CHAPTER 1

The Context of Urban Travel

Concepts and Recent Trends

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Many trace the dawn of the modern civil rights movement in the United States to events that transpired on a city bus in Montgomery, Alabama, on December 1, 1955, when Rosa Parks refused an order from a municipal bus driver to give up her seat to a white man. Her arrest and the subsequent Montgomery bus boycott (1955–1959), in which blacks refused to patronize the segregated city bus system, proved the power of collective action and brought Martin Luther King, Jr., to prominence. That the civil rights movement should have been born on a city bus is just one measure of how urban transportation is woven into the fabric of U.S. life.

Can you imagine what life would be like without the ease of movement that we now take for granted? The blizzards that periodically envelop major cities give individuals a fleeting taste of what it is like to be held captive (quite literally) in one's own home (or some other place) for several days. With roads buried under 6 feet of packed snow, you cannot obtain food, earn a living, get medical care for a sick child, or visit friends. As recent earthquakes in California and floods in the Midwest have illustrated, the collapse of a single bridge can disrupt the daily lives of tens of thousands of people and hundreds of businesses. The blackout that enveloped much of the U.S. Northeast and Midwest for a few days in August 2003 brought life to a standstill.

Transportation is vital to U.S. urban life and to life in other places as well because it is an absolutely necessary means to an end: It allows people to carry out the diverse range of activities that make up daily life. Because cities consist of spatially separated, highly specialized land uses—food stores, laundromats, hardware stores, banks, drugstores, hospitals, libraries, schools, post offices, and so on—people must travel if they want to obtain necessary goods and services. Moreover, home and work are in the same location for only a few people (about 3.3% of the U.S. workforce in 2000), so that to earn an income as well as to spend it one must travel.

Although people do occasionally engage in travel for its own sake (as in taking a Sunday drive or a family bike ride), most urban travel occurs as a by-product of trying to accomplish some other (nontravel) activity such as work, shopping, or mailing a letter. Only about half of 1% of all trips in the United States are trips for pleasure driving (U.S. Department of Transportation, Federal Highway Administration, 1994, p. 4-72). In this sense, the demand for urban transportation is referred to as a *derived demand* because it is derived from the need or desire to do something else. A trade-off always exists between doing an activity at home (such as eating a meal, watching a video, or doing laundry) or paying the costs of movement to accomplish that activity or a similar one somewhere else (such as at a restaurant, a movie theater, or a laundromat).

All movement incurs a cost of some sort, which is usually measured in terms of time or money. Some kinds of travel, such as that by auto, bus, or train, incur both time and monetary costs; other trips, such as those made on foot, involve an outlay primarily of time. In deciding which mode(s) to use on a given trip (e.g., car or bus), travelers often trade off time versus money costs, as the more costly travel modes are usually the faster ones. A trade-off is also involved in the decision to make a trip: the traveler weighs the expected benefits to be gained at the destination against the expected costs of getting there. Each trip represents a triumph of such anticipated benefits over costs, although for the many trips that are made out of habit this intricate weighing of costs and benefits does not occur before each and every trip.

Although transportation studies have emphasized the costs of travel, recent research suggests that for many people daily mobility can also be a source of pleasure and is not simply an aggravation to be endured in order to accomplish a necessary activity, like going to work. Some people, for example, enjoy the time they spend alone in the car on the commute, saying it's the only time during the day they have to themselves. Contrary to most transportation theory, these people don't seek to minimize the time or distance traveled on the journey to work or other trips (Mokhtarian, Solomon, & Redmond, 2001). In this case, the demand for travel is not purely "derived" from the demand to accomplish other activities, but something undertaken for its own good.

This chapter introduces some key concepts in urban transportation and sets the stage for the chapters that follow. In particular, I describe (1) the concepts of accessibility, mobility, and equity; (2) certain aspects of the urban context within which travel takes place; (3) recent trends in U.S. travel patterns; and (4) the policy context within which transportation analysis and planning in the United States are set. The overall goal of this book is help you understand the central role of transportation and transportation planning in shaping metropolitan areas.

CORE CONCEPTS

Accessibility and Mobility

Two concepts that are central to understanding transportation are accessibility and mobility. *Accessibility* refers to the number of opportunities, also called "activity sites," available within a certain distance or travel time. *Mobility* refers to the ability to move between different activity sites (e.g., from home to grocery store). As the distances between activity sites have become longer (because of lower density settlement patterns), accessibility has come to depend more and more on mobility, particularly in privately owned vehicles (POVs).

Accessibility and Land Use Patterns

Let me give an example from my own neighborhood in inner-city Worcester, Massachusetts. About 40 years ago, many different kinds of activities were located within three blocks of my house: a supermarket, a clothing store, a drugstore, a post office, several churches, a large park, three elementary schools, a bookstore, a bakery, a dry cleaning store, a laundromat, a barbershop, and several restaurants. In addition, several large manufacturing employers (a steel plant, a carpet-making firm, a textile machine manufacturer) were located on the other side of the residential neighborhood. Anyone who could walk had excellent accessibility to goods and services and even to employment. Access depended on pedestrian mobility rather than vehicular mobility. Although many of these places are still here, the manufacturing companies and the supermarket have closed; food stores in general have become significantly larger and simultaneously fewer in number and farther apart. Our neighborhood no longer has a grocery store within walking distance. Access to food now requires mobility by bus, car, or taxi. The successful creation of ever larger (and increasingly fewer) food stores *depends* on ever-escalating levels of mobility; we can now travel much farther by car, for example, in about the same amount of time it took us to get someplace on foot.

This example illustrates how the need for mobility can be seen as the *consequence* of the spatial separation between different types of land uses in the city, but enhanced mobility can also be seen as *contributing* to increased separation of land uses. Because improved transportation facilities enable people to travel farther in a given amount of time than they could previously, transportation improvements contribute to the growing spatial separation between activity sites (especially between home and work) in urban areas. As you will learn in the ensuing chapters, the goal of transportation planning has been to increase people's mobility, sometimes equating increased mobility with increased accessibility. Ausabel, for example, observes that transportation planners have engineered systems that seem "coded to seek low-cost speed to enable individuals to maximize range" (1992, p. 879). Planners and policymakers now recognize, however, that, through attention to land use planning, that is, by creating high-density urban neighborhoods much like my Worcester neighborhood of 40 years ago, accessibility can be achieved without increasing mobility.

This symbiotic relationship between transportation and land use is one reason geographers are interested in urban transportation. One could never hope to understand the spatial structure of the metropolis or to grasp how it is changing without a knowledge of movement patterns. The accessibility of places has a major impact upon their land values (and hence the use to which the land is put), and the location of a place within the transportation network determines its accessibility. Thus, in the long run, the transportation system (and the travel on it) shapes the land use pattern. In Chapter 2 Thomas R. Leinbach shows how this principle works at the intercity scale, and in Chapter 3 Peter O. Muller provides numerous historical examples of this interaction between transportation innovation and urban land use patterns at the intrametropolitan scale. In the short run, however, the existing land use configuration helps to shape travel patterns. The intimate relationship between transportation and land use is explicitly acknowledged by the fact that at the heart of every city's long-term land use plan is a transportation plan. In Chapter 4 Donald G. Janelle explores the fascinating question of how information technologies, such as the Internet, cell phones, and video conferencing, are changing the relationship between distance and accessibility, and therefore the relationship between accessibility and land use.

Measuring Accessibility

We can talk about the accessibility of *places* (i.e., how easily certain places can be reached) or of *people* (i.e., how easily a person or a group of people can reach activity sites). As we saw in the example above, an individual's level of accessibility will depend largely on where activity sites are located vis-à-vis the person's home and the transportation network, but it will also be affected by when such sites are open and even by how much time someone can spare for making trips. Urban planners and scholars have long argued that the ease with which people can reach employment locations, retail and service outlets, and recreational opportunities should be considered in any assessment of the health of a city. They have implied that accessibility should be a central part of any measure of the quality of life (see, e.g., Chapin, 1974; Scott, 2000; Wachs & Kumagi, 1973). Measuring accessibility in a meaningful way can be difficult, however.

