 Household Income ($)	Percentage Difference from All-Sector Average	Average 1990 Home Value ($)	Percentage Difference from All-Sector Average	Average Distance to Downtown Chicago (in miles)	Percentage Difference from All-Sector Average
North	21	63,074	27.73	193,914	50.68	23.4	9.35
South	30	41,533	-15.89	86,113	-33.09	19.5	-8.88
West	42	48,255	-2.28	127,136	-1.21	19.8	-7.48
Northwest	17	50,777	2.83	132,865	3.24	27.4	28.04
Southwest	7	45,265	-8.33	114,757	-10.83	18.4	-14.02
All sectors	117	49,379	0	128,695	0	21.4	0
South and Southwest	37	42,239	-14.46	91,532	-28.88	19.3	-9.81
North and Northwest	38	57,573	16.59	166,603	29.46	25.2	17.76

Source: Anthony Downs, The Brookings Institution.

farther out would be $1,122. This is still not enough to outweigh the added costs of driving the additional mile twice a day, which would equate to about $2,256 according to the preceding analysis. But $1,656 of that capitalized added cost consists of a money value assigned to the time consumed in that extra commuting. Only $600 of the total capitalized value is attributable to cash outlays for operating costs. Thus, if a commuter believes that the capitalized value of the extra 19.2 hours consumed by driving this additional mile is worth less than $1,122 minus $600, or $522, then he or she might deem it worthwhile to drive out farther to buy a less-expensive home. If the $522 savings is capitalized with an 8 percent capitalization rate, this figure amounts to an annual cost of $522 times 0.08, or $41.76, to account for those 19.2 extra hours, or implied time-cost of $2.18 per hour. The household would have to value its commuting time at less than $2.18 per hour for this trade-off to be economically worthwhile—a value judgment for the readers and each household to decide.

An Atlanta-Region Analysis

As yet another check on whether distance from downtown has any influence on home prices, a multiple regression analysis was conducted of 1990 median home values in 19 suburban communities on all sides of Atlanta. This is not a large sample of places, but it was the largest sample for which data were available. The dependent variable was the median value of homes as reported in the 1990 Census. The independent variables used in various combinations were the 1990 population of each place, the 1989 median income of its households, the distance of the center of that place from the State Capitol building in downtown Atlanta as measured in a straight line, and in which of the four directional quadrants, relative to the State Capitol, that place was located (that is, north, south, east, or west). There was no significant relationship between distance from downtown and home prices in any of the many combinations of variables used in the regressions, although the sign was always consistent with the view that home values decline as that distance increases. The correlation between those home values and distance was -0.1037. Because median incomes were highly correlated with home values (their correlation was 0.8896), regressions containing median income had high R-square values. In no equation was distance to the downtown statistically significant as an explanation for home values; it

Courtesy of R. Ewing

never had a t-value even close to 1.0. Presence in the northern quadrant had a 0.498 correlation with home values, whereas presence in the other three quadrants had low correlations with home values. This analysis, with its limitations, found no meaningful decline in home values as distance from the center of the Atlanta metropolitan area increased.

An Analysis of Standard Homes in Washington, D.C., Metropolitan Area Subdivisions Being Built by a Single Developer

To test the hypothesis that home prices for identical units tend to decline with distance from the center of a region, the sales prices of five standardized new homes being sold by Ryan Homes in various new subdivisions in the Washington, D.C., metropolitan area were analyzed. Ryan Homes is the largest homebuilder in the nation in terms of numbers of units built each year; it is also the largest in the Washington, D.C., metropolitan area. The Ryan Homes Web site lists more than a dozen new subdivisions being built by Ryan in the Washington area. It also shows photographs of each of the major single-family home models offered by subdivision, along with their approximate sales prices (stated as "Mid $330s," "Low $190s," and so on). Several models are offered in more than one subdivision, but at different prices. The distance of each subdivision from downtown Washington, D.C., in straight-line miles was measured; this distance was used as an independent variable in regressions in which the estimated price of a standard model served as the dependent variable. Because no one home model appeared in large numbers in any particular subdivision, each regression was based upon a very small sample—less than 10 cases. In addition, each regression had only one independent variable tested against the dependent variable, which was the price of that model home in each subdivision. Because the home models in each regression were identical, however, there was no need to include separate independent variables for all the traits of the homes themselves, such as number of bedrooms and baths, square feet of floor space, lot size, and the like.

Separate regressions were run for five different home models, each of which was being built in a different set of subdivisions. The greatest variation in price for a single model was for a "Victoria" model, which had a low price of $192,500 in Fredericksburg, Virginia (48 miles from Washington) and a high price of $437,500 in Alexandria, Virginia (18 miles from Washington)—2.27 times the lowest price. In all five regressions, the coefficient for distance from Washington had the expected negative sign, implying that home prices decrease with greater distance from the core. The simple correlations between home prices and distance to downtown ranged from -0.6138 to -0.8898, and the distance variable was statistically significant in all five regressions. The R-square values for the regressions ranged from a low of 0.38 to a high of 0.79. Most striking, the coefficients for distance all indicated that moving one mile farther out from downtown Washington would reduce the average price of each model home tested by between 1.23 and 1.43 percent—a remarkably narrow range. The average of these percentages was -1.32. *This analysis supports the hypothesis that home prices decline with greater distance from the center of a region, other things being equal.* (In this case, the "other things" that were equal included all the variable traits of each home.) However, it does not directly answer one question: Do home prices fall fast enough with greater distance to overcome the resulting increased costs of longer commuting? An earlier section of this chapter estimated that the capitalized value of the added cost of commuting one mile each way every workday is about $2,256 per year, including the value of the extra time required. For a savings of 1.32 percent of a home's value to exceed that cost, the home would have to be priced at more than $170,900. In 1999, the median prices of existing single-family homes sold in 15 metropolitan areas of the United States exceeded that price, according to the National Association of Realtors (2000).[4] Moreover, these 15 metropolitan regions contained 64.5 million residents in 1996, or 24.3 percent of the nation's total population. Thus, it seems likely that a great many housing consumers will find it worthwhile to move farther out from the center of their regions in order to buy homes at lower cost. Insofar as that is the case, this is a notable benefit of sprawl.

However, the aggregate benefit of such outward movement is not as large as might be suggested. In the 15 high-cost metropolitan areas mentioned above,

[4] The 15 areas were Los Angeles, San Francisco, San Diego, and Orange County in California; Washington, D.C.; New York City and Nassau–Suffolk in New York; Boston; Chicago; Denver; Honolulu; Seattle; Newark, New Jersey; and Bergen/Passaic and Middlesex/Somerset/ Hunterdon counties in New Jersey.


Courtesy of R. Ewing

developers were building approximately 143,000 new single-family homes per year in the late 1990s. The median price of new homes in these areas was about 16.1 percent higher than the sales prices of existing homes, based upon national ratios (U.S. Department of Housing and Urban Development 1999). This ratio makes it possible to compute the median prices of new homes for each metropolitan area since data on prices of existing single-family homes sold are available. Assume that moving one mile farther out from the region's center would save 1.32 percent of the median price of a new home in each region, as computed earlier. Then subtract the capitalized cost of commuting that one mile every working day for a year ($2,256—the figure computed earlier) to yield the net benefit to homebuyers of moving one mile farther out in each region. The average net benefit realized in these 15 high-cost regions is $1,151. Then, further assumptions must be made about what percentage of homebuyers in each region would be willing to move farther out, and how much farther out they would move, on average. If 10 percent of new buyers of single-family homes are willing to move farther out by an average of 10 miles—both high assumptions—then the total annual net savings in all 15 metropolitan areas combined would be about $114.4 million. That is a small amount compared to the total annual added costs of sprawl as computed in this study, which exceed $10 billion per year nationwide. If 50 percent of new homebuyers move out an average of 10 miles, the total net housing cost saving in these regions is $572 million. That would be more than 5 percent of the total added cost of sprawl compared to more compact growth patterns throughout the nation. But it seems unlikely that such a high fraction of new homebuyers would be willing to move that far out. Savings in other parts of the nation are irrelevant, since they would not exceed the added cost of driving farther out to achieve them, based on the lower home prices in those other regions. In summary, the total savings in housing costs from driving farther out are not likely in themselves to offset the total added costs of sprawl as computed in other parts of this study.

Conclusions about the Effect of Outlying Land on Housing Costs

The net results of the calculations set forth above — some complex, some simple—present preliminary evidence that home prices decline with distance from the center of a region. However, prices do not necessarily decrease enough to make it profitable for households to move farther out to save money, except in relatively high-cost housing markets. On the other hand, these calculations do not deny that possibility either—especially since many U.S. housing markets have high costs. Furthermore, millions of

Table 14.4
Dwelling-Unit Density per Acre for Single-Family Detached Housing by Division—Uncontrolled-Growth Scenario

	Undeveloped Rural		Rural Center		Suburban		Urban/Urban Center	
Census Division	Developed	Un-developed	Developed	Un-developed	Developed	Un-developed	Developed	Un-developed
New England	1.46	0.73	2.19	1.97	3.29	2.56	7.67	6.58
Mid-Atlantic	2.37	1.19	3.56	1.78	5.34	4.15	12.46	10.68
East North Central	3.06	0.95	3.82	1.42	4.26	1.89	6.63	3.44
West North Central	2.93	0.91	3.66	1.36	4.09	1.82	6.36	3.30
South Atlantic	3.15	0.58	4.73	0.87	6.25	3.20	6.25	3.20
East South Central	4.15	0.77	6.22	1.15	8.23	4.21	8.23	4.21
West South Central	3.64	0.67	5.45	1.01	7.22	3.39	7.22	3.69
Mountain	4.22	0.78	6.32	1.17	8.37	4.28	8.37	4.28
Pacific	4.99	0.92	7.49	1.38	9.91	5.07	9.91	5.07
Average	**3.63**	**0.83**	**4.87**	**1.37**	**6.32**	**3.48**	**8.122**	**5.06**

Source: Center for Urban Policy Research, Rutgers University.

Table 14.5
Lot Sizes and Dwelling Unit per Acre by Type of Area

Type of County	Dwellings per Acre—Developed	Average Lot Size in Sq. Ft.	Dwellings per Acre—Undeveloped	Average Lot Size in Sq. Ft.
Undeveloped/Rural	3.63	12,000	0.833	52,293
Rural Center	4.87	8,945	1.370	31,795
Suburban	6.32	6,892	3.478	12,524
Urban/Urban Center	8.12	5,363	5.060	8,609

Source: The Brookings Institution.

households have moved farther out because they *thought* they could purchase housing at lower prices by doing so or that their housing dollar would purchase more house for the same amount of money. Moreover, it is well established in the home-building business that such behavior by consumers is sensible, because land is undeniably cheaper farther out from the region's center. This behavior has even spawned a popular slogan: "Drive until you qualify!" Therefore, the weight of household behavior gives credence to the argument that sprawl permits people to buy distantly located homes at lower prices than they would have to pay for closer-in homes, *per unit of housing quality received*, despite the greater travel costs as measured by dollar and time expenditures.

Housing Benefits Stemming from Larger Outlying Lot Sizes

The analysis of housing densities presented in an earlier part of this study recognizes that the lower cost of farther-out land out encourages people to build housing at lower average densities than on sites closer to the core. This provides more land per dwelling and larger dwelling structures (more square feet per occupant). Both of these traits can be considered benefits of sprawl.

Table 14.4 (concerning the uncontrolled-growth scenario) presents single-family detached dwelling-unit densities (dwelling units per acre) for different regions. These numbers show that lot sizes are larger in farther-out areas, on the average, as shown in Table 14.5.

The average owner of a single-family detached dwelling in the developed portion of an urban or urban center county has a lot size less than half that of the average lot size in the developed portion of an undeveloped or rural county. In undeveloped portions of these counties (see Table 14.5), the owner in an urban or urban center county has an average lot size

Courtesy of G. Lowenstein

only one-sixth the size of the lot in an undeveloped or rural county. Even suburban lot sizes are significantly larger than those in urban or urban center areas: 28.5 percent larger in developed portions and 42.3 percent larger in undeveloped portions. Similar conclusions would apply to the other types of dwellings listed in Table 14.4: single-family detached, multifamily, and manufactured homes. More land provides the opportunity to commune with nature, larger play spaces for children, more gardening space, and so on, for those who live farther out than those who live closer in. Larger lot sizes, therefore, add value to the home both economically and by the healthy psychological benefits that accrue to the residents.

There are no national data readily available about changes in lot sizes and land prices with distance from the center of metropolitan areas. However, anecdotal evidence from the Twin Cities region indicates that a homebuyer of a typical close-in urban lot measuring 85 by 130 feet (11,050 square feet, or about one-fourth of an acre) will pay *more* for that land than a homebuyer in a fringe location who purchases a home on as much as one to two acres. For purposes of analysis, an assumption will be made that the first lot—fully developed with utilities and roads—costs \$55,000, or \$5 per square foot, whereas the second lot of one acre costs \$43,560, or \$1 per square foot. The buyer of the second lot, therefore, purchases four times as many square feet for 21 percent less money. How do we evaluate this advantage of bigger lot size farther out in this case? If the second buyer purchased only an 11,000-square-foot lot at the same price of \$1 per square foot, the owner would save \$44,000 compared to buying the urban lot of the same size. But the value of more land on a house lot typically rises much less than in direct proportion to increases in the size of the lot. Therefore, that "extra" land would not be worth \$44,000, because the \$11,000 difference for the farther-out lot would be more than \$1 per square foot. One can make an arbitrary assumption that the value of this "extra" land would be only about one-fourth of the added cost at the same \$1-per-square-foot rate, or about \$11,000.

The lot sizes in different types of areas set forth in Table 14.5 suggest that, in developed counties, the ratio of lot sizes to the smallest size (that in an urbanized county or urban center) is as follows: Suburban—1.285 to 1; Rural Center—1.668 to 1; Undeveloped or Rural—2.238 to 1. In undeveloped counties, these ratios are 1.455, 3.693, and 6.074 to 1, respectively. To be conservative, it will be assumed that, within developed counties, all four sizes of lots have the same market value, which means that the larger lots have much lower values per square foot. (In reality, the larger, farther-out lots would cost *less* than the urban lots despite their bigger sizes.) If a buyer of an urban lot containing 5,363 square feet pays the same amount as a buyer of a rural lot containing 12,000 square feet, the second buyer receives an "excess value" of 6,637 square feet, or an area increase of 138 percent. (This is analogous to the concept of "consumer surplus" in traditional economic theory—an amount by which the value received by consumers for some good or service in their own estimation exceeds the money amount they have to pay for it.) But this "excess value" is not 138 percent of the value of the urban lot, because increases in lot size have less-than-proportional value in financial terms. It will be assumed that the "excess value" is worth only one-fourth of what it would be on a proportional basis; thus, it would be worth 34.5 percent of the value of the urban lot. Another assumption is that urban lots comprise about 20 to 25 percent of the market values of the homes on them and the lot combined, or an average of 22.5 percent. Thus, if the home price of the dwelling on the urban lot is \$163,000 (the median price of new single-family homes built in the United States during the fourth quarter of 1999), then the land cost is

Courtesy of G. Lowenstein

22.5 percent of that amount, or $36,675 for 5,363 square feet, which equals $6.89 per square foot. The "excess value" of the rural lot is 34.5 percent of $36,675, or $12,652. This is a crude measure of the unpaid "welfare" benefit that the buyer of the rural home receives because land prices are cheaper in the more distant location than in the urbanized area of the region. Similar calculations show that the excess value of a suburban lot over an urban lot in a developed county is $2,613; that of a rural center lot over an urban lot is $6,125.

Housing Benefits Stemming from Larger Dwelling-Unit Sizes on Outlying Lots

Similarly, average housing-unit sizes are larger in farther-out areas than in closer-in areas for the following reasons.

- Land costs are lower farther out, making it possible to have room for larger dwellings at less additional cost.
- New housing units have been rising in average size over time, and the newest units are concentrated on the farthest-out edges of settlement.
- With greater distance from the center, the mix of housing-unit types changes toward more single-family detached housing and less multifamily housing; further, single-family detached units are larger, on the average, than the other types.
- Higher-income households move outward because their desire for land and space increases with income; therefore, they seek locations where they can purchase land less expensively—and such households tend to have larger housing units than less-affluent households.

Courtesy of G. Lowenstein

The earlier analysis of densities in this report does not specify dwelling-unit sizes, and there are no readily available data on variations in housing-unit size by distance from the center of each metropolitan region. Therefore, it is presently impossible to quantify this benefit produced by sprawl.

The Benefit of Providing Americans with the Type of Low-Density Living They Prefer

The widely touted ideal of the "American Dream" lifestyle has long included ownership of a detached single-family home on a sizable lot. That concept, put into practice over any large proportion of a region's territory, implies relatively low residential density. Proponents of sprawl claim such low density is superior to more compact forms of development because it provides a higher proportion of all residents of a region with the form of living they most desire. In 1975, a Roper poll asked the following question:

> We often hear people talk about what they want out of life. Here is a number of different things. (Card shown to respondent.) When you think of the good life—the life you'd like to have—which of the things on this list, if any, are part of that good life as far as you personally are concerned?

The highest-scoring item was "a home you own"; about 85 percent of Americans interviewed considered owning their own home part of "the good life" (Roper Reports 76–1 as cited in Struyk [1976]).

In 1997, Fannie Mae conducted a "National Housing Survey," asking 1,652 people in all parts of the nation about their housing preferences. Seventy-one percent of those interviewed said that a "single-family detached house with a yard on all sides" was the "ideal" form of dwelling, compared to only 15 percent who considered the "single-family attached townhouse"—the second choice—"ideal." Only 12 percent thought a multiple-family dwelling was "ideal"—6 percent favoring one in a structure with less than 10 units and 6 percent favoring one in a structure with 10 or more units. The percentages of persons interviewed who said they "could not live with" a particular type of dwelling were 56 percent for multifamily units in large structures, 52 percent for such units in smaller structures, 37 percent for duplexes or two-family houses, and 30 percent for attached single-family townhouses, but only 5 percent for single-family detached homes. Clearly, single-family detached homes are the preferred form of dwelling among most American households (Fannie Mae 1998). Moreover, far more Americans surveyed in this study thought suburbs or small cities were better places to live than large cities. This is shown by the responses in Table 14.6.

These responses demonstrate Americans' overwhelming preference for living in relatively low-density environments rather than high-density ones, even though 20 percent of the respondents said they had grown up in a large city and 20 percent said they lived in a large city at the time of the survey. That one-fifth of the respondents lived in large cities is particularly interesting because they were experiencing the benefits of city living in 1997, at the time they were surveyed. In addition, most respondents in Fannie Mae's 1997 National Housing Survey stated that key conditions of living were improving in suburbs far more than in large cities. More than 70 percent thought that was true of overcrowding, traffic, and congestion; 66 percent thought it was true of tensions between groups and races; and 64 percent thought it was true of crime, violence, and the prevalence of gangs.

In 1999, the National Association of Home Builders (NAHB) conducted a written survey of 2,000 randomly selected households to ascertain information about their housing preferences. One question was:

> You have two options: buying a $150,000 townhouse in an urban setting close to public transportation, work, and shopping, or purchasing a larger detached single-family home in an outlying suburban area with longer distances to work, public transportation, and shopping. Which option would you choose?

Eighty-three percent of the respondents chose the detached single-family home in a farther-out area; only 17 percent chose the urban townhouse (NAHB 1999a). More surprising was the hostility expressed by the respondents toward other forms of housing. Seventy-eight percent opposed the construction of any multifamily apartments in their neighborhoods; 77 percent opposed or strongly opposed the construction of smaller, higher-density homes in their neighborhoods; and 54 percent opposed the building of townhouses in their neighborhoods. When asked what they would be willing to accept if they could not afford to purchase the house of their choice, 58 percent

Table 14.6
Type of Place Where Americans Would Like to Live

Type of Place Where You Would Like to Live	Percentage of Respondents
Suburb near a large city	24
Small town not near a city	24
Rural area	22
Medium to small city	20
Large city	9
Not sure	1

Source: Fannie Mae (1998).

selected a location that was farther from shopping, entertainment, and other services—in short, more distant and more exclusively residential.

Thus, it appears that most American households over time have preferred, and still do prefer, living in single-family detached homes in low-density settlements as compared to more compact forms of residences and settlements. This conclusion supports the view that sprawl is more congruent with the residential preferences of most Americans than are more compact forms of settlement. However, it is not possible to fully quantify in financial terms the magnitude of this preference so that it can be directly compared to the quantifiable costs of sprawl described elsewhere in this report.

The Relationship between Sprawl and Commuting Times

In 1990, commuting times for persons living in the suburbs and working in some other part of the same metropolitan area were somewhat shorter than for persons living in central cities and working in some other part of the same metropolitan area.[5] This is shown in Table 14.7, which presents average commuting travel times in minutes for four groups.

Sprawl typically moves workplaces and homes into suburban locations, thereby somewhat shortening

[5] However, overall commuting times for suburban residents were slightly longer than for central-city residents because a higher percentage of suburban residents commuted to workplaces in other metropolitan areas, which involved much longer distances. Data from Pisarski (1996, 87).

Table 14.7
Average Commuting Travel Times for Four Groups
(in minutes)

	Work Destination	
Home Origin	**Central-City Workplaces in Same Metropolitan Area**	**Suburban Workplaces in Same Metropolitan Area**
Central-City Residents	18.8	23.0
Suburban Residents	16.9	19.4

Source: Pisarski (1996, 87).

average commute distances. Some urban economists (Gordon and Richardson 1997) have argued that sprawl prevents worse traffic congestion than would be spawned if new development occurred in more compact, higher-density settlement forms. However, the advantage of lower average commuting times for suburban residents is continually being eroded by their increased automobile usage, which puts more cars on the road during commuting and off-peak time periods. This is the concept of "induced travel." Transportation improvements that reduce travel time encourage people to travel more often. From 1980 to 1997, the number of automotive vehicles registered in the United States rose by 52.0 million; U.S. population increased by 40.5 million. There is some duplication in vehicle registrations across states, so that the increase in registrations may be somewhat overstated; however, measures of the number of vehicles *in use* have been corrected for that duplication. Nevertheless, since 1980, the growth rate of the number of automotive vehicles has been larger than the national population growth rate.

Furthermore, the average vehicle is being used more intensively than in the past. In 1983, the average number of miles traveled per vehicle was 11,739; in 1990, it was 15,000—an increase of 27.8 percent. Figure 14.1 shows the percentage increases in population, households, number of vehicles, and total vehicle-miles traveled in the United States from 1980 to 1995.


Courtesy of R. Ewing

Vehicle-miles traveled (VMT) has risen more than four times as fast as total population and twice as fast as the number of vehicles, but commuting times remain fairly stable. Consequently, the lower densities of outlying areas are being offset by more-intensive use of vehicles, bringing increased traffic congestion even to suburbs far from the core.[6] Opponents of sprawl argue that increased vehicle usage has occurred in part because of the greater physical separation of homes in sprawled areas from trip destinations like workplace, shopping centers, schools, and doctors' offices. So the degree to which sprawl actually has shortened total travel times of all types—not just commuting—is unclear. This issue will be discussed in the next section.

Sprawl Generates Less-Intensive Traffic Congestion than Do More Compact Settlements

Some proponents of sprawl maintain that one of its benefits is the generation of less-intensive traffic congestion than occurs in more compact development.[7] Because all types of land use are more diffused under sprawl than under compact development, the vehicles used by any population of a given size have more room to spread out than they do in densely settled cities. They point out that traffic congestion is normally worst in such high-density locations as Manhattan, downtown Boston, downtown Chicago, and San Francisco. Movement speeds are greater in the suburbs, on average, because of less-intensive congestion and the ability of drivers to use alternative routes.

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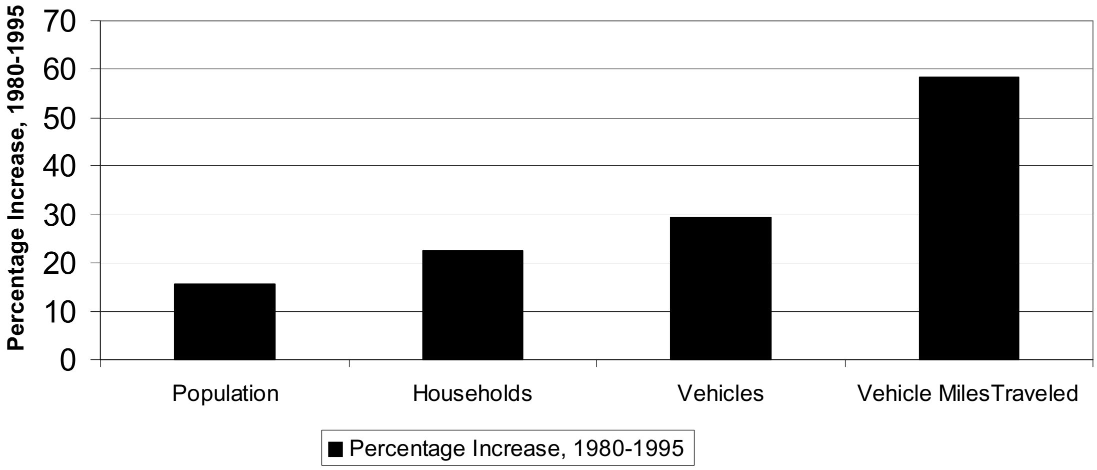
[6] Data in this paragraph taken from U.S. Bureau of the Census (1999 and earlier editions).

[7] The leading proponents of this position are Peter Gordon and Harry W. Richardson, who have written numerous articles defending sprawl and attacking more compact development. For example, see Gordon and Richardson (1997).

Figure 14.1
Percentage Increases in Population, Households, Vehicles, and Vehicle-Miles Traveled Between 1980 and 1995



Evaluating this argument about traffic congestion hinges on measuring different intensities of congestion in very specific parts of metropolitan areas. One of the characteristics of traffic congestion that makes generalizations about it so difficult is that it can differ radically at various locations within the same metropolitan area or city that are just a few blocks from each other. Further, detailed micro measurements of traffic congestion are difficult to find and even harder to aggregate into meaningful generalizations; therefore, it is not possible to make a definitive evaluation of this benefit of sprawl. However, some aspects of the issues can be commented upon, as follows:

- High-density areas usually are better served by public transit than are low-density areas, and a larger percentage of the populations of high-density areas travel by transit rather than by private vehicles. A recent study by Edward Glaeser and Jordan Rappaport (2000, Figure 9) showed that public transit usage in cities without subway systems was about 12.5 percent for persons living within one mile of the CBD, but declined steadily with distance from that district to less than 5 percent from five miles outward. In cities with subway systems, public transit usage was more than 40 percent for persons living within five miles of the CBD, declining steadily beyond that point though remaining at more than 25 percent at 10 miles out. Since densities are usually highest near the city's center, these findings indicate that many residents living in the densest areas do not depend upon private automotive vehicles for transportation. This certainly offsets to some degree the effects of concentrated population (and thus more potential car drivers) in each square mile in denser areas.

- Walking from home to work or to other destinations is also most prevalent in relatively high-density neighborhoods, further reducing the percentage of private-vehicle trips there. In 1990, large cities with the highest percentages of residents walking to work—in descending order of their percentages—were New York (6.7 percent), Pittsburgh (5 percent), San Diego (4.6 percent), Milwaukee (4.1 percent), Washington, D.C. (4 percent), and San Francisco (3.5 percent) (Pisarski 1996).

Courtesy of C. Galley

Thus, it can be argued that central-city locations do not have a 1-to-1 relationship of congestion based on the presence of population and average automobile use.

Sprawl as Compared to Compact Growth Reduces Total Travel Costs

Some proponents of sprawl claim that its heavy reliance on private automotive vehicle transportation generates lower total transportation costs in each metropolitan area than would occur under compact forms of growth that rely more on public transit. This benefit results because the per-passenger-mile cost of movement is greater for public transit than for private automotive vehicles. Chapter 11 of this study presents estimates of the per-passenger-mile costs of both modes of travel. A weighted average per-passenger-mile cost of bus and rail transit combined is estimated at 60.0 cents; the per-passenger-mile cost of private-vehicle travel of all types (not just worktrips) is estimated at 47.2 cents, or 21 percent less. At first glance, these data seem to support the position of sprawl proponents.

However, the total number of miles traveled in sprawling communities is likely to be much greater than that traveled in more compact communities because greater average distances separate residences from other destinations in outlying areas. Chapter 11 also estimates that, among persons with annual incomes of $15,000 to $39,999, the average daily distances traveled by persons who use private vehicles only is 18 miles in urban areas, 22 miles in suburban areas, 27 miles in exurban areas, and 31 miles in rural areas. Similar figures have been observed for other private-vehicle users with varying income levels, calculated for the same spatial classifications. Even people in the same income group as cited above who use transit travel only an average of 12 miles in urban areas and 22 miles in suburban areas.

Courtesy of R. Ewing

Chapter 11 also analyzes the aggregate effect upon miles traveled each day of the *increase in population* between 2000 and 2025 under two scenarios: uncontrolled growth and controlled growth. That increase in population would generate 1.228 billion more passenger-miles in both private vehicles and transit combined under the uncontrolled-growth scenario, and 1.179 billion more such miles under the controlled-growth scenario, for a difference of 49.56 million miles per day. In percentage terms, this is about 4 percent per day. The reduction is equivalent to about 15.5 billion miles per year (counting the full distance for each of 251 working days and half that distance for each of the other 104 weekend days). This difference is then translated into an estimate of travel-cost savings, including capital costs, operating costs, environmental costs, other social costs, and time costs. The total cost of the added population's movement is estimated to be $986.6 million per day under the uncontrolled-growth scenario and $962.5 million under the controlled-growth scenario, for a difference of $24.1 million per day, or a 2.4 percent reduction. Over an entire year, this cost savings from nationwide adoption of compact growth would be $7.5 billion (using the same calculation method as cited above for travel times). More than 40 percent of this cost reduction would consist of lower costs of travel time, computed at one-half the hourly earnings of each income group, multiplied by the hours saved. Two important conclusions emerge from this analysis:

- The total cost of additional travel from 2000 to 2025 would be larger under the uncontrolled-growth scenario than the controlled-growth scenario. Thus, *sprawl does not generate a social benefit of lower total travel costs compared to more compact growth; in fact, total travel costs would be higher under sprawl.*

- *The travel-cost savings from adopting the controlled-growth scenario compared to the uncontrolled-growth scenario are extremely small in comparison to the total national costs of travel by private vehicle and transit.* Table 11.29 in this report estimates that the total *added* daily travel costs in the uncontrolled-growth scenario from 2000 to 2025 will be about $986.6 million for an increase in population of 48.47 million persons, or an average daily travel cost of $20.35 per person. If that average is applied to the total


Courtesy of R. Ewing

U.S. population of 281.4 million in 2000, then total travel costs *per day* in private vehicles and on public transit in that year would be about $5.730 billion. The total savings *per day* achieved by shifting future growth from 2000 to 2025 completely from the uncontrolled-growth scenario to the controlled-growth scenario would be $24.7 million. That savings equals only 0.43 percent of the total cost per day of such transportation in 2000. Applying the same $20.35 daily travel cost per person to the estimated U.S. population of 342.2 million in 2025 shows that the total cost of travel in that year would equal about $6.956 billion *per day*. So the total savings *per day* achieved by shifting future growth from 2000 to 2025 *completely* from the uncontrolled-growth scenario to the controlled-growth scenario would save only 0.35 percent of total transportation costs in 2025.

Moreover, *these cost-savings estimates assume that most of the future metropolitan growth that could be shifted from uncontrolled to controlled growth would, in fact, be so shifted*. Moving from the former scenario, which is now almost universally prevalent, to the latter, which is extremely rare, would be a radical change in policy in American metropolitan areas. It is certainly not likely to occur in a majority of the areas to which it has been theoretically applied in this study. If only 20 percent of the nation's future growth from 2000 to 2025 were shifted from the uncontrolled-growth scenario to the controlled-growth scenario—an extremely high estimate of what is probable—then the transportation cost savings of that shift would be about 0.1 percent of the total of such costs in 2000 and 0.08 percent of those costs in 2025.

In conclusion, sprawl does not provide any overall benefits from reducing total ground transportation costs compared to more compact growth. The additional transportation costs stemming from sprawl are relatively small compared to those that would be generated by more compact growth.[8]

Leapfrog Development Is More Efficient Than Contiguous Development in the Long Run

Richard Peiser (1989) has advanced the argument that the leapfrog development pattern inherent in sprawl makes more efficient use of land than solidly building up land at the suburban periphery. Vacant land at the periphery of already-settled portions of a metropolitan area is typically developed with low-density uses, mainly because land costs are relatively inexpensive there (abstracting from differential accessibility to major traffic arteries). But if a large metropolitan area becomes settled with fully built-up peripheral expansion, sites that were once at its edges soon become much more central as the development "frontier" moves outward. The low-density uses initially placed on such sites become less appropriate because they are now relatively closer to the center of the metropolitan area. Moreover, the whole metropolitan area becomes larger; consequently, land costs near its center increase substantially. This makes it feasible for land at any given absolute distance from the center of the region to be developed with higher-density uses than were appropriate when those same sites were at the outer edge of ongoing development.

Sprawl makes it possible to accommodate this need to develop at higher densities because sprawl development often skips over outlying sites and "leapfrogs" onto still farther-out sites. The intervening sites that remain vacant can be developed at much higher densities at later times without incurring the substantial costs of clearing out obsolete, lower-density structures. If the number of "leapfrogged" sites is large,

[8] These calculations have not taken into account the costs of certain externalities often attributed to automotive travel, such as noise, air pollution, and greater importation of oil from abroad. Difficulties in measuring and economically evaluating such impacts, and intense controversies surrounding attempts to do so, have made it impossible for this study to assess their true relationships to sprawl in a reliable manner.

Table 14.8
Crime Rates in 1995 for Different Categories of Counties

Type of County	Number of That Type Analyzed	Average Crime Rate per 100,000 Residents
Urban Center (UC)	26	7,950
Urban (U)	68	5,920
Suburban (S)	219	5,133
Rural Centers (RC)	46	4,928
Rural (R)	688	3,521
Undeveloped (UND)	2,081	2,223
United States	**1**	**5,356**

Source: Anthony Downs, The Brookings Institution.

the resulting savings in acquisition and demolition costs necessary to create appropriately high-density development may be very significant compared to clearing and redeveloping once-peripheral sites containing low-density structures.

This argument undoubtedly contains some truth; the issue is just how much. The answer depends upon the following factors, among others: (1) the percentage of once-peripheral land in a region that is initially "skipped over" by developers and left vacant; (2) the rate at which the region expands in population and area, thereby raising the densities at which it is most appropriate to develop "skipped over" vacant sites; (3) the costs of demolishing the structures initially placed on once-peripheral land; and (4) the connection between "skipped over" sites and the region's major transportation arteries. These factors vary enormously from one region to another. Moreover, there are very few reliable databases on any of these elements.

Therefore, it is extremely difficult to estimate the economic savings that a region might reap from having left some of its initially peripheral land "skipped over" by developers.

In addition, bypassing a sizable fraction of the land in a metropolitan area when its periphery is initially being developed generates extra costs. Persons traveling to and from the area's outer edges must travel farther; roads and other infrastructure must be extended; and tax assessments on such land are often lower because it is not improved. These factors partly offset any benefits society might reap from holding "skipped over" sites as a form of reserve to accommodate future, higher-density development.

Crime Rates Are Lower and Neighborhood Security Is Greater in Farther-Out Areas

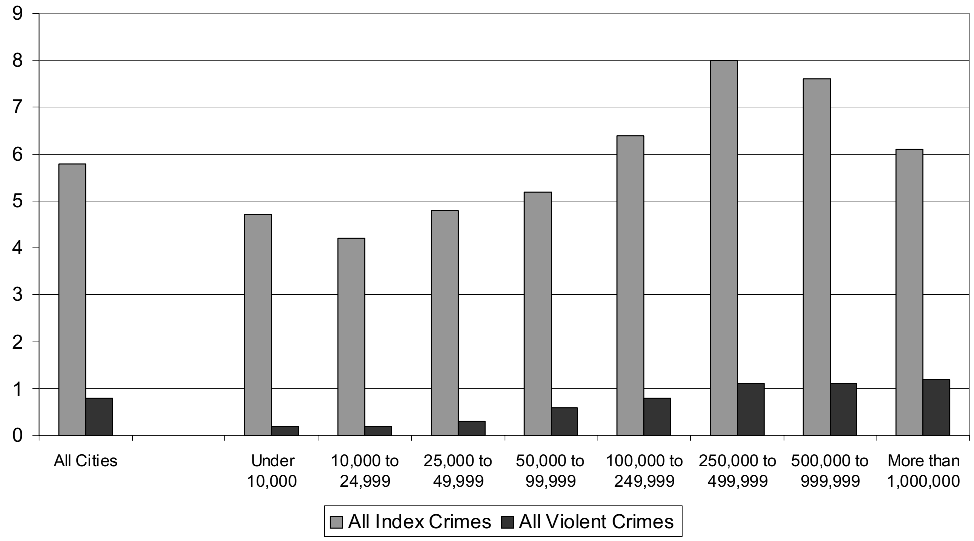
Most Americans perceive that crime rates per 100,000 residents are much lower in outlying suburban communities than in big cities, particularly in the poorest neighborhoods of those cities. This perception is borne out by Federal Bureau of Investigation (FBI) data on the rate of serious crimes reported to the police per 100,000 residents in different types of communities. Crime rates in 1995 for different categories of counties are set forth in Table 14.8.[9]

These numbers suggest that the more urbanized the county, the higher the crime rate. Crime rates in undeveloped counties were less than one-third those in urban center counties; suburban counties had crime rates 35 percent below those in urban center counties and 13 percent below those of urban counties.

More-recent crime data concerning the incidence of crimes in different types of cities confirms the widespread perception that crime rates are lower in most suburbs than in large cities (Table 14.9). Data for 1998 rates of index crimes and violent crimes for cities of different sizes are shown in Figure 14.2. This graph illustrates that small cities have lower crime rates than larger ones up to the classification of cities with

[9] The data on crime used here were prepared by the Federal Bureau of Investigation and taken from a CD published by the U.S. Census Bureau (1999). This CD shows the rate of serious crimes per 100,000 residents for all U.S. counties for which such information was available.

Figure 14.2
Crime Rates by City Size Groups
(in Thousands of 1998 Crimes per 100,000 Residents)



Source: Federal Bureau of Investigation (2000).

250,000 to 499,999 residents, which are shown to have the highest crime rates of any group reported (Federal Bureau of Investigation 2000). The FBI also analyzes crime rates for suburban counties and suburban cities separately from those for other places. In 1998, the rate of all index crimes per 100,000 residents was 4,615.5 for the entire nation and 5,704.0 for all cities, but only 4,062.2 for suburban cities within metropolitan areas (Table 14.10). Among such suburban cities, the index crime rate was actually somewhat higher for small cities with populations under 10,000 (4,738.9) than it was in those with populations from 25,000 to 50,000 (3,926.1). Rates of violent crimes, in particular, are much lower for suburbs than for large cities. The 1998 rate of violent crimes known to the police per 100,000 residents for all suburban cities in metropolitan areas was 349.6, which was less than half the violent crime rate in all cities containing more than 100,000 residents, and less than one-third that rate in all cities with more than 250,000 residents. Rural areas have the lowest crime rates of all. In 1998, the overall index crime rate for rural counties was 2,190.5 per 100,000 residents, and the violent crime rate there was only 254.5—less than one-fourth the rate in cities with more than 250,000 residents (Table 14.10).

Courtesy of A. Nelessen

Crime rates in all parts of the nation have been falling (Figure 14.3). The national rate for all index crimes peaked in the recession of 1980 and again in the recession of 1990 and 1991, but has declined 21.7 percent from 1991 to 1998. (However, it is still well above its late-1960s levels.) This decline has occurred in communities of all population sizes, as shown in Figure 14.4. Thus, the perception reported in the poll cited earlier that crime is occurring less in suburbs than in cities is not correct; crime rates have been falling in *both* types of communities, and by larger percentages in big cities than in small ones. Nevertheless, the view that suburbs are, on average, less prone to crime than large cities is clearly supported by these data.

A regression analysis of 1990 serious crime rates in 162 urbanized areas conducted as part of this study's

Table 14.9
Index Crimes by Geographic Area

City Arrests for All Index Crimes			
Year	**Number of Arrests**	**Estimated Population (in 000s)**	**Arrests per 100,000 Population**
1995	1,646,891	122,073	1,349
1996	1,594,716	123,259	1,294
1997	1,495,975	118,641	1,261
1998	1,362,709	119,505	1,140
All Violent Crimes			
1995		122,073	0
1996		123,259	0
1997	381,225	118,641	321
1998	364,489	119,505	305
Suburban County Arrests of All Index Crimes			
Year	**Number of Arrests**	**Estimated Population (in 000s)**	**Arrests per 100,000 Population**
1995	182,090	34,280	531
1996	181,168	34,676	522
1997	226,611	32,766	692
1998	209,962	33,169	633
All Violent Crimes			
1995	59,617	34,280	174
1996	58,618	34,676	169
1997	69,848	32,766	213
1998	64,859	33,169	196
Rural County Arrests of All Index Crimes			
Year	**Number of Arrests**	**Estimated Population (in 000s)**	**Arrests per 100,000 Population**
1995	97,378	17,805	547
1996	94,622	17,963	527

Source: Federal Bureau of Investigation (2000).

analysis of the relationship between sprawl and urban decline showed that the single independent variable most statistically significant as a possible cause of high crime rates was the percentage of households headed by females (Downs 1998, 74–75). Other independent variables with high beta scores and high t-statistics were the percentage of Hispanic-headed households, median family income (negatively related to crime rates), local taxes per capita, and the percentage of children living in poverty households. Because the crime data used were only for the central cities in these urbanized areas, not their suburbs, these conclusions may not apply directly to suburbs. Still, almost all of those variables tend to be higher in central cities (except for median income, which is usually lower) than in most suburbs, which implies that crime rates are higher in big cities than in most suburbs.

But does that conclusion make lower crime rates a benefit of sprawl? In other words, are the characteristics of sprawl the main reasons that crime rates are lower in outlying residential areas, or are other factors the major causes of this disparity?

The impact of different communities upon crime rates has long been the subject of study among criminologists. In their landmark book *Crime and Human Nature*, James Q. Wilson and Richard J. Herrnstein state that:

Table 14.10
Index Crimes over Time

City Population	1996 Index Crimes Number	1996 Index Crimes Rate	1998 Index Crimes Number	1998 Index Crimes Rate
Under 10,000	4,766.3	366.2	4,646.0	397.1
10,000 to 24,999	4,652.6	393.5	4,286.2	373.1
25,000 to 49,999	5,080.3	481.8	4,701.5	454.1
50,000 to 99,999	5,645.9	644.3	5,301.7	589.7
100,000 to 249,999	7,195.9	887.5	6,406.7	758.2
250,000 to 499,999	9,333.9	1,457.2	8,017.0	1,168.1
500,000 to 999,999	8,516.7	1,276.1	7,591.6	1,153.9
More than 1 million	7,168.9	1,517.8	6,152.6	1,286.8
All Cities	6,353.9	846.6	5,704.0	738.2

Year	Index Crimes Known to Police Number	Index Crimes Known to Police Rate	Violent Crimes Known to Police Number	Violent Crimes Known to Police Rate
1995	13,862,727	5,275.9	1,798,792	684.5
1996	13,473,614	5,078.9	1,682,278	634.1
1997	13,194,571	4,930.0	1,636,096	611.3
1998	12,475,634	4,615.5	1,531,044	566.4

1996 Crime Rates Per 100,000 Residents by Population Groups

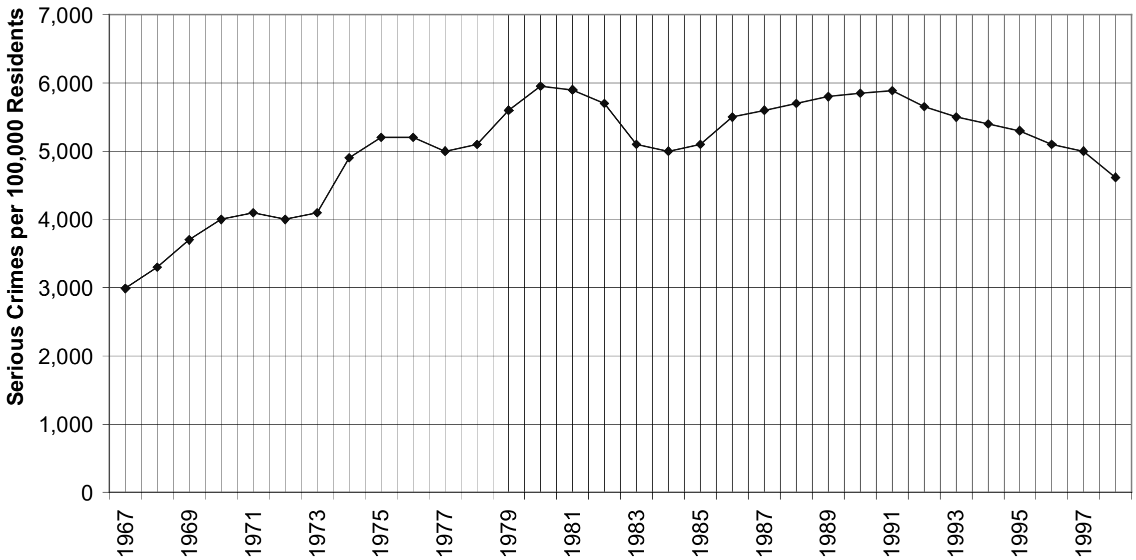
Area Type	Population Range	Number of Places	Index Crime Rate	Violent Crime Rate	Murder and NNMS Rate
Cities	Under 10,000	4,830	4,766.3	366.2	3.2
	10,000 to 24,999	1,342	4,652.6	393.5	3.4
	25,000 to 49,999	561	5,080.3	481.8	4.0
	50,000 to 99,999	305	5,645.9	644.3	6.1
	100,000 to 249,999	147	7,195.9	887.5	10.0
	250,000 to 499,999	38	9,333.9	1,457.2	18.9
	500,000 to 999,999	17	8,516.7	1,276.1	17.2
	More than 1 million	10	7,168.9	1,517.8	18.8
Cities	More than 249,999	65	8,117.9	1,443.7	18.4
	All	7,250	6,353.9	846.6	9.6
Suburban Counties		1,053	3,635.2	403.9	4.9
Rural Counties		1,991	2,257.4	242.6	4.8
Suburban Cities (in MSAs)	Under 10,000	2,639	4,860.8	338.4	2.6
	10,000 to 24,999	957	4,017.0	319.7	2.6
	25,000 to 50,000	396	4,333.1	401.3	3.2
	All	3,992	4,342.8	353.3	2.8
Nonsuburban Cities (in MSAs)	Under 10,000	2,191	4,639.2	403.7	4.1
	10,000 to 24,999	385	6,231.8	576.9	5.3
	25,000 to 50,000	165	6,805.4	667.8	5.9
	All	2,741	5,808.2	539.6	5
All	All		5,366.5	692.2	8.2

Source: Federal Bureau of Investigation (2000).