Personal accessibility is usually measured by counting the number of activity sites (also called "opportunities") available at a given distance from the person's home and "discounting" that number by the intervening distance. Often accessibility measures are calculated for specific types of opportunities, such as shops, employment places, or medical facilities. One measure of accessibility is presented in Equation 1,

$$A_i = \sum_j O_j d_{ij}^{-b} \qquad (1)$$

where A_i is the accessibility of person i, O_j is the number of opportunities at distance j from person i's home, and d_{ij} is some measure of the separation between i and j (this could be travel time, travel costs, or simple distance). Such an accessibility index is a measure of the number of potential destinations available to a person and how easily they can be reached. Accessibility is usually assessed in relation to the person's home because that is the base from which most trips originate; personal accessibility indices could (and perhaps should) also be computed around other important bases, such as the workplace.

The accessibility of a place to other places in the city can be measured in a similar way, using Equation 2:

$$A_i = \sum_j O_j d_{ij}^{-b} \qquad (2)$$

where A_i is the accessibility of zone i, O_j is the number of opportunities in zone j, and d_{ij} is, as before, a measure of the separation between i and j.

Although Equations 1 and 2 are structurally alike, the difference between the two is important. The first measures the accessibility of individuals, and the second indicates the accessibility of places (or zones) within a city. The second measure treats all those living in zone i as if they have the same level of accessibility to activity sites in the city; it does not distinguish among different types of people within a zone, such as those with or without a car.

Both these measures of accessibility are highly simplified representations; neither really addresses mobility nor includes dimensions such as the ability to visit places at different times of day. A third measure—that of space–time autonomy—takes both accessibility and mobility into consideration; it is a more satisfying measure conceptually than measure (1) but far more difficult operationally. The concept of space–time autonomy has been developed in the context of time geography and focuses on the constraints that impinge on a person's freedom of movement (Hagerstrand, 1970). These constraints include:

- *Capability constraints*—the limited ability to perform certain tasks within a given transportation technology and the fact that we can be in only one place at a time; for example, if the only means of transport available to you are walking and biking, the number of activity sites you can visit in, say, half an hour is lower than it would be if you had access to a car.
- *Coupling constraints*—the need to undertake certain activities at certain places with other people; for instance, that lunch meeting with your boss can only be scheduled when you both can be in the same place at the same time.
- *Authority constraints*—the social, political, and legal restrictions on access—for example, you can only conduct

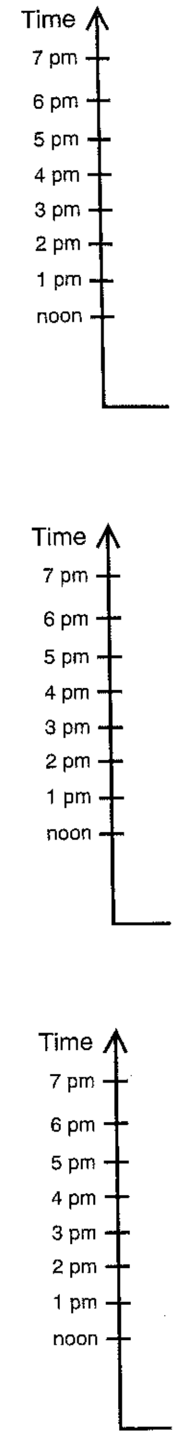

FIGURE 1
possibilities
5:00 P.M. to
increases in
Effects of c
permitting

> business at the bank or the post office during the hours they are open, and certain locations are off-limits to citizens without access permits.

Your access to places and activities is restricted by these constraints.

A measure of an individual's space–time autonomy is the *space–time prism*, a visual representation of the possibilities in space and time that are open to a person, given certain constraints (see Figure 1.1). The larger the prism, shown in each frame of Figure 1.1 as a parallelogram, the greater the individual's space–time autonomy in a specific situation.

Figure 1.1a, for example, shows the space–time autonomy for a person who is currently (at 5:00 P.M.) at work and who must arrive at the childcare center no later than 6:00 P.M. to pick up his daughter; the distance between these two locations is shown on the "space" axis. Somewhere in between he must stop at a food store to buy soup, bread, cheese, and a lottery ticket. In addition to these location and time constraints, the father in this example must conduct all travel either on foot or by bicycle. The slope of the lines in Figure 1.1 shows the maximum speed (in 1.1a, presumably by bicycle) that this person can travel. The prism outlines the envelope within which lies the set of all places that are accessible to him given these constraints. If no food store exists between *x* and *y* (shown on the "space" axis), then he lacks accessibility in this instance.

The concept of a space–time prism can also illustrate how changes in constraints can affect accessibility. If, in this example,

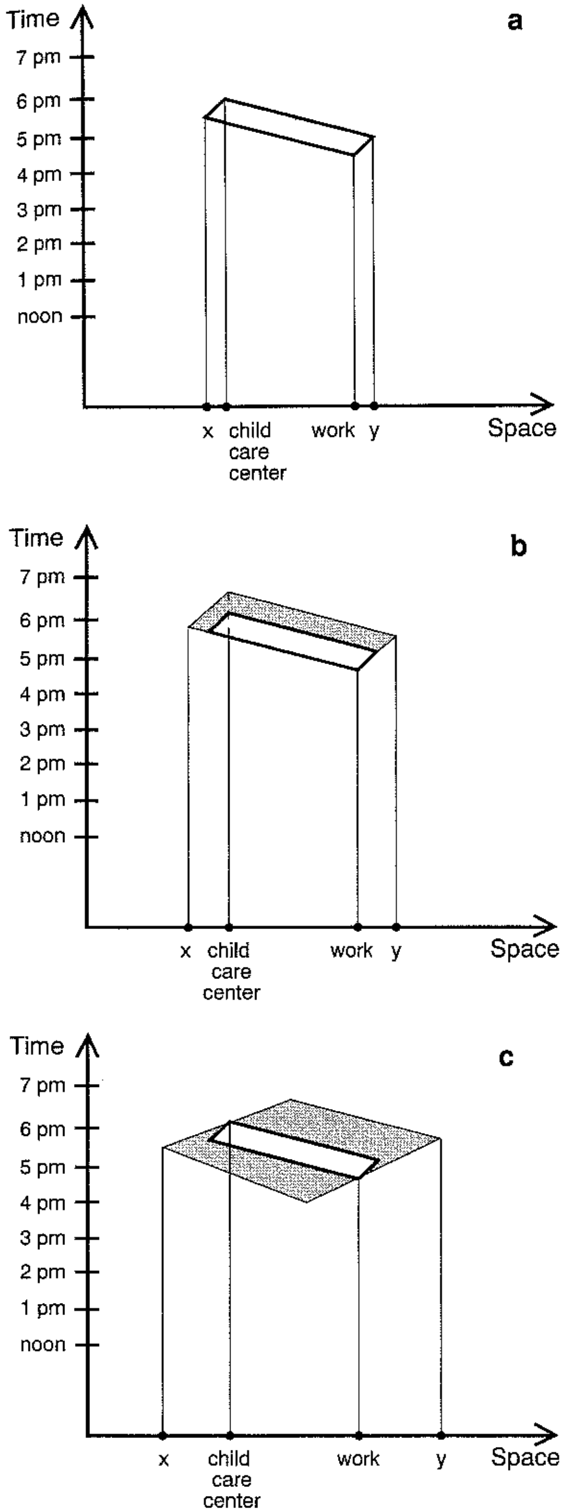

FIGURE 1.1. One measure of space–time autonomy is the space–time prism. (a) The prism defines the set of possibilities that are open to this father who must travel on foot or by bike from his place of work where he is at 5:00 P.M. to the childcare center, which closes at 6:00 P.M. (b) Effects of extended hours; the shading shows the increases in space–time autonomy if the childcare center were to extend its hours from 6:00 P.M. to 6:30 P.M. (c) Effects of car availability; the shading shows the increase in space–time autonomy if a car is available, thereby permitting higher speed travel.

the childcare center were to extend its hours until 6:30 P.M., the prism defining the set of possibilities would be enlarged (see shaded area in Figure 1.1b), and this man's space–time autonomy would be increased. Or suppose he traveled by car: he could then travel farther in the same amount of time, and the prism would therefore be larger. Notice that this greater speed is shown by the slope of the lines in Figure 1.1c, which is not as steep as in 1.1a and 1.1b where he is assumed to be traveling by bike. The shading in Figure 1.1c indicates the increase in space–time autonomy that would result from the availability of a car. Notice that the outer spatial limits of possibilities, shown in each case by x and y on the space axis, shift outward as constraints are eased. In general, the prisms show the relationship between time and space, and you can see that as the time constraints facing this father are reduced, the greater the space within which he can move.

Many factors can, then, affect space–time autonomy. For example, flextime work schedules, longer store hours, and purchasing a second car all enhance space–time autonomy by adding margins to the space–time prism. Lower speed limits, rigid school hours, and traffic congestion all constrain choice. Large families impose coupling constraints, which often affect women more than men. Babysitters, daycare centers, and children's growing up all reintroduce issues of space–time autonomy. You can see, however, that measuring space–time autonomy by including all of these relevant factors would be complicated.

Increasing people's space–time autonomy seems desirable in that it implies a greater accessibility to places and more discretion for spending one's time. We might question, however, the need for ever-increasing space–time autonomy and ever-increasing personal mobility. One question that transportation geographers and many others have begun to ponder is whether or not there is such a thing as too much mobility!

Equity

As we can see from the concept of space–time autonomy, someone's ability to reach places depends only in part on the relative location of those places; it also depends on *mobility*, the ability to move to activity sites, which in the United States usually requires an automobile. We have seen how the spatial organization of contemporary society demands—indeed assumes—mobility; yet not all urban residents enjoy the high level of mobility that the contemporary city requires for the conduct of daily life. Assessing the equity of a transportation system or a transportation policy requires that we consider who gains accessibility and who loses it as a result of how that system or policy is designed; it requires that we consider to what degree people's travel patterns are the outcomes of choice or constraints. How are the costs and benefits of transportation systems shared among different groups of people?

At the time of the Montgomery, Alabama, bus boycott in the late 1950s, as now, a disproportionate share of people with fewer economic resources relied on buses for transportation. At the start of the boycott in 1955, blacks comprised 45% of Montgomery's population but fully 75% of the bus ridership, and the majority of bus riders were women (Powledge, 1992; for an excellent treatment of the Montgomery bus boycott, see Garrow, 1988). People without access to cars are especially likely to lack the mobility necessary to reach job locations or other activity sites. In fact, lower-income people travel significantly less (they "consume" less transportation) than do higher-income people. In 2000, households with incomes under $25,000 were 22.5% of all U.S. households, but accounted for only 15.2% of all vehicle miles traveled.[1] Equity issues are so important in transportation that we devote a chapter to this topic (see Deka, Chapter 12, this volume).

This lack of mobility among certain groups of people is one part of the urban transportation problem. Because transportation is so essential to the very fabric of urban life, transportation issues and problems are inextricably bound up with other societal issues and problems such as economic well-being, social inequities, health, and environmental pollution. Before we consider these other aspects of the urban transportation problem, the next section of the chapter provides some background on the context within which travel takes place in the North American city and considers how this U.S. context differs from that in other countries.

THE CHANGING URBAN CONTEXT

How have U.S. cities been changing in recent decades? In particular, how have residential and employment patterns been changing? In addition to looking at patterns for U.S. cities as a whole, we focus on one city in particular—Worcester, Massachusetts—because the trends revealed here are similar to those in other U.S. cities and allow us to examine intraurban patterns and trends.

Residential Patterns

Table 1.1 presents data on some important demographic trends from 1970 to 2000 for

TABLE 1.1. Demographic Trends, Metropolitan Areas in the United States, 1970–2000

	1970[b]	2000
Population of MSAs[a]	139,418,811	225,981,711
Number of households in MSAs	43,862,993	84,351,108
Percentage of households in MSAs that are single-person	18.1	25.9
Percentage of MSA population living in central city	45.8	37.8
Percentage of households with no vehicle		
MSA	18.6	11.0
City	28.4	18.4
Suburbs	9.2	6.2
Percentage of households with more than one vehicle		
MSA	35.6	54.2
City	26.2	41.9
Suburbs	44.7	62.0
Percentage of population over 65 years of age		
MSA	9.3	11.9
City	10.8	11.5
Suburbs	8.0	12.1
Percentage of families below the poverty level		
MSA	8.5	8.7
City	11.0	13.6
Suburbs	6.3	6.0
Percentage of families headed by women		
MSA	11.5	18.0
City	15.5	25.0
Suburbs	8.3	14.2

[a]MSAs, Metropolitan Statistical Areas, which includes a central city/cities and the surrounding suburbs.
[b]For 1970, figures refer to SMSAs (Standard Metropolitan Statistical Areas) as defined at that time.
Source: Adapted from the Censuses of Population and Housing (U.S. Bureau of the Census, 1970, 2000).

U.S. metropolitan areas as a whole, and Table 1.2 contains data for the Worcester, Massachusetts, metropolitan area for the same variables from 1960 to 2000. The census figures in these two tables disclose a number of trends that hold important implications for travel patterns and for access, mobility, and urban transportation planning. Although the following discussion focuses on Worcester, you should put Worcester in the context of other U.S. metro areas by referring frequently to Table 1.1.

First, while the population of the Worcester metropolitan area (Metropolitan Statistical Area, or MSA) as a whole has grown somewhat (by 55% between 1960 and 2000), the number of households and the number of single-person households have increased dramatically, by 101% and 299%, respectively). The proportion of single-person households increased from only 13.6% of all MSA households in 1960 to nearly 27% of all households in 2000. The greater increase in households relative to population has implications for trip making because the number of trips made per person per day generally declines as household size increases. The trend to more households and more single-person households contributes significantly, then, to an overall growth in travel.

A second trend is that despite the increase in population and in households, the proportion of the population residing in the

TABLE 1.2. Demographic Trends, Worcester, Massachusetts, 1960–2000

	1960	1970	1980	1990	2000
Population of MSA[a]	323,306	344,320	372,940	436,905	502,511
Number of households in MSA	94,680	104,694	130,785	161,350	191,011
Percentage of households in MSA that are single-person	13.6	17.6	23.2	24.5	26.9
Percentage of MSA population living in central city	57.7	51.3	43.4	38.9	34.4
Percentage of households with no vehicle					
MSA	22.0	17.7	14.5	11.9	10.5
City	29.3	26.2	23.0	20.5	18.1
Suburbs	No data	7.6	7.5	6.3	6.3
Percentage of households with more than one vehicle					
MSA	15.2	28.6	43.2	52.4	53.1
City	11.1	19.4	29.1	37.6	36.9
Suburbs	No data	39.3	53.0	62.1	61.9
Percentage of population over 65 years of age					
MSA	11.9	12.0	13.4	14.2	13.3
City	13.6	14.7	16.3	16.0	14.1
Suburbs	9.5	9.2	11.3	13.0	12.8
Percentage of families below the poverty level					
MSA	No data	5.4	7.5	6.4	7.1
City		7.1	11.2	12.2	14.1
Suburbs		3.7	4.7	3.2	4.0
Percentage of families headed by women					
MSA	No data	11.3	15.1	16.0	11.6
City		15.2	21.1	24.2	15.6
Suburbs		7.2	10.9	11.5	9.4

[a]MSA, Metropolitan Statistical Area, which includes the City of Worcester and the surrounding suburbs.
Source: Adapted from the Censuses of Population and Housing (U.S. Bureau of the Census, 1960, 1970, 1980, 1990, 2000).

central city has steadily declined. A larger proportion of the metropolitan population (66% in 2000 vs. only 42% in 1960) now lives in the lower-density suburbs, which are more difficult to serve efficiently with public transportation. It's worthwhile looking at the data in Table 1.2 for the decades intervening between 1960 and 2000 because you can see how persistent the move to suburbanization has been, with an ever-diminishing proportion of the metropolitan population living in the city. As later chapters in this book make clear, urban and suburban areas have different transportation needs and priorities.