> The possibility that neighborhoods have only a modest effect on criminality should not be surprising to readers familiar with the longitudinal studies of criminal careers that we have reviewed in the preceding chapters. Once we take into account the influence of constitutional factors, family socialization, and school experiences, there is not much left to explain, at least insofar as serious offenders are concerned. (Wilson and Herrnstein 1985, 291)

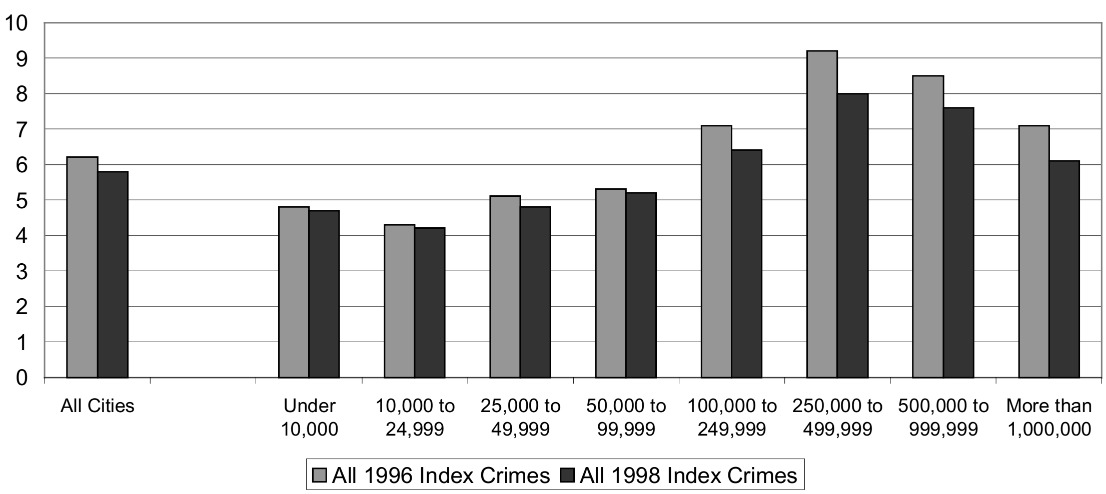
To put it another way, low crime rates in the outlying neighborhoods created by sprawl are not caused by the distant locations of those neighborhoods but by

Figure 14.3
Serious Crime in the United States, 1967–1998



Source: Federal Bureau of Investigation (2000).

Figure 14.4
1996–1998 Crime Rates by City Size Groups
(in Thousands of 1996 and 1998 Crimes per 100,000 Residents)



Source: Federal Bureau of Investigation (2000).

the particular groups of people who live in them. Because of the land-use controls and economic forces already described earlier in this report, the residents of outlying, sprawl-created neighborhoods tend to have higher incomes, fewer households headed by females, fewer children living in poverty, and lower percentages of Hispanic and other minority-group households than residents of core-area, concentrated-poverty neighborhoods. Thus, when suburban residents extol sprawl because there are lower crime rates in their neighborhoods than prevail in big cities, they are essentially praising the effectiveness of the regulatory and economic barriers they have erected to prevent population with what they perceive as less-desirable socioeconomic attributes from gaining entrée to the outlying areas. These exclusionary practices not only keep poor people *out of* the suburbs: the more insidious impact of such barriers compels very-low-income populations to live *concentrated together* in high-poverty neighborhoods. Of course, exclusionary barriers do not prevent the shocking outbreaks of violence in sprawled neighborhoods, such as the Columbine, Colorado, high school shooting spree in April 1999 and its most serious successor, two year later, in Santee, California. Violence is by no means a purely urban or lower-socioeconomic-class phenomenon.

Nevertheless, *to consider low crime rates in outlying areas a benefit of sprawl's defining traits is neither reasonable nor consistent with empirical data*. If America adopted more compact forms of peripheral settlement in the future but retained existing exclusionary suburban zoning and other underlying dynamics of the metropolitan growth process discussed in Chapter 13, the same concentration of very poor households in inner-core areas would probably not change. Long-established demographic settlement patterns of peripheral and inner-core residents would continue. Therefore, the same patterns and incidence of crime would probably persist. This result is implied by the fact that higher residential density was *not* a statistically significant cause of higher crime rates in this study's analysis of central cities in 162 urbanized areas.

The conclusion that sprawl itself is not a cause of lower crime rates assumes that if suburban exclusionary regulations were reduced and more low-income households moved out of concentrated-poverty neighborhoods *and became much more interspersed with nonpoor households in the suburbs*, suburban crime rates would not rise substantially. In other words, it is the *concentration* of very poor households—including many female-headed households with children—in inner-core poverty neighborhoods, not the mere presence of a small fraction of poor people, that leads to high crime rates.

That view is disputed by many suburban residents who believe that *any increase* in the number of low-income households in their now-exclusionary communities would be accompanied by notably more crime and less personal security. There is insufficient empirical evidence to present a definitive resolution of this argument. Therefore, it is not clear whether lower suburban crime rates can really be considered a benefit solely attributable to the phenomenon of sprawl. Still, in inner areas where development patterns are concentrated, crime is higher; in outlying areas where development patterns are more dispersed, crime is lower.

Sprawl Permits Suburban Residents to Enjoy Better-Quality Schools

Sprawl proponents maintain that a major reason why households move from central cities to suburbs is to enjoy better-quality schools. To determine whether superior suburban schools are indeed a benefit of sprawl, it is necessary to ascertain (1) to what extent suburban schools provide higher-quality education than big-city schools, and (2) if that is the case, to what extent this educational superiority is caused by the attributes of sprawl rather than by other factors.

Measuring the quality of education provided by any school is not easy because education has so many facets and dimensions. However, one recently adopted measure is the level of student achievement in a school as indicated by student performance on national achievement tests. The higher the level of student achievement, some claim, the better the learning environment in that school. This conclusion is based on the reasonable assumption that the quality of education for any one pupil is strongly influenced by the ability levels of his or her fellow students.

It should be emphasized that measuring a school's educational *quality* is different from measuring its educational *performance.* Students' achievement levels are also greatly affected by heredity and by their home environments. Accordingly, a school may exhibit very high—or very low—student achievement scores because of the student's innate abilities and/or their home environments apart from how well they are being educated in the school. Moreover, educa-

Courtesy of C. Galley

tional quality has many dimensions other than test scores, but these other dimensions are difficult to measure across school systems.

In the absence of better measurement devices, the present study uses national achievement test scores as a measure of school quality (but not necessarily school performance). The U.S. Department of Education has published National Assessment of Education Progress scores for various types of tests (reading, science, math, and so on) and for various grade levels on its Internet Web site.[10] This analysis employs national reading scores of 12-year-old children as tabulated by the geographic areas in which individual schools are located and by other relevant dimensions. The three geographic areas used are (1) central cities, (2) urban fringe areas and large towns, and (3) rural areas and small towns.

In the particular tests used in this analysis, the schools in each of these three areas are further divided into groups based upon the percentage of students in each school eligible for free lunches. This breakdown is used because free lunches are provided only to students from very-low-income homes, and the percentage of students in a school eligible for free lunches is employed as an indicator of the degree of concentrated poverty among those students. Poverty levels in general are higher in central cities than in fringe-area suburban communities, and poverty concentrations are much more common in the former than the latter. However, rural poverty levels are also quite high in many parts of the nation. These differences are reflected in Figure 14.5. The schools have been divided into seven categories, based on the percentage of students in them who are eligible for free lunches. In the first category, none of the students in a school are eligible—hence city schools have a higher percentage in this category (17 percent) than either urban-fringe schools (9 percent) or rural schools (2 percent). But the next category—1 percent to 5 percent of students eligible for free lunches—includes 10 percent of central-city schools, 28 percent of urban-fringe schools, and 8 percent of rural schools. Each of the next four categories—from 6 to 75 percent of all students eligible for free lunches—show similar percentages of central-city and urban-fringes schools. But the highest poverty category—76 percent to 99 percent of students eligible for free lunches—includes 14 percent of central-city schools but only 4 percent of both urban-fringe and rural schools. No schools in any category have 100 percent of their students eligible for free lunches. These data indicate less divergence in poverty characteristics between suburban and big-city schools, and greater poverty in rural schools, than might be expected from prevailing general opinions about this subject. Nevertheless, central cities have significantly higher fractions of their total student enrollments in high-poverty schools than do either urban fringe or rural areas.

The relevance of poverty levels to school achievement scores is shown in Figure 14.6. In all three geographic areas, reading achievement scores among 12-year-olds generally decline as the percentage of students eligible for free lunches increases. Thus, among students in central-city schools, those in schools where 76 percent to 99 percent of the students are eligible for free lunches have average reading scores 12 percent below those in schools where no students are eligible. This is not an enormous difference in scores, but it is similar to differences observed within schools in both urban fringes and rural areas.

These data lead to two tentative conclusions: (1) Suburban schools as a whole have somewhat higher achievement scores than central-city schools, and (2) A major cause of this difference is that central cities have greater poverty concentrations than most suburbs.

Another significant difference between most suburban schools and many central-city schools is their racial composition. The public school systems in the nation's largest cities are heavily dominated by students from minority groups, especially African Americans and Hispanics. In the 70 public school districts with enrollments of more than 50,000 students each in 1994, there was an average of 60.8 percent minority students. In 32 of these districts that were in large cities, however, the overall minority percentage was 79.8 percent, including five districts with more than 90 percent minority representation. Only three of these 32 districts had non-Hispanic white majorities. In contrast, in 18 of these large districts that were suburban, the overall minority percentage was 33.7 percent, including five districts with less than 20 percent and two districts with less than 10 percent minority school populations. Fifteen of the 18 districts had majorities of non-Hispanic white students.

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[10] Http://nces.ed.gov/nationsreportcard/TABLES (U.S. Department of Education 2000).

Courtesy of A. Nelessen

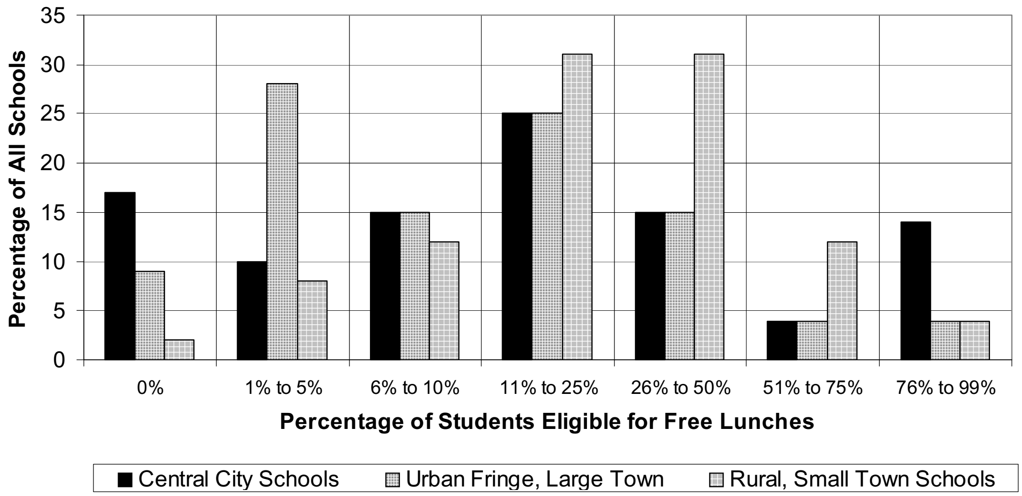
The remaining 20 large districts contained both central cities and suburbs and had an overall minority fraction of 51.4 percent (U.S. Department of Education 1996, 98–103).

The dominance of minority students in big-city public school systems has two implications that might contribute to the perception of suburban systems as superior in quality. First, whites often prefer not to live in communities in which more than about one-third of the residents are African American. This preference has been confirmed by repeated interviews with samples of white households about their residential desires as well as by innumerable instances of "neighborhood racial tipping" caused by inflows of African Americans into previously all-white areas (Massey and Denton 1993). Since public school enrollments primarily reflect residential settlement patterns (except where extensive busing occurs), large minority-student populations imply local percentages of minority residents exceeding that "threshold." Therefore, whites move out of central cities because they choose not to live in neighborhoods with largely minority households.

Moreover, achievement-test scores of African Americans and Hispanics—the two largest minority groups—are typically lower than those of whites on most tested subjects at all grade levels (U.S. Department of Education 1996). An example is shown in Figure 14.7. These data were taken from the National Assessment of Education Progress tables on the U.S. Department of Education's Web site. Figure 14.7 shows that, from 1971 to 1996, reading scores of 9-year-olds improved about 12 percent for African Americans and 7 percent for Hispanics, but only about 2 percent for whites. As of 1996, however, white students' scores remained 16 percent higher than those of African American pupils and 13 percent higher than those of Hispanic children.[11] Similar achievement-score differences are observed on tests of most other subjects and for most other age groups. The percentage differences observed in the test scores of students of different ethnic groups are similar in magnitude to the differences displayed in Figure 14.5 (reading

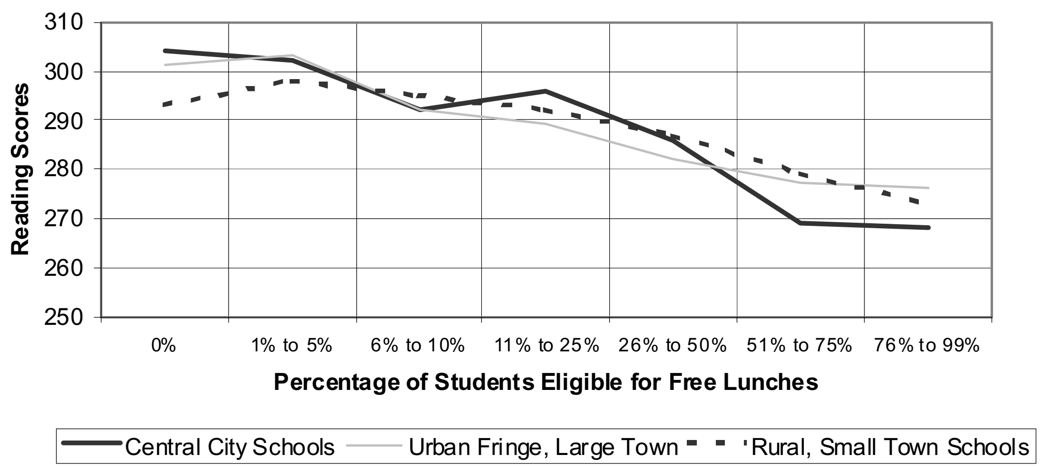
[11] This chart visually exaggerates the difference between minority and white test scores because it does not have a zero point of origin; hence it focuses only on the relatively small range of the difference in their scores. However, using a chart with a zero origin makes it almost impossible to see the difference between test scores of Hispanic and African American students.

Figure 14.5
Distribution of Schools by Eligibility for Free Lunches
(Age 12 Children)



Source: U.S. Department of Education (2000).

Figure 14.6
1998 Average Reading Scores of Schools by Eligibility for Free Lunches
(Age 12 Children)



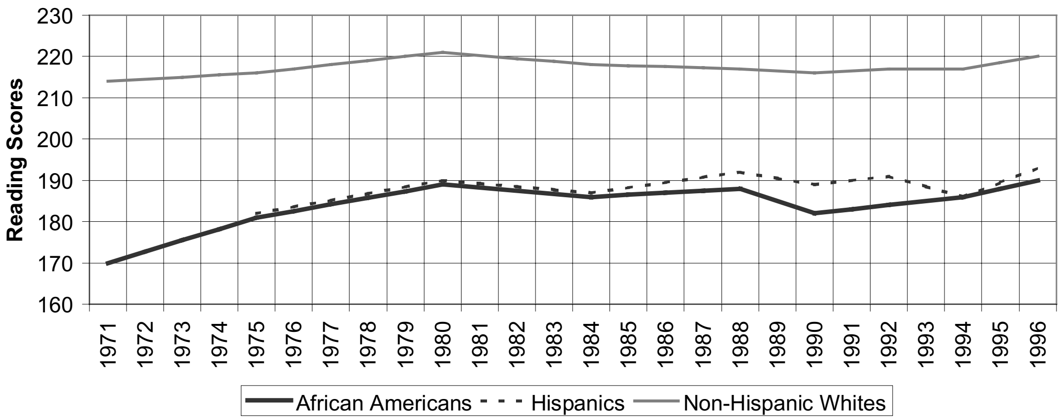
Source: U.S. Department of Education (2000).

scores of students of all types in schools, with school-lunch eligibility used as a surrogate for poverty). Thus, both concentrated poverty and ethnicity appear to have similar impacts upon achievement-test performance.

Apart from all other characteristics associated with race or ethnicity, these test-score disparities might lead white parents to conclude that sending their children to schools with few minority-group students would improve their children's education. Parents of school-aged children who ascribe to this view would regard the lower minority-group populations in suburban and farther-out communities as a benefit of moving to those communities, and therefore a benefit of the sprawl pattern of development that created such communities.

Conversely, other white and minority parents might conclude that insular, racially and ethnically homogeneous communities deprive their children of experiencing the diversity that increasingly is characterizing the United States, which is rapidly becoming a

Figure 14.7
Reading Scores of Nine-Year-Olds by Racial and Ethnic Group, 1971–1996



Source: U.S. Department of Education (2000).

society without any single ethnic majority group—including non-Hispanic whites. Moreover, perpetuating the exclusionary suburban policies that have institutionalized the huge disparities in the socioeconomic composition of suburbs and cities is unjust. Poor minority households have been relegated to urban ghettos to live alongside other poor households in neighborhoods that will never emerge from the conditions stemming from severe poverty and government disinvestment. This study supports the viewpoint that such exclusionary policies are destructive and socially reprehensible. The reality, however, is that white parents continue to regard the lower numbers of minority residents—and therefore minority students—in the suburbs and on the urban periphery (away from central cities) as a benefit of sprawl.

There may also be other important differences between public schools in the suburbs and those in big cities. Wealthier communities tend to spend more per pupil in educational outlays than big cities may be able to do—a function of greater wealth per household. For the 70 largest school districts in the nation discussed earlier (U.S. Department of Education 1996), however, average spending in the 1992–1993 school year per pupil was actually 20 percent higher in city school systems ($5,317) than in suburban systems ($4,441) and 15 percent higher than in rural and small-town systems ($4,606). Even so, many small but wealthy suburbs with their own school systems do spend more money per pupil than the public school systems in the central cities. In addition, parents and parent–teacher associations in small but wealthy suburbs often supplement public spending on their schools with substantial private contributions to school equipment, trips, teachers' assistants, and other improvements in the education received by their children. Also, parents have more chance of influencing educational practices and policies in small systems than in big-city systems because of the inevitable bureaucracies in the latter.

Overall, are suburban public school systems better than big-city public school systems? If judged solely by student achievement scores, the answer is "Yes." But that answer belies immense variations in quality in both types of systems. Interestingly, actual variations in student achievement scores among different

Courtesy of C. Galley

schools within each type of system are larger than the overall average differences between these types of systems.

Furthermore, the overall differences in student achievement levels between suburban and central-city public school systems are based, to a large extent, upon the higher average concentrations of poor and minority-group students in the inner city. Can this difference reasonably be considered an "advantage" or a "benefit" of sprawl? It probably is considered an advantage by certain white households, and it results from the exclusionary practices of suburban governments discussed earlier. This advantage is obtained at the larger societal cost of relegating poor households, especially poor minority households, to neighborhoods of concentrated poverty. Viewed from this perspective, it is not clear that the superiority of suburban schools is a net advantage or benefit at all.

In addition, as noted in the preceding chapter, the exclusionary practices of many suburbs do not result primarily from the key characteristics of suburban sprawl but from six other traits built into the American metropolitan-development process, five of which are not part of the defining traits of sprawl. Therefore, even if suburban school superiority could be considered a legitimate advantage of the American metropolitan-development process, that trait is not directly attributable to suburban sprawl per se, but to other aspects of the development process.

Fragmenting Governance among Many Small Units Increases Consumer Sovereignty

Urban economist Charles M. Tiebout advanced the theory that fragmentation of local government powers among many relatively small localities, each with full control over its own jurisdiction, improved the welfare of society, as compared to having fewer, larger local governmental units. Such fragmentation permits households to exercise a wide range of choices among combinations of local tax rates, local "bundles" of public services financed with those taxes, and other local conditions (Tiebout 1956). This array of choices enables individual households to find combinations of those elements compatible with their preferences. This argument was recently reinforced by William A. Fischel (2000) in his analysis of what he calls "homevoters"—that is, home-owning households that dominate local governments politically. Fischel argues that homeowners are strongly motivated to support local conditions that maximize the market values of their homes. A house is the largest asset most households possess; it is spatially immobile and has a market value strongly influenced by local conditions. Since homeowners cannot easily move these assets from one place to another, they become acutely interested in the local conditions that influence the market value of these assets. Consequently, they pressure local governments to produce conditions conducive to higher home values: good-quality schools, safe neighborhoods, adequate parks and recreation, low traffic congestion, and the exclusion of very poor households. Fischel regards this linkage of homeowner interest in local conditions to maximizing home values as a major virtue of having local government powers fragmented among many small municipalities. Since fragmentation of local government powers over land uses is a central component of sprawl, this virtue can be regarded as a benefit produced by sprawl—or at least by that one attribute of sprawl.

It might be possible to measure the incidence of this benefit by cataloging how many different combinations of tax rates, public services, and other local conditions are available from various local governments in American metropolitan areas. However, it would not be easy, or even possible, to move from such a measurement to placing some type of economic value on the results. Another approach might be doing a hedonic index regression analysis of housing prices across the nation in metropolitan areas with different degrees of fragmentation among their local governments, then estimating the impact of a variable measuring such fragmentation upon housing prices. This approach is not practical, however, because the degree of fragmentation among local governments varies systematically by regions of the nation; hence it would be confused with regional location. For historical reasons, metropolitan areas in the Northeast

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Courtesy of C. Galley

and Midwest have much more fragmented local government structures, on the average, than those in the South and West (see Chapter 1).

It is likely that suburban homeowner households do derive some benefit from local government fragmentation along the lines described above. However, society as a whole suffers a cost from the same fragmentation because it permits suburbs to adopt exclusionary zoning rules that exacerbate the concentration of poor households in older, inner-core areas. Suburban homeowners perceive that the market values of their homes will be reduced if multifamily apartments are built near those homes, or if households with markedly lower incomes move into or near their neighborhoods. This is clear from the National Association of Home Builders (1999a) survey, in which large majorities of the randomly chosen respondents opposed placing smaller, detached single-family homes or multifamily apartments near their own homes. Whether their perceptions of the impacts of such housing upon the values of their own homes are factually correct is not easily determined. Empirical studies of that subject have come up with ambiguous results. But, regardless of the facts, that is what most suburban homeowners perceive.

Consequently, in many suburbs, the home-owning majority of voters actively support local government ordinances that make it difficult or impossible for lower-cost housing units to be built near their homes. These include zoning laws, building codes, minimum-lot sizes and setbacks, minimum dwelling-unit sizes, stringent environmental review requirements, and other constraints. The result is clearly exclusionary: It has become more difficult for low- and moderate-income households living in inner-core neighborhoods to find housing they can afford in the suburbs. This was the unanimous conclusion reached by the bi-partisan Commission on Reducing Regulatory Barriers to Affordable Housing (1991) appointed by Jack Kemp, Secretary of Housing and Urban Development in the George W. Bush administration.

Thus, fragmentation of local government powers over land use provides local home-owning voters with both the motive for, and the means of, adopting exclusionary zoning. Such zoning, in turn, reduces the ability of low- and moderate-income households to move out of central cities and older suburbs into newer suburbs, thereby perpetuating the concentration of poverty in inner-core areas. The resulting pockets of poverty contribute to both adverse local conditions in inner-core areas and the withdrawal from those areas of many economically viable households and businesses. This chain of events imposes significant long-run costs upon society as a whole, as discussed in more detail in Chapter 13 of this report.

Because neither the benefits of fragmentation nor its costs can be quantified in ways that would permit direct comparison, it is not possible to determine whether this advantage of sprawl actually provides a net benefit or a net cost to society. Certainly, the total number of home-owning households living in metropolitan suburbs with relatively fragmented governance structures is larger than the total number of poor households living in inner-core, concentrated-poverty neighborhoods; therefore, the number of beneficiaries of this condition is larger than the number of people who directly suffer from it. But the hardships borne by low-income populations in concentrated-poverty neighborhoods are suffered more accutely by household members than the gains derived by those moving to outlying areas justify. The long-run impacts upon society of those adverse conditions and the resulting low skill levels, high crime rates, and high public-service costs in big cities extend the costs of this condition far beyond its immediate effects upon inner-core area households. Therefore, no definite conclusion can be drawn concerning whether this situation is indeed a net benefit of sprawl, though it is certainly considered a gross benefit by many households.

Fragmenting Government Powers over Land Uses Enables Suburban Residents to Create Neighborhoods That Are Relatively Homogeneous Socioeconomically

This benefit of a basic trait of sprawl is very similar to the one discussed in the preceding section but has a different emphasis. As noted above, the fragmentation of local government powers over land uses among many relatively small municipalities permits home-owning majorities in each to engage in exclusionary zoning. This has the effect of reducing the percentage of residents in the locality whose incomes are markedly below the median or average incomes in that community. Consequently, the income distribution in such communities is much more concentrated around the mean than it would be if the population there were representative of the income distribution in that metropolitan area as a whole. This is certainly not true of all suburbs; in fact, not all suburbs practice exclusionary zoning. Some have high numbers


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of low-income residents and even become havens for such households. But a significant number of suburbs in most metropolitan areas engage in exclusionary zoning for two different but mutually reinforcing reasons. The first reason is to protect the market values of their homes from declining, as explained earlier. The second reason is to create a neighborhood that is relatively homogeneous in the incomes and social status of its residents. This goal reflects a desire of most American households to live in neighborhoods where the socioeconomic status of other residents is similar to their own, or at least not much lower than their own.

The desire for relative homogeneity is by no means universal; millions of Americans prefer to live in neighborhoods containing a diversity of residents in terms of income, social status, ethnic background, and other traits. But repeated surveys—plus the observed behavior of the population—have shown that, for the most part, American households are comfortable living in neighborhoods where other people are much like themselves in characteristics important to them—that is, socioeconomic status, and often ethnic or racial composition. Whether this attitude is ethical or appropriate in a democracy is a controversial question, and one that should be raised. Both legally and morally, society has rejected it as inappropriate insofar as race and ethnicity are concerned—although that has not altered the fact that most Americans consider the racial composition of a neighborhood to be an important determinant of their willingness to live there. However, regardless of its propriety, the desire for relative socioeconomic homogeneity in residential communities is widespread. Moreover, it is encouraged by the practice among homebuilders of creating sizable residential subdivisions in which nearly all the homes cost about the same and reflect the same basic design preferences.

At first glance, there seems to be nothing wrong with the widespread sentiment that "I would like to live in a neighborhood where most other households are a lot like my household and have similar views about what makes life in a community desirable." But the application of this value at all levels of society would have unfortunate collective effects: It would cause very wealthy people to live with other very wealthy people; most middle-income people to live with other middle-income people; and most working-class people to live with other working-class people. Perhaps all of those groups would regard such an outcome as desirable, though it likely would discourage upward mobility. Extending this principle, very poor people would continue to live with other very poor people in what would therefore be concentrated-poverty neighborhoods. Experience in American cities and older suburbs over the past century shows that neighborhood conditions in concentrated-poverty areas do not provide healthy and constructive environments for people living there. Nor do those conditions provide educational and training opportunities for the children being reared there that are close or equivalent to the opportunities enjoyed by children reared in other parts of the metropolitan area. Thus, *nearly universal application of the principle of neighborhood homogeneity by socioeconomic status results in exclusion of the poor from mainstream society, with all the negative consequences discussed earlier in this report*. If, as stated earlier, whites prefer to live in areas containing no more than one-third African American households, this desire for socioeconomic homogeneity works to concentrate poor African American households together far more intensively than it does poor white or Hispanic households. That strengthens the negative consequences of concentrated poverty for poor African Americans, who comprise a disproportionately large number of all households living in concentrated-poverty neighborhoods, in the United States.

Thus, even though relative socioeconomic homogeneity of neighborhoods is considered a desirable outcome of sprawl by many Americans—and therefore a benefit of sprawl—it contributes to results considered extremely undesirable by other Americans. As with the case of fragmented governance and consumer sovereignty as a benefit of sprawl, it is not possible to weigh these two views about socioeconomic homogeneity in quantified terms in a scientific manner to determine whether this condition is a net benefit or a net cost to society as a whole. But in relation to developing policy responses to sprawl, it is imperative to take account of the negative results of this condition as well as its positive results.

Fragmenting Local Government Powers among Many Small Municipalities Increases the Influence of Individual Citizens upon Their Local Governments, Thereby Strengthening Democracy

Another consequence of fragmenting local government powers among many relatively small municipalities is that it magnifies the ability of individual citizens to influence their local governments compared to the influence they would have if they lived in more populous jurisdictions. The average citizen of a town containing 500 residents has a much better chance of persuading the local city council to adopt his or her views than the average resident of a city containing five million residents. In the former case, a higher proportion of all citizens know the members of the city council personally and can rather easily arrange to meet and talk with them. In the latter case, each citizen is viewed by the city council as an anonymous face in the crowd and is buffered from the council by an army of municipal bureaucrats that the citizen must penetrate before reaching the council.

This advantage of smaller size is indeed a major social benefit of fragmented government powers. It is surely one of the reasons why Americans are so enamored of retaining sweeping powers over decisions at the local municipal level rather than at higher levels of regional, state, or national bodies. Moreover, the ability to influence one's local government significantly, or to have the chance to do so, probably encourages greater personal participation in local government—and citizen participation is one of the keystones of democracy. Therefore, it is undeniable

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Table 14.11
Are the Alleged Benefits of Sprawl True Benefits to Society as a Whole?

Benefits of Sprawl	Perceived as a Benefit by Many People	Actually Caused by Sprawl or its Traits	Appears Widespread in Regions of the U.S.	Has Serious Negative Side Effects	Perceived as a Disadvantage by Many People	Unequivocally a Net Benefit to Society as a Whole
Lower land and housing costs	**Yes**	**Yes**	**Probably**	**No**	Partly	**Probably**
Larger average lot size	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**
Larger home and room sizes	**Yes**	Not clear	Not clear	**No**	**No**	No, because actual extent of occurrence is not clear
Reflects low-density preferences	**Yes**	**Yes**	**Yes**	**No**	Unclear, some say not enough other choices are available	**Yes**
Shorter commuting time	Probably	Not clear	Not clear	**No**	Yes, because longer driving distances are involved	Not clear
Less-intensive traffic congestion	Only by a few people	Not clear	Not clear	**No**	Yes	No, because actual extent of occurrence is not clear
Lower overall transport costs	No	No	No	**No**	Yes	No
More efficient use of infill sites	Only by a few people	**Yes**	Not clear	**No**	Yes	No, because actual extent of occurrence is not clear
Neighborhoods with lower crime rates	**Yes**	Partly	**Yes**	Yes, partly caused by exclusionary behavior	**Yes**	No, because partly caused by exclusionary behavior
Better-quality public schools	**Yes**	Partly	**Yes**	Yes, partly caused by exclusionary behavior	Yes	No, because partly caused by exclusionary behavior
Greater consumer life-style choices	**Yes**	**Yes**	**Yes**	Yes, helps perpetuate exclusionary behavior	Yes	**Yes**
More homogeneous communities	**Yes**	**Partly**	**Yes**	Yes, based directly upon very exclusionary behavior	Yes	No, because based directly upon very exclusionary behavior
Stronger citizen participation and influence in local governments	**Yes**	**Yes**	**Yes**	Yes, helps perpetuate exclusionary behavior	**No**	**Probably**

Source: Anthony Downs, The Brookings Institution.
Note: Shaded cells show conditions supporting value of benefits

that this result of fragmented local government is a social benefit. It is a key reason why so few Americans support completely replacing local government with regional or metropolitan authorities with full powers over land-use decisions.

Still, such fragmentation also leads to the exclusionary local policies discussed at length above, with all their negative consequences upon society. The ideal arrangement would be one in which local governance is fragmented enough to gain the citizen participation benefit but is also inclusive of mechanisms that prevent the unfortunate consequences of exclusionary practices. Formulation of this delicate equation is one of the objectives of the policy chapter in this report (Chapter 15).

Meanwhile, the outcome is the same for other alleged benefits of sprawl: It is perceived as a benefit by many people but as a source of social harm by others. There is no scientific formula for weighing these disparate views to determine whether it is a net benefit or a net loss to society as a whole. However, this study supports the view that no policies responsive to sprawl should try to eliminate small-scale local governments and replace them with larger-scale government bodies. Local government has a hallowed place in the American scheme of governance for good reasons and should be retained, though some of its less-attractive elements—for example, its exclusionary housing practices—should be modified through cooperative regional liaisons.

CONCLUSIONS

This chapter has reviewed the 13 published benefits of sprawl to determine how beneficial they really are, both to society as a whole and to specific groups within society. The "true" social value of any condition perceived to be a benefit of sprawl can be evaluated by subjecting it to the following tests:

- Is it *perceived to be a benefit* by a large number of people—regardless of whether it actually benefits them, or whether it also harms other people?

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Courtesy of R. Ewing

  Since a benefit is to some extent a psychological phenomenon, the perception that a condition is beneficial is only partially grounded in reality.

- Is this condition *actually caused by sprawl*, or by certain traits that are basic parts of the definition of sprawl? If a condition widely attributed to sprawl is perceived to be a benefit, but is not in reality caused by sprawl or any of sprawl's attributes, it is not a true benefit of sprawl.

- Does this condition *appear to be widespread enough* in the United States to be socially significant?

- Does this condition *have serious negative side effects or consequences* that offset its benefits, rendering its beneficence neutral when viewed from the perspective of society as a whole? This outcome is possible even if the condition is perceived as a benefit by large numbers of people.

- Is this condition *perceived to be a disadvantage* by large numbers of people? This test is related to the preceding one but refers to perceptions rather than the substantive realities of the preceding test.

- In summary, is this condition *unequivocally a net benefit to society as a whole?* This test does not require the condition to be totally beneficial, since almost all activities or conditions in society are harmful to at least some people. But this test summarizes the net implications of the other five tests.

The results of subjecting all 13 benefits of sprawl to these six tests have been summarized in Table 14.11. The 13 benefits form the rows along the left side of the chart, and the six tests described above form the columns across the top. Each cell states whether a


Courtesy of T. Delcorso

particular benefit meets that test. Cells that embody results favorable to the benefit's actually being a "true" benefit are shaded. The judgments succinctly expressed in each cell are those of the present study, based upon the detailed analyses of each benefit set forth earlier in this chapter and the literature search contained in *TCRP Report 39* (Burchell et al. 1998).

According to Table 14.11—and therefore according to the preceding analysis underlying it—three of the 13 benefits of sprawl are indeed "true" net benefits to society as a whole, and two others probably fit into this category. The three clearly beneficial are (1) larger average lot sizes, (2) reflection of consumer preferences for low-density living, and (3) providing consumer households with wider choices of more combinations of tax levels and social services than would occur under nonsprawl development. The two that are probably beneficial are (1) lower land and housing costs from moving farther out from each region's center, and (2) stronger citizen participation and local influence in small, fragmented local governments rather than large, bureaucratic ones.

Only one universal benefit is definitely not a "true" benefit, because the analysis in another part of this study showed that this condition did not really exist. This is that sprawl produces lower overall travel costs than more compact forms of development. The travel analysis discussed in another chapter of this report showed that overall travel costs would be higher under continued sprawl development than under more compact forms.

Four other conditions cannot be considered unequivocal benefits to society because it is not clear that they exist at a great enough scale across the nation to be socially significant. These are shorter commuting times, less-intensive traffic congestion, larger home and room sizes, and more efficient use of infill sites.

The remaining three benefits of sprawl are not unequivocally beneficial to society because they have seriously negative side effects or consequences. These are access to better-quality schools and access to neighborhoods with lower crime rates in peripheral areas distant from regional centers, and creation of relatively homogeneous neighborhoods. There is little doubt that many such outlying areas have better-quality schools and lower-crime neighborhoods than most inner-core areas. Many such areas are also much more homogeneous in their socioeconomic status and often the ethnic background of their residents than are many big-city neighborhoods or American society as a whole, with its diverse ethnic and racial composition. Moreover, these conditions are surely perceived as benefits by the residents of those peripheral areas. But, as discussed earlier, such neighborhoods achieve these benefits by engaging in economically and socially exclusionary practices that exacerbate the consequent concentration of very poor households in inner-core, high-poverty neighborhoods. Therefore, the conditions that the residents of these outlying areas perceive as benefiting them cannot be considered unequivocally good for society.

This same criticism might be made against two other benefits of sprawl, both of which are based upon the fragmentation of governance powers over land uses among many relatively small municipalities or towns. These are (1) a wider range of choices about combinations of tax and public service levels, and (2) greater citizen participation and influence in local government decision making. The fragmentation of governance powers over land use inherent in these conditions also enables local governments to engage in exclusionary behavior. However, these two conditions do not necessarily *require* the use of fragmented gov-

Courtesy of G. Lowenstein

Courtesy of R. Ewing

ernance powers to enact exclusionary regulations, whereas the attainment of homogeneous neighborhoods and schools with very few low-income residents does. Therefore, neither wider choice of tax and public service combinations nor greater citizen influence is inherently harmful to low-income households, though the outcomes of both benefits can produce such harm. Moreover, both these conditions are widespread and highly valued by millions of Americans—enough so that they are regarded in this study as net benefits to society.

Surveying the results of the preceding analysis of sprawl's benefits, is it possible to arrive at an overall conclusion concerning whether sprawl's "true" benefits—and others that surely contribute some positive results to many households—make sprawl superior to more compact forms of development? The response of reasoned judgment can only be negative. Sprawl has many significant benefits that cannot be measured empirically, or even roughly estimated in quantitative terms. It also has many costs that have similar traits. The same dynamics are true of all nonsprawl forms of development. Furthermore, there is an immense diversity of household views, values, and predilections among the nation's more than 281 million residents. Therefore, it would be foolish to conclude that any one form of future metropolitan development is unequivocally superior to all other forms. Different forms are better suited than others to specific conditions, times, circumstances, and resources. The purpose of this study is not to declare one form of future development "the winner" over all other possible forms. Rather, that purpose is to more fully illuminate and clearly delineate both the costs and benefits of all major forms of development—with emphasis upon sprawl because it has been so dominant in the United States for the past half-century. Such greater clarity and depth of understanding will enable citizens across the nation to make better choices about what particular policies concerning the future development of their metropolitan areas will best serve the long-term interests of their communities and regions.

Courtesy of R. Ewing

XV

Developing Policies in Response to Sprawl

A Menu of Alternative Responses

INTRODUCTION

How should policymakers respond to sprawl? This question is difficult to answer for several reasons.

First, *although suburban sprawl is only a form of metropolitan growth*, *it has been the dominant form in the United States for the past half-century*. While the sprawl form is synonymous with metropolitan growth, other more fundamental forces of metropolitan growth may be responsible for some of the negative effects often attributed to sprawl. These forces may have little to do with the pattern of growth. If so, then policies implemented to respond to specific traits of sprawl may not effectively counteract the negative effects of those more fundamental forces of metropolitan growth. For example, certain fundamental elements of growth (exclusionary zoning, not building enough inexpensive housing, etc.) contribute to the concentration of poor households—especially low-income minority households–within older core areas of American metropolitan areas. That concentration is in turn a major cause of adverse local conditions in high-poverty neighborhoods and the consequent withdrawal of many viable households and firms from central cities and older suburbs.

Second, *some measure of peripheral growth in U.S. metropolitan areas has been unavoidable in the past and probably will remain so in the future.* The reasons for this trend include large-scale population growth in metropolitan areas over the past 50 years, rising real income, and technological changes in transportation and communications. As a result of large-scale population growth, metropolitan areas had to accommodate many more people. Rising real income led to demands for more interior and exterior space per household. Those demands would not have been compatible with purely vertical expansion and higher population densities in previously settled areas. Therefore, metropolitan areas had to expand outward at the edges. The technological changes in transportation and the building industry reduced the cost of living in lower-density settlements, thereby enabling outward growth to occur at lower average densities than had been prevalent before World War II. These forces made relatively lower-density, outward expansion of U.S. metropolitan areas almost inevitable after 1950. No policy could have prevented that outcome.

The same fundamental expansionary forces are still at work today, in quite powerful forms. Therefore, it is likely that relatively low-density, outward movement of population will continue in all U.S. metropolitan areas experiencing population growth—the vast majority of such areas. Any policies responsive to sprawl must take realistic account of the need to continue accommodating these dynamic expansionary forces in some process of change.

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Third, *sprawl clearly produces benefits as well as costs for the residents of U.S. metropolitan areas* (see Chapter 14). In fact, it can be persuasively argued that, up to now, sprawl has been so widely accepted—even promoted and encouraged—by residents of U.S. metropolitan areas because the benefits produced have outweighed the costs. For this reason, policies designed to reduce the negative effects of sprawl should be examined to assess their effect on sprawl-produced benefits. For example, would the gains achieved by reducing the negative effects of sprawl be offset by the reduction of sprawl-produced benefits?

Thus, formulating and recommending policies in response to sprawl is not a simple task. It should not consist solely of identifying sprawl's negative effects and designing policies that would reduce those effects. Rather, sprawl must be seen as part of a continuing process of accommodating the basic elements of metropolitan-area dynamics. So, policies developed in response to sprawl must address its benefits as well as its costs. The recommendations made in this chapter attempt to take these complexities into account while helping to reduce the major negative effects of sprawl.

THE SPRAWL-GENERATING PROCESS IN SPECIFIC PARTS OF METROPOLITAN AREAS

As noted above, sprawl has been generated as part of the prevailing process of growth in American metropolitan areas. Those areas can be separated into the following geographic zones for purposes of analysis:

- core-area poverty neighborhoods
- downtown business districts in central cities
- other sections of central cities and older suburbs
- already developed suburbs with many amenities and a large proportion of high-income residents
- already developed suburbs with fewer amenities and an average or lower proportion of high-income residents
- still-expanding new-growth suburbs
- peripheral rural areas containing mostly undeveloped land

The dynamic forces operating in each of these zones can be divided into (1) activity-initiating occurrences or conditions that underlie change in each zone and (2) resulting developments in a zone that contribute to sprawl there or elsewhere. These forces are displayed in three accompanying flowcharts (Figures 15.1, 15.2, and 15.3) that show how the activity-initiating occurrences or conditions give rise to one or more rounds of resulting developments related to sprawl. Each flowchart covers some of the seven zones mentioned above. The charts describe the dynamic forces that generate sprawl and that must be either accommodated or changed by future policies responsive to sprawl.