Third, although the proportion of households having no vehicle has dropped since 1960 both for the MSA and for the City of Worcester, the percentage of households without a car has remained noticeably higher in the city than in the suburbs. This latter point is to be expected, given the higher incidence of elderly and low-income households in the central city and given the greater availability of public transportation there. Nevertheless, despite the fact that a smaller proportion of households is now carless than was the case in 1960 ("only" 10.5% in 2000 vs. 22% in 1960), many people must still rely for mobility upon the bus, taxis, a bicycle, their own feet, or rides from other people. Fourth, although the proportion of carless households has declined, the proportion of households with more than one vehicle has grown in both city and suburbs; by 2000, more than half of Worcester-area households had more than one car.

A fifth trend that is evident from examining Table 1.2 is that since 1960 the number (and proportion) of households that are likely to have special transportation needs—the elderly, the poor, and female-headed households—has risen somewhat, and certainly has not declined. Throughout this period, a higher proportion of the central-city population than of the suburban population has been elderly, though the central-city–suburban gap has been closing. In fact, the proportion of the MSA's elderly who live in the central city has been declining over the past 40 years—from 66% of the elderly in 1960 to 36% in 2000. This means that the number of elderly people living in the suburbs has increased markedly. Because some older people do not drive, their presence in the suburbs—where bus service is often infrequent or nonexistent—raises questions about how the mobility needs of this group can be met. The travel problems of single-parent households, headed mostly by women, stem from the difficulty of running a household single-handedly; earning an income, shopping, obtaining medical care and childcare all must be done by the one adult in the household, sometimes without the aid of an automobile.

Employment Patterns

Since the 1960s, jobs have been decentralizing from the central city to the suburbs. Traditionally, especially from the standpoint of transportation planning, the suburbs were viewed as bedrooms for the central-city workforce. Radial transportation systems, focused on the urban core, were organized in large part around moving workers from the suburbs to the central city in the morning and back to the suburbs again in the evening. But this simple pattern now describes only a small portion of current reality. In Worcester in 1960, for example, 42% of suburban workers had jobs in the central city; by 2000 only 22% of employed people living in the suburbs worked in the central city. Similarly, the proportion of the metropolitan labor force that works in the City of Worcester as opposed to surrounding suburbs has declined from more than two-thirds in 1960 to only about one-third in 2000.[2]

Hughes (1991) has documented the extent to which employment has moved from central-city Newark, New Jersey, and into the surrounding region. Although the Newark region as a whole experienced considerable job growth in the 30 years after 1960, the spatial distribution of employment shifted dramatically within the region, from the central city to the suburbs. Central-city job loss coupled with suburban job growth makes access to employment extremely difficult for people who live in the central city but do not have a car. In his study Hughes documents how relatively few suburban jobs in the Newark region can be reached by people living in central Newark without a car; they would have to take a commuter train, and even then, how do they reach the employment site from a suburban train station?

Hughes links this decentralization of employment over the past few decades to the increase in poverty in inner-city Newark. Clearly, as we saw in the case of Worcester, large numbers of residences as well as jobs have been moving to the suburbs in the past four decades. But because of the unequal access of different groups of people to suburban housing, not all social groups have been able to decentralize to the same degree. In particular, low incomes as well as racial discrimination in the housing market have prevented many people, especially those from minority groups, from moving to the suburbs. Hughes's analysis, as well as work by other scholars (e.g., Wilson, 1987), underlines how the reality of residential segregation in U.S. cities, together with changes in job location, has important implications for people's access—or lack of access—to employment opportunities. The term *spatial mismatch* refers to this "mismatch" between inner-city residential location and suburban job location, without the automobility needed to "connect the dots" (see Holzer, 1991, and Mouw, 2000, for reviews of the spatial mismatch literature).

In a detailed study of the Boston metropolitan area, Shen (2001) extends and deepens our understanding of the spatial access of low-skilled job seekers to employment. In particular, Shen argues that analysts should focus on the location of job *openings* rather than on the location of *employment* as Hughes (1991) did, and he shows that preexisting employment, concentrated in the central city, is the main source of job openings. Shen's analysis also demonstrates that residential location (e.g., city vs. suburb) is not as important as transportation mode is in accounting for differences in job seekers' access to jobs. That is, job seekers who travel by car will have higher than average accessibility to job openings from just about any residential location, whereas job seekers who depend on public transit will have substantially lower than average accessibility from most residential locations (Shen, 2001, p. 65). Devajyoti Deka (Chapter 12, this volume) takes up these issues of equity in access in greater detail.

The Issue of Scale

Our discussions of residential and employment location patterns provide a useful snapshot of some important urban processes that have transportation implications: the decentralization of population and employment and the concentrations of low-income, carless, and female-headed households in the central city. But the spatial resolution of the information discussed thus far is quite generalized; in tracing out demographic trends in Worcester and employment trends in Newark, we made no finer distinction than that between the central city and the suburbs. For understanding many problems, data at these scales are sufficient, but if transportation policies and facilities are to be tailored to the specific needs of different kinds of people such as the elderly or the carless, then it is important to know as precisely as possible where, *within* the suburbs and *within* the central city, members of these target groups live.

Maps at the level of the census tract (an area comprising 4,000–5,000 people on average) or the census block group (an area within a census tract, encompassing about 1,000 people) reveal the degree to which people and households with certain characteristics are clustered in certain areas within the city or within the suburbs. Census tract maps for the City of Worcester, Massachusetts, provide examples. Compare Figure 1.2, which shows the distribution of the population over age 65 in 1960, with Figure 1.3, which shows the distribution of elderly people in 2000. In these four decades not only has the overall proportion of the population that is over age 65 increased (notice that the bounds on the quartiles are much higher in the map for 2000 [Figure 1.3] than they were in 1960 [Figure 1.2]), the spatial distribution of elderly people within the city has become more diffuse. There are now far more tracts with at least 16% of their populations above the age of 65.

By contrast, the spatial pattern of families below the poverty line has changed relatively little between 1970 (Figure 1.4) and 2000 (Figure 1.5), although the overall percentage of the city's households falling below the poverty line has doubled (from 7.1% in 1970 to 14.1% in 2000) and the proportion of poverty households in high-poverty tracts is dramatically higher in 2000 than it was in 1970 (compare the bounds on the fourth quartile for 1960 with that for 2000). The northwest quadrant of the city has remained a high-income, low-poverty area.

Maps at the scale of the census tract can also highlight demographic characteristics with similar spatial patterns. Compare the 2000 census tract maps of poverty (Figure 1.5), female-headed households (Figure 1.6), and households without a vehicle (Figure 1.7). These maps show a spatial coincidence of female-headed households, the carless, and the poor within the City of Worcester; that is, the same areas tend to have a high percentage of female-headed households, households in poverty, and households without an automobile. These spatial correlations are not as strong for suburban tracts (cf. Figures 1.8 and 1.9). While the overall proportions of female-headed households and households without vehi-

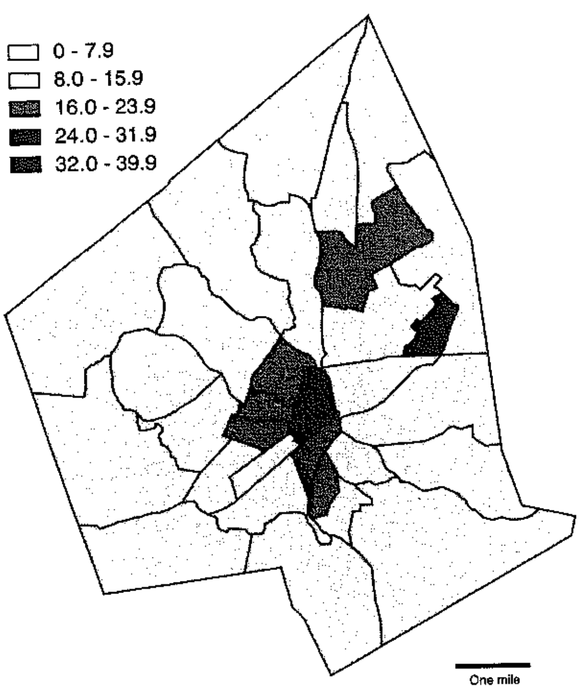

FIGURE 1.2. Percentage of population over 65 years of age in each census tract, 1960, Worcester, Massachusetts. Source: U.S. Bureau of the Census (1960).

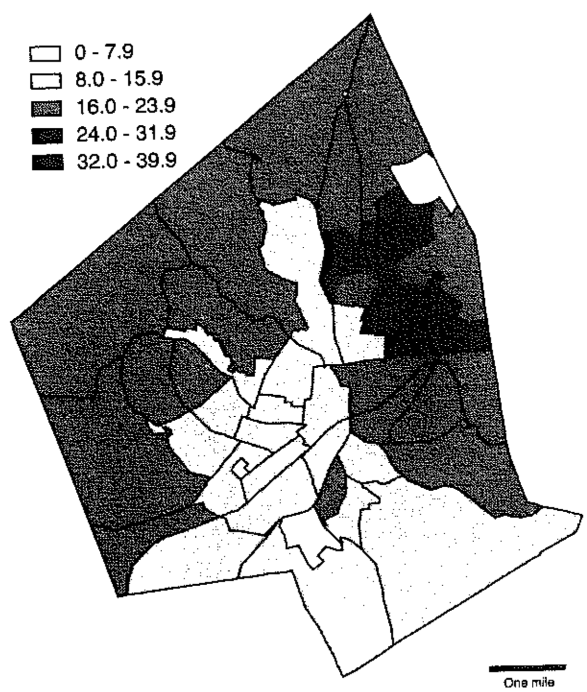

FIGURE 1.3. Percentage of population over 65 years of age in each census tract, 2000, in Worcester, Massachusetts. Source: U.S. Bureau of the Census (2000).

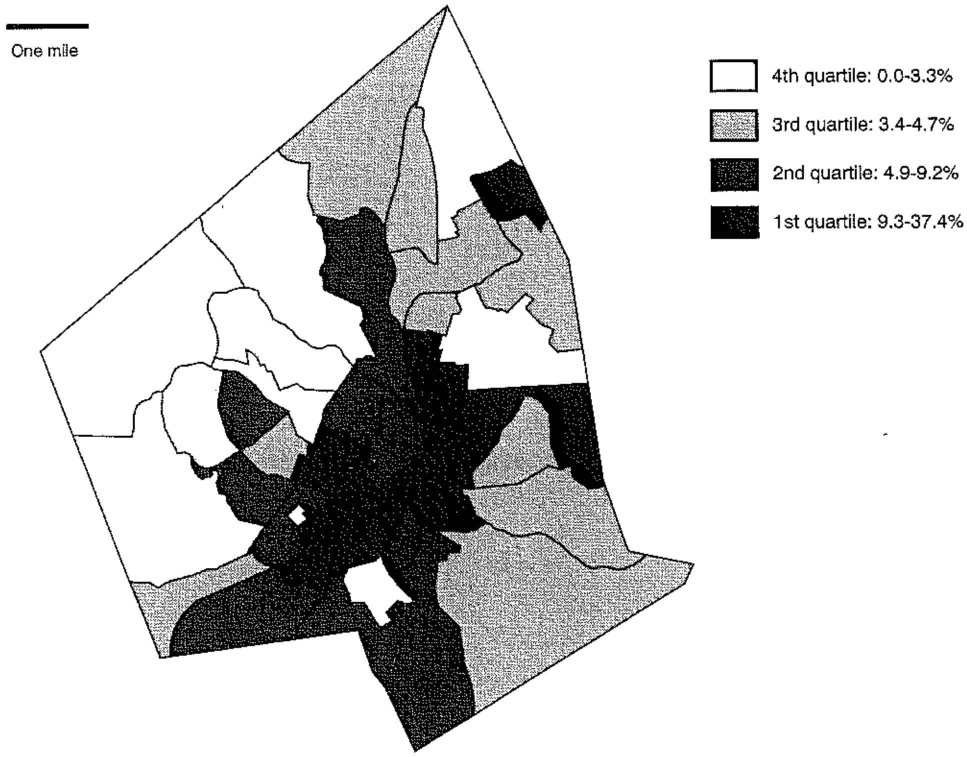

FIGURE 1.4. Percentage of households in poverty by census tract, 1970, Worcester, Massachusetts. Source: U.S. Bureau of the Census (1970).

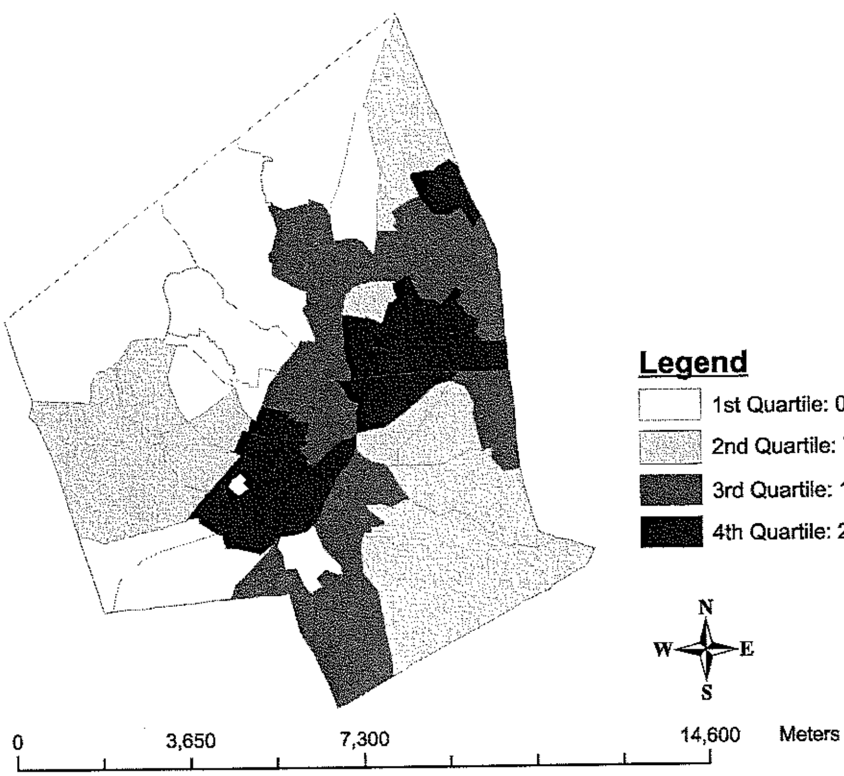

FIGURE 1.5. Percentage of households in poverty by census tract, 2000, in Worcester, Massachusetts. Source: U.S. Bureau of the Census (2000).