OUTCOMES OF THE SPRAWL-GENERATING PROCESS THAT REQUIRE REMEDIES

Table 7 in *TCRP Report 39* (Burchell et al. 1998) presents the negative effects of sprawl as derived from the literature search described in that volume. This table shows the outcomes of sprawl that have drawn the most criticism, and that, therefore, are most likely to need remedies. The specific negative effects selected from the TCRP Report and presented in Table 15.1 have been slightly revised to make them more amenable to policy analysis. The last column in

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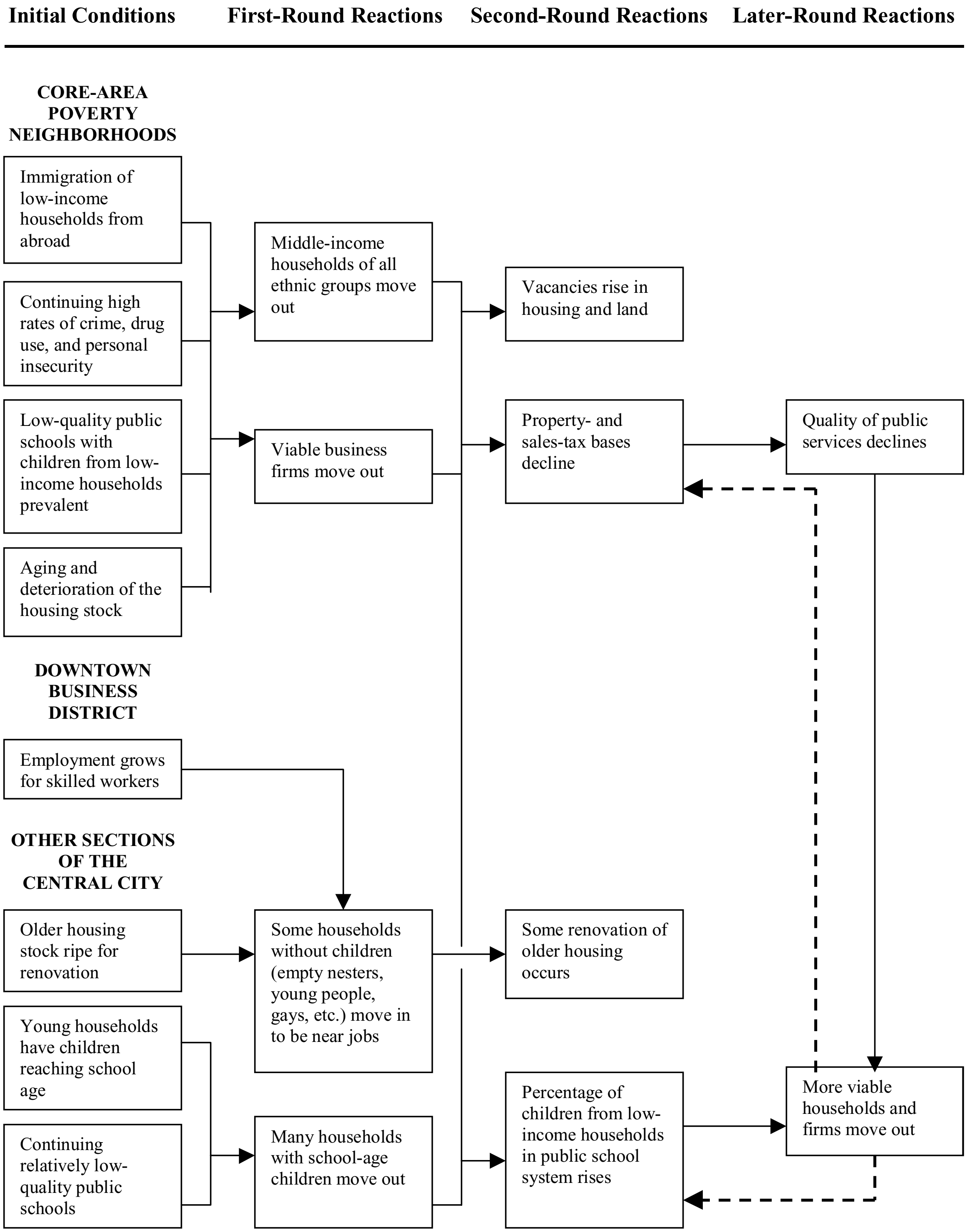
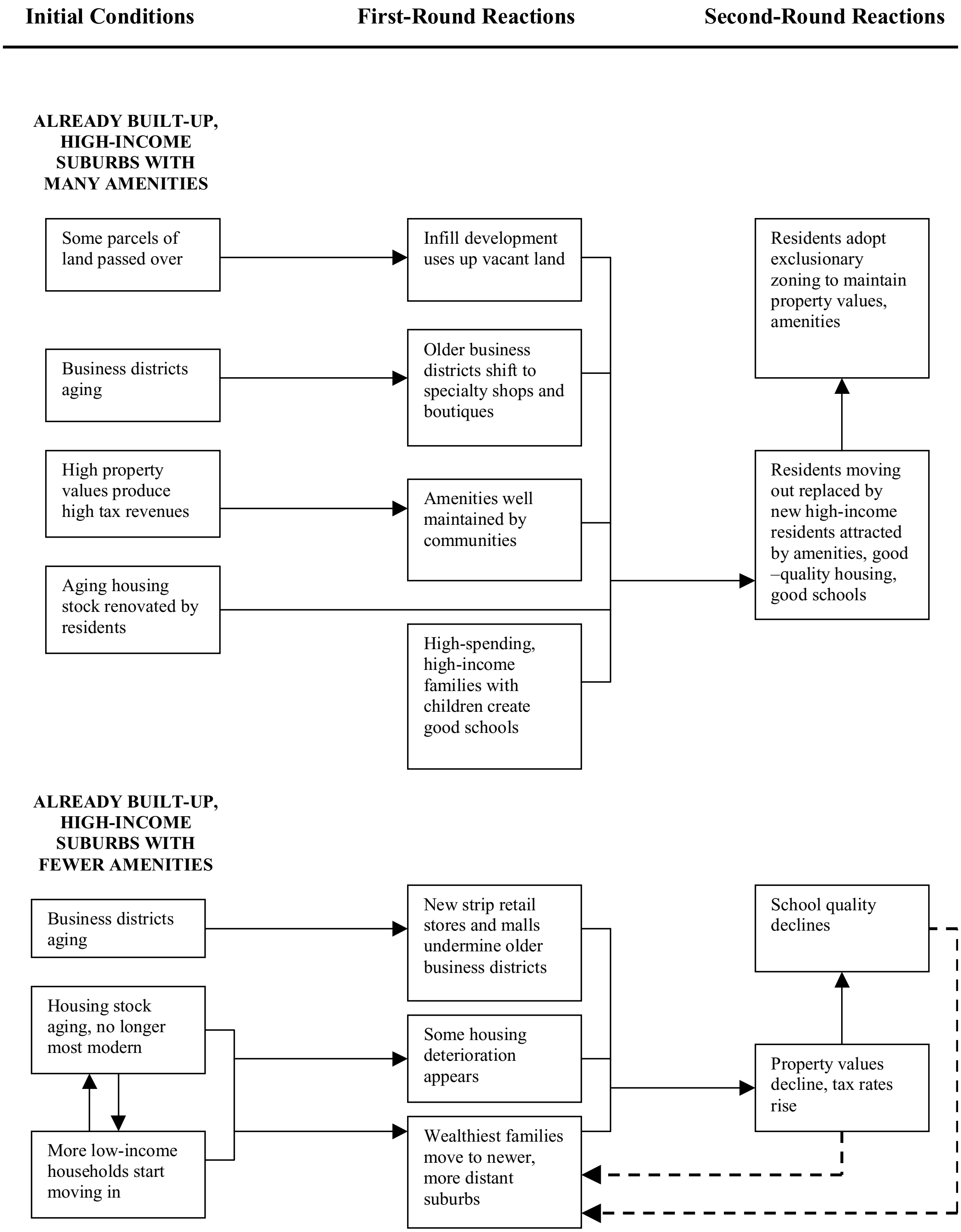
Figure 15.1
The Decline Process in the Central City



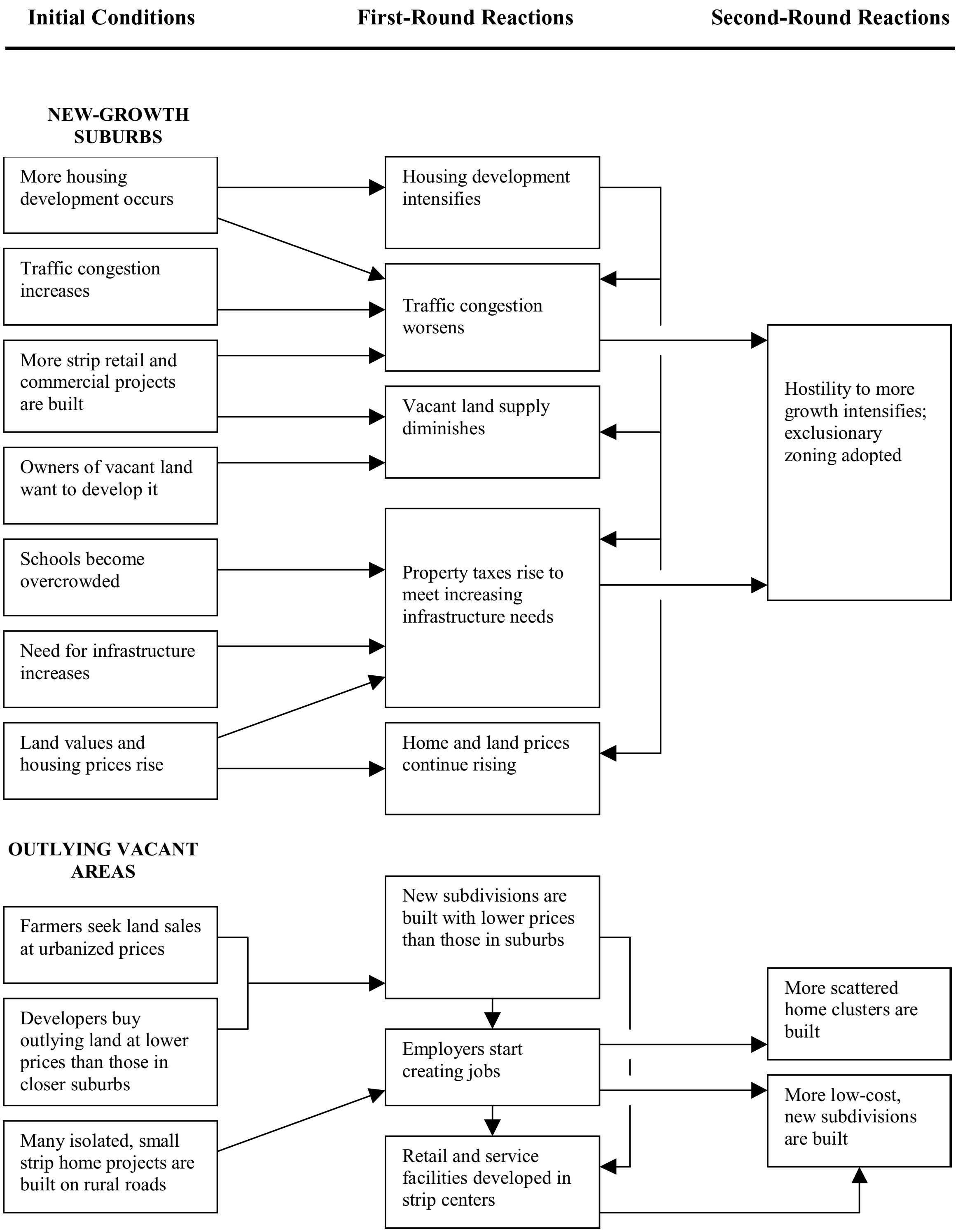
Source: Anthony Downs, The Brookings Institution.

Figure 15.2
The Decline Process in Older Suburbs



Source: Anthony Downs, The Brookings Institution.

Figure 15.3
The Decline Process in the Newer Suburbs



Source: Anthony Downs, The Brookings Institution.

Table 15.1
Outcomes of the Sprawl-Generating Process That Require Remedies

Areas of Substantive Concern	Negative Effects of Sprawl from TCRP Report 39	Revised Negative Effects for Policy Analysis in This Study
Public and Private Capital and Operating Costs	Higher infrastructure costs	Excessive infrastructure capital and operating costs and failure to use the available capacity of existing infrastructure
	Higher public service operating costs	
	Higher private development costs	Higher housing and other private development costs
	Higher aggregate land costs	
	More adverse public fiscal impacts	Higher government costs and taxes
		Undermining of outlying business districts by strip commercial development
Transportation and Travel Costs	More vehicle miles traveled	Excessive reliance on automobiles, excessive energy use, and imposition of high movement costs on households
	Longer travel times	
	More automobile trips	
	Higher transportation spending per household	
	Less cost-efficient and effective public transit	Inefficient use of public transit because of low-density development
	Higher social costs of travel	Increased traffic congestion
		Inadequate mobility of low-income residents due to lack of public transit services
Land/Natural Habitat Preservation	Loss of agricultural land	Absorption of too much once-vacant land, including environmentally sensitive land and rich agricultural land
	Reduced farmland productivity	
	Reduced farmland viability	
	Loss of environmentally fragile land	
	Reduced regional open space	
Quality of Life	Weakened sense of community	Weakened sense of community
	Aesthetically displeasing	**Not included**
	Greater stress	
	Higher energy consumption	**See transportation**
	More air pollution	Excessive air pollution
Social Factors	Fosters suburban exclusion	Exclusion of low-income households from suburban communities
		Shortages of affordable housing in the suburbs
	Fosters spatial mismatch	Location of jobs too far from inner-city areas of high unemployment
	Fosters residential segregation	Maintenance of residential segregation by race and income group
	Worsens city fiscal stress	Draining of taxable resources out of central cities and inner-ring suburbs
	Worsens inner-city deterioration	Inequitable distribution of public services among subregions and income groups
		Diversion of funds from maintaining existing infrastructure close to inner-city areas to building new infrastructure in outlying areas

Sources: Center for Urban Policy Research, Rutgers University (1998). Data interpretation by Anthony Downs, The Brookings Institution.

Table 15.1 shows the revisions used for the policy analysis in this study. The methods used to analyze proposed remedies for negative effects of sprawl are explained in later sections of this chapter.

CHARACTERISTICS OF THE U.S. METROPOLITAN GROWTH PROCESS TO CONSIDER WHEN FORMULATING POLICIES IN RESPONSE TO SPRAWL

Any analysis of policies proposed in response to sprawl must take into account certain characteristics of U.S. metropolitan areas and how these areas grow over time. Therefore, as a prelude to analyzing such policies, these characteristics are examined here.

Every U.S. region needs to experience some net population growth and the new development necessary to accommodate it in order to remain economically dynamic over the long run. This is true for the following reasons:

- Each region's total population grows through annual excesses of births and inmigration over deaths and outmigration. Further development is necessary to house the added people and households.

- Some development is necessary to replace obsolete and deteriorated housing and other facilities. If the required development does not occur, an entire region could gradually sink into functional obsolescence and physical decay.


Courtesy of C. Galley

- Immigration adds substantially to the population of the United States each year. Although relatively limited geographically, additional dwelling units and other structures must be developed to accommodate the increased number of households.

- Additional persons of working age (from 20 through 65) will be necessary to support the retired population in the future. People are living longer and will need to be supported by others still in their productive years.

For the above reasons, in the average metropolitan area with an initial population of one million, at least 11,000 additional housing units per year—plus similar additions to all other types of space—would be needed to accommodate natural increase, replacement of obsolete units, and net immigration from abroad.[1] The additional housing units needed are equivalent to approximately 3 percent of the initial supply of occupied units. In regions that offer above-average amenities, the amount of new development required would be greater. Such regions attract many in-migrants from other regions of the country, resulting in higher-than-average growth rates and greater demands for new development to accommodate increases in population.

Thus, policies designed to respond to suburban sprawl should accommodate at least some additional growth and development in any region; policies should not attempt to halt such growth altogether. This conclusion is reflected in the fact that, from 1990 to 1998, only 38 (or 11 percent) of the 332 metropolitan areas tracked by the U.S. Bureau of the Census lost population. Population increased in the other 89 percent, and the overall gain for the 332 areas combined was 8.65 percent, a compound annual growth rate of 1.04 percent (U.S. Department of Commerce 2000). Moreover, the population in 32 of these 332 areas increased by more than 20 percent during that period, resulting in compound growth rates of over 2.3 percent.

The total population growth of a metropolitan area cannot be controlled by policies adopted by the residents or governments within that metropolitan area

[1] The statistic is based on calculations presented in Downs (1999a, 61–69)

alone, although such policies might affect the rate of its growth. The population and economic activities of any metropolitan area are going to grow at rates determined primarily by certain basic characteristics of that area. These include the area's climate, physical size, geographic position, topography, past investments in business and infrastructure, and population composition. None of these traits can be significantly affected by policies adopted by individual local governments acting separately. Therefore, an individual locality cannot stop or even greatly affect the overall growth rate of its region by adopting growth-management policies within its own boundaries. This is the *Imperviousness Principle*: A region's growth rate is impervious to local governments' attempts to influence it. Even regional bodies cannot halt overall growth by adopting current population-serving limits over the entire region since newcomers can enter in spite of such limits. Policies that raise housing costs significantly might slow down the rate of growth of an area over time—although that outcome is not certain.

Attempts by individual localities to limit growth within their own boundaries normally cause the spread of growth beyond their boundaries and into other localities in the same region—thus generating more sprawl. Most growth-control policies limit or reduce local population densities. Such local controls push future growth farther outward—creating more sprawl—because developers typically move to more distant locations to build new housing to accommodate future growth. Or, the growth may shift into overcrowded inner-city areas where low-income immigrants are concentrated. Therefore, decentralized growth controls aggravate sprawl; they do not reduce it.

Thus, *when any one locality limits future growth within its own boundaries, that local policy simply moves the region's future growth to other areas in the region; total regional growth is not reduced.* This is the *Law of Demographic Displacement*. Consequently, nearly all local growth controls are essentially "beggar thy neighbor" policies. Each locality pursues the interests of its own residents without regard to those of other localities.

As any metropolitan area grows in overall population, the total number of low-income households within it almost always grows in absolute terms. This is because low-wage workers form a significant portion of every area's vital workers. The households containing these workers must be sheltered somewhere within or near the metropolitan area. Under current conditions, low-income households tend to disproportionately concentrate in older central cities and inner-ring suburbs because the oldest, most deteriorated, and, therefore, cheapest housing is concentrated there. The number of low-income households is especially likely to rise in metropolitan areas (e.g., the cities located near the Mexican border) experiencing heavy immigration from poorer nations. These are among the fastest-growing metropolitan areas in the nation.

If low-income households are disproportionately concentrated within the central city and other older neighborhoods in a metropolitan area, *as the whole area grows and the number of the low-income households in it rises absolutely, the percentage of the population consisting of low-income households must also rise in the central city and older suburbs.* This assumes no increase in overall density within those areas and no changes in community boundaries.

The only way to avoid such increasing concentration of the poor within the central city is to expand the supply of suburban housing available to low-income households as rapidly as the total number of such households in the MSA expands. This expanded supply can come from any of the following sources:

- New "stick-built" housing in the suburbs, subsidized to make it affordable to low-income households through (1) vouchers, (2) inclusionary zoning that creates such units in otherwise market-priced subdivisions, or (3) housing projects containing mainly low-rent housing
- Mobile homes in clusters or on individual lots
- Older, less desirable housing in the suburbs that "trickles down"
- Doubling up of households in existing housing in the suburbs (although this is illegal)
- New accessory apartments built in the suburbs by single-family homeowners

However, if the total suburban supply of housing units available to low-income households expands more slowly than the number of low-income households in the MSA, the concentration of poverty within the central city will rise, and more nonpoor households will move out of the central city and into the suburbs. This implies that attempts to reduce central-city poverty concentrations must involve expanding the supply of suburban housing affordable to the poor at a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rate faster than the total population growth of the entire metropolitan area.

The overall pattern of land use within a metropolitan area cannot be rationally controlled without placing significant limits on the growth permissible in surrounding counties just outside the metropolitan area. Limiting growth within the metropolitan area is ineffective if unlimited growth can take place just outside that area. In that case, growth will skip over the limited sections into the unlimited sections, thereby defeating the purpose of the growth limitations in the former.

Most of the important negative effects of sprawl are regional in nature, not local. As shown in Table 15.2, the vast majority of these negative effects are either primarily regional in nature, or both regional and local. Moreover, *adverse regional conditions cannot be remedied by individual localities adopting policies without any explicit means of coordinating those policies*. This applies to traffic congestion, air pollution, water pollution, infrastructure finance, and other growth-related problems. It therefore also applies to such proposed solutions as urban growth boundaries and moratoria or limits on new housing construction.

Nevertheless, almost all elected officials—federal, state, and local—recommend leaving growth-management policies to individual localities (including counties). This is true even though every local government is motivated to benefit only its own residents—not the region as a whole. Local elected officials have strong incentives to please the existing residents of their own communities, who control their reelection, and to ignore the welfare of all other persons, who cannot influence that reelection. Therefore, they make decisions on the basis of a highly parochial and narrowly defined view of "the public interest" that does not take much—if any—account of the welfare of the region as a whole. As a result, except in a few cases cited below, *nearly all growth-management policies supported by elected officials cannot possibly solve the regional growth problems that are most bothersome to residents.*

Most of the metropolitan regions in the nation that have adopted regionwide policies for growth management have done so because of some type of crisis. In Oregon, the crisis was potential development of the Willamette River Valley's farmland; in Florida, it was threatened development of the Everglades; in New Jersey, it was state Supreme Court decisions that threatened to end local zoning; in Georgia, it was federal government refusal to fund more highways in the

Table 15.2
Are Negative Effects of Sprawl Local or Regional?

Areas of Substantive Concern	Revised Negative Effects for Policy Analysis in This Study	Primary Effects: Local or Regional?
Public and Private Capital and Operating Costs	Excessive infrastructure capital and operating costs, and failure to use fully the available capacity of existing infrastructure	Regional
	Higher housing and other private development costs	Local and Regional
	Higher government costs and taxes	Local
	Undermining of outlying business districts by strip commercial development	Local and Regional
Transportation and Travel Costs	Excessive reliance on automobiles, using too much energy and imposing high movement costs upon households	Regional
	Inefficient use of public transit because of low density	Regional
	Increased traffic congestion	Regional
	Inadequate mobility of the poor due to lack of public transit services	Regional
Land/Natural Habitat Preservation	Absorption of too much once-vacant land, including environmentally sensitive land and rich agricultural land	Regional
Quality of Life	Weakened sense of community	Regional
	Excessive air pollution	Regional
Social Factors	Exclusion of low-income households from suburban communities	Local and Regional
	Shortages of affordable housing in the suburbs	Local and Regional
	Location of jobs too far from inner-city workers	Regional
	Maintenance of housing segregation by race, ethnicity	Regional
	Draining of taxable resources from inner-core areas	Regional
	Inequitable distribution and quality of public services	Regional
	Diversion of funds from maintaining existing infrastructures	Regional

Source: The Brookings Institution.

Atlanta area until air pollution levels there were reduced.

Insofar as local growth limits succeed in reducing new housing construction within the locality concerned, they tend to force up the prices of housing there as long as more people want to move in. Local restrictions on housing supply in the face of strong demand tend to increase the market prices—and rents—of both new and existing housing units there. Higher prices benefit existing homeowners but make it harder for newcomers to buy or rent homes in the locality. In fact, the benefit to existing homeowners is a key reason that local growth controls are so politically popular; existing homeowners form a majority of local residents in most U.S. suburbs. All of the empirical observations and logical principles described above are relevant to analyzing the likely effects of any policies being considered as appropriate responses to the negative effects of sprawl.

NEGATIVE EFFECTS OF SPRAWL RELATED TO URBAN DECLINE

The negative effects of sprawl on American society can be divided into two groups for purposes of subsequent analysis:

- *Those effects directly related to population and economic growth that primarily affect persons living and working in the suburban portions of the metropolitan area*. These include the following items taken from Table 15.2: increased traffic congestion; excessive air pollution; absorption of too much once-vacant land, including environmentally sensitive land and rich agricultural land; excessive infrastructure capital and operating costs, and failure to use the available capacity in existing infrastructure; higher housing and other private development costs; higher government costs and taxes; undermining of outlying business districts by strip commercial development; excessive reliance on automobiles; excessive energy use and imposition of high movement costs on households; and a weakened sense of community.

- *Those effects related to the concentration of low-income households in inner-core areas that primarily affect persons living and working in those core areas*. These include the following items taken from the preceding table: inefficient use of public transit because of low-density development; inadequate mobility of low-income residents due to lack of public transit services and exclusion from suburban communities; shortages of affordable housing in the suburbs; location of jobs too far from inner-city areas of high unemployment; maintenance of residential segregation by race and income group; draining of taxable resources out of central cities and inner-ring suburbs; inequitable distribution of public services among subregions and income groups; and the diversion of funds from maintaining existing infrastructure close to inner-city areas to building new infrastructure in outlying areas.

It is true that some of these effects harm both persons living in the suburbs and those living in core-area poverty neighborhoods. However, a major criticism of sprawl is that it has contributed to the decline of core areas of both central cities and older suburbs, and that such decline is a central problem in our society. (This criticism and its elaborations are covered in *TCRP Report 39* [Burchell et al. 1998].) Presumably, therefore, if sprawl is reduced or eliminated, the decline of these core areas would be significantly alleviated. That assertion has major implications for decision makers trying to determine the policies that ought to be adopted in response to sprawl (see Chapter 13).


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WHAT BROAD REMEDIAL STRATEGIES MIGHT ADDRESS SPRAWL'S NEGATIVE EFFECTS?

In order to formulate specific policies in response to sprawl's negative effects, this study has reviewed the literature and discovered that antisprawl advocates have proposed seven basic policy strategies to achieve that goal. These seven strategies are also key elements in the many approaches to "smart growth" proposed by different organizations, government agencies, academic observers, and others during the past few years. Each policy strategy consists of a broadly defined means of counteracting what its proponents believe are one or more negative effects of sprawl, as described in earlier sections of this report. These seven basic policy strategies are as follows:

1. *Limit the outward movement of new development* by encouraging more spatially compact metropolitan forms and restricting or prohibiting new outlying developments.
2. *Reduce society's current heavy dependence on private automobiles for ground transportation*, and substantially increase the use of various forms of public transit or walking and bicycling.
3. *Reduce the financial dependence of each local government's revenues on the property values and sales taxes occurring within its own boundaries* by developing some means of regional sharing of at least portions of these tax bases, or by increasing the role of state government financing in local governments.
4. *Provide more opportunities for low-income and minority households to move out of concentrated-poverty neighborhoods in inner-core areas and into suburbs* with higher average income levels and more racially integrated populations, mainly through provision of some type of housing subsidy for such households.
5. *Introduce new elements of urban design into land-use planning.* Examples are permitting more mixed-use developments instead of segregating different types of land use in separate zones; allowing grid street patterns as well as cul-de-sac patterns; and encouraging higher-density development around public transit stops.

Table 15.3
Relationships between Basic Policy Strategies and the Effects of Sprawl Needing Remedies

Revised Negative Effects for Policy Analysis in This Study	Limit Outward Movement of Growth	Reduce the Role of Private Vehicles	Share Local Tax Bases or Revenues	Provide Low-Income Housing in Suburbs	Create Regional Coordinating Agency	Introduce New Urban Design Elements	Revitalize Inner-Core Areas and Schools
Excessive infrastructure capital and operating costs, and failure to use the available capacity of existing infrastructure							
Higher housing and other private development costs							
Higher government costs and taxes							
Undermining of older business districts by strip commercial development							
Excessive reliance on automobiles, excessive energy use, and imposition of high movement costs on households							
Inefficient use of public transit because of low-density development							
Increased traffic congestion							
Inadequate mobility of low-income residents due to lack of public transit services							
Absorption of too much vacant land, including environmentally sensitive and rich agricultural land							
Weakened sense of community							
Exclusion of low-income households from suburban communities							
Excessive air pollution							
Shortages of affordable housing in the suburbs							
Location of jobs too far from inner-city areas of high unemployment							
Maintenance of residential segregation by race and income group							
Draining of taxable resources out of central cities and inner-ring suburbs							
Inequitable distribution of public services among subregions and income groups							
Diversion of funds from maintaining existing infrastructure close to inner-city areas to building new infrastructure in outlying ones							

Source: Anthony Downs, The Brookings Institution.
Note: Dark cells indicate that the basic policy strategy could have a major effect in alleviating the negative effect concerned. Lighter shading indicates that the basic policy strategy might have some effect in alleviating that negative effect.

6. *Revitalize concentrated-poverty and other neighborhoods in central cities* by reducing crime rates and substantially improving the average quality of public schools there, and by removing existing central-city government obstacles to cost-efficient development and the operation of businesses within such cities.

7. *Create some type of public agency at the regional level that has the authority to review and coordinate comprehensive land-use and other plans drawn up by individual localities* within the entire region.

Since these seven broad strategies are designed to alleviate the negative effects of sprawl, it would be desirable to indicate just which of those negative effects are, at least in theory, addressed by each strategy. This has been done in Table 15.3, entitled "Relationships between Basic Policy Strategies and the Effects of Sprawl Needing Remedies." The chart displays the seven policy strategies in seven vertical columns. The first column in this chart lists the 18 important negative effects of sprawl described earlier in this report. Cells in the chart that are darkly shaded indicate that the strategy in that column could have a significant effect in alleviating the negative effect shown in that row. Cells that are more lightly shaded indicate that the strategy in that column could have at least some positive effect in alleviating the negative impact shown in that row. These conclusions about the possible effectiveness of each strategy are based upon the researchers' subjective judgments concerning all the possible relationships between strategies and negative effects shown in the chart, as derived from the literature search and the analyses conducted. The chart shows that every negative effect of sprawl identified earlier in this report could, at least in theory, be somewhat or significantly alleviated by one or more of these seven basic policy strategies.

Admittedly, the relationships shown in this chart are broad and general. Therefore, it is necessary to analyze each of these seven basic policy strategies in much more detail, indicating the specific tactics that might be used to carry them out in practice. This is the subject of the next several sections of this report.

Criteria for Evaluating Specific Tactics

Before considering specific tactics for implementing each basic policy strategy, it is desirable to set forth some *criteria of desirability* for evaluating those tactics. These include the following:

- *Likely effectiveness in achieving the desired strategic outcomes*. To what extent will the specific tactic being considered actually achieve its goals if implemented?
- *Monetary costs*. How much would it cost to implement this tactic effectively?
- *Absence of strongly objectionable ancillary effects*. Would this tactic have any highly undesirable side effects or related ancillary impacts?
- *Administrative difficulty*. How difficult would it be to put this tactic into practice, in terms of the difficulties of administering it in the field?
- *Political acceptability*. How much political resistance and support would this tactic generate if put into practice? Would the surplus of its political support over its political opposition be large enough to get it passed in the required legislatures?
- *Permanence of effect.* How long would the positive benefits of this tactic endure?

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- *Consistency with other tactics and policy strategies*. To what extent would carrying out this tactic interfere with, or enhance, the implementation of other tactics or strategies that appear desirable?

These criteria will be applied to each specific tactic as it is considered in detail.

TACTICS FOR ENCOURAGING MORE SPATIALLY COMPACT METROPOLITAN DEVELOPMENT

The most significant basic policy strategy analyzed throughout this study is to encourage more compact metropolitan development by shifting uncontrolled growth in areas that are likely to experience sprawl into controlled growth in those areas or elsewhere. Most of the extensive national analysis conducted by Rutgers University in this study involves estimating how much future "uncontrolled" sprawl might feasibly be shifted from the areas where it now seems likely to occur into other areas closer to the center of the metropolitan areas concerned. In the country as a whole, 3 million development units could be shifted from one location to another if the controlled-growth scenario were carried out everywhere instead of the uncontrolled-growth scenario. Such shifts involve diverting future growth from one county to another more-developed county; other shifts involve diverting future growth from less-developed portions of a specific county to more-developed portions of the same county.

However, the amount of future sprawl that the study proposes to shift within or outside of any given county never encompasses *all* the future growth likely to occur there. Rather, the growth shifted would account for only a portion of the future growth likely to occur in the counties concerned under uncontrolled conditions. Thus, the tactics for shifting growth in most areas cannot involve the total prohibition of growth in the future. Rather, these tactics must both permit a substantial amount of future growth and simultaneously reduce that amount significantly below what it would be in the absence of public policy intervention.

Following are the specific tactics proposed in the literature for encouraging more spatially compact future metropolitan-area growth:

- *Regional urban growth boundaries*. Under this tactic, a state legislature requires planning officials in each metropolitan area, or perhaps each such area containing more than a given total population, to draw an urban growth boundary (UGB) around the periphery of that region in order to direct as much future growth as possible in that region within the boundary. The purpose of this tactic is to limit future "sprawl" development around the periphery of the region. In reality, very few U.S. metropolitan areas other than those in Oregon and Florida have adopted regional growth boundaries.

— Regional UGBs are not likely to be effective unless the state legislature also passes some type of limit or prohibition against privately financed growth in the territory immediately outside each UGB and extending for a considerable distance from that UGB. In the absence of such constraints, new development can spring up outside the UGB, thereby defeating its purpose.

- *Local urban growth boundaries*. Under this tactic, an individual locality draws an urban growth boundary within its own borders and constrains near-future urban development within that boundary. This tactic has been much more widely used than regional UGBs, but it is still employed by only a small fraction of all the localities in U.S. metropolitan areas.

— The tactic used often does not completely prohibit new development outside the local UGB, but refuses to provide publicly financed infrastructure outside the UGB. Thus, private developers can build outside the UGB, but within the locality, if they finance and build all the required infrastructure supporting their developments. In that case, the local UGB resembles a local infrastructure service district, as described below.

— Unless created within a broader regional or statewide framework of UGBs encompassing an entire metropolitan area, local UGBs may be ineffective at limiting the outward extension of growth over the entire region for two reasons. First, some localities in the region may not adopt UGBs at all. Second, little or no coordination will be created between those localities that do adopt local UGBs, so no rational overall scheme will arise for limiting outward growth in the region as a whole.

- *Regional urban utility or other infrastructure service districts*. Under this tactic, a state legislature empowers a statewide or regionwide public agency to designate certain limited territories within a metropolitan area as the only places in which public funds will be used to finance sewerage systems, water systems, roads, and other basic infrastructure supporting new development. This encourages private developers to locate their future projects within such service districts in order to benefit from public financing of those infrastructures. In some cases, the territory included in such a service district encompasses only part of the territory encompassed by a regional UGB. This tactic has been used successfully in the Twin Cities region of Minnesota.

- *Local urban utility or other infrastructure service districts.* Under this tactic, a local government designates certain limited territories within its boundaries as the only places in which it will use local public funds to finance sewerage systems, water systems, roads, and other basic infrastructure supporting new development. This encourages private developers to locate their future projects within such service districts in order to benefit from public financing of those infrastructures. In some cases, the territory included in such a service district encompasses only part of the territory encompassed by a local UGB. However, in most cases, if the locality has adopted a UGB, its infrastructure service district is coterminous with its UGB.

- *Large-lot zoning in rural areas*. Under this tactic, a state, county, or local government designates certain outlying portions of a metropolitan region, county, or locality as developable only with large minimum lots—much larger than those associated with most urban dwelling units. Such lot sizes may range from 10 acres to 200 acres or more. The purpose of such large minimum lot sizes is to discourage any significant amount of residential development in the territories so designated by raising the minimum cost of each dwelling unit, thereby forcing "normal" future development to occur closer to the center of the community concerned. Montgomery County, Maryland, has successfully used this tactic for many years.

- *High fees for exactions, proffers, and development permission*. This tactic consists of charging developers of new residential areas very high fees for each new unit to be built; requiring them to provide free land, school buildings, parks, and other facilities to the community for infrastructure serving those new developments; requiring developers to finance or build some of this infrastructure with their own funds; or taking very long periods of time to review proposed plans for such developments and to ultimately grant permission for their construction. The objectives of this tactic are to discourage new developments from occurring in the territories where these requirements are applied; to help finance the infrastructure required to service those developments; and often to prevent any dwellings built there from being affordable to relatively low-income households. This tactic is widely used throughout the United States, though probably more to help finance new infrastructure and to limit new growth in specific localities than to make new growth within a whole region more compact.

- *Restrictions on physically developable land*. This tactic consists of designating certain territories in a locality, county, or state as unavailable for future urban development, at least within the near future. These territories may be so designated because of their environmentally sensitive nature (such as wetlands in the Florida Everglades); their ownership by a federal government agency (such as the Department of Agriculture's land around the city of Las Vegas); their ownership by an Indian tribe (such as the land lying just east of Scottsdale, Arizona); their function as a watershed (such as the land just west of Interstate 280, south of San Francisco); their function as a habitat for endangered species (such as land along the Pacific Coast, south of Newport Beach, California); or for some other cause of unsuitability for development.

— The ostensible purpose of this tactic is to permit the territory concerned to carry out its specialized function in the region's ecology, which would not be possible if that territory were developed for normal urban uses. However, the real objectives may simply be to prevent further

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growth in that territory; to raise the price of existing land and housing by reducing the supply available to development; or to compel future growth to locate closer to the center of the already built-up area.

- *State financial aids contingent on restricting areas of future growth*. Under this tactic, a state legislature provides certain state infrastructure financing assistance to localities contingent on the designation by those localities of particular areas within their boundaries as development zones or growth zones, and the restriction of normal future urban development to areas within those zones. Maryland has adopted this tactic as the cornerstone of its "smart-growth" strategy. The objectives of this tactic are to make future urban development spatially more compact than it would otherwise be, and to preserve more open space, free from future development, than would be prescribed without such a policy.

- *Transferable development rights*. Under this tactic, owners of certain vacant or agricultural lands are required to keep those lands free from future urban development in return for the right to sell transferable development rights to developers who can shift the densities in those transferable rights to other parcels of land closer to existing settled areas. In theory, developers will be willing to pay for such transferable rights in order to increase the densities they can use in creating new projects on closer-in sites to higher levels than currently permitted on such sites, thereby increasing the market value of those sites. Such payments would compensate the owners of the vacant or agricultural land for having to forgo profits from selling their land to developers for purposes of normal urban development. The objectives of this tactic are to keep more outlying land in the form of open space, and to redirect future urban development onto closer-in sites at higher densities than would otherwise prevail there.

- *Requirements for adequacy of public facilities prior to development*. Under this tactic—sometimes called "concurrency"—local or state governments are prohibited from approving any new urban developments unless the major infrastructures needed to accommodate those developments (i.e., roads, streets, sewers, sewerage treatment systems, water systems, and, perhaps, schools) have already been built, or will be built simultaneously. This tactic is designed to prevent creation of new developments that place excessive additional loads on existing infrastructure because no capacity has been added to those infrastructure.

— This tactic sometimes has the undesirable result of causing new development to spread farther—thus aggravating sprawl—rather than to become more compact. This results when existing infrastructures—especially roads—in already built-up areas become so congested that they are judged to be inadequate to serve additional development. Existing vacant infill sites served by these infrastructures cannot be developed because of such concurrency requirements. In that case, developers often shift their operations to more rural locations where traffic loads are still low because little settlement has occurred; hence, existing facilities are considered adequate to support more development.

As noted above, these tactics are particularly relevant here because this report perceives society's major remedy to sprawl to be the creation of future development that is spatially more compact than it would be if past trends continued unabated. Thus, the

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Courtesy of A. Nelessen

planned or controlled-growth alternative to continued sprawl envisions a major "holding back" of future development closer to the center of each metropolitan area than it would be if fully uncontrolled. Such "holding back" would require use of one or more of the above tactics in each county where uncontrolled sprawl was to be remedied through more compact development. At present, except for high fees, exactions, proffers, and restrictions on developable land, these tactics are employed in only a small fraction of all U.S. counties or localities. *Therefore, employment of the other tactics listed above on any significant scale would involve a radical change in prevailing American metropolitan growth and development processes*.

Rating the Tactics for Encouraging More Compact Spatial Development against the Criteria of Desirability

In order to assess the likely effectiveness of each tactic described in the preceding section, it is necessary to rate each against the seven criteria of desirability presented earlier. This has been done for the first six criteria in Table 15.4, "Rating Tactics for Making Growth More Compact against the Criteria of Desirability." The first column lists the 10 tactics described briefly in the preceding section. Subsequent columns have headings for the first six criteria of desirability. Each specific cell contains a brief comment concerning how well the tactic in that row meets the specified criterion. The seventh criterion—consistency with other criteria—has been omitted because it refers to different possible sets of several tactics used simultaneously, rather than to each tactic separately. Hence, each tactic's consistency with others depends greatly on which of the others might be used with it at the same time; this will vary from one situation to another.

It should be emphasized that the substantive contents of Table 15.4 are based on subjective judgments, formulated in light of the literature search and analyses previously conducted and reported in *TCRP Report 39* and the earlier chapters of this report. The comments in each cell are, of course, subject to change by others who have different views. Table 15.4 has been constructed in such a way that altering the contents is relatively easy and straightforward.

Table 15.4
Rating Tactics for Making Growth More Compact against the Criteria of Desirability

Compact Growth Tactics	Actual Effect on Regional Compactness	Ease of Administration	Low Public Money Costs	Few Negative Side Effects	Political Acceptability	Permanency of Effects
Regional Urban Growth Boundaries (UGBs)	Effective if development outside boundary is prohibited or severely limited	Easy to operate once initial boundaries have been established	Inexpensive because no purchase of land or state aid needed	May cause rising land and home prices within boundary, but also can speed development process	Very low—hard to get adopted without some type of regional crisis	Probably great, but experience not yet long enough to be sure
Local Urban Growth Boundaries (UGBs)	Ineffective because local growth controls move growth to other parts of the region	Difficult because so many different places have different methods	Moderately costly because they need frequent adjustments	May cause rising land and home prices within boundary; also likely to deflect new growth farther out	Easier than regional UGBs, but hard to get adopted in all localities	Not enough experience with UGBs to determine permanency of effects
Regional Urban Service Districts	Effective—Similar to regional urban growth boundaries	Requires constant review of boundaries	Moderately costly because they need frequent adjustments	May cause rising land and home prices within boundary, but also can speed development process	Low—hard to get adopted without some type of regional crisis	Probably great, but experience not yet long enough to be sure
Local Urban Service Districts	Ineffective—Similar to local urban growth boundaries	Difficult because there are so many local variations	Moderately costly because they need frequent adjustments	May cause rising land and home prices within boundary; also likely to deflect new growth farther out	Easier than regional service districts, but hard to get adopted in all localities	Not enough experience with service districts to determine permanency of effects
Large-Lot Zoning in Rural Areas	Effective if used by all counties in the region; otherwise ineffective	Easy once established	Very inexpensive since no land acquisition involved	May pressure land prices within developable areas to rise	Opposed by farmers and developers; no strong base of local support	Seems to hold up if politically supported
High Development Fees and Exactions	Not regionally effective unless adopted throughout a region; otherwise growth is driven to low-fee areas, which are usually farther out	Difficult because fees are continually challenged by developers subject to political influences	Raise a lot of money even though costly to administer due to frequent changes	Makes new housing costlier for home buyers, low-income families	Easy to adopt because existing homeowners want newcomers to pay for development costs	Have been ineffective at stopping growth or making regions compact
Restrictions on Physically Developable Land	Effective for land where growth is blocked, but that rarely compacts growth for an entire region	Easy if reasons for not being developable are clear and unchanging	Inexpensive unless public is required to buy the land set aside	If nondevelopable land forms a large enough share of a region, will raise land prices in developable areas	Easy to adopt if local voters are key; varies if other owners involved	Can be great if reasons for nondevelopment are enduring
State Aid Contingent on Local Growth Zones	Effective if state aid is large enough to motivate localities to restrict growth to growth zones	Difficult because nature and size of aid must be adapted over time	Costly because state must provide enough aid for big incentives	Not implemented enough to determine if tactic has notable negative side effects	Low—fought by development industry, but localities may like it if aid is big enough	Not implemented enough to determine
Transferable Development Rights	Not effective because not applied to enough outlying vacant land, and few developers will buy such rights	Difficult because of complex individual transactions at both ends	Only costs are administrative, hence costs are quite low	May increase densities in close-in areas to levels opposed by local residents, but not widespread enough to be really detrimental	Opposed by farmers; no strong base of support	Can keep farmlands in open space a long time, but do not make regional growth more compact
Adequacy-of-Facilities Requirements	Ineffective because rules tend to drive new development to outlying low-traffic territories, causing sprawl	Very difficult because of need to continually measure adequacy	High costs for constant review of adequacy and compliance	Can drive new development farther out if built-up areas have high congestion levels	Not difficult to get passed, but hard to administer well	Ineffective at causing new regional growth to be compact

Source: Anthony Downs, The Brookings Institution.

Actual Effect on Regional Compactness

Assessing the actual effect of a tactic on regional compactness is an especially critical criterion for the purposes of this report because the major policy recommendation of the report is that future metropolitan growth should be made more compact than it would be if no further policy intervention were to occur. It is apparent from reading the entries in this column in

Table 15.4 that not all tactics will be equally effective in making future regional growth more compact. The following tactics are most likely to help accomplish that goal:

- Regional urban growth boundaries
- Regional urban service districts
- State aid contingent on local growth zones

The following tactics could contribute significantly to more compact regional growth if used by most counties in the metropolitan area concerned:

- Large-lot zoning in rural areas
- Restrictions on physically developable land

The following tactics are not likely to be effective in making future regional growth more compact:

- Local urban growth boundaries
- Local urban service districts
- High development fees and exactions
- Adequacy-of-facilities requirements
- Transferable development rights

A serious difficulty with the above conclusions is that *those tactics most likely to be effective in keeping future regional growth more compact are also the least politically acceptable, given present attitudes among voters and local officials*. Conversely, those tactics that are most politically acceptable are least likely to be effective in making growth compact.

The above analysis of the tactics aimed at achieving the broad policy goal of limiting the outward movement of new development has been more detailed than the analyses of the other broad policy goals presented in the following sections because this first policy goal is the most significant for purposes of this report.


Courtesy of C. Galley

TACTICS FOR REDUCING SOCIETY'S CURRENT HEAVY DEPENDENCE ON PRIVATE AUTOMOBILES FOR GROUND TRANSPORTATION

Among the broad policy goals most strongly advocated by the urban planning profession and by the most vehement critics of sprawl is the reduction of society's current heavy dependence on private automobiles for ground transportation in metropolitan areas. However, implementing this policy effectively is likely to prove extremely difficult, perhaps even impossible, within the prevailing economic, social, and political climate in the United States. Use of private vehicles for ground transportation is more dominant in the United States than in any other society. In 1995, 86.1 percent of all person-trips and 90.8 percent of all person-miles traveled in the United States were in privately owned vehicles. Only 1.8 percent of all person-trips and 2.1 percent of all person-miles were in public transit (Federal Highway Administration 1997a). Thus, even if the percentage of person-trips using transit *tripled* to 5.4 percent, the percentage of Americans using privately owned vehicles would be reduced from 86.1 percent to 82.5 percent—a relatively small decline of only 4.2 percent. The basic problem is that most Americans regard traveling by car as more convenient, more comfortable, more private, safer, sometimes less expensive, and usually much faster than traveling by public transit. It is therefore difficult to attract more patronage to public transit, no matter how much that mode of travel is improved. The only way to get a sizable number of Americans to shift to other modes of transportation is to make private driving much costlier and less convenient than it is now.

Therefore, the most obvious tactic for reducing the dependence on privately owned vehicles is to increase the price of gasoline by placing heavy taxes on its sale, as most other developed nations have done. This tactic has been decisively rejected by Congress and every federal administration for years and appears to have very little chance of ever being adopted—especially since the market price of gasoline has risen sharply in 2000. Thus, policymakers seeking to achieve a significant shift from privately owned vehicles to other means of ground transportation face a daunting task.


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Nevertheless, the following tactics are at least conceivable means of pursuing this goal:

- *Constructing light-rail transit systems or other fixed-pathway transit systems*. Under this tactic, existing railroad and streetcar rights-of-way, and in some cases new rights-of-way, are used as paths for lightweight fixed-rail cars to transport commuters and other travelers primarily from partially outlying portions of a region to its central business district. The goals are to shift many rush-hour commuters off the expressways; to provide better accessibility to people who cannot drive; to reinforce markets for office buildings and other employment activities in existing downtown areas and older business districts; and to reduce air pollution. This tactic has recently been adopted by quite a few regions in the United States, including Portland, Denver, Miami, San Diego, Dallas, and Los Angeles. In most cases, actual ridership on light-rail systems has fallen far short of initial estimates used in attracting political support for their creation. Therefore, substantial continuing public subsidies have been necessary to keep these systems running. Moreover, there has been little or no discernible reduction in peak-hour traffic congestion within the regions concerned. However, light-rail systems have strengthened demand for office space and other activities within the downtown areas they serve.

- *Constructing special-lane busway systems*. This tactic provides a much more flexible alternative to light-rail and other fixed-track systems because it permits the buses utilized to leave the fixed guideways at either end of the trip and serve many different connecting routes without requiring passengers to change vehicles. Houston, Texas, has established a large network of such busways instead of building a subway and light-rail system. Houston was one of only two major cities in the United States that had less traffic congestion in 1997 than in 1990, according to the Texas Transportation Institute.

- *Adopting higher gasoline taxes*. This tactic attempts to discourage people from driving as much as they do now by increasing the cost of doing so. Most developed nations that are not major oil producers have imposed high national taxes on gasoline, doubling or tripling the cost to consumers of the motor fuel itself. This has helped encourage much greater use of public transit, walking, and bicycling. However, repeated attempts to get the U.S. Congress to raise taxes on gasoline as a conservation measure have failed. This is true even when the market price of gasoline fell to record low levels (in real, inflation-adjusted terms) in early 2002. Political support for higher gas taxes diminishes further as the price of gasoline rises..

- *Increasing automobile license fees and sales taxes*. This tactic has been adopted in several relatively small nations, notably Singapore and Denmark, as a means of discouraging the use of private vehicles. Singapore charges a huge annual fee just to make a potential buyer eligible to own a private vehicle; further it imposes high sales taxes when the vehicle is purchased and high gasoline taxes when it is used. Denmark has a sales tax on imported vehicles—which means all new vehicles—of more than 100 percent, and high gasoline taxes. The United States has assiduously avoided using this tactic; in fact, in 1998, the governor of Virginia was elected largely on a platform of doing away with personal property taxes on existing automobiles. Hence, political support for this tactic is virtually nonexistent.

- *Using high-occupancy-vehicle (HOV) lanes of various types, including high-occupancy-toll (HOT) lanes.* This tactic does not attempt to reduce dependency on privately owned vehicles; instead, it attempts to reduce the number of such vehicles required to transport a given number of passengers during peak hours, thereby reducing traffic congestion in those periods. This goal is supposed to be accomplished by encouraging people to carpool so they can travel in specially designated lanes reserved for vehicles carrying more than one person. Since traffic in HOV lanes is relatively light, those who carpool can move faster during peak hours than those who do not. HOT lanes permit persons driving alone to travel in fast-moving lanes if they pay a special toll to gain entry onto them. This allows a driver to escape peak-hour congestion if he or she is willing to pay the toll, although it does nothing to alleviate peak-hour congestion for those who do not want to pay. HOV lanes have been established in many major metropolitan areas, but it is not clear to what extent they actually reduce overall traffic congestion. Some places, such as northern New Jersey, have actually begun removing HOV lanes after using them for several years and concluding that those lanes would carry more people per hour if there were no restrictions on who used them.

- *Charging high peak-hour tolls on major expressways and other commuter routes.* This tactic is designed to discourage enough people from traveling on the tolled roads during peak hours so that traffic can move swiftly there, reducing congestion. Congestion pricing has long been recommended by economists as a means of rationing scarce highway space. Implementation of this tactic has always been prevented by politicians who recognize that most citizens do not want to pay rush-hour tolls for two reasons. First, they think such tolls are just another form of taxation of something they now receive without monetary cost: the opportunity to drive during rush hours. Second, they believe this tactic provides unfair advantages to wealthy commuters who could travel swiftly while less-affluent commuters would have to travel at inconvenient times or on less-convenient routes. Therefore, few metropolitan areas have ever tried this tactic on any significant scale. When they have been tried in the New York-New Jersey metropolitan area, peak-period toll increases are imposed as off-peak period toll decreases to “EZ Pass” users. This tactic has had relatively limited exposure.


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— The HOT lanes tactic described earlier can also be considered a form of this tactic, although it does not eliminate peak-hour congestion for the majority of commuters who travel by automobile. The HOT lanes tactic does permit a relative few who are willing to pay to commute more quickly the opportunity to do so. However, even HOT lanes have rarely been tried in practice.

— The practicalities of implementing this tactic throughout a large metropolitan area have never been confronted, and they could be considerable. A lot of peak-hour traffic would undoubtedly be diverted onto nontolled local routes or into time periods just before and just after the peak hours. New technologies of collecting tolls without slowing cars at toll booths may have overcome some of the practical problems involved—but not the political ones.

- *Deregulating public transit delivery systems*. This tactic seeks to make public transit more competitive by permitting individual jitney service, small-scale bus lines, use of nonunion drivers with lower pay scales, more taxis in each locality, private commuter bus service on unregulated routes, and withdrawal of transit service from routes with very low ridership. Ending current transit and taxi monopolies should improve the quantity and quality of public transit, thereby increasing ridership over present low levels. If successful, this would shift at least some people from cars onto public transit.

- *Increasing development densities around public transit stops.* This tactic seeks to increase the number of people living close enough to public transit stops so they can conveniently walk to those stops, both to board transit there and to shop in the stores that usually cluster around such stops. The result would be a reduction in the daily number of automotive vehicle trips made by each person. It would also increase the number of potential transit patrons, thereby reducing the subsidies needed to operate public transit.

— If the average American is willing to walk half a mile to reach public transit, then higher density could be created within a circle containing 0.785 square miles (502 acres) and still be within


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walking distance. If residences occupied half the land in that circle at an average density of 20 units per acre, and if each household contained 2.68 persons on the average, then 13,480 persons could live within walking distance of each transit stop. If any sizable fraction of them actually used the transit serving that stop for daily commuting and other purposes, the vehicular traffic they generated each day could be greatly reduced.

— Unfortunately, experience indicates that this tactic suffers from two major flaws. First, local residents in communities served by transit stops often oppose increasing densities around those stops. Studies of the long-established San Francisco Bay Area Rapid Transit System (BART) show that most of its outlying stops have not been developed in accordance with this tactic, but are surrounded instead by parking lots to which residents drive before boarding BART. Second, even where high-density residential and commercial development has taken place near transit stops, a majority of the people living or working within walking distance nevertheless drive instead of using transit. Third, the percentage of all workers in a region well served by public transit who commute by transit remains relatively small, except in the New York City region, and traffic congestion levels remain high.

- Even so, it certainly makes sense to encourage high-density uses near public transit stops—especially those that link major employment centers and surrounding residential areas.

- *Subsidizing cars for low-income households*. This tactic is not designed to reduce the use of automotive vehicles but to make such use available to low-income households who cannot now afford it so they could more easily commute to suburban jobs from inner-core areas where unemployment is high.

- *Building more bike paths and pedestrian-friendly street landscapes.* This tactic is designed to make it easier for people to use alternative trip modes for short errands (e.g., shopping, going to and returning from school) and commuting to work, thereby reducing use of automobiles. The tactic includes building more sidewalks and separate bike paths; making landscapes more attractive; creating more retail outlets in residential areas to shorten distances between homes and stores; and putting some dwellings above retail outlets in business districts.

The most obvious tactics for reducing the dependence on privately owned vehicles have been presented. A number of other tactics, while not elaborated on, deserve mention—namely, distance-based automobile insurance costs and parking pricing.

Rating the Tactics for Reducing Dependence on Private Automobiles against the Criteria of Desirability

In order to assess the likely effectiveness of each tactic described in the preceding section, it is necessary to rate each against the seven criteria of desirability presented earlier. This has been done for the first six criteria in Table 15.5, "Rating Tactics for Reducing Dependence on Privately Owned Vehicles against the Criteria of Desirability." The first column lists the 10 tactics described briefly in the preceding section. Subsequent columns have headings for the first six criteria of desirability. Each specific cell contains a brief comment concerning how well the tactic in that row meets the specific criterion. The seventh criterion—consistency with other criteria—has been omitted because it refers to different possible sets of several tactics used simultaneously, rather than to each tactic separately. Hence, each tactic's consistency with others depends greatly on which of the others might be used with it at the same time; this will vary from one situation to another.

It should be emphasized that the substantive contents of Table 15.5 are based on subjective judgments, formulated in light of the literature searches and other empirical analyses previously conducted and reported upon in *TCRP Report 39* and in earlier chapters of this study. Table 15.5 has been constructed in such a way that altering the contents is relatively easy and straightforward.

Effect on Dominance by Privately Owned Vehicles. The effect of a tactic on the dominance of privately owned vehicles is probably the single most important criterion of desirability. After all, if a tactic is not likely to work effectively in achieving its purpose, there is not much point in trying to implement it, assuming it has nontrivial costs. The comments in this column in Table 15.5 reveal that *greatly increasing taxes on gasoline is the only tactic likely to have much effect in reducing automobile dependence in U.S. metropolitan areas,* and even this is likely to have little effect. U.S. automobile users will choose different types of automobiles before they will choose not to own an automobile. All other tactics would have little effect on the present high levels of use of privately owned vehicles for ground transportation. In theory, very high license fees and sales taxes might have some impact, but those fees and taxes would have to be increased immensely to be effective. However, neither of these two tactics has much chance of achieving political acceptability in the absence of another energy crisis like that which occurred in the 1970s. Those few tactics with relatively high political acceptability—constructing light-rail transit systems and more bikeways and pedestrian walks—would have little effect on reducing overall automobile dependency in U.S. metropolitan areas.

It thus appears that effectively implementing this basic policy will be extremely difficult. Some of the tactics derived from this policy are politically acceptable enough, and inexpensive enough, to implement without much difficulty, and they would produce some positive benefits. However, they would not greatly reduce society's dependence on privately owned automobiles for ground transportation. These tactics include building more bikeways and pedestrian walks and encouraging more high-density development near transit stops. Other tactics would be ineffective in achieving the stated goal and would incur major public-sector costs: for example, building light-rail systems and subsidizing cars for low-income households at significant scale.

The difficulty of reducing dependence on privately owned vehicles can be illustrated by analyzing a recent American Public Transit Association finding that public transit ridership rose 4.5 percent in 1999, while motor vehicle travel increased by only 2 percent (Layton 2000, A1, A12). The Association regarded this as a triumph for public transit. However, in 1995, only 1.8 percent of all person-trips were by public transit; 86.1 percent of all person-trips were by privately owned vehicles. If the mass transit share rose to 2 percent by 1999 and the privately owned vehicle share remained unchanged, then there were 452.9 billion person-trips of all types in 1999. The total *absolute gain* in 1999 for each mode was 391.8 million for mass transit, and 7.646 billion for privately owned vehicles. Thus, of the 1999 total absolute increase in trips of both types, 95.1 percent of the trips were in privately owned vehicles, and only 4.9 percent of the trips were on mass transit. In 1999, 2.27 percent of

Table 15.5
Rating Tactics for Reducing Dependence on Privately Owned Vehicles against the Criteria of Desirability

Transportation Tactics	Effect on Dominance by Privately Owned Vehicles	Ease of Administration	Low Public Money Costs	Few Negative Side Effects	Political Acceptability	Permanency of Effects
Constructing Light-Rail, Other Fixed Pathway Systems	Little effect on peak-hour traffic congestion; does strengthen downtown business districts	Not difficult to operate once a system has been built	Expensive to build and requires constant operating subsidies	Disrupts street traffic slightly when tracks are built along streets; no serious negative side effects	Strongly supported by manufacturers of light-rail cars, tracks; little powerful opposition	Lasts for decades, unless operating subsidies are too high
Constructing Special-Lane Busway Systems	Has helped reduce peak-hour congestion in Houston, but auto travel still hugely dominant	Not difficult to operate once a system has been built	Expensive to build and requires constant operating subsidies	Disrupts street traffic slightly when routes run along streets; no serious negative side effects	Mixed—opposed by auto companies and road builders who want funds for roads	Lasts for decades, unless operating subsidies are too high
Increasing Taxes on Gasoline	Reduces auto usage if taxes are set high enough, as in Western Europe	Relatively easy to operate, since already in place	Could raise huge amounts of money	Hurts low-income commuters forced to drive	Extremely low in the United States; has never come close to passing	Lasts only as long as high taxes are supported
Increasing Auto License Fees and Sales Taxes	Reduces auto ownership if taxes are set very high, as in Singapore and Denmark	Not difficult	Not costly; could raise some additional public funds	Prevents many low-income households from enjoying the benefits of auto usage	Extremely low in the United States because so many depend upon heavy auto use	Not permanent—subject to repeal by astute politicians
Using HOV and HOT Lanes	Little effect on peak-hour congestion and overall auto dominance	Not difficult to operate once built, but hard to strictly enforce rules	Costly because must use added lanes to gain acceptability	May carry low per-lane traffic compared with “normal” expressway lanes	Low—favored more by planners than by drivers	Not permanent—subject to repeal by astute politicians
Charging High Peak-Hour Tolls on Key Commuter Routes	High bridge tolls in New York have had little impact on traffic; not enough other experience available to judge effectiveness	Difficult to decide where to put toll facilities and to cope with diverted traffic patterns	Costly to install, but could raise large amounts from tolls after that	Could divert traffic to local streets; also inconveniences low-income commuters	Extremely low in the United States; only a few areas have ever tried it on any scale	Not known because there has been little experience with this tactic
Deregulating Public Transit	Has not been tried enough to evaluate impacts	Raises controversial political issues, conflicts	Should reduce the public costs of transit	Undermines public transit companies with high pay	Low—fought by transit unions and operators	Could last a long time if deregulation is sustained
Encouraging High-Density Development Near Transit Stops	Ineffective at reducing auto dominance; people living near transit stops still mostly use privately owned vehicles	Hard to overcome local neighborhood resistance; not difficult to encourage private development	Requires public money to build infrastructure serving high-density projects	Increases local traffic congestion in high-density areas	Mixed—many localities oppose higher-density development even when located near transit stops	Lasts for decades once high-density facilities are constructed
Subsidizing Cars for Low-Income Households	Has not been tried to a great extent, but would not reduce auto dominance	Difficult, although not yet tried at any large scale	Expensive if used at any large scale	Increases traffic on roads if carried out at any scale; can be costly in public funds	Low—only support comes from powerless poor who do not own cars	Lasts only as long as subsidies continue to be supported
Building More Bike Paths and Pedestrian Walks	Could reduce local trips but would not affect overall commute patterns substantially	Easy to administer once in place	Relatively inexpensive to build	No negative side effects	High—little organized opposition, low costs to create	Lasts for decades

Source: Anthony Downs, The Brookings Institution.

all trips were on mass transit. If mass transit usage continued to rise by 4.5 percent per year, and privately owned vehicle usage increased by only 2 percent, then it would take until 2011 for mass transit trips to reach 3 percent of all trips, and until 2024 for mass transit trips to reach 4 percent of the total. Thus, the shift of any significant percentage of all trips from privately owned vehicles to mass transit is not likely to happen for a long time.

REDUCING THE FINANCIAL DEPENDENCE OF EACH LOCAL GOVERNMENT'S REVENUES ON THE PROPERTY VALUES AND SALES TAXES OCCURRING WITHIN ITS OWN BOUNDARIES

A major fiscal problem within many metropolitan areas is that their central cities and some of their older, inner-ring suburbs have lost large portions of their former tax base because of out-migration of financially viable households and businesses to outlying suburban communities. At the same time, the concentration of high percentages of the region's low-income households within the inner-core communities generates high levels of public costs per capita there. This combination of shrinking tax bases and high per capita expenditures puts a "fiscal squeeze" on many central cities and older suburbs. They are compelled to raise their tax rates in order to pay for the spending their citizens want and need. However, when they raise property and sales taxes to cope with this fiscal squeeze, additional financially viable households and businesses are motivated to move to other municipalities with lower tax rates. This leaves behind an even higher percentage of residents with relatively low incomes. The entire situation forms a downward fiscal spiral that reduces the ability of these communities to pay for the services that their citizens need. The result is a lowering of both the quantity and quality of such public services as schooling, health care, police and fire protection, public libraries, parks and recreation, and public works (e.g., street maintenance). This reduction in the amount and quality of public services further motivates people with choices to move to other communities.

One obvious remedial strategy is to improve the quality of life within the city by upgrading the services its government provides. This strategy would reduce the motivation for viable households and firms to move out. Several aspects of such an improvement policy are examined under another strategy presented later in this chapter: revitalizing concentrated-poverty and other neighborhoods in central cities. Revitalizing a city and upgrading its public services normally requires spending more money. Where is such additional funding to come from? The following major tactics have been developed around the country:

- *Tax-base sharing.* Under this tactic, each community in a region designates some part of its assessed value base, or part of a stream of tax revenues, for inclusion in a regional pool of assessed values or tax revenues that is then divided among all localities in the pool by some formula, usually involving total population and perhaps other variables. The assessed values or revenue streams to be included in the base from which the shared pool is derived are only those *added to* each community subsequent to the date at which this arrangement is adopted by the state legislature. For each property created after that date, some percentage of the assessed value is retained by the locality where the property is built, and the remainder is placed in a regional pool of assessed values.

— The basic objectives of sharing tax bases are (1) to reduce competition among communities for nonresidential properties to add to their tax bases, since such properties added to any community also add to the pool shared by all communities; (2) to create a fairer distribution of tax benefits from properties created in each community that also impose costs upon surrounding communities; (3) to reduce disparities in assessed values per capita among communities within the same region so as to provide more equalized (but not equal) bases for financing local government services, including education; and (4) to permit regional land-use planning across a territory that contains parts of several different municipalities, each of which would not receive equal shares of future developments if rational plans were adopted for the region as a whole.

In the Twin Cities (Minneapolis and St. Paul, Minnesota) region, this tactic has significantly reduced disparities among the localities included in the pool concerning their assessed nonresiden-

Courtesy of R. Ewing

tial property values per capita. When this arrangement was put into effect in 1975, the greatest disparity was 50 to 1; today it is 12 to 1. It is not clear whether this tactic has greatly reduced competition among adjacent or nearby localities for added nonresidential development projects.[2]

Regional tax-base and revenue-sharing arrangements could vary in several key dimensions. Since only one U.S. region—the Twin Cities region of Minnesota—has adopted an extensive version of regional tax-base sharing, its experience provides the following guidelines concerning these possible variations.

— *The type of taxable property included*. The Minnesota approach includes only nonresidential properties created after the date on which the program was first adopted. It does not affect local residential tax bases or the original, past nonresidential tax bases of the communities involved. However, in theory, other tax-base-sharing arrangements could involve residential values as well. Moreover, it is possible to include sales tax receipts in a similarly shared pool, as Montgomery County, Ohio, has done with a 1 percent add-on sales tax.

— *The percentage of added assessed values included in the shared pool*. In Minnesota, 60 percent of added assessed values are retained by the community in which the new properties are located, and 40 percent are placed in the pool to be shared by all communities. This division recognizes that the place in which the new property is built must bear most of the added costs of serving that property, but it also recognizes that other communities may have to bear some added costs too.

— *The formula for allocating pooled assessed values among participating localities*. This formula will almost certainly include the population of each locality, but it may also make some allowance for the relative tax burdens placed on local citizens, or the proportion of low-income citizens within each locality, or other relevant factors.

— *Other examples of this tactic.* The Dayton, Ohio, region has adopted limited revenue sharing among 29 of 30 communities (both municipalities and townships) in Montgomery County. In January 1991, three incentive funds were established by the county based on a 1 percent county-option sales tax as well as the community agreement to pool some additional local tax revenues. As of 1999, the Economic Development fund, which receives \$5 million per year in sales tax revenues, has committed \$24.5 million in 117 public and private projects, matched by \$93 million in other local, state, and federal funds and \$142 million in private investment. The result is the creation of an estimated 9,000 or more new jobs and retention of another 9,000 jobs.

The Intermunicipal Tax Sharing Account in northern New Jersey shares tax revenues from the development of the Hackensack Meadowlands District among 14 local municipalities and two counties, parts of which are located within that district. This arrangement was developed because optimal overall land-use planning for the entire Hackensack Meadowlands District resulted in some localities having most of their land within the region designated for low-revenue parks and public uses, whereas other localities had some of their land in the region designated for high-revenue shopping centers and other commercial uses. In order to prevent the former localities from experiencing inequitable fiscal consequences compared with the latter, the state set up the Meadowlands Regional Development Agency in 1970. That agency serves as a conduit for tax revenues on all increases in assessed values that occurred within the district since 1973. Each municipality and county taxes the properties within its own boundaries at its usual tax rate, but tax revenues from those increases in


Courtesy of USFWS/S. Dobert

[2] The nature and history of this legislation are described by Myron Orfield (Brookings Institution and Lincoln Institute of Land Policy 1997).

assessed value that have occurred since 1973 go into a pool that is then redistributed to the 14 communities and two counties to offset the advantages and disadvantages resulting from the regionwide planning of land uses. This distribution also takes into account the increase in school capital facilities caused by new development within the district since 1973. The result is that some of the 14 communities and two counties are net contributors to the pool, and others are net recipients. In calendar year 1998, including an adjustment payment for 1997, five communities were net contributers into the pool, 10 were net collectors from the pool, and one broke even. The largest contributor paid $840,000, while the largest recipient collected $502,000 (Hackensack Meadowlands Development Commission 1972).

Monroe County, New York (including the city of Rochester), received authority from the state legislature to collect a local sales tax of up to 4 percent, which is added onto the state sales tax. Monroe County is currently collecting more than $300 million per year from this local sales tax. The county shares approximately two-thirds of its local sales tax revenues with specific municipalities and school districts within its boundaries. Approximately 32 percent of the revenues from this source are allocated to the city of Rochester, which thus collects more than $100 million annually from this source. *This revenue sharing provides about one-third of the city's revenues.* Because the county's boundaries encompass many other local communities, this is a more efficient way to shift money to the central city than permitting that city to add to its own sales taxes. If only the city had the added sales tax, consumers would buy goods and services from surrounding municipalities where that tax was not charged, thereby reducing the effectiveness of the tax within the city. Since the tax is assessed throughout the county, such evasion is more difficult.[3]

— Tax-base sharing enables local officials representing a majority of residents in the region to form a political coalition in support of regional arrangements in the state legislature, even if representatives of localities with a minority of the region's residents oppose such arrangements. This coalition can, in theory, overcome efforts by a minority of residents within a region to block the implementation of effective regional arrangements by refusing to participate in them voluntarily. Regional tax-base sharing can, in effect, create an incentive for representatives from localities containing a majority of the region's residents to support this—and possibly other—regional arrangements because their communities will gain higher tax bases per capita than they would achieve without tax-base sharing.

Courtesy of C. Galley

- *State government provision of a higher percentage of local revenue needs.* In some states, the state government provides a relatively high share of certain local revenue needs that in other states are met more fully by local governments. In the 1992 to 1993 school year, state governments as a whole paid 45.8 percent of the total cost of public elementary and secondary schools in the United States. However, the state government of Hawaii paid 90.1 percent of the total cost in its state. The state governments of Alaska, California, Delaware, Idaho, Kentucky, New Mexico, North Carolina, Oklahoma, Washington, and West Virginia paid more than 60 percent of the cost in their states. At the other end of the spectrum, the state of New Hampshire paid only 7.9 percent of the total cost of public elementary and secondary schools. The state governments of Connecticut, Illinois, Maryland, Massachusetts, Michigan, Missouri, Nebraska, Nevada, New York, Oregon, South Dakota, Vermont, Virginia, and Wisconsin paid less than 40 percent of such costs in their states (National Center for Education Statistics 1996, 153). State government provision of aid for other public functions also varied significantly across the nation, though

[3] Data on the Monroe County sales tax revenue-sharing program was obtained by telephone from the County Comptroller's Office on May 25, 1999 by Anthony Downs.

Table 15.6
Rating Tactics for Reducing Each Local Government's Dependence on Revenues Derived from within Its Own Borders

	Tactics for This Strategy	
Criteria of Desirability	**Tax-Base Sharing**	**Increased State Funding**
Effectiveness in Reducing Local Government Dependence on Local Sources of Revenues	Can sizably reduce per capita resource disparities among localities over the long run; takes a long time to do so	If state provides a high enough share of total revenues, tactic can be very effective; if not, tactic not very effective
Ease of Administration	Not difficult once it is implemented; setting the original formula may be complicated	Not difficult if a state has sufficient revenues to make a difference
Cost in Public Funds	Little additional cost to taxpayers	Adds directly to state costs; could cut local tax burdens somewhat
Few Negative Side Effects	Creates strong conflicts between poor localities and wealthier ones. Central cities may not always be beneficiaries	More state funding usually means less local control of funded functions. May cause higher state taxes
Political Acceptability	Highly controversial; requires a statewide legislative coalition of central cities and low-tax-base suburbs. Adopted in only one place	Resisted concerning schools because of local control issue; otherwise well received by localities, but resisted by state legislators
Permanence of Effects	Builds up greater effectiveness over time; no reason effects should not last	Effects last as long as the state continues providing a significant share of costs
Consistency with Other Tactics	Can easily be part of larger regional strategy; consistent with regional view	No significant inconsistencies except the reduction of local control over the use of funds

Source: Anthony Downs, The Brookings Institution.

not as much as for public elementary and secondary education.

— When a state government provides a high percentage of the funds needed to carry out some public service, the impact of sprawl on the ability of central cities and older suburbs to provide that service to their residents is greatly reduced.

Rating the Tactics for Reducing the Financial Dependence of Each Local Government's Revenues upon the Property Values and Sales Taxes Occurring within Its Own Boundaries against the Criteria of Desirability

The information in Table 15.6 rates the tactics described above against the criteria of desirability described in an earlier section of this chapter. The biggest problem with tax-base sharing has been the political difficulty of getting it adopted, because it essentially redistributes future tax burdens from one set of localities to another set. The localities that gain from this redistribution include those with relatively low per capita property-tax bases, especially those without much commercial and industrial property. The localities that lose—at least from a short-term perspective—are those with high per capita property-tax bases, especially those containing large amounts of commercial and industrial development. However, this latter group normally has much political influence in state legislatures and can therefore successfully resist attempts to shift their future tax revenues to less fortunate places. Consequently, only one metropolitan area in the United States—the Twin Cities area in Minnesota—has adopted significant tax-base sharing across an entire region for use in all types of government functions (though the tax base involved is confined to additional commercial and industrial property).

Using state funds to supplement local spending is a much more widely adopted tactic. This is especially true of funding for education; state courts have pressured state legislatures to "do something" to offset huge inequalities in past per-pupil funding among local school districts. Such legal pressures have often overcome political resistance to both raising state taxes and "interfering" with local control of schools. Even so, wide disparities in per-pupil spending still exist in many states.[4]

PROVIDING OPPORTUNITIES FOR LOW-INCOME AND MINORITY HOUSEHOLDS TO MOVE OUT OF CONCENTRATED-POVERTY NEIGHBORHOODS

Many long-time observers of urban problems and prospects have concluded that reducing the negative effects of concentrated poverty in inner-core neighborhoods requires reduction of the poverty concentrations there; changing prevailing behavior patterns among their residents without reducing poverty concentrations will not improve conditions. This strategy seeks to accomplish that goal by enabling and encouraging low-income residents of concentrated poverty areas to move to neighborhoods not marked by such concentrations—particularly to neighborhoods dominated by middle-income households.

Two fundamental obstacles must be overcome to make this strategy work. First, there is a large gap between the economic capacity of low-income households and the market costs of renting or buying housing units in nonpoverty neighborhoods. Somehow, that gap must be filled with funds from sources other than the households' limited resources. Second, the residents of nonpoverty neighborhoods frequently and vehemently resist the entry of households whose incomes are much lower than their own—especially if the incumbent residents are predominantly white and the newcomers are predominantly African Americans. That resistance must be overcome both to permit the newcomers entry and to create conditions under which they can improve their quality of life there. Possible tactics for coping with both these obstacles are described below.

- *Inclusionary zoning.* Under inclusionary zoning, residential developers of new housing subdivisions over some specified size (e.g., 10 units) are required to include within that project a certain percentage of units—usually between 15 percent and 20 percent—that are priced to be affordable to households with incomes below the areawide median income. The developers may be unable to include such low-priced (or low-rent) units at a reasonable profit per unit without some special countervailing advantage. That advantage is usually allowing the developer to build at a higher density than that for which the parcel concerned was originally zoned. The higher density spreads the original cost of the land over more units, thereby raising the profitability of the units not being reduced in price.

— The advantage of this tactic is that it does not require expenditure of a significant amount of public funds, since no direct subsidies are required to make these units affordable to relatively low-income households. It also mixes families occupying affordable units with those occupying market-rate units throughout the community, rather than isolating the former in "projects" known to be occupied by lower-income households.

— The disadvantage of this tactic is that the initial buyers of the affordable units can reap a windfall gain if they are permitted to sell them at full market price when they move. That would also remove such units from affordable status. To prevent this outcome, it is necessary to restrict ownership of such units to households with relatively low incomes; to place some administrative ceiling on the resale price that the initial owners can obtain when they move, and then to monitor the history of these units to ensure that this rule is followed; or to require that the initial owners remain in the below-market-rate units for some minimum number of years before they can resell them at market prices. All of these remedies require administrative oversight and some public expenditure of effort and funds.

— Montgomery County, Maryland, has used this program for several decades, with the result that several thousand more affordable units have been built there than would have been the case with-

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[4] Many state courts have viewed greater equalization of per-pupil, per-year spending among districts as an effective means of making educational opportunities more equal, even though there is little conclusive evidence that educational opportunities or results are heavily influenced by per-pupil, per-year spending.

out the program. It is much more effective for an entire county or even an entire state to adopt such a program than for individual localities to do so. Local governments are reluctant to adopt inclusionary zoning by themselves because doing so would "handicap" home builders operating within their boundaries compared with those operating in nearby localities that did not have such a program. Also, usually no one community has a territory large enough so that adoption of this program throughout that territory would make much difference in the entire region—but that would not be true of a large county within that region.

- *Creation of a housing trust fund using money from real estate transfer taxes or other dedicated revenue sources to subsidize occupancy of housing by low-income households in suburban communities*. Most state governments have large enough jurisdictions so that they can impose a real estate transfer tax on all transactions within their boundaries without creating a "handicap" for home builders there, compared with those in adjacent states, or discouraging people from living in their states. The funds from such a tax can be dedicated to reducing the rents for occupants of some housing units within the state, enabling them to move into parts of the region they normally could not afford.

— A drawback of this tactic is that any transfer taxes that are politically acceptable to the real estate industry are bound to be relatively small; therefore they cannot accumulate enough funds to permit a significant number of households to move out of concentrated-poverty areas into better suburban communities.

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- *Regionwide use of HUD (U.S. Department of Housing and Urban Development) housing vouchers, administered by central-city housing officials, to encourage low-income households to move out of central cities and into surrounding suburban areas where far fewer such households are concentrated in any one neighborhood*. In the past, federal housing vouchers issued or administered by a central-city housing authority could be used only for occupancy of units located within that same city. However, that regulation has been changed; now, such vouchers can be used anywhere within the same metropolitan area if apartment owners will accept them. Public housing authorities in some large central cities have proactively begun to encourage applicants to seek rental units in neighborhoods far from inner-core, concentrated-poverty areas. This typically requires counseling of potential tenants concerning such elements of the rental transaction as knowledge of leases and contracts, dress and manners, familiarity with neighborhoods far from the inner-core neighborhoods where they grew up, and appropriate negotiating methods.

— Experience in the Chicago region, based on the *Gautreaux* court decision, indicates that households making use of vouchers most often improve their living conditions and economic performance to a significant degree. More than 5,000 household moves out of inner-core areas have been completed under that program, half to suburban areas and half to sections of Chicago far from poverty concentrations.

— HUD launched a wider version of the Chicago program called "Moving to Opportunity" under former Secretary Henry Cisneros; the program continued under Secretary Andrew Cuomo. Unfortunately, Congress has undermined wider application of this approach, but it is still being tried on a very small scale in a few metropolitan regions. Definitive evaluation of its success has not been completed.

— This tactic also fits very well with recent efforts, encouraged by HUD, to reduce the concentration of very poor and single-parent households in large central-city public housing projects, especially high-rise projects. By helping voucher recipients move significant distances from those projects, HUD has also helped local public authorities demolish some or even all of the project

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units, thereby reducing the negative effect of such large concentrations of very poor households on the surrounding area.

- *Giving owners of large single-family homes in suburban communities the legal right to establish auxiliary or accessory apartments in part of their dwellings if they meet certain minimum standards, thereby increasing the total supply of low-rent units outside of concentrated-poverty neighborhoods.* This tactic was strongly recommended by the Commission on Reducing Regulatory Barriers to Affordable Housing in its report, *Not in My Back Yard*, published in 1991.

— The tactic has the triple advantage of expanding the low-rent supply, helping elderly homeowners supplement their incomes so they can afford to maintain their homes, and not costing public authorities any significant amount of money. The Commission believed that the adoption of this policy by local governments would allow thousands, even millions, of low-rent units to be created in a very short time period without major public spending.

— Unfortunately, most local governments in communities containing large numbers of sizable older homes occupied by the elderly have rejected this tactic: They believe it would cause too much local traffic, generate local parking problems, and downgrade the values of surrounding homes. Therefore, this opportunity to expand the low-rent housing supply quickly and at low public cost has been shelved in favor of preserving the pristine single-family character of many older neighborhoods.

- *Having the state government, or some regional agency, define numerical "targets" for the amount of low- and moderate-income housing that each locality ought to contain within its borders, and ensuring that state financial aid to local governments is available commensurately with their success at meeting those "targets."* The basic idea underlying this tactic is that each community in a region eventually ought to bear its fair share of providing housing for the poorer elements of the region's population rather than leaving that task to other areas. This is the procedure used by the New Jersey Council on Affordable Housing. Few, if any, localities will assume this responsibility voluntarily; they must be pressured from outside their localities in ways that provide meaningful incentives for them to do so.

— Recent studies (Burchell et al. 1994) indicate that suburban communities typically do not extend a welcome mat to low-income people. These residents are considered "fiscal losers" because they require higher public spending on the services they consume than the public revenues they provide from taxes on the properties they occupy, or the expenditures they make in the community. Low-income people are also perceived as economic threats because their presence reduces home values, and their behavior may increase crime rates and decrease school academic performance. Therefore, many communities deliberately "zone out" the types of housing likely to be affordable to relatively low-income households. This shifts the responsibility for providing such housing elsewhere—even though other nearby communities are concurrently adopting similar "stick-it-to-my-neighbors" policies.

— Left to their own resources, individual localities are much more likely to concentrate on keeping poor people out of their jurisdictions than on providing housing for them. Encouraging localities to do so will require public pressure and the threat of adverse publicity if they fail to act responsibly. This involves two elements: (1) determining to what extent more affordable housing ought to be built within each locality, and (2) creating incentives that will motivate local officials there to encourage its development.

— An independent agency can develop a method of estimating how much more housing affordable to low- and moderate-income households needs to be built in the region as a whole to shel-


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ter its population; measuring how much housing of this type already exists within each locality; and assigning a target for creating more such housing within each locality based on the first two steps. In New Jersey, affordable-housing-need numbers were calculated by Rutgers University after the state supreme court's *Mount Laurel* decisions created the New Jersey Council on Affordable Housing and charged the agency with that mandate.

— Few states have tried linking significant financial aid with the performance of localities in meeting targets for providing affordable housing. The kinds of aid concerned could be for improving streets and roads or building new ones; updating sewer and water systems and sewerage treatment plants; creating or maintaining parks and recreational areas; improving law enforcement and fire protection methods or equipment; or even general assistance.

- *Strengthening enforcement of antidiscrimination laws in housing markets and placing responsibility for such enforcement in a single regionwide agency run on a nonprofit, public-private basis*. Although the real estate industry maintains that very little racial or other discrimination is practiced in American housing markets today, repeated studies by "testers" ostensibly seeking to buy or rent homes, and repeated statistical analyses of lending institution behavior, have shown again and again that such discrimination—though usually subtle—is actually widespread. This is especially important because the low-income populations of inner-city poverty neighborhoods contain disproportionately large percentages of minority-group households. Therefore, racial and ethnic discrimination is one way in which these households are discouraged from escaping inner-core areas and moving into predominantly middle-income suburban communities. Vigorous enforcement of antidiscrimination laws in housing markets—especially in the suburbs—is essential.

— One effective version of this tactic is centralizing a region's effort to enforce antidiscrimination laws in a single regionwide agency operated by a combination of public- and private-sector representatives. This has long been done in the Chicago region. The agency there not only orchestrates antidiscrimination measures but also provides mortgage assistance, home-search assistance, legal assistance, and other aids to inner-city or minority households seeking housing in the suburbs. Such centralization prevents representatives of one part of the region from "holding back" on enforcement within their own communities so as not to "disadvantage" those communities in the eyes of the real estate profession or local homeowners, as compared with other communities where such laws are largely ignored. However, this approach requires steady funding from local or regional foundations, rather than from public sources, in order to "keep the heat on" in ways that are bound to be controversial.

- *Adopting state laws that permit developers of affordable housing to override local zoning boards that "unreasonably" prevent them from building such units in their communities*. The "snob zoning" law adopted several decades ago in Massachusetts was a forerunner of this approach. It permitted developers who proposed to build low-cost units for low- and moderate-income households in areas that were zoned for multifamily residences to sue local zoning boards that refused them permission for such projects


Courtesy of C. Galley

on grounds that clearly seemed "unreasonably" exclusionary. If the developer could show that his proposal met usual zoning and building codes, the state could override the local government's refusal to grant permits and allow the developer to proceed.

— A major drawback of this tactic is that it requires developers to antagonize local governments by suing them, when the developers often will have to deal with the same officials later when trying to undertake some other project in that area. The likelihood that an official whom a developer antagonizes today will be vengefully hostile to whatever projects that developer proposes tomorrow strongly discourages developers from using this tactic.

• *Appointing statewide commissions to review existing local zoning laws to determine how existing regulatory barriers to affordable housing might be reduced through both state and local actions*. The federal government undertook this tactic in 1989 when HUD Secretary Jack Kemp appointed such a commission. However, the federal government has little power to alter the most potent regulatory barriers to affordable housing. Nearly all of those obstacles are built into state laws or into local laws that are potentially subject to state government review and override. Therefore, a governor interested in helping to reduce the negative effects of concentrated poverty in the state could appoint a commission to examine existing obstacles of this type and make recommendations to the governor and the state legislature about how to remove them.

— Among the most important obstacles to creating more affordable housing in the suburbs is an acute shortage of land zoned for multifamily residential uses in those communities. HUD's commission discovered that many suburban communities had zoned only minuscule fractions—if any—of their total developable land for multifamily housing. Yet 17.9 percent of all housing units in the United States in 1997 were multifamily units in structures containing five or more units, and about one-third of all households lived in rental units (U.S. Department of Commerce 1999).


Courtesy of G. Lowenstein


Courtesy of C. Galley

— This tactic is becoming increasingly relevant to the economic future of regions where extremely high housing costs may jeopardize future job growth. The most striking example is the San Francisco Bay Area. Housing costs are so high there that certain types of workers essential to the future prosperity of the area—including teachers, police officers, and health-care personnel—cannot afford to live there. The turnover rates in those professions have already hit almost unsustainably high levels. In December 1999, the median price of a single-family home sold in Santa Clara County was $359,500; in San Mateo County, the median price was $400,000; in the city of San Francisco, it was $415,000; in Marin County, it was $450,000 (California Association of Realtors 2000). The last three prices are more than triple the national median price of $133,000. A downturn in the economy could find this area hard-pressed to retain firms able to attract and keep workers at anything less than astronomical wages. Under such circumstances, both state and local governments would have strong incentives to reduce the immensely effective existing regulatory barriers against building affordable housing in the Bay Area.