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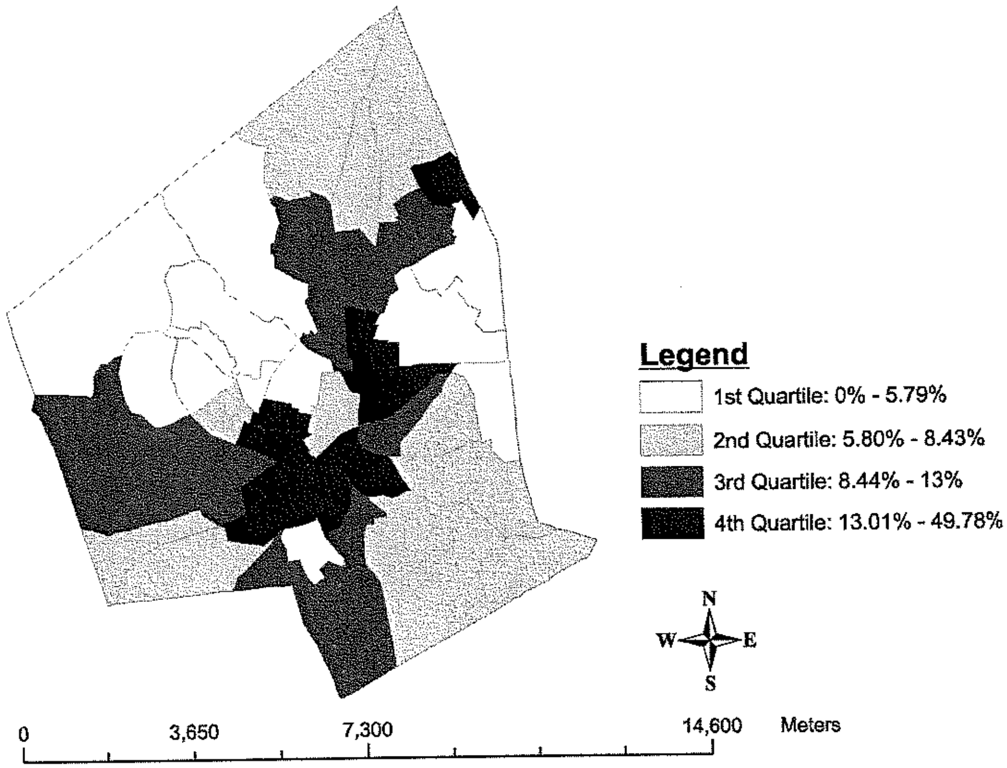

FIGURE 1.6. Percentage of households headed by women in each census tract, 2000, in Worcester, Massachusetts. Source: U.S. Bureau of the Census (2000).

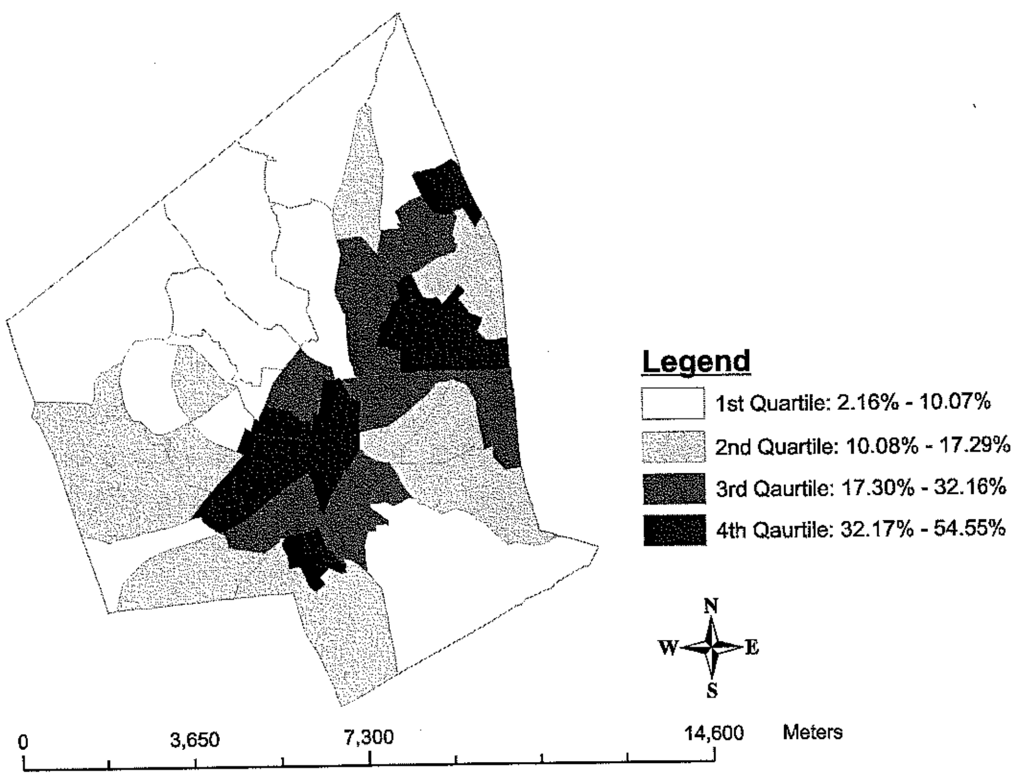

FIGURE 1.7. Percentage of households without a vehicle by census tract, 2000, in Worcester, Massachusetts. Source: U.S. Bureau of the Census (2000).

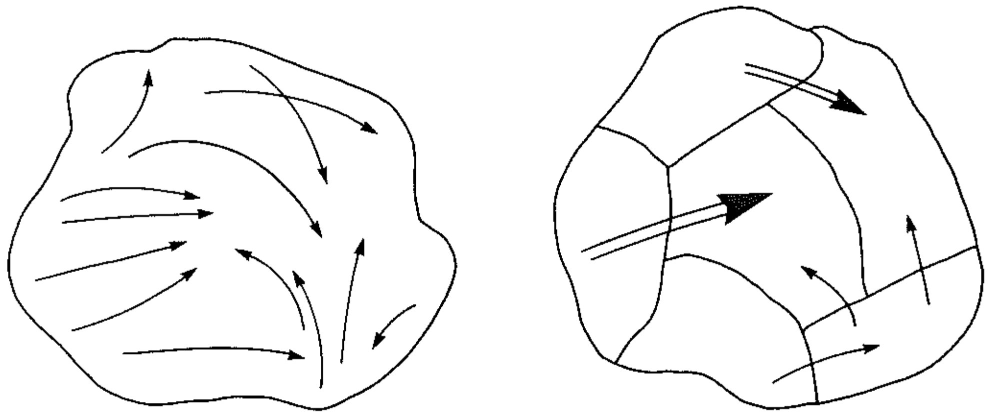

FIGURE 1.11. (a) Individual trips, showing points of origin and destination. (b) Individual trips aggregated by origin and destination zones. Thickness of arrow indicates volume of flow between zones.

ent travel patterns from people in $22,000 households, but the zonal data will portray only an "average" behavior for the people of the zone. The more homogeneous an area is, the closer the zonal data will come to approximating the characteristics of the individuals living within that zone. Census tract boundaries or the boundaries of traffic zones (areal units often used in transportation studies) sometimes split relatively homogeneous areas, adding heterogeneity to the resulting zones. In general, the larger a tract or zone, the less likely it is that all the households living there will share similar characteristics.