Table 15.7
Rating the Tactics for Providing Opportunities for Households to Move out of Concentrated-Poverty Neighborhoods against the Criteria of Desirability

Specific Tactics	Effect on Providing Opportunities to Live in Suburbs	Ease of Administration	Low Public Money Costs	Few Negative Side Effects	Political Acceptability	Permanence of Effects
Inclusionary Zoning	Can increase income mix in many suburbs over time, but operates slowly	Complex home resale price requirements	Little public funding required	Few; blends affordable units with market units	Very controversial among builders and localities	Permanent, if resale price limits are enforced
Housing Trust Fund	Probably will not be funded adequately enough to have much effect	Hard to decide who gets funds	Could be quite costly when implemented on a large scale	Uses identifiable subsidized units	Opposed by real estate industry as another tax	Permanent, but on a very small scale
Regionwide Use of HUD Vouchers	Could help many leave concentrated-poverty areas and move to the suburbs	Rationing by place is hard; inner-city people resist long-distance moves	Could be costly if implemented at a big enough scale to work well	Few bad side effects other than local resistance	Suburbs will resist poor newcomers, but vouchers are already legal for HUD to use	Requires continued HUD funding over time
Right to Create Accessory Apartments	If widely used, could have a major effect in many older suburbs in many regions	Easy to manage once owners' right to create added units is legalized	Almost no public funds required; aids elderly owners	Some increase in local traffic	Low; homeowners fight entry of poor households, fear lower home values	Permanent with very low public costs
Defining Local Affordability Targets and Incentives	Would create more pressure for local openness, but unlikely to be enough to work	Not difficult for research; attempts to allocate funds would be controversial	Defining targets is not costly; providing strong incentives is costly	May cause older cities to become less accepting of affordable units	Localities and builders will reject targets but accept incentives if passed and funded well	Has little effect without strong incentives; then quite variable
Strengthening Enforcement of Antidiscrimination Laws	Some help at opening suburbs to minorities, but will not end segregation in housing	Using "testers" is controversial but is the most effective means of enforcement	Minor costs of court cases, field research, unified administration	Can increase racial tensions, but not greatly or widely	Realtors and home builders will resist, but could be done if political leadership is strong	Can positively influence racial attitudes over the long run
Local Zoning Overrides	Would work in a small number of cases, but most builders fear retaliation	Requires a separate housing court to handle zoning disputes	Mostly cost of housing cases	Very few bad side effects	Localities will fight, but some home builders will support politically	A good degree of permanency but will occur only on a small scale
State Regulatory Barriers Review Commission	Mostly informational; will not have a major effect without funded incentives	Very easy to administer once the commission is established	Commission costs little	None	Not much resistance because it will not be thought to be effective	Little effect unless a governor ties to incentives

Source: Anthony Downs, The Brookings Institution.

Rating the Tactics for Providing Opportunities for Households to Move out of Concentrated-Poverty Neighborhoods against the Criteria of Desirability

Table 15.7 rates the eight tactics described above against the criteria of desirability for policy tactics presented in an earlier section of this chapter. The criterion of "Consistency with Other Tactics" is omitted from this chart because all these tactics are quite consistent with each other. In fact, some would strengthen one or more of the others. For example, widespread use of HUD housing vouchers in the suburbs would create a stronger rental market for accessory apartments developed in large, existing single-family homes.

The criterion of actual effectiveness in providing opportunities for households from concentrated-poverty areas to live in the suburbs depends heavily on the scale at which each tactic is implemented. Several tactics could be quite effective in a region if used at a relatively large scale; these include inclusionary zoning, the regional use of HUD housing vouchers, and permitting owners of large single-family homes to develop accessory apartments. Two of these three mechanisms could be implemented on a large scale with little total cost in public funds. Others are not likely to be effective in a direct way, either because they are mostly hortatory (e.g., appointing a state regulatory barriers commission) or because they are almost certain not to be implemented on any significant scale (e.g., a housing trust fund and local zoning overrides). Few of these tactics would have bad side effects, even if adopted at a significant scale. However, almost all have limited political acceptability in suburban communities because their fundamental objective—opening suburban communities to entry by low-income households from concentrated-poverty areas—is considered inimical to the interests of most existing homeowners there.

INTRODUCING NEW ELEMENTS OF URBAN DESIGN INTO LAND-USE PLANNING

A complaint against suburban sprawl, often voiced by architects, designers, and urban planners, is that it results in excessive uniformity and sameness of design in residential subdivisions across the county. These critics bemoan the fact that so many subdivisions have curved streets ending in cul-de-sacs; no sidewalks for pedestrians or bike paths for cyclists; few trees because developers have leveled most of them to build homes more cheaply; no intermixtures of homes, shops, and workplaces in close proximity; too little variety in housing types because of the dominance of single-family detached homes with side yards; and wide commercial streets lined with the same parade of ugly fast-food restaurants and service outlets found in one town after another. Sprawl opponents contend that such stultifying sameness dulls the spirit of all who behold it, and the separation of types of land uses precludes the possibility of people gathering or encountering each other spontaneously to stimulate their interest, creativity, and sense of community.

These same critics also bemoan the dominance of automobile travel in sprawled communities, which dis-

Courtesy of R. Ewing

Courtesy of G. Lowenstein

courage all other forms of movement because the homes are so spread out and so separated from all other types of activity by distances too great for walking. Moreover, the resulting low densities make the use of public transit economically unfeasible, thereby isolating all those who cannot move by driving their own vehicles because of poverty, age, disability, or youth. What these opponents of sprawl want are new forms of community design that will permit the following:

- less reliance on private automobiles
- a greater variety of housing types built in close proximity
- more opportunities for people to meet, gather, and interact spontaneously
- more intermingling of different land uses to shorten daily travel trips and encourage personal interaction
- less concentration of automobile trip routes through a few local bottlenecks
- greater sense of aesthetic pleasure and community

Following are some of the tactics suggested for attaining one or more of these goals:[5]

- *Changing building codes to permit alleys behind homes and off-street garages*, so as to shift parking to areas behind homes and reduce the dominance of the streetscape by parked cars
- *Requiring new subdivisions to contain sidewalks and bike paths* to facilitate non-auto movements

[5] For a discussion of these and other "new urbanist" policies, see Katz (1994).

- *Constructing new subdivisions around some central public place* (e.g., a town square) adjacent to a public transit stop
- *Changing zoning codes to permit mixed commercial and residential uses in the same structures or on the same block*, including allowing apartments to be built above retail or service outlets
- *Prohibiting or limiting the use of cul-de-sac street design and replacing them with grid street patterns*
- *Changing zoning codes to permit a mix of single-family attached, single-family detached, and multifamily housing within the same block or neighborhood*
- *Increasing the percentage of residentially zoned land in a community zoned for multifamily or mixed residential uses*
- *Zoning areas near public transit stops for relatively high-density uses*, both commercial and residential
- *Changing street construction codes to permit narrower and less-heavy-duty-constructed streets* that discourage heavy commuter traffic

Because most of these tactics are so narrow in scope and, for the most part, involve changing the rules and regulations that govern the creation of new residential subdivisions, it is not appropriate to evaluate them with the same criteria of desirability used to evaluate the other policy tactics described in preceding sections of this chapter.

In fact, the impacts of all of these tactics on the negative effects of sprawl would mainly be confined to the microscale rather than the macroscale. Most of these tactics focus on the aesthetic and efficiency qualities within individual residential subdivisions, rather than on the areawide effects of sprawl. Hence, even if these tactics were employed at a large scale in a growing region, they would not have much impact on many of the key adverse effects of sprawl that most of the other policies described in this chapter are designed to reduce: for example, traffic congestion, air pollution, excessive absorption of open space, and the high tax costs of constructing infrastructure to serve new developments. The "new urbanists" claim their designs would notably reduce the number of automobile trips in a region by replacing many such trips with walking and bicycle trips, and by encouraging greater use of public transit, but their policy tactics would affect mainly short trips within neighborhoods rather than the longer trips that generate most of the traffic congestion in large metropolitan areas. Their claims to reduce longer trips by shifting more travel from cars and trucks to public transit depend on implementation of other policies beyond the subdivision or neighborhood level, for example, the building of more transit facilities, increases in bus services, and increases in the costs of using private vehicles (e.g., gasoline taxes, road tolls, parking fees). These tactics are outlined in other parts of this chapter.

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Courtesy of C. Galley

One advantage of most of the urban design tactics described above is that they impose almost no additional costs upon the public sector. In fact, most of these tactics are changes in the rules and regulations that govern the private construction of subdivisions and neighborhoods. It is hard to see why anyone would strongly oppose increasing the range of design alternatives available to private architects and developers. Therefore, these tactics have not been subjected to a detailed evaluation against a defined set of criteria of desirability.

REVITALIZING CONCENTRATED-POVERTY AND OTHER NEIGHBORHOODS IN INNER-CORE AREAS

A major strategy in almost every approach to counteracting sprawl is improving the quality of life in inner-core areas. This strategy seeks to halt or slow the massive drain of viable households and firms out of inner-core areas and into surrounding suburbs, which has created many "downward fiscal spirals" in central cities and older suburbs, as noted earlier. This strategy also seeks to encourage more households to move from outlying suburbs into central cities and inner-ring suburbs, thereby strengthening those communities fiscally, socially, and economically. After all, the best way to slow the sprawling growth of outlying suburbs is to provide a notable share of the households moving there with closer-in living alternatives that seem preferable to them.

How to improve the quality of life in inner-core areas is a massive subject that deserves a complete study of its own. Therefore, this sprawl-focused policy analysis cannot present an in-depth examination of all the ways to accomplish such a strategy. Instead, presented here is a listing of relevant possible tactics, without much detailed analysis of how each one might be effectively implemented.

Probably the two most important tactics are *increasing personal security by reducing the crime rate* and *improving the quality of public schools*. Crime and insecurity on the one hand, and low-quality public schools on the other, have been the two most powerful factors motivating viable households and firms to move out of central cities and older suburbs and into more sprawled locations.

Fortunately, in the past few years, major strides have been made in reducing crime rates in the nation's largest cities. This has occurred because of demographic shifts in city populations, the increased incarceration of offenders, and new methods developed by police departments to thwart criminal behavior.[6] From 1994 to 1998, the national rate of serious crimes per 100,000 persons declined by 14.1 percent. From 1998 to 1999, the same rate fell 7 percent for the entire nation and 6 percent for cities containing 500,000 or more residents (Federal Bureau of Investigation 2000). Crime and personal insecurity affect everyone in cities; so making progress in improving security issues can become a major incentive for more people and businesses to consider staying in, or moving to, city locations.

Improving the quality of public school education has proved much more difficult in most large cities, and it is not clear that much progress is being made. The biggest obstacle is the concentration within many inner-core-area schools of high percentages of students from very poor homes with environments not conducive to educational achievement. Many of these students live in one-parent families, often in crowded quarters, in an environment basically hostile to education. They are often undernourished, have few books, with no place at home in which to study. They are not encouraged by their families to read or to develop their learning abilities. They are pressured by their peers to engage in drug use and other illegal activities and to scorn educational achievement, and they spend a lot of time watching television. Often, their parents do not participate in school activities or take much interest in their behavior at school. In many cases, students are moved frequently from one school to another as their parents shift residences. When a school is attended predominantly by children from such homes, it is extremely difficult for even the best teachers and administrators to provide those children with an excellent education.

School quality is an important determinant of where many families with children choose to live, but an increasing percentage of all American households do not include school-age children. In 1998, of the 102.53 million households in the United States, only 34 percent included children under 18 years of age (United States Bureau of the Census 1999, 62). Moreover, a


Courtesy of C. Galley

[6] For a discussion of such methods, see Kelling and Coles (1996) and Bratton and Knobler (1998).


Courtesy of C. Galley

disproportionate share of households with children live in the suburbs; many central cities contain even smaller proportions of households with children. Many households without children can be attracted to live in cities in spite of poor public schools, if levels of personal security are high there. In addition, thousands of immigrants live in central cities because they cannot afford costlier housing in the outlying areas. These households gladly send their children to public schools regardless of the quality of those schools because they want their children to learn English and become acculturated as Americans—and because they cannot afford private schools. For these two reasons, poor-quality public schools are not as significant a deterrent to central-city living as they were in the past, nor are they as important a deterrent as high crime rates and lack of personal security.

In fact, many mayors and other city leaders are focusing their efforts to attract people into their communities on households with no children. These households include young unmarried people, young married couples, single people, empty nesters, members of the gay community, retired people, and the elderly.

Other tactics for improving the quality of life and economically revitalizing inner-core areas are as follows:

- *Locating all additional public-sector facilities that employ many workers within the core areas of cities and older suburbs*. Although public officials cannot control where private firms locate new facilities, they can control where the public sector places its new offices and other facilities. By putting all such facilities in the underdeveloped portions of central cities and older suburbs, public officials can inject large doses of added jobs and purchasing power into those neighborhoods. This can substantially improve job opportunities and other living conditions in those areas.

- *Making vacant land available for immediate development by private entrepreneurs*. Developers are often discouraged by the difficulty of assembling sizable parcels of vacant land within large cities. Often, land is subdivided into many different ownerships, and it may be contaminated with pollutants from former occupants. If city governments use their powers of eminent domain to acquire many small parcels and group them together into much more usable large parcels, that removes a major obstacle to private development. Getting such parcels zoned for commercial, industrial, or residential use removes another obstacle. If developers realize they can purchase land that is ready and entitled for immediate development with minimal delays, they will be much more strongly encouraged to do so. City assistance in either removing past pollutants or obtaining permission to develop sites without such removal will also encourage private development.

- *Creating streamlined development approval and permission processes*. A major obstacle to private development within large cities is the need for an entrepreneur to get his project plans approved by dozens of separate city agencies, each of which has different criteria for approval. The city could streamline this process by allowing a developer to bring his plans to one location where all the relevant agencies were present and each could start work on the approval process immediately. This could shorten the development process by many months, thereby making it much more economically feasible.

- *Ending restrictions on the use of mobile homes or factory-built housing*. Many cities prohibit the use of mobile homes or other factory-built housing as dwellings within their borders, or they restrict such units to very limited and relatively undesirable locations. Since these types of housing are among the least costly available, this prevents making new, entirely adequate low-cost housing available to thousands of households who cannot afford anything more expensive. Changing this policy would benefit thousands of low- and moderate-income households.

- *Reducing requirements for unnecessarily expensive building materials or procedures*. Many urban building codes require the use of costly materials that could be replaced by equally satisfactory but less expensive, newer materials. Cities should systematically review their building code requirements and remove such unnecessary, cost-raising elements.

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- *Permitting creation of accessory apartments in single-family homes*. This tactic was presented in a preceding section in connection with making more low-cost housing available in the suburbs, but it also applies to inner-core areas. By allowing owners of single-family homes of certain minimal sizes to add accessory apartments to their units *as a matter of right*, cities could both greatly expand the supply of low-cost rental units and help elderly residents living in large homes stay in those homes as long as they wish.

- *Ending residential rent controls or modifying existing controls to permit owners to raise rents to market levels whenever vacancies occur.* Although only a few cities still have rent controls, those that do are to some extent inhibiting the construction of new rental units within their boundaries, even if they theoretically exempt newly built units. The biggest rent-control city—New York—still prohibits owners from raising rents to market levels when vacancies occur. This is a policy that definitely inhibits the construction of new units.

- *Using federal Community Development Block Grant funds to improve basic infrastructures and amenities in inner-core areas*. Many inner-core areas need better parks and recreational facilities, cleaned-up vacant lots, the removal of abandoned and deteriorated buildings, repairs of potholes and deteriorated streets, and other physical improvements. Such uses of federal funds would not only improve the quality of life in inner-core areas but also make such areas more attractive to people or firms considering a move from another location.

- *Encouraging major in-city institutions to invest in improving the areas around them*. Hospitals, universities, museums, medical clinics, and major public facilities are often located in inner-core areas where deterioration has taken place around them. If they want to improve their ability to keep workers and to recruit new ones, they would profit from upgrading the neighborhoods around them. Many have long been doing so by buying nearby land and deteriorated structures, building new facilities or housing for their workers, rehabilitating older structures, maintaining local grounds and structures at high standards, and creating new parks and recreational spaces.

- *Reducing taxes in ways that will encourage new development or rehabilitation of older structures*. Property-tax laws often discourage new development or rehabilitation because new or upgraded structures are soon assessed at higher levels and must pay higher taxes. Providing tax abatements for initial periods and phasing taxes in over long periods can result in new improvements that increase property values in surrounding areas—thereby avoiding any net revenue loss for the city.

- *Taxing land and buildings separately, with much higher tax rates on land than on buildings, in order to encourage development of vacant sites.* This was the policy suggested long ago by Henry George, and adopted by a few cities and nations around the world. The goal is to pressure owners to build on their vacant land by taxing the land at high rates but the structures placed on the land at much lower rates. This system has long been used in Pittsburgh. However, switching an entire city or county to this system raises difficult transition issues that need careful exploration before this tactic is implemented.

- *Demolishing large-scale, high-rise public housing projects and replacing them with federal rent vouchers.* High-rise public housing projects tend to discourage development in the surrounding territory. HUD has adopted a policy of encouraging such demolition in many large cities in order to remove the "blighting" impact of huge concentrations of public housing on the economic and other development of surrounding blocks. The tenants displaced by such demolitions are given portable federal rent vouchers so they can move to better quarters in the private sector, assuming such quarters are available.

Rating Tactics for Revitalizing Inner-Core Areas against the Criteria of Desirability

Table 15.8 rates the tactics for revitalizing inner-core areas against the criteria of desirability formulated earlier. The table includes reducing crime rates and improving the quality of public schools as tactics. However, it does not evaluate these tactics against the criterion of consistency with each other because there are no major inconsistencies among them.

The second column in the table evaluates the effectiveness of each tactic in achieving, or helping to achieve, the revitalization of inner-core areas. Clearly, this is the most important criterion. As already noted, the most effective tactics for inner-core-area revitalization are reducing crime rates and increasing security, and improving the quality of public schools. The next most effective tactics are locating all new public facilities in inner-core areas and encouraging major institutions located there to make large investments in improving their surroundings. If carried out at a large enough scale in a single neighborhood, these two tactics in themselves have the potential to completely revitalize that neighborhood. That is also true of making vacant parcels available for immediate development by entrepreneurs (in the case of a single large vacant parcel developed as a unified project) and reducing or abating taxes (again, if done for a single large development project that dominates its neighborhood). However, these two tactics are most often done at a smaller scale, and therefore fall into the category discussed next.

Another set of tactics essentially removes general obstacles to long-term improvements in many neighborhoods but would not accomplish revitalization in any one area quickly. These tactics include streamlining all city approval and permit-granting procedures; reducing requirements for overly expensive building materials or methods; making vacant parcels available for immediate development by entrepreneurs; reducing or abating taxes on new or rehabilitated structures; using Community Development Block Grant funds to improve local amenities; ending rent controls; giving owners of large single-fam-

Courtesy of C. Galley

Table 15.8
Tactics for Revitalizing Inner-Core Areas Rated against the Criteria of Desirability

Revitalization Tactic	Effectiveness in Revitalizing Inner-Core Neighborhoods	Ease of Administration	Low Costs to the Public Sector	Absence of Negative Side Effects	Political Acceptability	Permanency of Effect
Reducing Crime Rates and Increasing Security	The single most effective tactic for raising the acceptability of any given neighborhood; but results must be well publicized	Difficult to administer; requires major reform of policing methods in most large cities	Significant costs are necessary, but costs not as high as those for physical investments	All effects are beneficial, except for a higher imprisonment rate among young men	Highly acceptable to almost all elements of the community	Will remain in effect as long as effective methods are maintained with vigilance
Improving the Quality of Public Schools	If accomplished, can greatly improve the attractiveness of an area for households with school-age children	Extremely difficult to accomplish in poor inner-core areas with high percentages of students from very poor homes	Varies widely, since lack of money is not a key problem. Many inner-city schools do need higher funding	All effects are beneficial	Highly acceptable to almost all elements of the community; teachers' unions may be motivated by alternatives: vouchers, charter schools, other competition	Should remain effective as long as initially successful methods are maintained
Locating All New Public Facilities in Inner-Core Areas	A single large facility can greatly affect a whole inner-core neighborhood. Total effect depends on the number of jobs created	Inner-core facilities are more difficult to administer than those located on suburban sites. Cities should cooperate	Land costs in inner-core areas should be lower than those in high-income suburbs. Other costs are not much different from other sites	May cause some added traffic congestion if many workers must commute from outside the inner-core area	May cause political conflicts because suburban officials will want to capture some of these facilities	Positive long-term effects as long as the new facilities remain in business with high employment levels
Making Vacant Land Available for Immediate Development by Private Entrepreneurs	Can encourage housing and retail developers and industrial firms to enter inner-core areas if security is adequate	Assembling and buying vacant sites, and ending pollution on them, can be time-consuming and costly for local government	If sites are sold to developer at no cost reduction, the main costs would be time and holding costs, and some administration costs	If revitalization succeeds, land and housing prices may rise in areas affected, harming low-income renters living there. This is true of all revitalization tactics	May arouse some political opposition if the developer has not cleared basic plan with local residents and organizations	Should have a positive long-term effect if developers' projects are economically successful
Streamlining All City Approval and Permitting Processes for New Development	Removes a major barrier for developers of all types, who must take account of the time-cost of money	In most large cities, requires a major overhaul of existing bureaucratic procedures. Existing officials will resist such major changes	If implemented correctly, this tactic will reduce costs to city government	All effects are beneficial	Highly acceptable to all elements except some conservative city bureaucrats	Should remain effective as along as initially successful methods are maintained
Ending Restrictions on the Use of Mobile Homes and Manufactured Housing	Could make some low-cost housing available in some areas; in itself, would not be enough to revitalize inner-core neighborhoods	Not difficult	Very little cost, since the costs of installing rest with private developers	Might cause resistance from some neighbors of relatively valuable housing	May be opposed by local homeowners and by building-trades unions. Otherwise acceptable	Has same permanence as construction of traditional housing, if well maintained
Reducing Requirements for Unnecessarily Expensive Building Materials and Procedures	Can reduce the costs of new units by 10 percent to 20 percent; will not in itself achieve major revitalization	Easy, once revisions to law are drafted and adopted	Very little costs except for building inspections, which are necessary in any event	All effects are beneficial	May be opposed by building-trade unions and some parts manufacturers. Otherwise acceptable	Has the long-term effect of reducing the costs of housing construction and rehabilitation

Continued on next page

Table 15.8—*Continued*

Revitalization Tactic	Effectiveness in Revitalizing Inner-Core Neighborhoods	Ease of Administration	Low Costs to the Public Sector	Absence of Negative Side Effects	Political Acceptability	Permanency of Effect
Permitting Creation of Accessory Apartments in Single-Family Homes as a Matter of Right	Could add greatly to the low-rent housing supply; would not revitalize whole neighborhoods	Easy, once revisions to law are drafted and adopted	Very little costs except for building inspections, which are necessary in any event	Might cause added traffic in some neighborhoods; could reduce home values if overused in one area. Otherwise, no negative effects	May be opposed by owners of high-value homes who fear the loss of property values. May also be opposed by owners of rental apartments	Would have the long-range effect of expanding the low-rent housing supply; could do so over very large parts of urbanized areas
Ending Residential Rent Controls or Permitting Decontrol upon Vacancy	Could raise rental-owner investments in rent-controlled cities and lead to more new rental construction there	Ending controls is much easier to administer than having them; decontrol is also easier to administer than stringent rent controls	Public sector saves money by ending controls; little cost to vacancy decontrol if rent control is retained	Rents would rise for people in controlled units who have not moved for a long time	Opposed only by advocates of low-rent interests and politicians benefiting from renter votes	Ending controls would expand long-run housing supplies; vacancy decontrol has little revitalization effects
Using Community Development Block Grants to Improve Core-Area Amenities	Can be a very important ingredient in the overall upgrading of inner-core neighborhoods	Complex to decide who gets funds and how to allocate funds among potential types of uses	No additional cost to local governments, which get these funds anyway	The only negative effect is a shift of funds from other potential uses to improve city conditions	Favored by neighborhood development organizations; might be opposed by central business district advocates who want the money used there	Amenity effects can last a long time, but generally need continued renewal of grants to retain long-run effects
Encouraging Major In-City Institutions to Invest in Improving Their Surroundings	Can cause a dramatic turnaround in areas near such institutions; this is a major source of effective revitalization in many cities	Difficult to persuade private institutions, but they do most of the administering once they are persuaded	Local government may have to invest in street and other infrastructure improvements; can be costly for major projects	Upgrading poor areas may displace some poor renters living there. This is an inherent impact of effective revitalization anywhere	Often opposed by local politicians representing low-income renters who may be displaced. Otherwise will be widely accepted	Can have a permanent upgrading effect as long as the key institution keeps up support for amenities it has developed
Reducing or Abating Taxes on New or Rehabilitated Structures	Can generate large projects that have major effects on specific neighborhoods	Complex to design and administer	Loss of tax revenues is the major cost to city governments	Postpones tax collections to pay for services needed by new, tax-abated developments	May upset neighborhood advocates who see tax benefits going to wealthy developers; hence, the size of acceptable application is limited	Can help create new long-term projects, but tax losses eventually disappear when abatements expire
Taxing Land and Buildings Separately, with Land Taxed at Much Higher Rates	Will not directly lead to revitalization; would have biggest impact over the long term	Very complex to make a transition from the present taxation system to this new system	High administrative and installation costs. May lead to some lawsuits from property owners with big windfall losses	May create windfall gains and losses for property owners in the short run	Will be opposed by major real estate interests with large investments inland and by land speculators. Requires a major public educational program to achieve broad acceptance	Effect would be permanent as long as the new system is retained
Demolishing Large-Scale, High-Rise Public Housing Projects and Replacing Them with Housing Vouchers	Can drastically change the character of neighborhoods formerly dominated by large high-rise projects	Complex and controversial to decide which projects to demolish and how to provide shelter to those displaced	The housing authority must replace shelter benefits with cash vouchers to enable displaced families to pay rent elsewhere. Can be very costly	Sends many low-rent households to the local private rental market, which may not contain enough units of appropriate sizes and low rents	May be opposed by low-rent tenant advocates and the local housing authority, and by neighborhood organizations. Acceptable to most of the wider community	Removal of the negative effects of large high-rise projects on the local neighborhood can be part of permanent change toward revitalization

Source: Anthony Downs, The Brookings Institution.

ily homes the right to create accessory apartments; and ending restrictions on the use of mobile or manufactured housing.

Demolishing a large high-rise public housing project can dramatically alter a neighborhood, but the removal of such a project in itself must eventually be accompanied by a positive redevelopment of the site in order to truly revitalize the area. The last tactic—using separate tax rates for land and buildings—is a long-run reform tactic that would take many years to have a major effect.

In practice, it is rare for any one tactic to have the power to revitalize an entire inner-core-area neighborhood by itself. Rather, *under most circumstances, neighborhood revitalization will occur only if many different tactics are employed simultaneously and their implementation extends over a long time.* Thus, using this strategy effectively requires a long-term orchestration of policies by many different public agencies and private actors. That is one reason why revitalization of inner-core areas has proved so difficult to achieve over the past several decades—though it certainly has been done many times.

The Gentrification Problem

All inner-core-area revitalization tactics have one ironic negative consequence: The more they succeed in improving the areas concerned, the higher the land and housing prices there are likely to rise. Such increases in prices will harm low-income renter households living in the area because their rents are likely to go up too. Some low-income homeowners will also suffer from higher property taxes that they may have difficulty paying if they are retired or have very low current incomes. However, that cost to them is partly offset by the higher value of their homes.

In many greatly revitalized neighborhoods, a large percentage of the initial low-income residents are eventually forced to move away because more affluent households enter the area and substantially bid up land and housing prices. This process has become known as *gentrification.* It has caused advocates of low-income renters to oppose policies that substantially revitalize some inner-core neighborhoods.

In the long run, opposition to inner-city revitalization makes no sense, because it amounts to a policy of *slum preservation*. The fundamental problem is that millions of American households have incomes so low that they cannot afford to occupy—and maintain—housing units built to the middle-class standards that prevail in America. In 1997, 5.4 million of the American households that had incomes below 50 percent of the median income and did not receive any housing assistance were paying 50 percent or more of their incomes for housing, or were living in severely inadequate units (U.S. Department of Housing and Urban Development 2000). Because the 12.3 million persons in these households cannot afford standard-quality units, they occupy older, often deteriorated units in less-desirable neighborhoods. Such units have low rents precisely because they are older, often deteriorated, located in undesirable areas, and frequently overcrowded. This type of housing is commonly referred to as *slum housing.* Since the founding of this nation, slum housing has provided shelter to households that could not afford the legally and culturally required minimum standards most Americans consider essential. The shelter it provides is still crucial in many large cities and older suburbs, especially those located where very poor immigrants enter the United States. Even the richest areas of the country have significant amounts of slum housing, because housing prices are so high in these areas that the low-wage workers that serve the wealthier households can only afford to live under substandard overcrowded conditions. Examples can be found near the Silicon Valley in northern California and in East Los Angeles in southern California.

Should society prevent the revitalization of deteriorated inner-core areas in order to permit poor households to continue living there at low rents—even if there are households with higher incomes willing to move in and improve those areas? This is an important policy issue to which there is no easy answer. In the long run, a city needs to continually upgrade its existing housing stock to avoid having that stock deteriorate to the point of physically endangering its

Courtesy of C. Galley

occupants. However, in the short run, revitalization of low-rent areas on a large scale can cause hardships for thousands of poor households. The traditional resolution of this dilemma has been to permit gentrification to occur in areas where the market supports it, but also to allow the subsequent deterioration of other neighborhoods nearby into which poor, displaced households have moved. Thus, the provision of shelter for the very poor is like the "hot potato" in the children's game, in which a "heated" spud is tossed from person to person as each tries to get rid of it as soon as possible.

The long-term solution to this problem is to raise the housing purchasing power of the very poor, either through higher wages, or income assistance, or some type of housing assistance. To enable the very poor to continue living in less-desirable housing is not an appropriate long-run solution—especially if that housing is physically and functionally substandard. Yet until American society is willing to underwrite the considerable cost of raising the housing-purchasing power of the very poor so they can all afford to occupy and maintain standard-quality units, many of them will have to occupy substandard units somewhere. No community is anxious to provide such units; in fact, nearly all communities energetically seek to avoid doing so. As a result, this social function is eventually performed by those communities that are unable to prevent the very poor from living in substandard units within their boundaries.

At present, many mayors and other public officials in cities with inner-core areas that are performing this function are trying to reduce the burdens on their communities of doing so. Therefore, they are anxious to encourage gentrification when they can. Their efforts fit into the strategy of antisprawl proponents who want to divert future growth from the edges of metropolitan areas into the central sections. Until America solves the basic dilemma just described, pursuing that strategy will indeed cause hardship for many inner-core-area, low-income renters. The more future growth is shifted from the metropolitan periphery to the center or near the center, the greater will be the demand for land and housing in these locations. That will drive up the prices of inner-core-area land and housing, compared with what would happen under continued sprawl development. True, some of the per-unit price increase can be offset by raising densities in the areas affected, but most American households do not favor increases in density near their homes. So, there are strong political limits on how much growth diversion to the center can be offset by higher densities there.

This study cannot resolve this basic social dilemma, which has plagued America ever since the middle class came to dominate the setting of housing-quality standards across the country. How each metropolitan region deals with this issue is up to its leaders and citizens. However, they should at least be aware of the nature of this inherent problem and take it into account as they formulate and implement policies in response to sprawl.

SOME INITIAL ASPECTS OF CREATING REGIONAL AGENCIES TO REVIEW AND COORDINATE LAND-USE PLANS DRAWN UP BY INDIVIDUAL LOCALITIES

As noted in the beginning of this chapter, most of the major, directly growth-related problems in U.S. metropolitan areas are regional in nature, rather than purely local. However, local political and legal institutions currently have the greatest power to adopt policies to respond to those problems. Their most important powers are control over land uses within their boundaries through zoning and building codes, and at least partial control over traffic arteries that pass through their boundaries. However, the policy viewpoints of local governments are inherently parochial. They take far greater account of the effects of their policies on their own local residents—who can vote for or against locally elected officials—than of the effects on people living elsewhere in the region, or of the effects on the region as a whole. In fact, no public officials, and few private officials, within the typical U.S. metropolitan region are motivated to act for the benefit of the region as a whole. *The resulting inherent tension between the regional effects of land-use decisions and the purely local perspective of those who make or regulate such decisions poses the single greatest challenge to effective and efficient planning and action within each region.* Therefore, one key strategy for effectively coping with growth-related problems is to create one (or, in some cases, more than one) regional organization that has the responsibility and the legal and political authority to coordinate the land-use and other related plans developed by individual localities and other government bod-

Courtesy of C. Galley

ies. This organization may have narrowly defined authority over a single domain of action—for example, airports, or water and sewerage systems, or ground transportation—or it may have much broader authority over multiple domains as they relate to land use in general.

In practice, the probability that such a regional approach might actually be adopted is very different for different specific problems. To understand this variation, it is convenient to group most of these problems into two categories. For *mainly technical problems*, there is at least some positive probability that regional remedies might be attempted. For *mainly social problems*, that probability is extremely low, for reasons explained below.[7]

Mainly technical problems involve clearly regionwide conditions and do not reflect the personal characteristics of the people concerned. Examples are traffic congestion, air pollution, water contamination, need for sewage treatment, use of contaminated "brownfield" sites, "wasteful duplication" of public services, excessive consumption of vacant land and open space by development, and excessive consumption of energy in movement. In most cases, it is obvious to everyone that these problems exist throughout the region and that their ramifications flow across the entire region—or at least that they clearly affect many municipalities. In addition, these problems involve objective conditions that can be defined technically and measured. Examples are levels of congestion or pollution and the amount of open space consumed. These mainly technical problems are not influenced by the personal traits of the people living in different parts of the region.

[7] Much of the analysis in the remainder of this chapter is adapted from Downs (1999b).

In contrast, *mainly social problems* involve conditions that are initially perceived as primarily local in nature, and these are affected by the personal traits and behavior of the people concerned. Such social problems include shortages of affordable housing, excessive concentration of the poor in inner-core neighborhoods, inequitable distributions of fiscal resources and public services, and lack of mobility. The most crucial aspect of these social problems is that they all affect answers to the question: "Who will be my neighbors?" Most Americans have definite views about the kinds of people they want as neighbors. Therefore, this question is always perceived as a personal, localized issue. Moreover, Americans have strong desires to exercise local influence and control over their local or neighborhood environments—both socially and physically. Hence, they are very reluctant to decrease any local influence they now exercise (mainly through zoning regulations) about what types of people will live near them and the physical environments in which they will live. Therefore, they oppose shifting any such influence to organizationally more remote centers of power. In addition, few elected officials ever want to share powers they now exercise with any other governmental body.

These forces create a strongly embedded hostility among American suburbanites toward awarding any authority now legally exercised by their local governments to a regionwide agency. This hostility is commonly expressed in two slogans: "We do not want to lose any of our *local sovereignty* over our communities," and "We do not want to add any *additional layers of government* to those that already exist." In practice, local governments do not have sovereignty over truly regional problems because those problems cannot be solved—or in many cases, even seriously affected—by purely local policies. However, this fact is ignored by those opposed to any regionalization of presently local government powers.

Courtesy of C. Galley

Each of the mainly social problems cited above encounters similar hostility to regional solutions. The issue of affordable housing generates this hostility because most Americans do not want to have poor people as neighbors. Rightly or wrongly, they associate intense poverty with social maladies like gangs, high crime rates, and poor educational attainment. Also, many Americans do not want to live where a sizable proportion of their neighbors are members of specific ethnic groups. So they regard any attempt made against their will to increase the amount of affordable housing within their own communities as an unwarranted restriction of their "local control" over their own environment.

Because the issue of excessive concentration of the poor in many older neighborhoods can be counteracted only by some type of voluntary decentralization of poor people, it raises the question, "Who will be my neighbor?" The implied answer to that question is that other people who are not poor would become neighbors of the poor— and not always voluntarily. The issue of inequitable distributions of fiscal resources and public services also raises this question because such inequities arise from large-scale variations in the income levels of different municipalities. Remedying such inequities would mean somehow redistributing resources among those municipalities. Lack of mobility raises this question, because those who are immobile are mainly those who cannot afford to own and drive cars, those who are disabled, or those who are too young or too old to do so.

All of these social problems also have regional implications, but those implications are less obvious and less central to the concerns of most suburbanites. For example, shortages of affordable housing near new jobs handicap inner-city unemployed workers in obtaining jobs and reduce the attractiveness of the entire region to firms considering the location of new plants or offices. Overcoming such shortages for the entire region would require some means of allocating additional affordable-housing units among different communities—especially among those communities that have little such housing now. That would amount to putting pressure on many localities to accept higher percentages of low-income households. However, few localities are willing to give a regional agency control over the future of their neighborhoods. So, political resistance to regional arrangements concerning all these social issues will be enormous. That is why *the probability that regional arrangements will actually be adopted is much lower for mainly social problems than it is for mainly technical problems.*

Courtesy of C. Galley

Some growth-related problems are neither mainly technical nor mainly social. Examples of these include higher taxes to pay for infrastructure; loss of a sense of community in low-density settlements; and pressure on households to spend excessive amounts on transportation. The last two are probably not susceptible to remedies based on regional arrangements. The issue of paying for infrastructure was discussed earlier in this chapter under another policy strategy.

One result of the above considerations is that—with very few exceptions—regional governance arrangements have been seriously proposed or adopted for those operating systems that are mainly technical and that clearly transcend the boundaries of individual localities. Such regional governance arrangements encompass the physical structures that make up each operating system, regulation of the vehicles and vehicle movements using those physical structures, and the means of financing the creation, maintenance, and operation of those structures. The technical operating systems include the following:

- ground transportation networks of freeways, roads, and streets
- airports, seaports, bridges, tunnels, and other key transportation linkages
- water, sewerage, and waste-treatment systems
- systems of regulation aimed at controlling air pollution
- parks and recreational areas and other cultural facilities (e.g., concert halls and stadiums)

Other systems also transcend individual, local boundaries, but these are less likely to be considered appropriate for regional governance arrangements be-

Courtesy of S. El-Shakhs

cause they are more social than technical in nature. These systems include the following:

- provision of affordable housing for low-income households, especially the provision by public authorities of direct subsidies for the shelter of a large number of such households
- enforcement of antidiscrimination laws and regulations applicable in housing and labor markets
- preparation and application of comprehensive land-use plans and zoning regulations. However, a few states have passed laws requiring local governments in a region to draft land-use plans that serve state-defined goals and that are subject to review and alteration by regional or statewide bodies.
- administration of regionwide tax levies

Regional Arrangements That Might Be Addressed to Attack These Problems

At least nine different types of regional arrangements have been either tried or proposed as methods of addressing the problems described above. These are briefly set forth below, along with their major advantages and disadvantages and examples of where they have been used.

- *Functionally specialized agencies* are the most commonly used regional arrangements, primarily for the mainly technical problems described earlier. Examples are The Port Authority of New York and New Jersey, the Southeastern Pennsylvania Transit Authority, and the Metropolitan Sanitary District in the Chicago region. Each of these agencies focuses on a narrowly defined set of activities that are mainly technical in nature and clearly regional in origin and effects. Their advantage is that the need for regional scope concerning their specific functions is so obvious that it often overcomes the unwillingness of individual localities to give up authority over those functions. Also, local governments feel much less threatened by shifting such a small part of their authority to an overarching agency than they would if they had to share much broader powers. These agencies receive special funding powers from the state legislatures that create them. One of their main disadvantages is that they are mostly appointed bodies that are rarely directly accountable to the citizens whom they affect. Another disadvantage is that they have such narrowly defined powers that they may overlook key linkages with other types of activity in developing their own regional plans and strategies. For example, regional airport authorities may fail to recognize the major effect their facilities will have on future land-use and transportation patterns in all parts of the region.

- *Purely voluntary confederations,* such as the regional Councils of Government (COGs) found in most U.S. metropolitan areas, are relatively easy to establish, mainly because they almost never have any real authority over any of their members. That lack of authority is their central drawback. Such organizations can rarely tackle controversial issues effectively or deal with any issues involving uneven allocations of resources among their members. Thus, any issue that requires the distribution of significant overall costs among specific places will founder under this type of arrangement. On the other hand, these agencies can draw attention to key issues and provide a great deal of relevant information about them to the public, if they have significant resources and if their staffs are allowed to publish research results.

- *Public-private coalitions or associations* also lack authority, but they are excellent vehicles for calling attention to key issues and developing alternative plans for dealing with those issues—without choosing among those alternatives. Such coalitions can form without legislative authorization and can include broad cross sections of government, business, labor, academe, and religious institutions. This makes them good vehicles developing broad consensus on key issues among civic leaders and the public. However, they are


Courtesy of G. Lowenstein

incapable of implementing actual public policies or making controversial policy recommendations. Most "visioning" bodies, such as Oregon's 2040 Plan and Los Angeles's Vision 2020 Group, are of this type.

- *Federally created regional agencies* are usually functionally specialized, but they can also have the power to carry out policies and the money with which to do so. Examples are the Air Quality Control Boards set up in major metropolitan areas under the authority of the U.S. Environmental Protection Agency, although these are mostly operated through state governments as well.

- *Federally mandated regional agencies* can have planning authority over specialized functions that are funded by the federal government. For example, the Metropolitan Planning Organizations (MPOs) set up in response to the Federal-Aid Highway Act of 1962 are concerned with surface transportation. The federal government will not fund any surface transportation activities or facilities within a region unless specific proposed activities have been approved by the regional MPO as part of an overall regional plan. Similar arrangements could be established for all types of activities at least partly funded with federal money (e.g., housing, health care, sewerage treatment, and water systems).

- *State government agencies* can act as regional coordinators of some specific function, especially if they supply or administer most of the funding required. For many years, state highway or transportation departments developed regional highway plans for most large metropolitan areas. They worked with local governments but had the lion's share of the power because they supplied most of the money—either state funds or funds from the federal government administered by the state. In a few states, the Department of Community Affairs acts as a coordinator for local government land-use plans.

- *Regional bodies with broad authority over several key functions* must be established by state legislatures under the U.S. federal system. The most well-known examples in the United States are in Portland, Oregon, and in the Twin Cities Region of Minnesota. The Portland Metro is a directly elected body with authority over surface transportation systems, sewerage and water systems, and the coordination of local land-use plans. The Twin Cities Metropolitan Council has authority over surface transportation and major utilities, and advisory authority on low-cost housing. The council is appointed by the governor. The advantage of such bodies is that they exercise true regional powers over several closely related functions; hence, they can develop and carry out rational plans. The disadvantage is that it is extremely difficult to round up enough political support to establish them.

- *Regional governments formed by merging municipalities and counties* have emerged in a handful of U.S. metropolitan areas, notably Indianapolis, Jacksonville, Lexington-Fayette, Nashville-Davidson, and Miami-Dade County. These bodies can be established by gaining consensus from only two groups: city and county officials. Their main advantage is that they encompass all local government functions with regionwide powers. The main disadvantage is that growth tends to move out beyond the initial boundaries governed by the regional body, so those initial boundaries encompass only part of the true region thus formed. This has happened in Toronto and Indianapolis, for example.

- *Contracts between separate governments* can establish legally authorized bodies that carry out specialized functions throughout the territories of the entities that have signed the contract. This permits economies of scale not possible within smaller entities. A second key advantage of this arrangement is that it does not usually require constitutional changes or actions by state legislatures; it can be accomplished by two or several municipalities acting on their own. Therefore, it is not necessary to get all the governments within a region to agree on such an arrangement in order to put it into operation. Of course, in that case, the agency's powers do not cover the entire region. Cities in the Phoenix, Arizona, metropolitan area and in Los Angeles County have carried out many such arrangements. These arrangements often involve the county government supplying services to small municipalities for a fee.

Rating the Desirability of These Regional Organizational Arrangements

Because the above regional organizational forms are somewhat different in nature from the other types of policy tactics analyzed in this chapter, a separate set of criteria has been devised for evaluating them. Table 15.9 shows the application of five such criteria and provides some specific examples for each of these nine specific forms of regional arrangement. The first substantive column shows how each form can be legally established, and the second substantive column comments on the political difficulty of such establishment. The next two columns comment on the suitability of each form for both recommending regional policies and implementing them. The fifth substantive column suggests the ability of each form to deal with highly controversial issues, like those connected with most of the mainly social problems described earlier. The last column provides examples of each form. The comments developed in this matrix are based on knowledge of the literature as well as on subjective judgments. Other commentators might have different views. But in any case, this matrix presents a means of organizing information about the nine forms of regional arrangement in a convenient fashion.

The information presented suggests that a region trying to establish effective regional planning for its future may be wise to employ more than one of these organizational forms over time. It might start with a public-private association for preliminary exploration of regional problems and issues and later shift to a more powerful form for actual regional coordination and implementation of land-use plans. The initial organization can thus lay the groundwork for a long-range regional strategy and then set in motion the citizen-participation processes necessary to create widespread political support for that strategy. This approach is discussed further in the last section of this chapter.

How Should a Region Create a Sensible Overall Policy Strategy Concerning Its Future Growth?

It should be clear from the preceding analysis that *no single overall policy strategy concerning future growth is suitable to all, or even most, of America's many and diverse metropolitan regions*. Different regional conditions call for different policy responses. In fact, a region's overall growth-related policy strategy should be designed to fit its own circumstances and conditions.

However, the preceding sections of this chapter have set forth a great many growth-related strategies and

Table 15.9
Regional Organizational Forms Matrix

Organizational Form	Means of Establishing	Political Difficulty in Establishing	Suitable as a Vehicle for Recommending Policies	Suitable as a Vehicle for Implementing Policies	Ability to Act or Reach Consensus on Controversial Issues	Specific Examples
Functionally Specialized Agencies	**State Legislature** Authority over this function must be awarded to an agency with regional jurisdiction by the state legislature	**Relatively Easy** Voters and local officials can see the need if dealing with mainly technical problems	**Great** Agency has authority over the workings of the function in which it specialized, so it can implement policies relatively well	**Great** Agency has authority over the workings of the function in which it specialized; hence, it can implement policies relatively well	**Moderate** Agency still must reach some consensus with large jurisdictions within its territory on such issues	New York Port Authority; Chicago Metropolitan Sanitary District; Washington Airport Authority
Purely Voluntary Confederations or Associations	**Agreement among Participants** If participants are all local governments, action by the state legislature may be needed for official status	**Relatively Easy** Since members know they will not have to do what the organization recommends, they join easily	**Poor** It will be difficult to obtain consensus among all members on any issues involving conflicts of interest or controversies	**Very Poor** Individual members can ignore policies that are recommended by the group as a whole	**None** Individual members can ignore policies that are recommended by the group as a whole	Regional Councils of Government (COGs) in most metropolitan areas
Public-Private Coalitions	**Private Action** No permission from higher authorities is needed; simple nonprofit incorporation will do	**Relatively Easy** Private and public officials can join and not have to speak for their organizations officially	**Excellent** It is often possible to get consensus on difficult issues, since none of the members are acting in their official capacities	**None** Such a body has no power to get any of the organizations represented to act in ways it may recommend	**Poor** Such a body has no power to get any of the organizations represented to act in ways it may recommend	Los Angeles Vision 2020; St. Louis Regional Chamber of Commerce
Federally Created Regional Agencies or Departments	**Congress** Federal bodies with regional powers to act must be created by specific acts of Congress; there are not many in existence	**Very Difficult** Congress will rarely create federal agencies that interfere with state or local government powers	**Good** Regional offices or major federal agencies or departments often will recommend national department policies	**Moderate** Regional federal offices will implement national policies only if strong support for them exists in Congress	**Fair** Regional federal offices are reluctant to implement controversial policies if strongly opposed within a region by local governments	Air Quality Management Districts under Clean Air Act
Federally Mandated Regional Agencies (can operate through state agencies)	**Congress** Congress can mandate that each region create a special agency to plan for and distribute funds	**Very Difficult** Congress will rarely mandate creation of regional agencies that interfere with state or local government powers	**Good** Such agencies are under pressure to recommend policies congruent with national federal policies in the subject areas concerned	**Moderate** Such agencies still must create consensus before having much ability to implement recommended actions	**Poor** These agencies lack the political power or will to enforce controversial policies on resisting local or state governments	Metropolitan Planning Organizations for surface transportation in response to the Federal-Aid Highway Act of 1962
State Government Agencies or Departments	**State Legislature** States create such agencies as part of normal functional operations; agencies then assume regional powers	**Relatively Easy** States usually have such agencies as part of their normal functional operations	**Fair** State agencies assume regional powers and make recommendations congruent with state policies	**Good** State agencies can exercise strong power in practice but usually in only one functionally specialized type of action	**Fair** State political leaders are reluctant to take on serious opposition by local or city governments	State Transportation or Highway Departments in many states; state Community Planning Department in a few
Regional Bodies with Broad Authority	**State Legislature** States can give regional bodies the power to override local governments and exercise functional authority	**Very Difficult** States will create such agencies only when under emergency or crisis conditions	**Good** If they have broad powers, they can recommend policies affecting the entire region across several interrelated subject areas	**Excellent** Because they have the power to act, they can implement regional policies much better than other organizational forms	**Good** Since the jurisdiction covers the entire region, they can take account of all interest and income groups in designing policies	Portland Metro elected government; Georgia Regional Transportation Authority (GRTA) appointed by governor
Mergers of Municipal and County Governments	**State Legislature** Only states can permit the merger of cities and counties but will usually not do so unless supported by voters	**Moderately Difficult** Needs strong leadership from the central-city major and county executives, as well as the governor	**Good** Since these bodies have broad powers, they can design policies affecting the entire merged area across several interrelated subject areas	**Excellent** Since merger creates a unified general government, it has strong powers to act concerning many functions in the areas concerned	**Good** Because the result is a unified general government, it has responsibility for all groups in the areas covered, but not outside those areas	Indianapolis + Marion County, Indiana; Nashville + Davidson County, Tennessee; Jacksonville + Duval County, Florida
Contracts between Separate Governments	**Individual Governments** Can be established simply by agreements between individual municipalities, usually for narrowly defined specialized functions	**Easy** Needs only an agreement between the localities concerned; can avoid highly controversial functional activities	**Moderate** These agreements rarely innovate really new policies; mainly aimed at achieving economies of scale through consolidating similar public services	**Good** Have the power to implement policies within narrowly defined specialized services covered by the contracts; not useful for broader services	**Poor** Mostly designed to implement administratively efficient economies of scale, which rarely involve controversial issues or policies	Phoenix area fire departments; Los Angeles County police services

Source: Anthony Downs, The Brookings Institution.

tactics that any region might consider in designing such an overall strategy. How should a region go about deciding which of these strategies and tactics are best suited to its needs? We believe there is a definite *overall strategy-creation process* that can be used in any region to formulate an effective growth strategy, regardless of the specific policies that ultimately are chosen in this process. This single—admittedly rather general—process is applicable almost everywhere because forming effective public policies in a democracy requires certain essential elements that must be carried out in roughly the same order in any community, large or small.[8] Residents of a metropolitan area will not accept a growth strategy handed to them without significant prior consultation, so there must be some means of enlisting both initial and later input from many different groups. However, the process must begin with a small group and then shift later to broader participation. This process involves the following specific steps:

- *Form a small steering group of community leaders or representatives to start working on a tentative growth plan suitable to their metropolitan area*. The membership of this group should reflect a broad cross section of relevant interest groups in both the public and private sectors. These should include subgroups defined in terms of geography, socioeconomic status, occupation, ethnicity, and political perspective. Just how this should be done cannot be described here. For one thing, there are too many means of accomplishing such participation to discuss all of them in detail. However, the group should be kept small enough so that it can engage in productive face-to-face discussion sessions.

— The persons chosen should be asked *not* to act initially as official representatives of the groups to which they belong, but simply as citizens focused on the region's future growth. Of course, the views of each will be heavily influenced by the groups to which he or she belongs, but it is important to start off without tying the hands—or thoughts—of any members of this group to any "official position."

- *Have this group tentatively identify the most pressing growth-related problems in the region and the basic future goals to which they think growth ought to lead*. Problem identification is often done by polling a random sample of citizens concerning what issues they consider most critical. The citizens and officials in a metropolitan area would probably not even consider adopting a regional growth strategy unless they believed one or more growth-related problems were extremely serious. Goal identification is more difficult because it involves unknowable future conditions and the aspirations of different groups. However, it is vital to have some idea what type of future different people in the region would like to see realized.

— It is crucial that this group take account of the effects of the growth process, and its ramifications, on the concentration of poverty in older inner-core areas. A likely tendency will be to focus almost exclusively on directly growth-related problems that mainly affect suburbs, but this tendency should be overcome.

- *Conduct more detailed factual studies of both the problems and goals identified as most important*. One purpose of such studies should be to reject much further consideration for (1) problems that cannot realistically be solved or greatly reduced; (2) goals that are too unrealistic to be given practical consideration; and (3) goals that completely ignore or oppose key interests of one or more major groups in the region. Another purpose is to tentatively identify the major policy responses that might be adopted to remedy each important problem, or achieve each important goal, without choosing among possible alternative policies. These actions demand intensive and time-consuming briefings, discussions, and de-


Courtesy of G. Lowenstein

[8] The basic steps in this process have been adapted from Downs (1994, Chapter 12).

liberations that cannot be carried out effectively by large groups.

- *Arrive at as much consensus as possible (within this small group) concerning a prioritized set of problems and goals that are most significant to the region's future*. "Prioritized" means that the problems and goals have been roughly ranked in order of what the participants believe is their relative importance to the region's future.

- *Start informing larger groups in the region concerning the tentative findings reached*. The purpose of this step is to begin engaging a broader set of citizens in the strategy-formation process. Members of the small steering group should report to their own organizations on the nature of the deliberations, and get tentative—but not yet official—feedback from those organizations.

- *Conduct more-detailed analyses of possible policy responses to the most important problems and goals identified earlier*. This step involves the following substeps:

— Identify policies related to each problem or goal that might address each. This might have been done to some extent in a preceding step. These policies should contain alternative means of dealing with six key elements of future growth: (1) residential density, (2) whether there should be any limits on the outward extension of future growth, (3) ground transportation, (4) the density of commercial and industrial activities, (5) governance over land uses (including infrastructure finance), and (6) how and where low-income households should be provided with housing. These six elements are crucial ingredients of any rational future strategy concerning regional growth.


Courtesy of A. Nelessen

— Develop specific criteria of desirability concerning those policies.

— Analyze the benefits and costs of each policy in relation to each problem or goal. Take account of the disparate views of different groups involved.

— Tentatively choose those policies that seem best suited to each problem or goal. This overall set of policies should include substantive recommendations concerning at least the six elements of the region's future growth mentioned above.

— Examine this set of policies to determine their internal consistency, and revise them as necessary where inconsistencies appear. From this set, develop a coherent, internally consistent overall vision of what growth-related policies for this region ought to be. Conflicting choices within a single field of activity must be reconciled to achieve the most promising overall improvement in the area's problems. Possible inconsistencies among elements in different fields of activity must also be reconciled or at least limited. For example, a tightly drawn urban growth boundary would be inconsistent with spreading out jobs to reduce average travel times for workers who live in the suburbs. Adjustments in both elements might be necessary.

— Define one or two basic themes that express the essence of the final vision. People can much more easily understand overall themes than the detailed elements underlying them.

- *Create a more formalized body to review and modify the findings of this steering group and to initiate broader citizen participation*. It is vital not to go too far toward conclusions that look finalized before broadening participation so that more people can identify the results as their own. This step should create the means for many more citizens to become involved in the strategy-formation process. This can be done in a variety of ways. Members of the small steering group that has formulated the plan must return to the broader groups they represent and from whom they received ideas. Their initial presentations should combine strong advocacy with a willingness to listen to critical responses.

Courtesy of R. Ewing

- *Adjust the overall strategic vision to take account of the responses received through broader participation, and then create a final version*. This step may be more an ongoing process (starting with the preceding step) than a single, well-defined activity. It may occur over a considerable period as the formal small group—the successor of the steering group—repeatedly revises and tests the revisions against public opinion.

- *Disseminate the final version widely and seek to get its key recommendations adopted by the major regional media and the necessary legislative bodies*. An intensive public relations campaign must begin to drum up public support. This is critical. The success of the campaign will determine whether the new strategy will actually be adopted. Exactly how to do this cannot be described here because of the variety of decision-making processes in different areas. However, members of the small group that formulated the plan must spend as much time and energy—and perhaps more—carrying out this step as they did carrying out all the preceding steps.

Of course, these steps are rather general, and they may need to be varied considerably in specific regions in order to suit local conditions. However, they should convey the basic nature of the process necessary to formulate an effective, long-run, overall regional-growth policy strategy.

Courtesy of R. Ewing

XVI

Future Research on Sprawl:
Making the Commitment

INTRODUCTION

Although this report is an important and necessary first step in the study of sprawl and its impacts, much work remains to be done if this research is to be of real value. The missing pieces of the total sprawl picture must be identified. Therefore, it is crucial that a commitment be made to a meaningful research agenda. The transportation, land-use, and housing research communities, in pursuing this agenda, can help achieve the goal of a sustainable and fulfilling life for all citizens of the United States.

To discuss a proposed research agenda, a uniform method for categorizing and evaluating potential research must be established. The organization of proposed research will follow the order of this study's presentation of information: definitions, forces generating sprawl; sprawl's resource impacts (land conversion, infrastructure costs, property development costs, public service costs, and so on); sprawl's personal impacts (travel costs, quality of life, and social costs); and dealing with sprawl (sprawl's benefits as well as procedures to mitigate sprawl). Research objectives will be presented in a simple summary statement of what is proposed followed by a more detailed statement of what is required.

Future research should involve collaboration by members of multiple professional fields. The research partnership responsible for the current report is an unusual one. Those with specialties in housing, land use, transportation, and economics have all provided important information and perspective. It has proven to be an important collaboration, helping to move us toward a better understanding of sprawl. Experts in the above fields can make little sustained progress without continued commitment to both undertaking additional research and implementing what has been learned here; they must be joined by others to continue to "flesh out" what has already been achieved in sprawl research. This chapter identifies the additional research that should be undertaken to better understand sprawl.

DEFINING AND MEASURING SPRAWL

Classification System for Counties

Some type of classification or grouping system for counties ought to be developed to be used in identifying relationships between urban decline, quality of life, other characteristics, and sprawl. The classification system could utilize such variables as poverty levels, median household incomes, median housing values, percentages of dwellings owner occupied and renter occupied, percentages of female-headed households, and so on, to group counties into relatively homogeneous categories.

Population and Employment Demand

Population and employment demand are the major forces behind a geographic area's future resource needs. Growth-management efforts require reliable and valid baseline information in the planning and implementation of peripheral development in centers, close-in development in urban service areas, and core redevelopment and infill projects. Projecting these parameters is an uncertain process that requires updating and sensitivity analyses to provide the best inputs for future planning and growth-management activities.

Research is needed to assess the variety of demographic projections available at the county level. Current projections are promulgated by a variety of vendors for population, households, and employment, usually in increments of five to 10 years for 20- to 30-year futures. Information would be compared and the strengths and weaknesses of the data discussed, especially as they relate to the needs of alternative-development studies. These commercial data sources are of value in that individual counties add up to a regional and national projection for various points in the future. The weakness of these projections is that they contain limited localized data that could alter results significantly at a substate level. Little research exists that compares the projections from WEFA, Woods and Poole, and others.

Courtesy of C. Galley

Courtesy of G. Lowenstein

A Microdefinition of Sprawl

Most policymakers and interest groups do not conceptualize sprawl at a countywide level; rather, they think of it in terms of local development patterns: as strip commercial, homogeneous tract housing, auto-oriented, low-density, low-rise development. The *type of growth in a small place* (not explored herein) is equally if not more important in defining sprawl than the *amount of growth in a larger political jurisdiction* (the size level used extensively in this study). These groups can often point to examples of significant sprawl in what are defined as nonsprawl counties, and significant nonsprawl development (smart growth) in so-called sprawl counties. This study successfully isolates and provides control measures for sprawl in counties that are not urban. It is less effective in defining and reacting to sprawl in urban areas where there is no net growth, or similarly, in defining and reacting to growth in peripheral areas characterized by free-standing centers rather than traditional sprawl development forms. Spread development in urban areas must be better defined as sprawl; compact development in rural areas must be better defined as nonsprawl.

Sprawl on a Smaller Scale

A multidisciplinary group of city planners, geographers, and environmentalists interested in sprawl (there should be no shortage) ought to assist a research team in developing more-detailed data on development patterns that constitute sprawl. These experts could participate in focus groups charged with defining sprawl in terms of the scale, type, and density of development. A research team could be assembled to analyze data, standardize information, and draw conclusions from 12 to 15 focus groups' examinations of differing development patterns that constitute sprawl.

A Sprawl Definition Utilizing Percentages of Walking, Biking, and Transit Trips

There is a positive correlation between sprawl and automobile use. Locations with 95 percent automobile use may be very different from those that depend on automobiles for closer to 100 percent of all trips. Locations where walking, biking, and taking public transit to work are common usually are not classic examples of sprawl. These locations should be researched; their nonautomobile-use percentages might be established as cutoff points in identifying potential or actual sites of nonsprawl development.

GROWTH AND SPRAWL

Analysis of the Economic Model of Sprawl

Residential developers have created and refined a cost model that allows them to produce relatively inexpensive low-density housing while externalizing various costs and passing them on to the public sector. These costs include those associated with the provision of an arterial system to distribute traffic from subdivisions, as well as utility infrastructure. How do you legitimately account for the prorated public costs of development? A useful case study would analyze the "full" distribution of public and private costs for multiple types of greenfields and brownfields developments—those that follow traditional suburban structure and those based on more-urban patterns.

Market Trends: How Do They Support and/or Counteract Sprawl?

Technological and lifestyle changes are altering many aspects of our everyday lives. For example, the emergence of online shopping for everything from movies and pizza to houses and cars is transforming the public's purchasing habits. Also, after decades of urban flight, many households are rediscovering the urban core. These and other well-noted changes, such as the move toward smaller and nontraditional family arrangements and immigrants' penchant for urban living, may profoundly impact the way in which cities grow in the future. Are these changes capable of counteracting the sprawling suburban growth of the last 40 years?

SPRAWL AND DEVELOPABLE AGRICULTURAL AND ENVIRONMENTALLY FRAGILE LAND IMPACTS

Development and Land Conversion

Data is often misused and incorrectly interpreted. In comparisons of growth and land conversion, two statistics that appear to be related are virtually meaningless. These relate to percentages of land taken relative to percentages of development completed. One often hears that population has expanded by 10 percent, whereas the remaining land has been depleted by 30 percent. This is a meaningless comparison unless the base numbers are known and it is clear what land has been taken for development versus other purposes. It is necessary to obtain a measure of typical land loss per capita (i.e., 0.2 acres), so that a frame of reference exists for determining excess land takings relative to population growth.

Prime Agricultural Land

Agricultural land losses are more serious if they involve the loss of *prime* agricultural lands. Agricultural lands may be divided into prime and nonprime depending on their soil type. With GIS and agricultural land classification, the loss of *prime* agricultural lands to development could be separated from the loss of all agricultural lands. This is imperative if agricultural land losses are to be considered within the context of future domestic agricultural land required to feed domestic and nondomestic households.

Courtesy of C. Galley

Courtesy of C. Galley

Isolating Environmentally Fragile Land

Other than forests, which are well mapped, and wetlands, which are well protected, there is no computerized method for isolating and tabulating lands that need protection from real estate development. A nationwide California Urban Futures–type modeling effort must be undertaken to classify lands in the path of development by degree of environmental protection. The amount of fragile land consumed by development or avoided by compact growth could then be calculated.

Land Preservation and Property Rights

Property rights associated with land are based on a variety of specific rights or interests. For example, interests may include mineral rights, water rights, farmland-rental agreements, conservation easements, and other elements of landownership. These interests can be held and traded separately, allowing public agencies to influence land disposition in ways other than regulation or outright ownership. Examples of public policy tools used to garner land are conservation purchase programs, wetlands reserve programs, farmland protection easements, transferable development rights, and real estate tax preferences. Researchers should explore options for land conservation through various acquisition alternatives, each appropriate to a particular context or stage of land preservation. Outright purchase may prove too expensive a land-use option in the long run.

GIS Overlays for Sensitive Lands Sprawl Research

GIS overlays are powerful educational tools. Much of the decision making regarding development projects is based on GIS maps (e.g., hydrology and environmental variables; socioeconomic, administrative, and other factors). Acceptance and support for development and redevelopment projects will be improved by creating clear, accurate, and useful overlays designed to meet the public's and decision makers' information needs and by widely distributing such overlays (via the Internet, for example). An inventory of potential environmental restraints at a substate level should be developed. The GIS maps could be prioritized according to their usefulness in communicating important development information to decision makers and the public. A model statewide map series could be distributed (with other literature) through various outlets to educate and inform locals across the country.

SPRAWL AND INFRASTRUCTURE IMPACTS

A Fact Book on Development Costs

The main function of local governments is to do an efficient job of the task that traditionally has been theirs: providing development infrastructure and public services. Local governments require a continuous supply of information about how to accomplish these tasks with maximum efficiency. There is a great demand for engineering and pro forma–level data on different types of development, and the material lends itself to quantification. A "fact book" of impacts that presents standardized development costs for a range of development types under a variety of assumptions could be invaluable to local officials. This information would make a great contribution to local debates about the opportunities for and requirements of smart growth.

Water and Sewer Laterals versus Compact Development

Rutgers University employs a water and sewer lateral model that is driven almost exclusively by the unit-mix differences of development alternatives. Very little credit is given for compact development affecting infrastructure costs. Engineering studies of infrastructure savings related to compact growth need to be cataloged, standardized, and systematized. The results of such analyses could be incorporated into models of the above type to determine savings and costs related to different development scales and densities of similar units under spread versus compact development.

SPRAWL AND TRANSPORTATION IMPACTS

Relationship between Commuting Times and Distance of Residential Areas from the MSA Center

The relationship between commuting times and distance from the MSA center needs further investigation to evaluate the claim that people living farther out have shorter commuting times—and therefore benefit from sprawl. A preliminary regression analysis is used in this study, which compares the median 1990 commuting time of local residents in each of 49 Boston suburbs as a dependent variable (regardless of where they work) with each suburb's distance from the Boston Statehouse as the independent variable. This analysis shows that a one-mile increase in distance from the center causes a 3.9 minute decline in commuting time. (The median commuting time for all 49 suburbs was 21.55 minutes; the median distance from the center of the MSA was 11.46 miles.) This type of analysis should be repeated in other locations at increasing distances from the center of an MSA, making more information available to evaluate the relationship between distance from the center of a metropolitan area and resultant commuting times.

Induced Travel and Sprawl

There has been a significant body of work analyzing the incidence of induced travel. Although there is an emerging consensus that expansions of the road system induce additional travel, the issue merits more attention. One must critically examine at different scales (see below) the conclusion that road building creates more total travel as opposed to simply lessening travel on other modes.

Regional versus Local Scale

The structure of one's neighborhood, community, and region each have separate and intertwined impacts on travel behavior. A comprehensive analysis of the transportation impacts of sprawl must incorporate these relationships and account for their linkages. A series of case studies and empirical analyses focusing on several metropolitan areas could shed light on interactions, causes, and effects of development and travel behavior that are often blurred when aggregated to the national scale.

The Costs and Benefits of Transportation Improvements

A standard approach to examining the economic impacts of transportation improvements is through input-output analysis. The results of these analyses consistently show a net economic benefit due to transportation improvements. How are other parts of the region negatively impacted when economic activities choose to be near a new transportation improvement? The research community must reevaluate the cost/benefit procedures and assumptions currently in use to include potential losses by other host locations in the region due to transportation improvements in other jurisdictions.

The Rutgers University Road Model and Road Costs

In this and other studies, the Rutgers University Road Model has been used to project local road lane-mile needs under alternative future development scenarios. Is this "bird's-eye view" of the relationship between population density and road density adequate for macroanalyses of future local road lane-miles and costs under alternative futures? An analysis of this simple approach versus information that might be gleaned from a traditional transportation-demand model needs to be undertaken by the transportation research community.

Courtesy of G. Lowenstein

Courtesy of R. Ewing

What Type of Transit Use Makes Sense and When Is It Called For?

There is current and continuing strong interest in including transit modes as part of smart growth development activities. More information is needed regarding what types of transit make sense at differing densities. The research community should produce a guide to workable transit, focusing on what densities, land-use mix, pedestrian factors, and so on dictate technology choices for transit. This guide would link the transit mode to development density. It would also allow the economics of transit to be better understood by the general public.

Impacts of Light-Rail Systems on Traffic Congestion

Another issue needing additional study is the impact of light-rail and other fixed-route public transit systems on local traffic congestion. Proponents of light-rail systems claim that they will help reduce traffic congestion; opponents say that this has not happened where such systems have been put in place. Research should compare levels of traffic congestion measured at the MSA scale in different regions that have, or lack, light-rail systems, taking into account other relevant variables, such as total land area, population, income levels, climate, and so on.

Correctly Pricing Transportation

There is considerable interest these days in "getting the prices right" in transportation. Environmentalists and supporters of mass transit believe the "right" prices will induce people to switch from automobiles to public transit. They advocate a variety of additional charges on vehicles, fuel, road use, emissions, and so forth. Economists believe that the "right" prices will lead to an economically efficient and socially desirable distribution of transportation modes and fuels. More research should be undertaken using full-cost analysis to correctly establish the price of travel by various modes. Full-cost analysis should be funded to better understand the relative importance of transportation problems, illuminate trade-offs, and evaluate transportation alternatives.

SPRAWL AND QUALITY-OF-LIFE IMPACTS

Measuring Quality of Life

Quality of life is difficult to measure empirically. Usually a "places-rated scheme" is selected to profile communities relative to quality of life because people can come to some level of agreement about it. Significant research must be commissioned to measure quality of life in an area and then determine, under a controlled-growth regimen of intracounty and intercounty movement, whether quality of life has changed for new residents under this scenario.

Courtesy of T. Delcorso

Relationship between Housing Cost and Distance of Residence from the Center of an MSA

This relationship should be studied with greater rigor to determine whether moving out from the center (thereby increasing sprawl) confers the benefit of lower housing costs upon residents who make such moves. This can be done through a hedonic regression analysis of individual housing prices as the dependent variable. Distance from the MSA center, other locational traits, specific housing unit characteristics, and additional relevant variables likely to affect housing prices could be used as the independent variables. Some of these variables may be obtained from *American Housing Survey* data. It would be desirable if the sample set included housing units in multiple MSAs; separate samples could be developed for a number of MSAs.

Relationships between Distance from MSA Center and (1) Lot Sizes and (2) Housing Floor Areas

There is very little clear evidence about whether two alleged benefits of sprawl—larger lot sizes and larger housing sizes farther from the center of an MSA—actually exist, or to what degree they exist in relation to distance from the center. Nor is there any way to quantify the value of these benefits if they do exist. It would be desirable to research the relationship between the distance of housing units from the center of the MSA and these two key variables. If data on lot size, housing unit size, and distance from the center of the MSA are available for a large sample of housing units, along with data on other relevant traits of the housing units concerned, such an analysis could be carried out.

The Personal Costs of Sprawl

A comparative framework demonstrating the personal costs (health and wealth) of sprawl versus the capital-accumulating advantages of housing in more distant locations should be developed. Is there any evidence that strip development landscapes or long commutes have impacts on mental health? Does the lack of exercise associated with commuting by automobile impact equally on physical health? Do rural house price increases constitute a significant purchase price advantage in the region? If so, people will continue to move outward to take advantage of this real-

Courtesy of C. Galley

ity. Studies should be conducted to determine how emotional fatigue and physical health are related to trip length, and also how comparative resale price increases relate to distance from the central core.

The Effectiveness of Community Development Corporations in Improving the Overall Economic Standing of Their Communities over Time

Private foundations, banks, other corporations, and governments have poured billions of dollars into support for local community development corporations (CDCs) carrying out specific projects designed to improve the quality of life in their communities. Most commonly these improvements entail the building of new housing units or the rehabilitating of older housing units. However, it is not clear whether the long-term impacts of these projects actually raise the overall economic level of welfare in those communities. An analysis of changes in overall neighborhood conditions over extensive periods in areas where CDCs have been very active would help determine whether this strategy of "neighborhood enrichment" is actually working. David Rusk carried out a preliminary analysis of this type and concluded that CDCs were failing to lift their neighborhoods out of poverty or deprived status (Rusk 1999). However, a broader and more comprehensive empirical study of this issue would provide critical guidance to urban policymakers.

SPRAWL AND SOCIAL IMPACTS

Urban Decline and Sprawl

Sprawl has not been linked conclusively to urban decline, which can exist under both sprawl (subur-

Courtesy of A. Nelessen

ban neighborhoods and urban centers) and nonsprawl (several of New York City's boroughs) conditions. Significant investigation into the causes of urban decline (crime, poor schools, high taxes, low housing resale values) and their linkages to sprawl should be undertaken. To examine the relationship between urban decline and sprawl more fully, it would be desirable to test more variables against urban decline than are used in the current study. Some of the variables that could be used are

- School dropout rates in central cities.
- School test scores, if some overall measure of in-city test scores is available.
- The ratio of total housing units built in the MSA's suburbs (or the entire MSA if suburban breakouts are not available) for the period 1980 to 1990 to the increased number of households in the MSA for the period 1980 to 1990. The hypothesis would be that a high ratio would create "housing surpluses" in the overall MSA, drawing households out of the central city into the suburbs and contributing to central-city urban decline.

Economic Segregation and Socioeconomic Homogeneity in Suburban Communities

Exclusionary zoning by suburban communities is a basic feature of the American metropolitan development process with serious negative consequences for central cities. How widespread and severe such exclusion is has not been accurately measured in many MSAs. Measuring the degree and extent of the resulting economic segregation and socioeconomic homogeneity in suburbs in a number of MSAs with basically different traits (such as geographic region, physical size, levels of annexation, total population, ethnic composition, and income levels) would provide evidence about how pervasive and potentially important these traits really are.

Outreach/Participatory Techniques to Engage All Groups

All revitalization efforts in areas of human habitation and use ultimately are locally based and implemented. If local people do not actively support and participate in the design and implementation of neighborhood revitalization, possibilities for successful outcomes of these efforts at sprawl amelioration are seriously jeopardized. Local priorities and concerns must be integrated into revitalization objectives for successful program implementation. In addition, project stakeholders and decision makers do not always know how to collect and/or use socioeconomic information to support revitalization projects or to design and/or implement alternative plans. Outreach/training efforts are required to assist both groups. The tools of community participation must be reworked to ensure all stakeholders are involved and that communities of color and poverty are aware of the changes that could affect them as a result of smart growth.

Courtesy of C. Galley

Courtesy of C. Galley

Use of Infill Sites to Accommodate Future Development

The possibility of using infill development to accommodate future growth in an MSA depends in part upon the existing availability of vacant sites closer to the center of the MSA than the edges of its contiguously settled areas. At present, there is little reliable information about the amount of infill land suitable for future development in each MSA. Empirical research measuring amounts of developable land for a large sample of MSAs would be helpful in estimating both the possibility of using such sites to accommodate future growth and the potential benefit of sprawl in creating such sites. This would require detailed surveys of vacant land in different metropolitan areas.

The Impacts of Revitalization Efforts on Existing Residents

Inner-area revitalization as a curative measure to sprawl will result in a wide array of benefits and costs. Some of the costs may translate into potentially adverse physical, social, and economic effects. In addition, the beneficial and adverse effects of revitalization may have disproportionate impacts on minority and low-income populations. The proposed research would: (1) identify minority and low-income populations potentially affected by revitalization associated with antisprawl initiatives; (2) assess potential beneficial and adverse physical, social, and economic effects on these vulnerable groups; and (3) develop and implement a revitalization strategy to maximize beneficial effects and minimize and mitigate negative effects.

Impacts of Regional Urban Growth Boundaries on Housing Prices

The use of regional urban growth boundaries (UGBs) has become controversial because those opposed to them claim that they tend to raise housing prices within the boundaries. Further research needs to be carried out to verify whether this is indeed the case. A recent analysis of home prices in the Portland region as well as several other western regions shows that the median price of homes sold in Portland (which has a growth boundary) rose faster than the median price in the other western regions. It is difficult to empirically analyze this issue because no other region except Lexington, Kentucky, has a strong UGB that has been in place long enough to have had any significant impact, making it hard to isolate the impact of the UGB from the impacts of other factors.

SPRAWL AND PUBLIC CHOICE

Does the Consumer Really Prefer the Suburban Lifestyle?

One often hears that consumers have spoken and their primary demand is for a house in the suburbs with a two-car garage. How much choice have consumers

Courtesy of G. Lowenstein

Courtesy of G. Lowenstein

been given? What is the true nature of the factors that seem to coalesce into a preference for the urban fringe? Is the recent rediscovery of close-in suburban centers an indication of a different trend in the future? Can research efforts such as Visual Preference Surveys be used to better articulate or amend the "American Dream"?

GOVERNMENT STRUCTURE AND POLICIES

The Impact of Tax Policies on Sprawl

How important is the ratable chase in fostering sprawl? Researchers have noted the perverse impact of municipal tax policies, which tend to pit one local government against the other. These policies may also tend to promote sprawling development patterns as one community competes with its neighbors for the next large shopping mall or big box store. Additional research must investigate the extent to which local property or sales tax policies act as a catalyst for sprawl.

The Impact of Other Government Policies on Sprawl

A GAO report concludes that there has not been a sustained public subsidization of outward development in the United States, that government policies such as FHA and VA single-family mortgages, income tax deductions of mortgage interest, Interstate Highway System financing, state and county road subsidies, and inexpensive automobile fuel have not subsidized the suburbs as opposed to urban areas. The conclusions of this widely circulated report need to be examined and analyzed (GAO 1999).

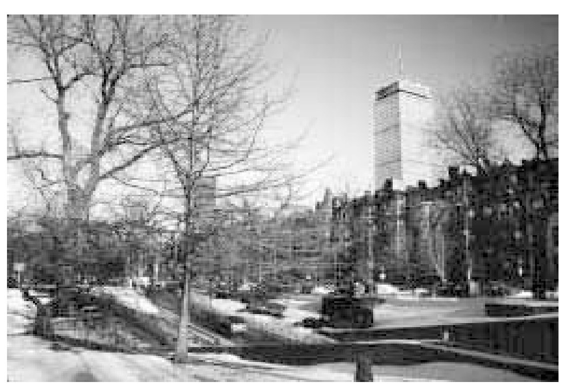
Government Structure and Land Development

It is often said that the region will not change because there is no zoning or land-use power at state or regional levels and local governments are too interested in their own futures to do anything collectively for the region. One of the frequent "excuses" for the failure to deal with sprawl is that the local government structure is unable to act in the region's best interest. To what extent is this excuse valid? What types of relationships must exist between local, regional, state, and federal governments for there to be a regionally useful outcome from a local land-use decision?

SPRAWL AND PRIVATE-SECTOR ACTIVITIES

The Role of Corporate Location Decisions

The role of the private sector is often not considered in analyses of sprawl. It is blamed on the government (federal, state, or local). What about the private sector, specifically corporate relocation policies that abandon perfectly acceptable development locations in favor of communities in the same or different regions that will grant long-term tax concessions? Research should be undertaken on corporate/government location decisions and their relationship to smart growth and transportation. Whereas the impact of targeting new public employment on the revitalization of neighborhoods has been acknowledged, the effects of corporate decision making on industrial relocation and community downturn continue to be ignored. Corporations in the United States are free to relocate at will even though their current site may



Courtesy of C. Galley

contain infrastructure put in place specifically for them. Should this policy continue?

The Market as a Cure for Sprawl

The market is also ignored in analyses of the causes and cures of sprawl. If the market creates sprawl, shouldn't it be able to cure it as well? Research is needed to assess what pricing mechanisms might limit or even redirect sprawl. The political obstacles to implementing such pricing strategies must be identified and steps taken to overcome these obstacles. If congestion can be successfully lessened through congestion pricing, what level of price increase is going to work? Who would be impacted by the pricing change and what is their financial capacity to accept this change? Who would object to the use of this technique, and how formidable would their objection be? The cost of limiting or curing sprawl must be established and evaluated.

NEW TOOLS FOR SPRAWL CONTROL

Repairing Sprawl

The ability to react to sprawl is very limited. Given the ubiquity of sprawling development patterns throughout the United States, what tools are required to deal with its effects? What can be done with the millions of acres of suburban residential and commercial development passed over in the quest for more development farther out? What techniques of urban revitalization could be used to address common re-use situations and problems?

Creating a Growth-Management Handbook

How thick is the growth-management handbook as it exists today? Answer: not very thick at all. This type of best-practices manual has to be increased tenfold in size; furthermore, most techniques are not sorted by problem. Tools for attacking sprawl growth (parking ratios, location-efficient mortgages, automobile insurance costs related to miles traveled, mixed-used zoning) must be cataloged and their effectiveness and potential in different environments and at different levels of sprawl evaluated.

BENEFITS OF SPRAWL

Measuring the Benefits of Sprawl

The study's conclusion is that many of the benefits of sprawl (1) are hard to measure, (2) lack clear causal connections to sprawl, and (3) probably cause or are associated with offsetting negative effects. Benefits of sprawl merit significant investigation; their potential link to a second round of costs, if any, also needs to be further researched.

CRITERIA FOR RATING RESEARCH SUGGESTIONS

One way to sift through the above suggestions is to rate them according to criteria related to importance and ease of implementation. Each of the previously discussed research agenda items in this chapter is given a score of 9, 6, or 3, depending upon how they rate on the following three evaluation characteristics: societal importance, conceptual difficulty, and practical costs**.** These characteristics are based on the following criteria:

- Importance in determining sprawl-related policies. Possible degrees of importance can be rated high, moderate, or low.

- Difficulty of executing conceptually. The conceptual difficulty of carrying out each research project could be rated as relatively easy because data are at least theoretically available, moderately hard because data are difficult to get, or very difficult because required data cannot be produced.

- Practical costs of executing. The practical cost of carrying out each research project could be rated as less expensive, moderately costly, or very expensive.

In Table 16.1, which follows, these criteria have been applied to the suggested research projects described herein using ratings for each of the evaluation characteristics. These ratings, while admittedly based on limited experience and subjective views, ultimately produce a listing of the 10 to 12 most important, easiest, and least expensive research projects to implement (see shaded areas).

Table 16.1
Required Future Research on Sprawl and Its Impacts

Research Projects	Ratings for Each of Three Criteria of Feasibility: Societal Importance	Conceptual Difficulty	Practical Costs	Total Points	Priority
Defining and Measuring Sprawl					
Classification system for counties	Low (3)	Moderately Hard (6)	Less Expensive (9)	18	3
Population and employment demand	Moderate (6)	Moderately Hard (6)	Very Expensive (3)	15	3
A microdefinition of sprawl involving types of growth	High (9)	Moderately Hard (6)	Moderately Costly (6)	21	2
A microdefinition of sprawl involving land-use patterns	High (9)	Easy (9)	Moderately Costly (6)	24	1
A microdefinition of sprawl involving walking, biking, and transit	High (9)	Moderately Hard (6)	Moderately Costly (6)	21	2
Growth and Sprawl					
Develop an appropriate economic model of sprawl	High (9)	Very Difficult (3)	Very Expensive (3)	15	3
Market trends: How do they support and/or counteract sprawl?	Moderate (6)	Moderately Hard (6)	Moderately Costly (6)	18	2
Developable Agricultural and Environmentally Fragile Land Impacts					
Development and land conversion	Moderate (6)	Easy (9)	Less Expensive (9)	24	1
Identify and map prime agricultural land	Moderate (6)	Easy (9)	Less Expensive (9)	24	1
Isolating fragile land	Moderate (6)	Moderately Hard (6)	Moderately Costly (6)	18	2
Land preservation and property rights	High (9)	Easy (9)	Less Expensive (9)	27	1
GIS overlays for sensitive lands sprawl research	Moderate (6)	Moderately Hard (6)	Very Expensive (3)	15	3
Sprawl and Infrastructure Impacts					
A fact book on development costs	Moderate (6)	Easy (9)	Less Expensive (9)	24	1
Water and sewer laterals versus compact development	Low (3)	Easy (9)	Less Expensive (9)	21	2
Sprawl and Transportation Impacts					
Relationship between commuting times and distance of residential areas from the MSA center	Moderate (6)	Moderately Hard (6)	Moderately Costly (6)	18	3
Induced travel and sprawl	High (9)	Very Difficult (3)	Moderately Costly (6)	18	3
Regional versus local scale	Low (3)	Easy (9)	Moderately Costly (6)	24	1
The costs and benefits of transportation improvements	Moderate (6)	Very Difficult (3)	Moderately Costly (6)	15	3
The Rutgers Model on road costs	Low (3)	Easy (9)	Less Expensive (9)	21	2
What type of transit makes sense and when is it called for?	High (9)	Moderately Hard (6)	Moderately Costly (6)	21	2
Impacts of light-rail systems on traffic congestion	Moderate (6)	Very Difficult (3)	Moderately Costly (6)	15	3
Correctly pricing transportation	High (9)	Moderately Hard (6)	Moderately Costly (6)	21	2

Continued on next page

Table 16.1—*Continued*

Research Projects	Societal Importance	Conceptual Difficulty	Practical Costs	Total Points	Priority
	Ratings for Each of Three Criteria of Feasibility				
Sprawl and Quality-of-Life Impacts					
Measuring quality of life	High (9)	Very Difficult (3)	Moderately Costly (6)	18	2
Relationship between housing costs and distance of residence from the center of an MSA	Moderate (6)	Easy (9)	Less Expensive (9)	24	1
Relationship between distance from MSA center and lot sizes and housing floor area	Low (3)	Easy (9)	Less Expensive (9)	21	2
The personal costs of sprawl	High (9)	Very Difficult (3)	Moderately Costly (6)	18	3
The effectiveness of community development corporations in improving the overall economic standing of their communities over time	High (9)	Very Difficult (3)	Very Expensive (3)	15	3
Sprawl and Social Impacts					
Urban decline and sprawl	High (9)	Moderately Hard (6)	Moderately Costly (6)	21	2
Economic segregation and socioeconomic homogeneity in suburban communities	High (9)	Moderately Hard (6)	Moderately Costly (6)	21	2
Outreach/participatory techniques to engage all groups	High (9)	Easy (9)	Moderately Costly (6)	24	1
Use of in-fill sites to accommodate future development	Moderate (6)	Easy (9)	Very Expensive (3)	18	3
The impacts of revitalization efforts on existing residents	High (9)	Moderately Hard (6)	Moderately Costly (6)	21	2
Impacts of regional urban growth boundaries on housing prices	High (9)	Moderately Hard (6)	Moderately Costly (6)	21	2
Sprawl and Public Choice					
Does the consumer really prefer the suburban lifestyle?	High (9)	Easy (9)	Moderately Costly (6)	24	1
Government Structure and Policies					
The impact of tax policies on sprawl	Moderate (6)	Easy (9)	Moderately Costly (6)	21	2
The impact of other government policies on sprawl	Low (3)	Very Difficult (3)	Moderately Costly (6)	12	4
Government structure and land development	Moderate (6)	Moderately Hard (6)	Moderately Costly (6)	18	3
Sprawl and Private-Sector Activities					
The role of corporate location decisions	High (9)	Moderately Hard (6)	Moderately Costly (6)	21	2
The market as a cure for sprawl	High (9)	Easy (9)	Moderately Costly (6)	24	1
New Tools for Sprawl Control					
Repairing sprawl	Moderate (6)	Moderately Hard (6)	Moderately Costly (6)	18	3
Creating a growth-management handbook	Moderate (6)	Easy (9)	Less Expensive (9)	24	1
Benefits of sprawl					
Measuring the benefits of sprawl	High (9)	Very Difficult (3)	Very Expensive (3)	15	3

Source: Center for Urban Policy Research, Rutgers University

Courtesy of G. Lowenstein

For example, one of the proposed research agenda items, identifying prime agricultural land, if viewed as having moderate societal importance, would be given a 6; if viewed as conceptually easy to investigate, would be given a 9; and if viewed as relatively inexpensive to undertake, would also be given a 9. The total score for this research agenda item would be 24, which would place it in priority 1, the highest research category based on these criteria. Research priority categories are set relative to score as follows:

Priority 1: Three highest ratings; two high ratings and one middle rating—score of 27 or 24.

Priority 2: One highest rating and two middle ratings—score of 21.

Priority 3: One high rating, one middle rating, and one low rating; two middle ratings and one low rating; two low ratings and one high rating; or three middle ratings—score of 15 or 18.

Priority 4: Three low ratings; two low ratings and one middle rating—score of 9 or 12.

Of these approximately 40 suggested future research tasks, about one-quarter, or eleven, have the highest possible score for societal importance, ease of conceptualization, and low practical costs. They are:

Defining and Measuring Sprawl. (1) Create a microdefinition of sprawl involving land-use patterns.

Land Conversion Aspects of Sprawl. (2) Determine average land conversion per capita or per household in the United States and use that figure to view the effects of growth on various inventories of critical lands. (3) Define or map prime agricultural land using soils or other criteria. (4) Determine at what percentage of market price a taking is initiated for various categories of privately held land.

Sprawl and Infrastructure Impacts. (5) Provide a fact book on multipliers relative to value on the capital costs of development for various types of land uses.

Sprawl and Transportation Impacts. (6) Undertake research to better understand the separate and intertwined impacts of regional, community, and neighborhood structure on travel behavior.

Sprawl and Quality-of-Life Impacts. (7) Determine a quantitative relationship between housing costs and distance from the center of a metropolitan area.

Sprawl and Social Impacts. (8) Prepare an outreach guide identifying best practices for engaging community groups.

Sprawl and Public Choice. (9) Determine the extent of consumer preference for sprawl development and its effects.

Sprawl and Private-Sector Activities. (10) Determine ways that the market could be redirected to support nonsprawl development patterns.

Courtesy of G. Lowenstein

New Tools for Sprawl Control. (11) Prepare a smart-growth handbook keyed to the context of development.

CONCLUSION

The realities of sprawl and its impacts have been researched to a significant extent in this report. Additional research is certainly called for. What has been provided here is a catalog of research projects that are both important and relatively easy to carry out. That does not mean that other, more difficult research should not be initiated. Clearly, research on the benefits of sprawl is underrepresented in the literature. Additional studies must be undertaken on the relationship between sprawl and quality of life and sprawl and urban decline. A better definition of sprawl must be found; so too must a more encompassing sprawl index emerge. These topics are all ripe for future investigation.