The kind of areal (or zonal) data shown in the Worcester maps are useful for providing an overview of population distributions and employment locations within the MSA, for showing where certain population characteristics coincide in space, and for suggesting where certain transportation policies might best be deployed. They are not particularly useful for indicating what characteristics occur together at the household or individual level or for investigating how and why people make travel decisions or how they might respond to a particular transportation policy such as increased headways on a bus route (i.e., longer times between buses) or the installation of a bicycle lane on a certain route. Such questions require data for individuals rather than for areas.

Transportation analysts use both area (*aggregate*) and individual-level (*disaggregate*) data in studying movement patterns in cities. Studies taking an aggregate approach use data for areal units called "traffic zones" and group separate trips together according to their zone of origin and their zone of destination (see Figure 1.11). The focus is on the flows between zones: how many trips does a particular zone "produce" (in other words, how many trips leave zone *i*) or "attract" (how many of those trips end in zone *j*)? What are the characteristics of zone *i* and zone *j* that might account for the volume of flows leaving *i* and arriving at *j*? Can you explain the size of the flow from *i* to *j* in terms of the attractiveness of *j* and its distance from *i*? These are some of the questions an aggregate approach to transportation analysis seeks to answer.

In recent years, transportation analysts have begun using individual- and household-level data in addition to areal data. These disaggregate data often use more finely grained spatial codes as well, such as street addresses instead of zones. The conceptual base of the disaggregate approach is the person's daily travel activity pattern, rather than flows between zones. Figure 1.12 shows a schematic, bird's-eye-view of a hypothetical daily travel pattern; you could try mapping your own travel behavior like this over the course of several days. The questions posed in a disaggregate context are aimed at individuals or households rather than at zones: What sociodemographic characteristics are related to a household's level of trip making? What factors affect why a person selects one destination or mode rather than another? What proportion of those who live in the suburbs and work in the central city will shift from commuting by drive-alone auto to a car pool or van pool if a high-speed, high-occupancy vehicle (HOV) lane is installed on their journey-to-work route?

The scale distinction—between aggregate and disaggregate approaches—threads throughout many of the chapters in this book, particularly those in Part II, which focuses on the ways planners analyze movement patterns in order to design and implement changes to the urban transportation system. It is important to understand at the outset the close interdependencies among the scale at which you collect data, the types of models you can build (i.e., how you can simplify and make more comprehensible some of the overwhelming complexities that characterize flow patterns), and the kinds of policy analysis you can carry out. Always ask, At what scale is this transportation issue or problem being conceptualized.

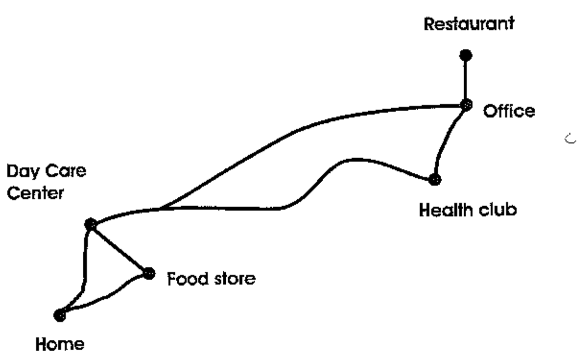

FIGURE 1.12. One person's hypothetical daily travel pattern.

TRENDS IN U.S. TRAVEL PATTERNS

Americans have more mobility, particularly the kind that is provided by motorized vehicles, than people anywhere else on earth. In 1997, Americans logged 4.6 trillion passenger miles of travel by all motorized modes, and 92% of those miles were by automobile; this total amounts to more than 14,000 miles of travel per person per year (U.S. Department of Transportation, Bureau of Transportation Statistics, 1999, pp. 35–37). Moreover, American mobility has been increasing in recent years, despite threats of fuel shortages and concerns about environmental pollution. Between 1975 and 1997, person miles of travel (a person mile of travel, or PMT, is one person traveling 1 mile) in the United States grew by 77%. In part, this increase simply reflects population growth, but even more important are increases in the number of trips made per person and in average trip length (Pisarski, 1992; U.S. Department of Transportation, Bureau of Transportation Statistics, 2001, pp. 85–86).

These trends are tied to two other ones: the increasing number of vehicles on the road and the growing proportion of the U.S. population that is licensed to drive. In 1960, there was only about one car for every 3.8 people in the country; by 2000 there was one car for every 1.3 of the 281 million people in the United States (United Nations, 1961, 2001). The growth in rates of auto ownership has been accompanied by increasing proportions of licensed drivers in the population. Whereas in 1960 only 71.7% of people over age 16 had a driver's license, by 2001 93% of men and 87% of women (90% of the population over age 16) were licensed to drive (U.S. Bureau of the Census, 1962; U.S. Department of Transportation 2003b). In fact, in recent years women have disproportionately accounted for increased levels of travel in the United States. Although women's daily rate of trip making used to be lower than men's, by 1995 it was the same as men's at 4.3 local trips per day, while men's average trip length of 10 miles is still greater than women's with 8 miles (U.S. Department of Transportation, Federal Highway Administration, 2001, pp. 4-9, 4-12).

These increases in licensed drivers and in the number of private vehicles have fueled an increase in vehicle miles traveled (VMT; 1 VMT is 1 mile traveled by a vehicle; if a vehicle has four passengers, then 1 VMT would equal 4 PMTs [passenger miles traveled]). Between 1989 and 1999, VMT increased by almost 30%, or 2.5% annually. At the same time, vehicle miles per capita grew by 16% (U.S. Department of Transportation, Bureau of Transportation Statistics, 2001, p. 87). These increases reflect shifts from walking and transit to autos as well as lower levels of vehicle occupancy. Average vehicle occupancy for all trips fell from 1.9 in 1977 to 1.6 in 1990 and has stayed at that level since (Pisarski, 1992, p. 12, U.S. Department of Transportation, 2003a, p. 11). Fewer people are now passengers and more are drivers, so that, increasingly, more cars are being used to serve the same number of riders. The combined impact of these trends is evident in the steady increase in VMT (see Figure 1.13).

Urban transportation planning has for decades focused largely on the work trip. This overarching concern with the journey to work reflects several factors. First, of all the purposes for which people travel (including work, socializing, recreation, shopping, and personal business), work used to account for the largest proportion of trips. Second, work trips are associated with the morning and evening "peaking problem"; because most people have to be at work between 7:00 A.M. and 9:00 A.M. and leave 8 hours later, work trips have been concentrated in time. The peak load associated with the work trip has placed the greatest demands on the transportation system. As