Courtesy of R. Ewing

Appendixes

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Appendix A
Special County Definitions[1]

ALASKA

Northwest Arctic Borough, AK (02188)
Kobuk, AK (02140)
Remainder of Alaska, AK (02999)
Aleutian Islands, AK (02010)
Aleutian Islands East Borough, AK (02013)
Aleutian Islands West Census Area, AK (02016)
Bethel Census Area, AK (02050)
Denali Borough, AK (02068)
Dillingham Census Area, AK (02070)
Haines Borough, AK (02100)
Kenai Peninsula Borough, AK (02122)
Lake and Peninsula Borough, AK (02164)
North Slope Borough, AK (02185)
Prince of Wales-Outer Ketchikan, AK (02201)
Sitka Borough, AK (02220)
Skagway-Yukatat-Angoon, AK (02231)
Skagway-Hoonah-Angoon Census Area, AK (02232)
Southeast Fairbanks Census Area, AK (02240)
Valdez-Cordova Census Area, AK (02261)
Wrangell-Petersburg Census Area, AK (02280)
Yakutat Borough, AK (02282)
Yukon-Koyukuk, AK (02290)

ARIZONA

Yuma + La Paz, AZ (04027)
La Paz, AZ (04012)
Yuma, AZ (04027)

HAWAII

Maui + Kalawao, HI (15901)
Kalawao, HI (15005)
Maui, HI (15009)

IDAHO

Fremont, ID (16043)
Fremont, ID (16043)
Yellowstone Park, ID (none)

MONTANA

Park (incl. Yellowstone Park), MT (30901)
Park, MT (30067)
Yellowstone Park, MT (30113)

NEW MEXICO

Valencia + Cibola, NM (35061)
Cibola, NM (35006)
Valencia, NM (35061)

VIRGINIA

Albemarle + Charlottesville, VA (51901)
Albemarle, VA (51003)
Charlottesville City, VA (51540)
Alleghany + Clifton Forge + Covington, VA (51903)
Alleghany, VA (51005)
Clifton Forge City, VA (51560)
Covington City, VA (51580)
Augusta + Staunton + Waynesboro, VA (51907)
Augusta, VA (51015)
Staunton City, VA (51790)
Waynesboro City, VA (51820)
Bedford + Bedford City, VA (51909)
Bedford, VA (51019)
Bedford City, VA (51515)
Campbell + Lynchburg, VA (51911)
Campbell, VA (51031)
Lynchburg City, VA (51680)
Carroll + Galax, VA (51913)
Carroll, VA (51035)
Galax City, VA (51640)
Dinwiddie + Colonial Heights + Petersburg, VA (51918)
Dinwiddie, VA (51053)
Colonial Heights City, VA (51570)
Petersburg City, VA (51730)
Fairfax + Fairfax City + Falls Church City, VA (51919)
Fairfax, VA (51059)
Fairfax City, VA (51600)
Falls Church City, VA (51610)
Frederick + Winchester, VA (51921)
Frederick, VA (51069)
Winchester City, VA (51840)
Greensville + Emporia, VA (51923)
Greensville, VA (51081)
Emporia City, VA (51595)
Halifax + South Boston, VA (51925)
Halifax, VA (51083)
South Boston City, VA (51780)
Henry + Martinsville, VA (51929)
Henry, VA (51089)
Martinsville City, VA (51690)
James City + Williamsburg, VA (51931)
James City County, VA (51095)
Williamsburg City, VA (51830)
Montgomery + Radford, VA (51933)
Montgomery, VA (51121)
Radford City, VA (51750)
Pittsylvania + Danville, VA (51939)
Pittsylvania, VA (51143)
Danville City, VA (51590)
Prince George + Hopewell, VA (51941)
Prince George, VA (51149)
Hopewell City, VA (51670)
Prince William + Manassas + Manassas Park, VA (51942)
Prince William, VA (51153)
Manassas City, VA (51683)
Manassas Park City, VA (51685)
Roanoke + Salem, VA (51944)
Roanoke, VA (51161)
Salem City, VA (51775)
Rockbridge + Buena Vista + Lexington, VA (51945)
Rockbridge, VA (51163)
Buena Vista City, VA (51530)
Lexington City, VA (51678)
Rockingham+Harrisonburg, VA (51947)
Rockingham, VA (51165)
Harrisonburg City, VA (51660)
Southampton + Franklin, VA (51949)
Southampton, VA (51175)
Franklin City, VA (51620)
Spotsylvania + Fredericksburg, VA (51951)
Spotsylvania, VA (51177)
Fredericksburg City, VA (51630)
Washington + Bristol, VA (51953)
Washington, VA (51191)
Bristol City, VA (51520)
Wise + Norton, VA (51955)
Wise, VA (51195)
Norton City, VA (51720)
York + Poquoson, VA (51958)
York, VA (51199)
Poquoson City, VA (51735)

WISCONSIN

Shawano (includes Menominee), WI (55901)
Menominee, WI (55078)
Shawano, WI (55115)

Source: Woods & Poole (1998)

[1] Federal Information Processing Standards (FIPS) codes are defined by the National Institute of Standards and Technology to give numeric "names" to geographic areas such as counties and are provided in the parentheses.

Appendix B
Numeric Codes and Names for EAs

Code	Name	Code	Name
1	Bangor, ME	44	Knoxville, TN
2	Portland, ME	45	Johnson City-Kingsport-Bristol, TN-VA
3	Boston-Worcester-Lawrence-Lowell-Brockton, MA-NH-RI-VT	46	Hickory-Morganton, NC-TN
4	Burlington, VT-NY	47	Lexington, KY-TN-VA-WV
5	Albany-Schenectady-Troy, NY	48	Charleston, WV-KY-OH
6	Syracuse, NY-PA	49	Cincinnati-Hamilton, OH-KY-IN
7	Rochester, NY-PA	50	Dayton-Springfield, OH
8	Buffalo-Niagara Falls, NY-PA	51	Columbus, OH
9	State College, PA	52	Wheeling, WV-OH
10	New York-Northern New Jersey-Long Island, NY-NJ-CT-PA-MA-VT	53	Pittsburgh, PA-WV
11	Harrisburg-Lebanon-Carlisle, PA	54	Erie, PA
12	Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	55	Cleveland-Akron, OH-PA
13	Washington-Baltimore, DC-MD-VA-WV-PA	56	Toledo, OH
14	Salisbury, MD-DE-VA	57	Detroit-Ann Arbor-Flint, MI
15	Richmond-Petersburg, VA	58	Northern Michigan, MI
16	Staunton, VA-WV	59	Green Bay, WI-MI
17	Roanoke, VA-NC-WV	60	Appleton-Oshkosh-Neenah, WI
18	Greensboro-Winston-Salem-High Point, NC-VA	61	Traverse City, MI
19	Raleigh-Durham-Chapel Hill, NC	62	Grand Rapids-Muskegon-Holland, MI
20	Norfolk-Virginia Beach-Newport News, VA-NC	63	Milwaukee-Racine, WI
21	Greenville, NC	64	Chicago-Gary-Kenosha, IL-IN-WI
22	Fayetteville, NC	65	Elkhart-Goshen, IN-MI
23	Charlotte-Gastonia-Rock Hill, NC-SC	66	Fort Wayne, IN
24	Columbia, SC	67	Indianapolis, IN-IL
25	Wilmington, NC-SC	68	Champaign-Urbana, IL
26	Charleston-North Charleston, SC	69	Evansville-Henderson, IN-KY-IL
27	Augusta-Aiken, GA-SC	70	Louisville, KY-IN
28	Savannah, GA-SC	71	Nashville, TN-KY
29	Jacksonville, FL-GA	72	Paducah, KY-IL
30	Orlando, FL	73	Memphis, TN-AR-MS-KY
31	Miami-Fort Lauderdale, FL	74	Huntsville, AL-TN
32	Fort Myers-Cape Coral, FL	75	Tupelo, MS-AL-TN
33	Sarasota-Bradenton, FL	76	Greenville, MS
34	Tampa-St. Petersburg-Clearwater, FL	77	Jackson, MS-AL-LA
35	Tallahassee, FL-GA	78	Birmingham, AL
36	Dothan, AL-FL-GA	79	Montgomery, AL
37	Albany, GA	80	Mobile, AL
38	Macon, GA	81	Pensacola, FL
39	Columbus, GA-AL	82	Biloxi-Gulfport-Pascagoula, MS
40	Atlanta, GA-AL-NC	83	New Orleans, LA-MS
41	Greenville-Spartanburg-Anderson, SC-NC	84	Baton Rouge, LA-MS
42	Asheville, NC	85	Lafayette, LA
43	Chattanooga, TN-GA	86	Lake Charles, LA

Continued on next page

Appendix B—*Continued*

Code	Name	Code	Name
87	Beaumont-Port Arthur, TX	130	Austin-San Marcos, TX
88	Shreveport-Bossier City, LA-AR	131	Houston-Galveston-Brazoria, TX
89	Monroe, LA	132	Corpus Christi, TX
90	Little Rock-North Little Rock, AR	133	McAllen-Edinburg-Mission, TX
91	Fort Smith, AR-OK	134	San Antonio, TX
92	Fayetteville-Springdale-Rogers, AR-MO-OK	135	Odessa-Midland, TX
93	Joplin, MO-KS-OK	136	Hobbs, NM-TX
94	Springfield, MO	137	Lubbock, TX
95	Jonesboro, AR-MO	138	Amarillo, TX-NM
96	St. Louis, MO-IL	139	Santa Fe, NM
97	Springfield, IL-MO	140	Pueblo, CO-NM
98	Columbia, MO	141	Denver-Boulder-Greeley, CO-KS-NE
99	Kansas City, MO-KS	142	Scottsbluff, NE-WY
100	Des Moines, IA-IL-MO	143	Casper, WY-ID-UT
101	Peoria-Pekin, IL	144	Billings, MT-WY
102	Davenport-Moline-Rock Island, IA-IL	145	Great Falls, MT
103	Cedar Rapids, IA	146	Missoula, MT
104	Madison, WI-IL-IA	147	Spokane, WA-ID
105	La Crosse, WI-MN	148	Idaho Falls, ID-WY
106	Rochester, MN-IA-WI	149	Twin Falls, ID
107	Minneapolis-St. Paul, MN-WI-IA	150	Boise City, ID-OR
108	Wausau, WI	151	Reno, NV-CA
109	Duluth-Superior, MN-WI	152	Salt Lake City-Ogden, UT-ID
110	Grand Forks, ND-MN	153	Las Vegas, NV-AZ-UT
111	Minot, ND	154	Flagstaff, AZ-UT
112	Bismarck, ND-MT-SD	155	Farmington, NM-CO
113	Fargo-Moorhead, ND-MN	156	Albuquerque, NM-AZ
114	Aberdeen, SD	157	El Paso, TX-NM
115	Rapid City, SD-MT-NE-ND	158	Phoenix-Mesa, AZ-NM
116	Sioux Falls, SD-IA-MN-NE	159	Tucson, AZ
117	Sioux City, IA-NE-SD	160	Los Angeles-Riverside-Orange, CA-AZ
118	Omaha, NE-IA-MO	161	San Diego, CA
119	Lincoln, NE	162	Fresno, CA
120	Grand Island, NE	163	San Francisco-Oakland-San Jose, CA
121	North Platte, NE-CO	164	Sacramento-Yolo, CA
122	Wichita, KS-OK	165	Redding, CA-OR
123	Topeka, KS	166	Eugene-Springfield, OR-CA
124	Tulsa, OK-KS	167	Portland-Salem, OR-WA
125	Oklahoma City, OK	168	Pendleton, OR-WA
126	Western Oklahoma, OK	169	Richland-Kennewick-Pasco, WA
127	Dallas-Fort Worth, TX-AR-OK	170	Seattle-Tacoma-Bremerton, WA
128	Abilene, TX	171	Anchorage, AK
129	San Angelo, TX	172	Honolulu, HI

Source: Survey of Current Business (February 1995).

Note: Codes are assigned beginning with 1 in northern Maine, continuing south to Florida, then north to the Great Lakes, and continuing in a serpentine pattern to the West Coast. Except for the Western Oklahoma EA (126), the Northern Michigan EA (58), and the 17 EAs mainly corresponding to CMSAs, each EA is named for the metropolitan area or city that is the node of its largest CEA and that is usually, but not always, the largest metropolitan area or city in the EA. The name of each EA includes each state that contains counties in that EA.

Appendix C
Growth Rate Threshold Values Defining Significant Sprawl for EAs

	Households (%)		Employment (%)			Households (%)		Employment (%)	
EA	1980–2000	2000–2025	1980–2000	2000–2025	EA	1980–2000	2000–2025	1980–2000	2000–2025
1	1.72	1.04	2.35	1.32	46	1.78	1.02	2.89	1.27
2	1.91	1.13	3.10	1.32	47	1.33	0.96	2.29	1.29
3	1.94	1.04	2.55	1.32	48	1.36	1.04	2.03	1.32
4	2.31	1.52	2.81	1.37	49	2.26	1.65	3.18	1.48
5	1.36	1.04	2.06	1.32	50	1.36	1.04	2.36	1.32
6	1.36	1.04	2.03	1.32	51	1.33	1.29	2.10	1.38
7	1.36	1.04	2.03	1.32	52	1.36	1.04	2.03	1.32
8	1.36	1.04	2.03	1.32	53	1.36	1.04	2.03	1.32
9	1.36	1.04	2.03	1.16	54	1.36	1.04	2.03	1.32
10	1.43	1.04	2.19	1.32	55	1.36	1.04	2.02	1.34
11	1.69	1.04	2.60	1.32	56	1.36	1.04	2.03	1.32
12	1.88	1.03	2.83	1.32	57	1.38	1.04	3.61	1.39
13	2.43	1.26	3.17	1.97	58	2.66	2.34	4.70	1.80
14	2.43	1.36	2.67	1.28	59	1.36	1.04	1.81	1.48
15	2.67	1.54	3.67	1.46	60	1.79	1.02	2.73	1.32
16	1.36	1.04	2.03	1.32	61	2.59	1.74	4.54	1.70
17	1.63	1.04	2.03	1.32	62	1.61	1.59	3.36	1.55
18	1.96	1.05	2.63	1.35	63	1.59	1.21	3.12	1.32
19	2.62	1.83	2.92	1.72	64	1.69	1.28	2.02	1.42
20	3.35	1.68	4.48	1.42	65	1.36	1.01	3.06	1.20
21	2.08	1.19	2.33	1.39	66	1.36	1.04	3.43	1.32
22	1.87	1.09	2.26	1.30	67	1.27	1.52	2.90	1.32
23	2.42	1.04	2.60	1.32	68	1.36	1.04	2.03	1.32
24	1.78	1.56	1.65	1.30	69	1.36	1.04	2.03	1.32
25	4.09	2.09	4.07	1.78	70	1.86	0.75	3.00	1.56
26	3.67	2.46	3.67	2.00	71	2.14	1.65	3.27	1.55
27	1.53	1.20	2.03	1.25	72	1.36	1.26	1.89	1.35
28	5.24	1.61	2.91	1.60	73	1.36	0.96	2.31	1.37
29	3.69	2.26	4.48	2.38	74	1.94	1.59	3.90	1.58
30	5.99	2.87	6.90	2.94	75	1.36	1.04	2.03	1.32
31	4.71	2.05	4.90	2.32	76	1.36	1.04	2.03	1.32
32	6.96	2.38	2.03	2.75	77	1.36	1.04	2.03	1.32
33	4.56	3.26	8.43	3.14	78	1.69	1.78	3.09	1.57
34	5.77	3.53	6.85	3.61	79	1.09	1.11	2.03	1.41
35	1.61	1.02	3.82	1.98	80	1.36	1.04	2.03	1.32
36	1.34	1.23	2.31	1.69	81	4.83	3.64	5.58	2.81
37	1.32	1.04	1.91	1.32	82	2.90	2.34	2.44	2.64
38	1.51	1.04	2.06	1.31	83	2.47	1.09	2.32	1.54
39	1.45	1.06	2.67	1.76	84	1.53	1.47	2.76	1.90
40	4.30	2.21	5.04	1.97	85	1.44	1.04	2.03	1.32
41	2.00	0.96	2.15	1.32	86	1.36	1.04	2.03	1.32
42	1.81	1.58	2.73	1.59	87	1.36	1.18	2.03	1.51
43	1.80	1.76	3.43	1.77	88	1.36	1.04	2.03	1.32
44	2.34	2.07	3.30	2.09	89	1.36	1.04	2.03	1.32
45	1.36	1.04	2.03	1.32	90	1.50	1.07	2.93	1.64

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Appendix C—*Continued*

	Households (%)		Employment (%)			Households (%)		Employment (%)	
EA	1980–2000	2000–2025	1980–2000	2000–2025	EA	1980–2000	2000–2025	1980–2000	2000–2025
91	1.36	1.04	2.90	1.36	136	1.36	1.04	2.03	1.32
92	2.74	2.08	4.56	2.33	137	1.36	1.04	2.03	1.32
93	1.36	1.04	2.76	1.32	138	1.36	1.04	2.03	1.32
94	2.15	1.48	3.50	1.64	139	2.79	2.02	3.90	2.47
95	1.36	1.04	2.03	1.63	140	1.36	1.04	2.03	1.32
96	1.36	1.04	2.28	1.32	141	3.97	2.51	5.19	2.11
97	1.36	1.04	2.03	1.32	142	1.36	1.04	2.03	1.32
98	1.36	1.04	1.70	1.32	143	1.36	1.13	2.03	1.33
99	1.36	1.04	2.03	1.32	144	1.36	1.04	2.03	0.82
100	1.36	1.04	2.03	1.32	145	1.36	1.04	2.03	1.32
101	1.36	1.04	2.03	1.32	146	2.26	1.05	3.65	1.65
102	1.36	1.04	2.03	1.32	147	2.19	1.41	2.38	1.52
103	1.36	1.04	2.03	1.38	148	1.61	1.83	2.99	2.19
104	1.24	0.97	2.41	1.11	149	1.36	1.04	2.03	1.32
105	1.36	1.04	2.03	1.32	150	2.44	1.38	3.01	1.49
106	1.36	0.86	2.03	1.32	151	4.31	2.51	4.09	2.40
107	1.60	1.55	3.26	1.59	152	2.35	2.34	3.62	2.61
108	1.36	1.66	2.42	1.77	153	8.04	2.85	6.61	3.16
109	1.36	0.59	2.03	1.36	154	3.81	3.14	6.19	2.91
110	1.36	1.04	2.03	1.12	155	1.36	1.04	2.03	1.37
111	1.36	1.04	2.03	1.32	156	3.21	3.11	4.56	2.78
112	1.36	1.04	2.03	1.32	157	2.86	2.00	2.71	2.06
113	1.36	1.04	2.03	1.44	158	3.54	2.90	3.89	2.52
114	1.36	1.04	2.03	1.32	159	4.35	2.32	3.78	2.06
115	1.36	1.20	1.53	1.53	160	3.52	1.51	4.56	2.21
116	1.36	1.04	2.03	1.28	161	2.62	2.45	3.07	2.65
117	1.36	1.04	1.70	1.32	162	2.72	2.07	2.89	2.40
118	1.36	1.04	2.03	1.32	163	2.49	1.53	3.31	1.59
119	1.36	1.04	2.03	1.31	164	4.03	2.02	5.58	2.33
120	1.36	1.04	2.03	1.32	165	2.52	0.68	1.79	1.11
121	1.36	1.04	2.03	1.32	166	2.06	2.44	2.10	2.20
122	1.36	1.04	2.03	1.32	167	2.01	2.37	2.89	2.07
123	1.36	1.04	2.03	1.38	168	1.36	1.04	2.03	1.32
124	1.36	1.00	1.84	1.35	169	1.95	1.40	2.21	1.26
125	1.11	0.82	1.39	1.09	170	3.72	2.86	4.40	2.44
126	1.36	1.04	2.03	1.32	171	3.45	1.69	3.38	1.86
127	2.21	1.00	2.66	1.32	172	4.21	3.22	4.05	2.46
128	1.36	1.04	2.03	1.32					
129	1.40	1.04	2.03	1.32					
130	5.14	2.12	6.54	2.09					
131	2.35	1.38	2.73	1.34					
132	1.36	1.04	2.03	1.32					
133	5.05	2.82	4.86	2.22					
134	4.14	2.24	3.89	2.23					
135	0.42	1.04	2.03	1.32					
Note: The average national growth rates are:						**1.36**	**1.04**	**2.03**	**1.32**

Source: Center for Urban Policy Research, Rutgers University.

Appendix D
162 Urbanized Areas

No.	Urbanized Area Place Name	1990 Population Central City	Outside	Total	1990 Land Area (in Square Miles) Central City	Outside	Total
1	Akron, OH	223,019	304,844	527,863	62.2	194.9	257.1
2	Albany-Schenectady-Troy, NY	220,917	288,189	509,106	42.7	166.0	208.7
3	Albuquerque, NM	384,736	112,384	497,120	132.2	93.6	225.8
4	Allentown-Bethlehem-Easton, PA-NJ	202,794	207,642	410,436	41.3	100.8	142.1
5	Amarillo, TX	157,615	319	157,934	87.9	0.3	88.2
6	Anchorage, AK	226,338	0	226,338	1,697.6	0.0	1,697.6
7	Ann Arbor, MI	109,592	112,469	222,061	25.9	50.3	76.2
8	Antioch-Pittsburg, CA	109,759	44,009	153,768	30.5	31.0	61.5
9	Appleton-Neenah, WI	65,695	95,223	160,918	17.1	40.5	57.6
10	Atlanta, GA	394,017	1,763,789	2,157,806	131.8	1,004.9	1,136.7
11	Atlantic City, NJ	37,986	132,007	169,993	11.3	77.4	88.7
12	Augusta, GA-SC	44,639	241,899	286,538	19.7	169.2	188.9
13	Aurora, IL	99,581	92,462	192,043	33.5	49.6	83.1
14	Austin, TX	465,622	96,386	562,008	217.8	55.4	273.2
15	Bakersfield, CA	174,101	128,504	302,605	61.9	36.3	254.5
16	Baltimore, MD	736,014	1,153,859	1,889,873	80.8	511.7	592.5
17	Baton Rouge, LA	219,531	146,412	365,943	73.9	111.6	185.5
18	Biloxi-Gulfport, MS	87,094	92,549	179,643	42.2	86.7	128.9
19	Binghamton, NY	53,008	105,397	158,405	10.4	55.0	65.4
20	Birmingham, AL	265,968	356,106	622,074	148.5	250.3	398.8
21	Boise City, ID	125,738	42,203	167,941	46.1	25.4	71.5
22	Boston, MA	574,283	2,201,087	2,775,370	48.4	842.8	891.2
23	Bridgeport-Milford, CT	189,854	224,009	413,863	38.3	122.4	160.7
24	Brockton, MA	92,788	68,122	160,910	21.5	49.0	70.5
25	Buffalo-Niagara Falls, NY	389,963	564,369	954,332	54.7	230.8	285.5
26	Canton, OH	84,161	160,415	244,576	20.2	88.9	109.1
27	Charleston, SC	80,414	313,542	393,956	43.2	207.7	250.9
28	Charleston, WV	57,287	107,131	164,418	29.5	63.6	93.1
29	Charlotte, NC	395,934	59,663	455,597	174.3	67.4	241.7
30	Chattanooga, TN-GA	152,466	144,489	296,955	118.4	138.4	256.8
31	Chicago, IL-Northwestern Indiana	2,783,726	4,008,361	6,792,087	227.2	1,357.3	1,584.5
32	Cincinnati, OH-KY	364,040	848,635	1,212,675	77.2	434.5	511.7
33	Cleveland, OH	505,616	1,171,876	1,677,492	77.0	558.9	635.9
34	Colorado Springs, CO	280,995	71,994	352,989	127.8	48.7	176.5
35	Columbia, SC	98,052	230,297	328,349	117.1	81.8	198.9
36	Columbus, GA-AL	173,196	47,502	220,698	95.6	36.8	132.4
37	Columbus, OH	632,910	312,327	945,237	190.9	154.0	344.9
38	Corpus Christi, TX	257,453	12,553	270,006	135.0	20.5	155.5
39	Dallas-Fort Worth, TX	1,006,877	2,191,382	3,198,259	342.4	1,100.6	1,443.0
40	Davenport-Rock Island-Moline, IA-IL	95,333	168,685	264,018	61.4	84.6	146.0
41	Daytona Beach, FL	61,921	159,420	221,341	32.2	95.6	127.8
42	Dayton, OH	182,044	431,423	613,467	55.0	218.4	273.4
43	Denver, CO	467,610	1,050,367	1,517,977	153.3	305.5	458.8
44	Des Moines, IA	193,187	100,479	293,666	75.3	84.4	159.7
45	Detroit, MI	1,027,974	2,669,555	3,697,529	138.7	980.7	1,119.4
46	Durham, NC	136,611	68,744	205,355	69.3	36.5	105.8
47	El Paso, TX-NM	515,187	55,830	571,017	162.6	57.6	220.3
48	Erie, PA	108,718	68,950	177,668	22.0	35.7	57.7
49	Eugene-Springfield, OR	157,352	31,840	189,192	51.4	14.1	65.5
50	Evansville, IN-KY	126,272	56,815	183,087	40.7	34.2	74.9
51	Fayetteville, NC	75,695	166,068	241,763	40.6	96.4	137.0
52	Flint, MI	140,761	185,262	326,023	33.8	130.0	163.8
53	Ft. Lauderdale-Hollywood-Pompano Beach, FL	149,377	1,088,757	1,238,134	31.4	295.7	327.1
54	Fort Myers-Cape Coral, FL	45,206	175,346	220,552	22.0	102.2	124.2
55	Fort Wayne, IN	173,072	75,352	248,424	62.7	41.4	104.1

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Appendix D—*Continued*

		1990 Population			1990 Land Area (in Square Miles)		
No.	Urbanized Area Place Name	Central City	Outside	Total	Central City	Outside	Total
56	Fresno, CA	354,202	99,186	453,388	99.1	33.6	132.7
57	Grand Rapids, MI	189,126	247,210	436,336	44.3	178.9	223.2
58	Green Bay, WI	96,466	65,465	161,931	43.8	56.3	100.1
59	Greensboro, NC	183,521	10,987	194,508	79.8	12.4	92.2
60	Greenville, SC	58,282	189,891	248,173	25.1	123.0	148.1
61	Harrisburg, PA	52,376	240,528	292,904	8.1	141.7	149.8
62	Hartford-Middletown, CT	139,739	406,459	546,198	17.3	224.0	241.3
63	Honolulu, HI	365,272	267,331	632,603	82.8	55.9	138.7
64	Houston, TX	1,630,553	1,271,298	2,901,851	539.9	637.4	1,177.3
65	Huntington-Ashland, WV-KY-OH	54,844	114,750	169,594	14.9	71.1	86.0
66	Huntsville, AL	158,782	21,533	180,315	106.4	25.9	132.3
67	Indianapolis, IN	731,327	183,434	914,761	361.7	107.2	468.9
68	Jacksonville, FL	627,128	111,290	738,418	445.6	61.8	507.4
69	Jackson, MS	196,637	92,648	289,285	109.0	107.9	216.9
70	Joliet, IL	76,836	93,881	170,717	27.8	55.7	83.5
71	Kalamazoo, MI	80,277	84,153	164,430	24.6	60.1	84.7
72	Kansas City, MO-KS	584,913	690,404	1,275,317	419.3	342.5	761.8
73	Knoxville, TN	165,121	139,345	304,466	77.2	141.6	218.8
74	Lancaster-Palmdale, CA	166,133	21,057	187,190	75.7	7.2	82.9
75	Lancaster, PA	55,551	138,032	193,583	7.4	79.9	87.3
76	Lansing-East Lansing, MI	127,321	137,774	265,095	33.9	64.8	98.7
77	Las Vegas, NV	258,295	439,053	697,348	83.3	147.8	231.1
78	Lawrence-Haverhill, MA-NH	121,625	115,737	237,362	40.3	70.1	110.4
79	Lexington-Fayette, KY	218,925	1,776	220,701	95.2	2.9	98.1
80	Lincoln, NE	191,972	586	192,558	63.3	1.1	64.4
81	Little Rock-North Little Rock, AR	237,536	67,817	305,353	142.6	56.6	199.2
82	Lorain-Elyria, OH	127,991	96,096	224,087	43.5	103.5	147.0
83	Los Angeles, CA	4,831,936	6,571,010	11,402,946	653.9	1,311.8	1,965.7
84	Louisville, KY-IN	269,063	485,893	754,956	62.1	220.5	282.6
85	Lowell, MA-NH	103,439	78,212	181,651	13.8	53.3	67.1
86	Lubbock,TX	186,206	1,700	187,906	104.1	4.5	108.6
87	Madison, WI	191,262	53,074	244,336	57.8	39.9	97.7
88	McAllen-Edinburg-Mission, TX	142,559	120,633	263,192	60.4	63.9	124.3
89	Melbourne-Palm Bay, FL	122,278	183,700	305,978	92.3	140.9	233.2
90	Memphis, TN-AR-MS	610,337	214,856	825,193	256.0	85.0	341.0
91	Miami-Hialeah, FL	546,552	1,368,108	1,914,660	54.8	297.9	352.7
92	Milwaukee, WI	628,088	598,205	1,226,293	96.1	415.9	512.0
93	Minneapolis-St. Paul, MN	640,618	1,439,058	2,079,676	107.7	955.3	1,063.0
94	Mobile, AL	196,278	104,634	300,912	118.0	110.9	228.9
95	Modesto, CA	164,730	65,879	230,609	30.2	21.9	52.1
96	Montgomery, AL	187,106	22,901	210,007	135.0	21.4	156.4
97	Nashville, TN	483,427	89,867	573,294	376.4	107.1	483.5
98	New Haven-Meriden, CT	189,953	261,533	451,486	42.6	145.1	187.7
99	New London-Norwich, CT	65,931	90~,355	156,286	33.8	75.8	109.6
100	New Orleans, LA	496,938	543,288	1,040,226	87.4	182.7	270.1
101	New York, NY-Northeastern New Jersey	7,322,564	8,721,448	16,044,012	308.9	2,657.5	2,966.4
102	Norfolk-Virginia Beach-Newport News, VA	824,343	498,755	1,323,098	370.4	293.3	663.7
103	Ogden, UT	63,909	195,238	259,147	26.1	126.8	152.9
104	Oklahoma City, OK	444,719	339,706	784,425	452.9	193.9	646.8
105	Omaha, NE-IA	335,795	208,497	544,292	100.6	92.4	193.0
106	Orlando, FL	164,693	722,433	887,126	67.3	327.3	394.6
107	Oxnard-Ventura, CA	142,216	338,266	480,482	24.4	132.7	157.1
108	Pensacola, FL	58,165	195,393	253,558	22.6	132.7	155.3
109	Peoria, IL	113,504	128,849	242,353	40.9	88.2	129.1
110	Philadelphia, PA-NJ	1,585,577	2,636,634	4,222,211	135.1	1,029.1	1,164.2

Continued on next page

Appendix D—*Continued*

No.	Urbanized Area Place Name	1990 Population Central City	Outside	Total	1990 Land Area (in Square Miles) Central City	Outside	Total
111	Phoenix, AZ	983,403	1,022,836	2,006,239	419.9	321.2	741.1
112	Pittsburgh, PA	369,879	1,308,866	1,678,745	55.6	722.5	778.1
113	Portland-Vancouver, OR-WA	437,319	734,839	1,172,158	124.7	263.3	388.0
114	Providence-Pawtucket, RI-MA	160,728	685,565	846,293	18.5	280.2	298.7
115	Provo-Orem, UT	154,396	66,160	220,556	56.5	43.1	99.6
116	Raleigh, NC	207,951	97,974	305,925	88.1	87.8	175.9
117	Reading, PA	78,380	107,887	186,267	9.8	50.0	59.8
118	Reno, NV	133,850	79,897	213,747	57.5	35.7	93.2
119	Richmond, VA	87,425	502,555	589,980	29.7	273.0	302.7
120	Riverside-San Bernardino, CA	390,669	779,527	1,170,196	132.8	327.3	460.1
121	Roanoke, VA	96,397	81,880	178,277	42.9	48.8	91.7
122	Rochester, NY	231,636	388,017	619,653	35.8	184.2	220.0
123	Rockford, IL	139,426	68,400	207,826	45.0	46.1	91.1
124	Sacramento, CA	414,050	682,955	1,097,005	126.1	207.6	333.7
125	Salem, OR	107,786	49,293	157,079	41.5	15.3	56.8
126	Salt Lake City, UT	159,727	629,720	789,447	39.0	214.9	254.0
127	San Antonio, TX	935,933	193,221	1,129,154	333.0	105.0	438.0
128	San Diego, CA	1,110,549	1,237,868	2,348,417	324.0	366.2	690.2
129	San Francisco-Oakland, CA	723,959	2,905,557	3,629,516	46.7	827.4	874.1
130	San Jose, CA	782,248	652,771	1,435,019	171.3	167.1	338.4
131	Santa Barbara, CA	85,571	96,592	182,163	18.9	29.9	48.8
132	Santa Cruz, CA	49.G40	103,315	152,355	13.3	85.4	98.7
133	Santa Rosa, CA	113,313	81,247	194,560	33.7	33.5	67.2
134	Sarasota-Bradenton, FL	50,961	393,424	444,385	14.6	178.4	193.0
135	Savannah, GA	137,560	61,070	198,630	62.6	88.0	150.6
136	Scranton-Wilkes-Barre, PA	81,805	306,420	388,225	25.2	176.1	201.3
137	Seattle, WA	516,259	1,227,827	1,744,086	83.9	504.0	587.9
138	Shreveport, LA	198,525	57,964	256,489	98.6	47.~9	146.5
139	South Bend-Mishawaka, IN-Ml	105,511	132,421	237,932	36.4	84.0	120.4
140	Spokane, WA	177,196	101,842	279,038	55.9	57.7	113.6
141	Springfield, MA-CT	156,983	375,764	532,747	32.1	269.8	301.9
142	Springfield, MO	140,494	18,592	159,086	68.0	12.7	80.7
143	Stamford, CT-NY	108,056	79,144	187,200	37.7	41.6	79.3
144	Stockton, CA	210,943	51,103	262,046	52.6	21.2	73.8
145	St. Louis, MO-IL	396,685	1,549,841	1,946,526	61.9	666.3	728.2
146	Syracuse, NY	163,860	225,058	388,918	25.1	108.5	133.6
147	Tacoma, WA	176,664	320,546	497,210	48.0	184.8	232.8
148	Tallahassee, FL	124,773	31,111	155,884	63.3	25.7	89.0
149	Tampa-St. Petersburg-Clearwater, FL	280,015	1,428,695	1,708,710	108.7	541.0	649.7
150	Toledo, OH-Ml	332,943	156,212	489,155	80.6	112.8	193.4
151	Trenton, NJ-PA	88,675	209,927	298,602	7.7	88.1	95.8
152	Tucson, AZ	405,390	173,845	579,235	156.3	90.2	246.5
153	Tulsa, OK	367,302	107,366	474,668	183.5	120.9	304.4
154	Utica-Rome, NY	68,637	89,916	158,553	16.3	75.2	91.5
155	Washington, DC-MD-VA	606,900	2,756,131	3,363,031	61.4	883.2	944.6
156	Waterbury, CT	108,961	66,106	175,067	28.6	44.7	73.3
157	W. Palm Beach-Boca Raton-Delray Beach, FL	67,643	727,205	794,848	49.3	257.3	306.6
158	Wichita, KS	304,011	34,778	338,789	115.1	29.4	144.5
159	Wilmington, DE-NJ-MD-PA	71~,529	378,087	449,616	10.8	177.0	187.8
160	Winston-Salem, NC	143,485	41,699	185,184	71.1	49.6	120.7
161	Worcester, MA-CT	169,759	145,907	315,666	37.6	101.1	138.7
162	Youngstown-Warren, OH	95,732	265,895	361,627	33.8	133.5	167.3
	Totals	**58,353,928**	**80,503,983**	**138,857,911**	**17,040.9**	**33,532.8**	**50,730.2**

Source: Anthony Downs, The Brookings Institute

Appendix E
Sprawl Index Summary Table

Rank	Urbanized Area Place Name	Composite Sprawl Index	Score for: Total Urban Area Land Size	Outlying Population Density	Ratio of Central to Outlying Density	Percent of Population in Central City	Percent of Population Outside of Urbanized Area	Percent City Commuters Driving Alone	Percent City Commuters Using Car Pools	Fragmented Local Governments	Ratio of City Percent Poor to Suburban Percent Poor	Composite Sprawl Score if Land Size and Outlying Density Are Weighted Quadruple
1	Harrisburg, PA	59.24	3.46	66.11	52.74	97.97	61.59	49.16	70.19	72.96	58.96	49.46
2	Antioch-Pittsburg, CA	56.41	0.44	71.66	35.09	92.86	99.25	91.89	39.75	20.37		47.69
3	Utica-Rome, NY	55.91	1.46	76.13	48.76	84.24	61.28	77.53	45.34	81.54	26.89	49.06
4	Reading, PA	54.87	0.38	56.93	51.32	82.50	54.80	62.67	56.52	73.81	54.90	44.38
5	Lancaster, PA	54.34	1.32	65.51	60.16	93.42	66.54	62.50	49.69	46.39	43.56	45.97
6	Joliet, IL	54.04	1.19	66.35	22.70	84.42	64.09	89.53	44.10	75.59	38.38	45.93
7	Lowell, MA-NH	54.00	0.63	70.71	70.72	67.90	43.27	82.77	51.55	22.29	76.19	46.67
8	Hartford-Middletown. CT	53.67	6.60	63.78	61.63	94.57	64.82	52.03	47.20	16.35	76.05	46.28
9	Scranton-Wilkes-Barre, PA	53.10	5.23	65.26	25.83	93.77	48.11	75.51	58.39	89.00	16.81	45.96
10	Kalamazoo, MI	51.40	1.23	72.05	32.26	87.45	75.74	81.25	20.50	62.28	29.83	45.49
11	Lawrence-Haverhill, MA-NH	51.37	2.11	67.04	25.31	70.52	40.26	72.30	80.12	22.29	82.35	44.65
12	Grand Rapids, MI	50.88	5.98	72.41	42.77	85.86	65.63	89.19	23.60	41.79	30.67	46.21
13	Greensboro, NC	50.82	1.49	82.31	35.93	88.76	100.00	93.07	28.57	15.36	11.90	47.25
14	Winston-Salem, NC	50.76	2.46	83.22	33.23	74.07	78.36	87.67	33.54	42.55	21.71	47.59
15	Milwaukee, WI	50.54	15.88	71.29	62.91	60.38	17.64	72.97	32.92	20.90	100.00	47.76
16	Dallas-Fort Worth, TX	50.27	47.79	60.25	20.45	80.73	25.51	81.93	45.34	63.42	27.03	51.77
17	Lorain-Elyria, OH	49.83	3.37	81.47	43.87	56.78	21.29	97.13	34.16	90.64	19.75	46.86
18	Syracuse, NY	49.35	2.91	58.59	43.57	83.81	58.42	62.50	36.02	57.29	41.04	41.91
19	Peoria, IL	49.24	2.75	70.84	26.30	71.56	35.03	94.43	14.91	100.00	27.31	44.26
20	Fort Wayne, IN	48.79	1.90	63.67	21.00	66.76	55.91	94.43	28.09	83.47	25.91	42.39
21	Rochester, NY	48.79	5.87	57.95	42.52	84.10	51.15	69.93	33.54	43.87	50.14	42.03
22	Greenville, SC	47.90	3.40	69.18	20.82	100.00	86.06	80.41	36.65	16.40	18.21	43.26
23	Rockford, IL	47.67	1.45	70.38	28.91	62.07	45.36	94.93	27.33	77.32	21.29	42.97
24	Binghamton, NY	47.43	0.57	61.74	36.82	86.00	49.23	73.48	38.51	49.88	30.67	40.92
25	Youngstown-Warren, OH	47.33	4.06	60.24	19.69	90.42	48.87	94.43	26.09	49.80	32.35	41.26
26	Durham, NC	47.29	1.95	62.40	14.49	90.44	93.37	83.45	47.20	14.77	17.51	41.24
27	Cleveland, OH	47.22	20.12	58.14	43.36	82.86	29.24	68.92	37.89	29.95	54.48	43.98
28	Pittsburgh, PA	47.07	25.00	63.84	50.84	90.94	36.70	42.06	34.78	56.21	23.25	46.01
29	Trenton, NJ-PA	46.91	1.61	52.43	66.91	78.28	10.25	62.33	67.08	13.55	69.75	38.95
30	Detroit, ML	46.88	36.69	45.66	37.69	81.64	16.37	73.99	50.93	16.18	82.75	44.60
31	Daytona Beach, FL	46.84	2.71	66.71	15.96	90.88	54.72	81.76	29.19	33.70	45.94	41.99
32	Canton, OH	46.63	2.07	63.98	31.97	84.58	46.57	94.59	16.77	46.51	32.63	41.19
33	Charlotte. NC	46.54	6.61	82.33	35.53	70.91	74.62	89.86	31.06	16.08	11.90	45.71
34	Minneapolis-St. Paul, MN	46.54	34.76	69.93	54.67	80.41	22.19	61.32	16.15	43.42	35.99	48.86
35	Augusta, GA-SC	46.43	4.80	71.46	21.94	95.99	38.04	73.31	62.73	18.36	31.23	43.11
36	Huntington-Ashland, WV-KY-OH	46.19	1.28	67.78	31.57	88.68	56.13	80.91	30.43	47.34	11.62	41.53
37	Raleigh, NC	45.87	4.36	77.72	29.28	81.50	78.99	92.91	21.12	14.77	12.18	43.94
38	Knoxville, TN	45.59	5.83	80.35	30.09	77.24	58.96	89.70	32.30	15.66	20.17	44.59
39	Lincoln, NE	45.53	0.53	89.37	78.81	10.91	12.11	87.67	28.57	60.33	41.46	45.30
40	Oxnard-Ventura, CA	45.26	3.71	49.11	31.65	84.69	34.59	73.82	100.00	4.94	24.79	37.72

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Appendix E—*Continued*

Rank	Urbanized Area Place Name	Composite Sprawl Index	Score for: Total Urban Area Land Size	Score for: Outlying Population Density	Score for: Ratio of Central to Outlying Density	Score for: Percent of Population in Central City	Score for: Percent of Population Outside of Urbanized Area	Score for: Percent City Commuters Driving Alone	Score for: Percent City Commuters Using Car Pools	Score for: Fragmented Local Governments	Score for: Ratio of City Percent Poor to Suburban Percent Poor	Composite Sprawl Score if Land Size and Outlying Density Are Weighted Quadruple
41	Erie, PA	45.08	0.31	61.44	35.42	65.12	43.60	75.51	51.55	46.68	26.05	39.40
42	Cincinnati, OH-KY	45.05	15.87	61.01	33.42	81.89	25.21	73.31	29.19	44.23	41.32	42.41
43	Flint, MI	45.95	3.94	71.55	40.46	72.38	29.78	93.41	29.81	23.72	39.50	42.07
44	Lansing-East Lansing, MI	45.91	1.71	57.56	24.46	75.90	47.53	90.03	27.95	57.32	21.71	38.80
45	Fort Myers-Cape Coral, FL	44.63	2.58	65.75	16.58	93.04	41.96	77.03	67.08	3.48	34.17	40.45
46	New London-Norwich, CT	44.59	2.08	76.20	22.65	83.16	56.76	54.39	41.61	31.41	33.05	42.41
47	Worcester, MA-CT	44.52	3.08	71.19	43.31	69.38	41.75	79.39	32.92	22.29	37.39	41.57
48	Davenport-Rock Island-Moline, IA-IL	44.49	3.33	60.20	10.78	78.33	30.38	95.27	23.60	83.72	14.85	39.40
49	Appleton-Neenah, WI	44.40	0.30	53.06	22.62	85.13	60.06	97.64	0.00	72.67	8.12	37.31
50	Birmingham, AL	44.35	12.00	71.60	17.43	73.49	31.83	88.18	50.93	26.63	27.03	43.33
51	Atlanta, GA	44.32	37.29	64.96	23.58	93.23	33.25	62.64	22.98	13.53	47.20	47.04
52	Providence-Pawtucket, RI-MA	44.27	8.57	51.16	49.16	92.31	31.17	64.53	50.93	11.29	39.36	38.51
53	Wichita, KS	44.25	3.28	76.39	30.91	40.17	37.05	98.99	16.77	75.12	19.61	42.49
54	Albany-Schenectady-Troy, NY	44.24	5.48	65.34	41.26	79.97	50.21	54.73	24.22	47.42	29.55	40.71
55	Louisville, KY-IN	44.09	8.01	56.01	27.22	77.06	25.10	81.08	33.54	57.71	31.09	39.26
56	Des Moines, IA	44.03	3.80	76.23	29.83	54.67	31.00	85.14	44.72	38.40	32.49	42.43
57	Allentown-Bethlehem-Easton, PA-NJ	43.70	3.20	58.88	33.00	70.91	38.10	78.38	37.89	47.57	25.35	38.63
58	Riverside-San Bernardino, CA	43.69	14.10	52.45	17.10	91.32	67.25	84.29	52.17	5.88	8.68	39.53
59	Brockton, MA	43.59	0.74	72.25	42.98	65.34	39.19	86.32	37.27	22.29	25.91	40.75
60	Baltimore, MD	43.53	18.64	54.98	55.93	74.32	25.36	45.44	55.28	3.15	58.68	40.84
61	St. Louis, MO-IL	43.30	23.29	53.57	38.14	90.43	26.88	71.79	38.51	9.95	37.11	41.35
62	Stockton, CA	42.99	0.86	51.88	23.03	60.35	55.82	86.66	46.58	40.08	21.71	36.34
63	Madison, WI	42.97	1.68	73.45	34.44	51.51	41.04	62.84	22.98	52.61	46.22	40.81
64	Wilmington, DE-NJ-MD-PA	42.87	4.76	57.36	42.92	92.56	15.23	60.30	42.24	14.14	56.30	38.15
65	Springfield, MA-CT	42.78	8.67	72.20	48.61	78.83	11.51	84.80	31.68	23.82	24.93	41.84
66	Evansville, IN-KY	42.70	0.89	66.84	25.86	58.87	42.19	95.78	21.12	54.24	18.49	39.16
67	Akron, OH	42.44	7.14	68.78	31.74	71.07	24.21	92.57	24.84	29.69	31.93	40.65
68	Nashville, TN	42.42	14.90	83.25	21.19	54.77	51.30	91.39	34.16	15.41	15.41	45.08
69	Waterbury, CT	42.38	0.84	70.48	35.66	54.67	25.78	88.01	45.34	9.95	50.70	39.69
70	Indianapolis, IN	42.37	14.40	65.84	16.36	50.57	41.40	91.22	34.16	44.71	22.69	41.47
71	Toledo, OH-MI	42.37	4.96	72.35	41.30	49.24	24.98	97.13	16.15	45.55	29.69	40.88
72	Bridgeport-Milford, CT	42.22	3.84	63.46	37.50	61.53	8.26	76.69	54.04	9.95	64.71	38.79
73	Chicago, IL-Northwestern Indiana	42.19	52.64	41.05	57.44	70.20	18.73	37.67	42.86	19.96	39.22	44.05
74	Jackson, MS	42.18	5.76	82.86	29.09	54.06	32.94	86.99	39.13	17.65	31.09	43.03
75	Philadelphia, PA-NJ	41.91	38.23	48.85	63.42	72.91	17.45	34.97	32.92	23.46	44.96	42.56
76	Savannah. GA	41.86	3.49	86.15	43.84	50.18	28.21	78.55	39.75	19.72	26.89	43.04
77	Ann Arbor, MI	41.81	0.94	55.36	26.20	83.50	67.12	63.85	8.07	55.86	15.41	36.35
78	Chattanooga, TN-GA	41.69	7.13	79.16	17.08	68.91	36.84	91.22	34.16	22.54	18.21	42.27
79	Aurora, IL	41.58	1.18	62.79	22.08	73.81	48.49	89.19	42.86	7.27	26.61	37.74
80	Dayton, OH	41.56	7.70	60.57	23.20	86.97	43.58	75.00	44.72	17.47	14.85	38.59

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Appendix E—*Continued*

			Score for									
Rank	Urbanized Area Place Name	Composite Sprawl Index	Total Urban Area Land Size	Outlying Population Density	Ratio of Central to Outlying Density	Percent of Population in Central City	Percent of Population Outside of Urbanized Area	Percent City Commuters Driving Alone	Percent City Commuters Using Car Pools	Fragmented Local Governments	Ratio of City Percent Poor to Suburban Percent Poor	Composite Sprawl Score if Land Size and Outlying Density Are Weighted Quadruple
81	Ogden. UT	41.56	3.57	69.26	22.02	85.12	2.70	82.60	60.87	26.45	21.43	39.50
82	Mobile, AL	41.44	6.17	81.16	24.41	63.29	45.29	97.64	26.71	15.93	12.32	42.33
83	Columbus, OH	41.42	10.15	59.51	22.63	56.96	36.51	88.68	24.84	43.96	29.55	38.79
84	Tulsa, OK	41.37	8.76	82.27	31.20	51.83	40.56	95.61	21.74	26.60	13.73	43.03
85	Little Rock-North Little Rock, AR	41.34	5.15	76.08	19.25	57.75	49.68	95.44	34.78	23.00	10.92	41.05
86	Biloxi, GA-MS	40.77	2.75	78.69	26.77	77.56	52.15	75.00	29.19	14.15	10.64	40.75
87	Kansas City, MO-KS	40.69	24.44	59.76	9.58	67.81	23.85	85.64	35.40	36.90	22.83	41.25
88	McAllen-Edinburg-Mission, TX	40.35	2.59	62.31	17.31	67.57	38.51	83.11	68.94	17.37	5.46	37.19
89	New Haven-Meriden, CT	40.28	4.76	64.02	34.25	69.02	18.22	56.42	34.78	9.95	71.15	37.93
90	Atlantic City, NJ	40.21	1.37	65.95	27.29	94.76	57.41	16.55	11.80	41.24	45.52	37.59
91	Charleston, WV	40.17	1.52	66.37	15.96	82.95	42.16	80.74	29.19	28.10	14.57	37.68
92	Baton Rouge. LA	40.13	4.69	73.81	31.35	62.86	37.71	90.54	26.09	11.89	22.27	39.78
93	Houston, TX	40.08	38.68	60.18	20.96	57.64	21.37	80.57	47.20	7.91	26.19	43.82
94	Richmond, VA	40.00	8.70	63.25	22.14	96.69	39.08	68.41	36.65	5.23	19.89	38.39
95	Springfield, MO	39.94	1.09	70.78	19.54	50.39	48.87	95.27	19.25	30.28	23.95	38.34
96	Green Bay, WI	39.93	1.76	76.79	26.22	54.23	20.60	95.27	11.18	41.27	32.07	39.67
97	Corpus Christi, TX	39.93	3.66	87.78	43.12	28.41	28.02	87.50	55.90	19.07	5.88	42.24
98	Buffalo-Niagara Falls, NY	39.86	8.11	51.19	40.36	72.29	24.25	63.51	36.02	17.34	45.66	35.77
99	Santa Cruz, CA	39.77	1.71	75.85	42.20	84.59	41.34	63.34	23.60	6.67	18.63	39.37
100	Pensacola, FL	39.76	3.65	70.61	24.20	89.39	32.37	95.27	24.22	6.20	11.90	38.71
101	Huntsville, AL	39.67	2.86	83.40	24.85	49.28	47.21	100.00	24.22	14.00	11.20	41.05
102	Melbourne-Palm Bay, FL	39.65	6.32	73.97	14.07	74.59	28.61	94.43	36.02	12.62	16.25	39.85
103	Roanoke, VA	39.60	1.47	66.50	18.54	61.39	25.31	89.86	40.99	11.16	41.18	37.36
104	Shreveport, LA	39.46	3.35	75.84	23.03	50.81	39.08	93.58	30.43	24.60	14.43	39.52
105	Boston, MA	39.01	28.87	47.86	62.90	88.41	17.20	27.20	16.15	22.29	40.20	38.75
106	Tampa-St. Petersburg-Clearwater, FL	38.76	20.60	47.28	13.50	92.99	21.32	85.81	39.75	5.73	21.85	36.83
107	Tacoma, WA	38.65	6.31	65.37	29.38	75.14	18.63	85.47	34.78	11.78	21.01	37.53
108	Charleston, SC	38.61	6.93	69.86	17.07	90.49	27.34	75.17	24.84	18.80	16.95	38.52
109	New York, NY-NE New Jersey	38.59	100.00	34.48	100.00	62.06	8.98	0.00	3.73	2.76	35.29	50.05
110	Sarasota-Bradenton, FL	38.53	4.94	55.98	21.91	96.35	11.31	84.29	39.75	6.90	25.35	35.30
111	Orlando, FL	38.20	11.85	55.94	15.35	93.09	33.84	74.83	29.19	10.20	19.47	36.48
112	South Bend-Mishawaka, IN-MI	38.10	2.45	68.53	25.46	61.62	4.53	90.03	32.92	29.80	27.59	37.06
113	Lubbock,TX	38.05	2.05	92.46	65.55	17.60	19.15	95.10	25.47	12.72	12.32	41.73
114	Boise City. ID	37.78	0.78	66.83	22.73	61.84	53.06	96.11	11.80	16.05	10.78	36.19
115	Tallahassee, FL	37.74	1.38	75.83	22.54	50.11	40.83	86.15	34.78	12.11	15.97	38.09
116	Provo-Orem, UT	37.68	1.74	69.36	24.65	44.55	20.04	63.18	44.72	26.68	44.26	36.83
117	Salt Lake City. UT	37.68	7.03	41.50	19.35	91.53	32.37	77.03	34.16	12.92	23.25	32.32
118	Santa Rosa, CA	37.64	0.63	51.58	19.19	76.16	61.22	89.19	21.74	7.97	11.06	33.03
119	Salem, OR	37.17	0.27	35.68	11.16	65.85	53.39	81.93	45.96	28.77	11.48	29.49
120	Lexington-Fayette, KY	37.14	1.69	87.77	0.00	49.55	56.00	91.89	22.98	15.59	8.82	40.18

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Appendix E—*Continued*

Rank	Urbanized Area Place Name	Composite Sprawl Index	Score for Total Urban Area Land Size	Score for Outlying Population Density	Score for Ratio of Central to Outlying Density	Score for Percent of Population in Central City	Score for Percent of Population Outside of Urbanized Area	Score for Percent City Commuters Driving Alone	Score for Percent City Commuters Using Car Pools	Score for Fragmented Local Governments	Score for Ratio of City Percent Poor to Suburban Percent Poor	Composite Sprawl Score if Land Size and Outlying Density Are Weighted Quadruple
121	Fayetteville, NC	36.76	3.02	65.61	14.98	77.92	14.72	93.75	33.54	10.24	17.09	35.78
122	West Palm -Boca -Delray FL	36.76	8.84	43.58	6.72	99.13	9.76	85.81	41.61	14.26	21.15	32.54
123	Austin, TX	36.62	7.69	65.27	17.01	48.37	41.22	83.78	33 ' 54	16.86	15.83	36.56
124	Washington, DC-MD-VA	36.43	30.70	37.70	43.85	92.09	24.99	18.58	25.47	8.37	46.08	35.54
125	Montgomery, AL	36.41	3.69	78.64	17.93	38.76	34.62	95.95	33.54	12.91	11.62	38.31
126	Oklahoma City, OK	36.22	20.50	65.03	7.76	57.67	22.32	95.95	30.43	12.91	13.45	38.84
127	Stamford, CT-NY	35.99	1.05	62.02	20.86	72.33	53.09	78.04	13.04	5.01	18.49	34.21
128	Columbus, GA-AL	35.91	2.87	74.23	19.43	36.14	18.90	89.53	31.68	14.53		37.04
129	Santa Barbara, CA	35.82	0.00	35.51	19.40	82.65	62.24	74.66	32.30	6.63	8.96	28.59
130	Lancaster-Palmdale, CA	35.45	1.17	41.62	10.39	33.92	28.06	83.45	76.40	8.56		29.42
131	Seattle, WA	35.40	18.48	51.37	34.97	80.24	17.45	58.61	24.22	9.02	24.23	35.21
132	Sacramento, CA	35.30	9.76	34.33	13.82	77.49	31.83	80.57	47.20	3.24	19.47	30.00
133	Anchorage. AK	35.30	56.51	100.00	0.00	0.00	0.00	80.74	44.10	1.04		53.71
134	Omaha, NE-IA	35.06	4.94	54.95	20.48	51.08	18.28	91.22	26.71	24.64	23.25	33.02
135	Modesto, CA	35.06	0.11	39.95	25.10	59.73	46.34	93.24	35.40	8.36	7.28	29.05
136	Bakersfield, CA	34.87	7.05	29.33	11-00	73.19	54.58	95.27	29.81	6.77	6.86	28.20
137	Spokane. WA	34.72	2.22	64.76	24.86	54.81	27.95	86.99	21.74	10.38	18.77	34.23
138	Portland-Vancouver, OR-WA	34.57	11.63	44.29	17.40	76.51	27.80	69.26	31.06	12.88	20.31	31.92
139	Fresno. CA	34.29	2.88	41.07	16.76	57.13	49.09	90.71	30.43	7.77	12.75	29.36
140	San Antonio, TX	34.24	13.34	63.26	21.14	31.57	18.12	83.45	47.20	8.67	21.43	35.87
141	Las Vegas, NV	34.21	6.25	40.70	14.45	74.97	22.35	84.46	49.07	4.56	11.06	29.91
142	Columbia, SC	34.19	5.14	43.80	4.12	84.32	33.95	63.34	24.22	14.63		30.03
143	Memphis, TN-AR-MS	34.12	10.02	49.54	13.06	42.38	22.19	86.82	44.72	14.10	24.23	32.38
144	Albuquerque, NM	33.87	6.07	76.03	33.56	37.31	19.17	91.22	26.09	7.87	7.56	36.74
145	San Francisco-Oakland, CA	33.47	28.29	29.90	61.12	88.72	14.99	24.49	22.36	6.49	24.93	31.72
146	New Orleans, LA	33.35	7.59	40.64	26.47	65.97	23.40	58.45	46.58	5.67	25.35	29.65
147	Amarillo, TX	32.98	1.35	78.77	23.35	17.15	19.36	96.45	33.54	11.72	15.13	35.81
148	Ft. Lauderdale-Hollywood-Pompano, FL	32.87	9.54	26.50	17.89	94.75	1.70,	83.78	33.54	7.10	21.01	26.93
149	El Paso, TX-NM	32.74	5.88	80.65	45.26	13.89	4.27	84.46	52.17	3.45	4.62	36.95
150	Los Angeles, CA	32.32	65.70	0.00	20.42	64.04	5.55	69.59	46.58	2.87	16.11	32.53
151	Phoenix, AZ	32.23	23.73	36.43	10.18	60.30	12.73	83.95	44.72	4.54	13.45	31.37
152	Jacksonville, FL	32.10	15.72	64.05	10.82	33.16	22.78	92.23	44.10	6.05	0.00	35.21
153	Denver. CO	31.74	14.05	31.36	12.28	76.56	7.94	75.34	32.30	6.41	29.41	28.13
154	Tucson, AZ	31.74	6.78	61.52	18.63	42.18	16.14	77.36	42.86	2.53	17.65	32.70
155	Colorado Springs, CO	31.26	4.38	70.49	20.59	31.43	13.61	91.05	31.06	6.96	11.76	33.73
156	Miami-Hialeah, FL	31.26	10.42	8.32	30.07	77.21	1.43	62.33	62.73	4.30	24.51	22.50
157	Norfolk-Va. Beach-Newport News, VA	31.02	21.08	66.05	18.12	46.18	10.33	54.05	37.27	3.43	22.69	36.04
158	Eugene, OR	31.02	0.57	54.92	18.77	47.73	40.66	76.01	12.42	14.51	13.59	29.71
159	Reno, NV	30.481	1.52	55.32	14.40	51.02	19.72	80.57	30.43	3.43	17.93	29.66
160	San Diego, CA	29.071	21.98	32.52	14.04	59.74	7.35	78.89	30.43	2.08	14.57	28.34
161	San Jose, CA	28.591	9.93	22.02	16.18	51.37	5.13	89.36	41.61	3.08	18.63	23.54
162	Honolulu, HI	27.63	3.08	4.53	12.77	60.57	29.89	52.20	73.29	0.00	12.32	18.10

Source: Anthony Downs, The Brookings Institution.

Appendix F
Independent Variables Used in the Regression Analysis Relating Sprawl to Urban Decline

The 69 independent variables used in the regession analysis relating sprawl to urban decline are described in this appendix. The first column names the independent variables and gives the abbreviations for each as used in the regressions. The second column briefly explains the theoretical relationship each might be expected to have with the two dependent variables. The next two columns show the expected mathematical sign of each independent variable in regressions using the extent to which a central city's population rose or fell during the 1980s (CHG8090%) and the index of urban decline-distress calculated for each central city (DECLINDX) as dependent variables. In the last two columns classifications of each independent variable are given. The first of these two columns shows whether each variable is considered primarily a cause (C) or a result (R) of the dependent variable; the second column shows those independent variables that are constituents of the sprawl index (S) or the urban decline-distress index (D). Concerning some independent variables, it is ambiguous whether they are primarily causes or primarily results; they could be either under different circumstances. Both C and R signs are shown for these variables.

	Theoretically Expected Relationships to Percent Population Change, 1980-1990, or to Urban Decline-Distress Index				
Names of the Independent Variables and their Abbreviations in Regressions	**Reason for Expecting Indicated Impact upon Each Dependent Variable in Regressions**	**Expected Mathematical Sign: CHG8090%**	**Expected Mathematical Sign: DECLINDX**	**Acts as Cause (C) or Result (R)**	**In Sprawl Index (S) or Decline Index (D)**
1. Percent of 1990 residents Hispanic (PCTHISPN)	Rapid Hispanic immigration could cause faster population growth	Positive	Negative	C	–
2. Percent of 1990 residents members of any minority groups (PCTMINOR)	Higher percentages would probably cause whites to withdraw from city schools and neighborhoods or refuse to move into them	Negative	Positive	C	–
3. Percent of 1990 residents African American (PCTBLACK)	Higher percentages would probably cause whites to withdraw from city schools and neighborhoods or refuse to move into them	Negative	Positive	C	–
4. Percent of those 25 and over in 1990 who had graduated from high school (PCTGRAD)	Higher percentages would indicate a higher quality work force that would attract businesses	Positive	Negative	C	D
5. Percent of those 25 and over in 1990 who had college bachelor's degrees (PCTBACH)	Higher percentages would indicate a higher quality work force and higher-income residents	Positive	Negative	C	–
6. Percent of 1990 residents receiving public assistance (PCTPUBAS)	Higher percentages would indicate a less able work force with fewer workers privately employed	Negative	Positive	R	–
7. Percent of 1990 residents receiving social security payments (PCTSOCSC)	Higher percentages indicate fewer residents available for jobs that would fuel economic growth	Negative	Positive	R	–
8. Percent of 1990 work force unemployed (UNEMPLY%)	High levels indicate lack of dynamism in local economy or lack of adequate skills in work force	Negative	Positive	C	D
9. Percent of population aged 18-24 (AGE18T24)	This group includes those most likely to commit crimes or be unemployed	Negative	Positive	C	–
10. Percent of population aged 5-17 (AGE5TO17)	This group also includes many quite likely to commit crimes or be unemployed	Negative	Positive	C	–
11. Median age of city population in 1990 (MEDINAGE)	Younger age indicates more immigrants entering a dynamic economy	Negative	Positive	C	–
12. Percent of central-city residents with incomes below the official poverty level (%POVPERS)	More poor people indicates lack of local prosperity and skills	Negative	Positive	C, R	D
13. Percent of all households headed by females with no spouse present (FEMFAM%)	Such households are more likely to be poor and children from them are less likely to do well in school	Negative	Positive	C	–

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Appendix F—*Continued*

Names of the Independent Variables and their Abbreviations in Regressions	Reason for Expecting Indicated Impact upon Each Dependent Variable in Regressions	Expected Mathematical Sign: CHG8090%	Expected Mathematical Sign: DECLINDX	Acts as Cause (C) or Result (R)	In Sprawl Index (S) or Decline Index (D)
	Theoretically Expected Relationships to Percent Population Change, 1980-1990, or to Urban Decline-Distress Index				
14. Median household income in 1989 in the central city (MEDINC89)	Higher incomes would indicate more prosperous residents	Positive	Negative	C	D
15. Change in median household income, 1979–1989 (INCCHG79)	Greater rise in median income would indicate rising wages and salaries due to economic prosperity	Positive	Negative	R	–
16. Percent of households with 1989 incomes of $75,000 or higher (INCOV74K)	More high incomes could indicate greater prosperity or greater gap between rich and poor	Positive	Negative	C	–
17. Percent of households with 1989 incomes under $5,000 (INCUND5K)	More low-income people show lack of local prosperity and skills	Negative	Positive	C	–
18. Percent of 1990 housing units built before 1940 (PRE1940%)	Higher percentages would indicate an older housing stock likely to be obsolete, less valuable, and occupied by lower-income households	Negative	Positive	C, R	D
19. Percent of 1990 housing units consisting of one-family detached dwellings (PCTIUNIT)	Higher percentages would indicate high share of residents who could afford their own homes	Positive	Negative	C	–
20. Percent of 1990 housing units in structures with 5 or more units (PCT5PLUS)	Higher percentages would indicate high share of residents who could not afford homeownership	Negative	Positive	C	–
21. Percent of housing units vacant in 1990 (PCTVAC90)	Greater vacancy indicates less household prosperity and smaller increases in local population	Negative	Positive	C, R	–
22. Mean January temperature, 1960–1991 (JANTEMP)	Warmer climate would attract skilled workers and retirees to aid the local economy	Positive	Negative	C	–
23. Mean July temperature, 1960–1991 (JULYTEMP)	Warmer climate would attract skilled workers and retirees to aid the local economy	Positive	Negative	C	–
24. Gov't employees per 100,000 residents in 1990 (EMPIOOOO)	High ratios of city workers indicate inefficiency, likely high taxes and bureaucratic obstacles for businesses.	Negative	Positive	C	–
25. Total local government taxes per capita in 1990 (TAXPCAP)	High taxes will drive viable businesses and households to move elsewhere	Negative	Positive	C	–
26. Local government expenditures per capita in 1990 (GOVXPCAP)	Higher spending could indicate better-quality services, but also more-intrusive government policies	Positive	Negative	C	–
27. Local government revenues per capita (REVPCAP)	High revenues indicate more government activities likely to discourage business investment and retention in city	Negative	Positive	C	–
28. Serious crimes per 100,000 residents (CRIMPCAP)	High crime rates might cause people to move out of the city, or not to move into its neighborhoods	Negative	Positive	C	–
29. Violent crimes per 100,000 residents (VIOCPCAP)	High crime rates might cause people to move out of the city, or to not move into its neighborhoods	Negative	Positive	C	D
30. Density of city population in 1990 (DENS90)	Higher-density cities would be older and more likely to decline	Negative	Positive	C	–
31. Percent of total population working (WRK%POP)	More workers would indicate greater prosperity that both illustrates growth and attracts more growth	Positive	Negative	C	–

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Appendix F—*Continued*

Names of the Independent Variables and their Abbreviations in Regressions	Theoretically Expected Relationships to Percent Population Change, 1980-1990, or to Urban Decline-Distress Index: Reason for Expecting Indicated Impact upon Each Dependent Variable in Regressions	Expected Mathematical Sign: CHG8090%	Expected Mathematical Sign: DECLINDX	Acts as Cause (C) or Result (R)	In Sprawl Index (S) or Decline Index (D)
32. Percent of workers commuting by driving in a car or truck alone (DRIVALON)	Newer areas would have more auto dependence and would grow faster	Positive	Negative	C	S
33. Percent of workers commuting in carpools (%CARPOOL)	No clear implication regarding population growth or distress	Positive	Negative	C	S
34. Percent of workers commuting either in carpools or by driving alone (the sum of the two preceding variables) (AUTOCOM%)	This would be dominated by commuters driving alone	Positive	Negative	C	–
35. Percent of workers commuting by using public transit (%PUBTRAN)	Major public transit systems are in older cities with high densities likely to be losing population	Negative	Positive	R	–
36. Average minutes spent commuting (COMUTMIN)	Longer commuting trips make areas less desirable for residents	Negative	Positive	C, R	–
37.Population density in urbanized fringe areas outside the central city or cities (OUTDEN90)	Higher fringe density would indicate more immigration into the overall metropolitan area—hence more city growth	Positive	Negative	C	S
38. Annual precipitation in inches (PRECIPIN)	Areas with high rainfall and snowfall would be less attractive places to live and therefore grow more slowly	Negative	Positive	C	–
39. Presence of a state capital (STATCAPL)	State capitals attract business firms and government offices, which cause higher-than-average growth	Positive	Negative	C	–
40. Percent of families with female head, no spouse present, living in poverty (POVFEMFM)	Higher percentages would indicate greater poverty and lower incomes in the city, which would not be attractive to potential newcomers	Negative	Positive	C, R	–
41. Percent of local government spending on police (EXP%POLC)	Higher percentages would indicate stronger police protection	Positive	Negative	C, R	–
42. Percent of local government spending on highways (EXP%HGWY)	Higher percentages would indicate better road conditions	Positive	Negative	C	–
43. Percent of metropolitan area population living outside the urbanized area's boundaries (%MSAOUTS)	Higher percent could indicate less-intensive immigration or greater spread from rapid growth, also means more sprawl	Negative	Positive	C	S
44. Composite sprawl score computed as described above (SPRLSCR6)	Greater sprawl would tend to accelerate withdrawal of viable resources from older central core areas	Negative	Positive	C, R	S
45. Ratio of median household income in the central city to that in the fringe area of each urbanized area (UAINCRAT)	Higher ratios would mean larger "gaps" between high suburban incomes and lower city incomes	Negative	Positive	C, R	–
46. Median household income in fringe portions of each urbanized area (UAEDGMED)	The higher fringe incomes are, since city median income is measured separately, the bigger the "gap" between suburban incomes and city incomes	Negative	Positive	C	–
47. Number of municipal governments per 100,000 residents (LOCPIOOK)	The larger the number of local governments, the easier it is for them to adopt exclusionary zoning that increases the concentration of poor in the central city	Negative	Positive	C	S

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Appendix F—*Continued*

Names of the Independent Variables and their Abbreviations in Regressions	Theoretically Expected Relationships to Percent Population Change, 1980-1990, or to Urban Decline-Distress Index: Reason for Expecting Indicated Impact upon Each Dependent Variable in Regressions	Expected Mathematical Sign: CHG8090%	Expected Mathematical Sign: DECLINDX	Acts as Cause (C) or Result (R)	In Sprawl Index (S) or Decline Index (D)
48. Degree of residential segregation of African Americans related to non-Hispanic whites, shown by a dissimilarity index (AFROSEG)	Greater racial segregation in housing would reduce opportunities for the African-American population, thereby cutting their contribution to the economy	Negative	Positive	C	–
49. Degree of residential segregation of Hispanics related to non-Hispanic whites, shown by **a** dissimilarity index (HISPNSEG)	Greater ethnic segregation in housing would reduce opportunities for the Hispanic population, thereby cutting their contribution to the economy	Negative	Positive	C	–
50. Percentage of MSA residents with incomes below poverty level (MSA%PV90)	More poor people indicates lack of local prosperity and skills	Negative	Positive	R	–
51. Percent of MSA suburban residents with incomes below poverty level (SUB%PV90)	More poor people indicates lack of local prosperity and skills	Negative	Positive	C	–
52. Percentage growth in total MSA population from 1980 to 1990 (MSA8090%)	Higher growth would stimulate city prosperity	Positive	Negative	R	–
53. Percentage growth in MSA suburban population, 1980 to 1990 (MSASUB%)	Higher suburban growth would stimulate city prosperity	Positive	Negative	C	–
54. Percentage of all 1980 MSA residents living in high-poverty neighborhoods (MSANPA80)	More concentrated poverty creates adverse city conditions	Negative	Positive	C	–
55. Percentage of all poor MSA residents living in high-poverty tracts (MSACPA80 or 90)	More concentrated poverty creates adverse city conditions	Negative	Positive	C	–
56. Jargowsky's index of 1980 income separation by neighborhoods (MSANSA80 or 90)	More economic segregation creates more adverse conditions	Negative	Positive	C	–
57. Percentage of residents 16-19 who are not in school and have not graduated from high school (HS%DRPOT)	Higher high-school drop-out rates reduce employment and income prospects of residents	Negative	Positive	C	D
58. Percent change in central city population from 1990 to 1994 (%CHG9094)	Higher growth indicates less urban distress or decline	Positive	Negative	–	D
59. Area of central city in square miles (AREA)	Ambivalent—to be determined by analysis	Unknown	Unknown	C, R	–
60. 1990 population of the central city (POPUL90)	Ambivalent—to be determined by analysis	Unknown	Unknown	C, R	–
61. 1989 income per capita in central city (INPCAP89)	Higher income indicates less distress	Positive	Negative	C	D
62. Total MSA population in 1990 (MSAPOP90)	Ambivalent—to be determined by analysis	Unknown	Unknown	–	–
63. Median 1989 household income in the entire metropolitan area (MSAINC89)	Higher income indicates less distress and more growth potential	Positive	Negative	–	–
64. Percentage of total 1990 MSA population living within the central city (%MSACENC)	Higher percent in central city means less sprawl; should cause faster growth and less decline	Positive	Negative	C	S

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Appendix F—*Continued*

Names of the Independent Variables and their Abbreviations in Regressions	Theoretically Expected Relationships to Percent Population Change, 1980-1990, or to Urban Decline-Distress Index: Reason for Expecting Indicated Impact upon Each Dependent Variable in Regressions	Expected Mathematical Sign: CHG8090%	Expected Mathematical Sign: DECLINDX	Acts as Cause (C) or Result (R)	In Sprawl Index (S) or Decline Index (D)
65. Ratio of central-city poverty percentage divided by suburban poverty percentage (CITSUBPV)	Higher ratio means greater concentration of poverty in the city and more sprawl; should cause slower growth	Negative	Positive	C, R	S
66. Total physical area of urbanized area in 1990 (URBLND90)	More land area is either a cause or a result of faster growth, and also of more sprawl	Negative	Positive	C,R	S
67. Ratio of 1990 central-city population density divided by urban fringe population density (DENRATIO)	The higher this ratio, the more likely cities are to lose population to surrounding lower-density suburban areas	Negative	Positive	C, R	S
68. Change in central-city geographic area from 1980 to 1990 in square miles (AREA%CHG)	The more territory a city has annexed, the larger its population growth should be	Positive	Negative	C	–
69. Percent change in central-city population, 1980 to 1990. (CHG8090%)	This is the dependent variable for city population change. More growth should be related to less decline	Identical	Negative	C	D

Source: Anthony Downs, The Brookings Institution.

Appendix G
Explanation of the Definition of Sprawl

INTRODUCTION

Fifteen representative EAs are presented in chapter 5 to provide the reader with an insight into sprawl growth in the United States. To illustrate the application of the thresholds and characterization criteria (e.g., the definition of sprawl) presented in chapters 2 and 4, the county designation process for the counties of the Austin-San Marcos, TX EA from chapter 5 is presented here.

CLASSIFYING COUNTIES

The Austin-San Marcos, TX EA comprises 10 counties in the state of Texas. Texas is a low-density state. The low-density-state grouping (from Table 2.2) applies to states with household densities between 11.8 and 36.1 households per square mile. In the 1995 baseline year, Texas had a household density of 25.5 households per square mile. The categories of county development type (urban, urban center, suburban, rural, rural center, and undeveloped) are determined by density thresholds for the density group of the state (low-, moderate-, or high-density states nationwide). Since there are only undeveloped, rural, and urban counties in the Austin-San Marcos, TX EA, rural-center and urban-center development types are not discussed here. The thresholds for undeveloped, rural, and urban county development types in the low-density-state grouping are presented as less than 25 households, less than 75 households, and less than 300 households per square mile, respectively (see Table 2.3). Seven of the 10 EA counties have household densities of less than 25 households per square mile and are designated as undeveloped counties. They are Bastrop, Blanco, Burnet, Caldwell, Lee, Llano, and Milam counties. Hays and Williamson counties have household densities between 25 and 75 households per square mile and are designated as rural counties. Finally, Travis County (Austin) falls above the urban threshold and is designated as an urban county (see Table G).

FINDING SPRAWL COUNTIES

The sprawl status of nonurban counties is determined by comparing their projected annual growth and growth rates in both households and employment with the two sets of criteria presented in chapter 2. Sprawl is taking place if (1) the county's annual growth rate (of households, employment, or both) is in the upper quartile of the EA's annual county growth rates (households, employment, or both) and exceeds the average annual national county growth rate, and its absolute growth exceeds 40 percent of the average annual absolute national county growth; or (2) the county's absolute level of growth exceeds 160 percent of the average annual absolute national county growth.

Household and employment growth are determined for all counties for the periods 1980 to 2000 and 2000 to 2025 to provide both historical and future designations of sprawl or nonsprawl. Growth rates for each period are calculated and the upper quartile of county growth rates for each EA is established. (Table 4.1 shows the average annual national growth rate and the average annual absolute increase for both periods.) The growth rate threshold values for each EA are presented in Appendix C.

For the period 1980 to 2000, three counties (Bastrop, Hays, and Williamson) are designated as sprawling based on their absolute household growth and growth rates. The evaluation is repeated for the 2000 to 2025 period and these projections for household growth are shown in Table G. Although in other EAs employment growth may be a necessary separate factor for qualification because household growth is insufficient, in the Austin-San Marcos, TX EA, all qualification takes place relative to household growth. It is therefore not necessary to show employment growth qualifications.

For the first set of criteria for the period 2000 to 2025, computed growth rates and the computed absolute growth of counties in the EA (see Table G) are compared with the upper-quartile EA growth rate thresholds, average annual national county growth rates, and the absolute average annual national county growth. Burnet, Hays, and Williamson counties satisfy all of the growth rate and absolute growth thresholds for households and are designated as sprawling counties. The remaining counties' *absolute* growth is tested against the second criterion (thresholds are shown in Table 4.1). Both Hays and Williamson coun-

Table G
Example of Sprawl Definition and Control Criteria Using Household (HH) Growth in Austin-San Marcos, TX EA

County				2000 to 2025 Sprawl Criteria				
				Set 1			Set 2	
Name	Type	Annual Growth Rate (%)	Absolute Annual Growth	Upper Quartile of Annual Average EA Growth Rate >2.12 %	Average Annual National County EA Growth Rate 1.04% HH	40% of Average Annual National County Growth 131 HH	160% of Average Annual National County Growth 525 HH	2000 to 2025 Sprawl Status
Bastrop	UND	1.57	283	–	N/A	N/A	–	S-C
Blanco	UND	1.48	50	–	N/A	N/A	–	NS
Burnet	UND	2.12	273	x	x	x	–	S-C
Caldwell	UND	1.12	121	–	N/A	N/A	–	NS
Lee	UND	1.09	62	–	N/A	N/A	–	NS
Llano	UND	1.57	101	–	N/A	N/A	–	NS
Milam	UND	0.91	88	–	N/A	N/A	–	NS
Hays	R	2.60	832	x	x	x	x	S-C
Williamson	R	3.78	3,130	x	x	x	x	S-NC
Travis	U	1.57	4,659	N/A	N/A	N/A	N/A	NS

Source: Center for Urban Policy Research, Rutgers University.

Note: The six county-type categories are: Undeveloped (UND), Rural (R), Rural Center (RC), Suburban (S), Urban (U), Urban Center (UC). The three categories of sprawl status are : Nonsprawl (NS), Sprawl-Controlled (S-C), and Sprawl-Noncontrolled (S-NC).

(x) indicates that the criterion is met; (–) indicates that the criterion is not met.

ties satisfy the second sprawl criterion (absolute growth of 160 percent of the national county average), but they have already been designated as sprawling counties on the first set of criteria. Although Bastrop County does not meet the criteria for sprawl for the period 2000 to 2025, it was a sprawling county in the earlier 20-year period and so is designated as sprawling, though declining. The declining sprawl category is used because of the amount of future growth contained in such counties and the fact that most fall below the original sprawl threshold but remain above the 25 percent reduction threshold. Such counties, including Bastrop County, are reduced to the control threshold even though they may have fallen just below the sprawl threshold in the second period.

CONTROLLING SPRAWL COUNTIES

In the controlled-growth scenario, a portion of the growth in peripheral counties is redirected to more-developed counties. The redirection objective is to significantly reduce sprawl in the rural and undeveloped counties. In the Austin-San Marcos, TX EA, for example, the capacity of Travis County allows for the redirection of sufficient households and jobs to control the sprawl in Burnet and Hays counties. Sprawl growth in Williamson County could not be controlled because redirection of its growth would raise the growth level of Travis County above the sprawl level. Smaller counties, such as Burnet and Hays counties, are controlled before larger counties so that a larger number of counties can be controlled. Some counties (e.g., Bastrop County) are designated as controlled because their absolute growth and growth rate have dropped below the sprawl thresholds—a result of the growth trends in those counties.

CONCLUDING NOTE

It should be noted that using the upper quartile of county growth rate within an EA in no way predefines a 25 percent sprawl rate of counties nationwide. In this example EA, the percentage of counties that are designated as sprawling is 40 percent. This is due to the three-part set of selection criteria for households (set 1 in Table G). The second criterion (set 2 in the table), which could have accounted for two counties being designated as sprawling in this example, is independent of the upper-quartile growth rate threshold and occasions a significant amount of sprawl designation. Thus, there are multiple qualifying criteria that mitigate the influence of the upper-quartile criterion.

Courtesy of R. Ewing

Glossary

The following definitions are intended to assist the reader with the terminology specific to the study. Various empirical procedures used in the analysis may incorporate definitions slightly different from those found below.

Agriculture—Farming in all its branches. Includes activities such as the following:

1. the production, cultivation, growing, and harvesting of any agricultural, viticultural, or horticultural commodities;
2. the raising and/or the breeding of livestock, including but not limited to dairy and beef cattle, sheep, goats, fur-bearing animals, companion animals, poultry, and swine;
3. the breeding, boarding, raising, or training of equine;
4. the production of nursery, sod, floriculture, and forest products; and
5. the harvesting, storage, grading, packaging, processing, distribution, and sale of such commodities where such activities occur at the point of production.

Aquifer—A subsurface geological formation that supplies water to wells or other surface waters.

Brownfields—Any former or current commercial or industrial site that is vacant or underutilized and on which there has been, or there is suspected to have been, a discharge of contaminants.

Capital facilities—The land, building, and other physical facilities under public ownership, or operated or maintained for public benefit, that are necessary to support development and redevelopment and to protect the public health, safety, and welfare.

Cluster development—A form of development that permits an increase in overall density of development and that devotes remaining land area to open space, recreation, preservation of environmentally sensitive areas or agriculture.

Compact—A pattern of land development with sufficient density of development and proximity between uses and activities to encourage pedestrian movement and efficient provision of public facilities and services.

Conversion—A change in the use of land or a structure

Decreasing sprawl—A sprawl designation used in this study to identify counties that met the sprawl criteria for the 1980 to 2000 period but did not meet the criteria for the 2000 to 2025 period.

Density—The number of families, individuals, dwelling units, households, or housing structures per unit of land.

Developable land—Unimproved land exclusive of the following:

1. public open space,
2. land precluded from development due to deed restrictions, and
3. land deemed undevelopable by state or local regulation of natural features (e.g., slopes, wetlands, etc.).

Development—The division of a parcel into two or more parcels followed by construction, reconstruction, conversion, structural alteration, or enlargement of any structure for the property owner's use.

Economic Area (EA)—The unique group of counties, defined by the Bureau of Economic Analysis, that encompasses both metropolitan and nonmetropolitan locations and that forms an economically related geographic area.

Ecosystem—An integrated system of living species, their habitat, and the processes that affect them.

Environmentally fragile lands—Areas that are critical to maintaining biodiversity, including those containing

1. habitats of endangered or threatened plant or animal species,
2. pristine waters,
3. coastal and freshwater wetlands,
4. prime forested areas,
5. ridgelines, gorges, and ravines,
6. grasslands, and
7. staging areas for migratory species.

Exaction—A contribution or payment required as an authorized precondition for receiving a development permit.

Exclusionary zoning—Development regulations that result in the exclusion of low- and moderate-income and minority families from a community.

Exurban area—The fringe area between a suburbanized area and rural areas that is subject to development pressures with existing or planned infrastructure.

F-statistic—A statistic measuring the extent to which two variables are related.

Fiscal impact analysis—An analysis of the costs and revenues associated with development activities.

Floodplain or **flood-prone area**—The channel and the area adjoining the channel of a stream or river that have been or may be covered by floodwater.

Floor-area ratio (FAR)—The sum of the area of all floors of a building or structure compared with the total area of the site.

Fringe area—The area of transition between two different dominant land uses or other recognizable characteristics.

Growing sprawl—A sprawl designation used in this study to identify counties that did not meet the sprawl criteria for the 1980 to 2000 period but did meet the criteria for the 2000 to 2025 period.

Growth management—The conscious public effort to induce, restrain, or accommodate development in any geographic setting and at any governmental level.

Habitat—The natural environment of an individual animal or plant, population, or community.

Housing mix—The types of residential housing associated with a locale and number of each type present.

Impact fee—an assessment on a development to help finance the cost of improvements or services.

Inclusionary zoning—Regulations that provide incentives to construct housing that is affordable to low- and moderate-income households.

Infrastructure—Those systems under public ownership, or operated or maintained for public benefit, that are necessary to support development, maintenance, and redevelopment and to protect the public health, safety, and welfare.

Land—Real property, including improvements and fixtures thereon, above or below the surface.

Laterals (water or sewer)—Pipes conducting water or sewage from individual buildings to larger pipes, called trunks or interceptors, usually located in the street.

Master plan—A comprehensive, long-range plan intended to guide the growth and development of a community or region.

Metropolitan Statistical Area (MSA)—A geographic area consisting of a large population nucleus and adjacent areas exhibiting a high degree of economic and social integration.

Mixed-use development—A tract of land with two or more different uses, such as residential, office, manufacturing, retail, public, or entertainment.

Mobile home—A factory-built, single-family structure that meets the National Manufactured Home Construction and Safety Standards.

Multifamily housing—A building containing three or more dwelling units, including units that are located one over the other.

Municipality—Any city, borough, village, or township of the state, but not a county or school district.

Nonresidential unit—A nonresidential space of 1,000 square feet.

Nonsprawl—A sprawl designation used in this study to identify counties that do not meet the sprawl criteria for both the 1980 to 2000 period and 2000 to 2025 period.

Parcel—A quantity of land, either vacant or holding structures, that can be defined geographically.

Per capita—A measurement that is presented in terms of units per person.

Quartile—A subset of data containing 25 percent of the total data set.

R-squared—A sample statistic that tells how well a model fits the data. The **adjusted R-squared** is a corrected statistic that more closely reflects the goodness-of-fit of the model in the data.

Regression analysis—A mathematical technique used to build a model relating a specific parameter to other variables of interest.

Rural center—A rural-development-type county that is an economic node for the surrounding counties.

Septic system—An underground individual sewerage system with a septic tank used for the decomposition and treatment of wastewater before it is discharged to groundwater.

Sewer—Any pipe or conduit used to collect and carry away sewage or storm-water runoff from the generating source to the treatment plant or receiving body of water.

Significance level—The percentage of the data that is not as supposed or tested for.

Single-family attached housing—One dwelling unit attached to one or more dwelling units, side by side, with each dwelling unit located on a separate lot.

Single-family detached housing—A building containing one dwelling unit that is not attached to any other building and that is surrounded by yards.

Standard error—An estimate of the variation of the dependant variable about a nominal value; e.g., a regression curve.

Sustained sprawl— A sprawl designation used in this study to identify counties that meet the sprawl criteria in both the 1980 to 2000 period and the 2000 to 2025 period.

t-score—A statistic measuring the extent to which two variables are related.

Taking—To take, expropriate, acquire, or seize property without compensation.

Transfer of Development Rights (TDR)—The reassignment of all or part of the permitted density on one parcel of land to another parcel of land.

Transit—A vehicle or transportation system, including heavy and light-rail, buses, vans, and other services, owned or regulated by a governmental agency and used for the mass transportation of people.

Urban center—A city of statewide importance. An urban center is a large settlement that has a large population and a high intensity of mixed land uses, including industrial, commercial, residential, and cultural uses.

Urban service area—A defined geographic area where there are government-supplied public facilities and services.

Vehicle-miles traveled (VMT)—An estimate of the total number of miles traveled on the highway and street system. VMT is used as an indicator for both vehicular and roadway utilization.

Wastewater management plan—A description of existing and future wastewater-related jurisdictions, wastewater service areas, and selected environmental features and domestic treatment works.

Wetland—An area that is saturated or inundated with surface water or groundwater at a frequency and duration sufficient to support hydrophilic vegetation and that is characterized by hydric soils.

Courtesy of R. Ewing

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Courtesy of R. Ewing

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The National Research Council was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purpose of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both the Academies and the Institute of Medicine. Dr. Bruce M. Alberts and Dr. William A. Wulf are chairman and vice chairman, respectively, of the National Research Council.

Abbreviations used without definitions in TRB publications:

AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
IEEE	Institute of Electrical and Electronics Engineers
ITE	Institute of Transportation Engineers
NCHRP	National Cooperative Highway Research Program
NCTRP	National Cooperative Transit Research and Development Program
NHTSA	National Highway Traffic Safety Administration
SAE	Society of Automotive Engineers
TCRP	Transit Cooperative Research Program
TRB	Transportation Research Board
U.S.DOT	United States Department of Transportation

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