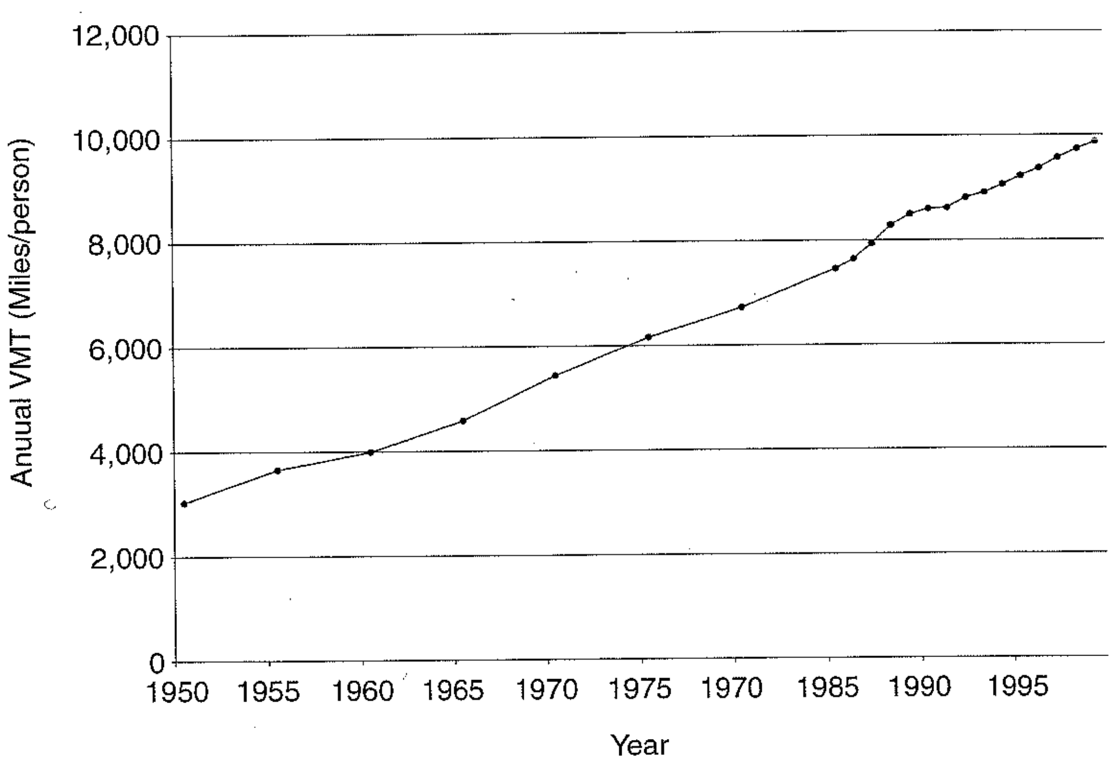

FIGURE 1.13. Annual vehicle miles traveled per person, 1950–1999. Source: U.S. Department of Energy (2001).

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you will see in the chapters describing the urban transportation planning process (Chapters 5, 6, and 7, this volume), urban transportation planners have traditionally aimed to provide a transportation system with enough capacity to handle the work trip, under the assumption that such a system can then easily accommodate travel for other purposes. (Obviously, this assumption will be erroneous if nonwork trips have a markedly different spatial configuration from work trips.) A final reason for transportation planners to focus on the work trip is that people tend to travel longer distances for work than for other purposes. The average work trip length in 2001 (13.4 miles) was double the average distance traveled for shopping (6.7 miles), for example (calculated from National Household Travel Survey [NHTS]).

The first two of these patterns have been changing in recent years, however. First, the proportion of travel for nonwork purposes (e.g., socializing, recreation, personal business) has increased significantly. Whereas in 1969, work and work-related travel accounted for more than 41% of all local trips, by 2001, it accounted for only about 15% (U.S. Department of Transportation, 2003a, p. 10). Although travel for all purposes has grown substantially, nonwork travel has increased at a faster rate than work travel has. This increase in nonwork travel can be traced to increases in the number of affluent households and two-earner households, which spur more trips to childcare centers, restaurants, shops, fitness centers, and the like. Another reason is the decline in household size (and therefore a greater number of households for a given population), because "it is the care and upkeep of households, almost independent of the number of persons in the household that frequently governs trip making" (U.S. Department of Transportation, Bureau of Transportation Statistics, 1994, p. 54). Commuting costs are now a smaller proportion of the average household's total transportation cost than in the past.

A second change in work travel is that the morning and evening peaks have been declining, so that even though overall VMT and congestion have grown, travel is becoming more spread out over the day and less concentrated in the peak commuting hours (U.S. Department of Transportation, Bureau of Transportation Statistics, 1999, p. 57; U.S. Department of Transportation, 2003a, p. 11). This change is in part related to the replacement of jobs in manufacturing with service-sector jobs, which tend to be more geographically dispersed and to have more staggered hours of employment. It is also due to the increase in part-time and contingent work, which shifts many work trips to off-peak times.[3] These two trends (the increase in nonwork travel and the decline in rush-hour peaks) suggest that the blame for traffic congestion can no longer be placed solely on the work trip.

Not only do people travel longer distances to work than they do for other purposes, work travel *distances* have been increasing, whereas *travel time* to work has been holding steady. In 1975, average travel distance to work was about 9 miles and the average travel time was approximately 20 minutes (U.S. Bureau of the Census, 1979). In 1995, the average work trip covered 11.6 miles and took 21 minutes (U.S. Department of Transportation, Federal Highway Administration, 2001, p. 6-11). These national averages mask a great deal of variability, of course, among different groups of people, defined, for example, by place of residence (e.g., central city, suburb, small town), age, gender, and travel mode. The relatively constant travel time despite the increase in mileage (and the resulting increase in average speed) reflects in part the improvements in the transportation system (especially highways) that make it easy to travel farther within a given amount of time. But the increase in average work trip speed also reflects shifts in travel mode away from carpooling, mass transit, and walking and into single-occupant vehicles (Pisarski, 1992).

It is important to understand a number of other important characteristics of work travel, including the size and composition of the workforce, the structure of commute trips, and the modes of transportation used. Since the late 1960s, the creation of jobs (and therefore the number of workers) has outpaced population growth. Between 1980 and 1990, for example, the U.S. population grew by less than 10%, but the number of workers increased by more than 19% (U.S. Department of Transportation, Bureau of Transportation Statistics, 1994, p. 52).[4] The entry of large numbers of women into the paid labor force has been a major contributor to this trend; whereas in 1960 36% of women age 16 to 64 were in the paid labor force, by 2000 that figure had risen to 58%, and more than three-fifths (63%) of mothers of children under age 6 were in the labor force (U.S. Bureau of the Census, 1960, 2000). Women now comprise more than 45% of those making work trips.

The spatial pattern of commuting flows has become more complex; the traditional suburb-to-central-city commute has not been the dominant work trip type since at least as long ago as 1970 (Plane, 1981). In 2000, if we exclude work trips made within and between nonmetropolitan areas and look only at trips made within metropolitan areas, the national pattern of commuting flows looks quite intricate (see Table 1.3). The within-suburb or suburb-to-suburb commute is clearly dominant, accounting for about two-fifths of all metropolitan work trips. The "traditional" commute (suburb to central city) accounts for less than one-fifth (only 17.4%) of all journeys to work, and the reverse commute (central city to suburb) is 7.6% of commuting flows.

Given the complexity of the flow patterns depicted in Table 1.3, it is perhaps not surprising that the proportion of work trips made by auto has consistently increased while the proportion made on public transit (bus, commuter rail, subway) has continued to decline (Figure 1.14). In 2000, less than 5% of work trips in the United States were made on transit, a figure that masks a great deal of place-to-place variability (U.S. Bureau of the Census, 2000). (For a thorough discussion of public transit, see Chapter 8.) By 2000, the proportion of people driving alone to work had increased (to about 80%), while the proportion carpooling had decreased from roughly 20% in 1980 to 12%. Those commuting by private vehicle in 2000 accounted for 88% of all work trips (U.S. Department of Transportation, Bureau of Transportation Statistics, 2001, p. 98).

Taken together, these trends—more vehicles on the road, increasing VMT, longer trips in terms of distance—add up not only to more mobility, which many Americans clearly value, but also to many of the problems associated with transportation and primarily with the car, including congestion; air, water, and noise pollution; energy consumption; urban sprawl; traffic accidents; and health problems. A study undertaken by the Natural Resources Defense Council (NRDC) (Miller & Moffet, 1993) finds that a substantial portion of the cost of automo-

TABLE 1.3. Commuting Flows in U.S. Metropolitan Areas

Suburbs to central city	18,175,489	17.4%
Within suburbs	40,745,878	39.0%
From suburbs to outside home MSA	7,650,705	7.3%
Central city to suburbs	7,984,014	7.6%
Within central city	27,425,079	26.3%
From central city to outside home MSA	2,402,466	2.3%

Note. Base (workers over 16 living in MSAs): 104,383,631. Source: U.S. Bureau of the Census (2000).

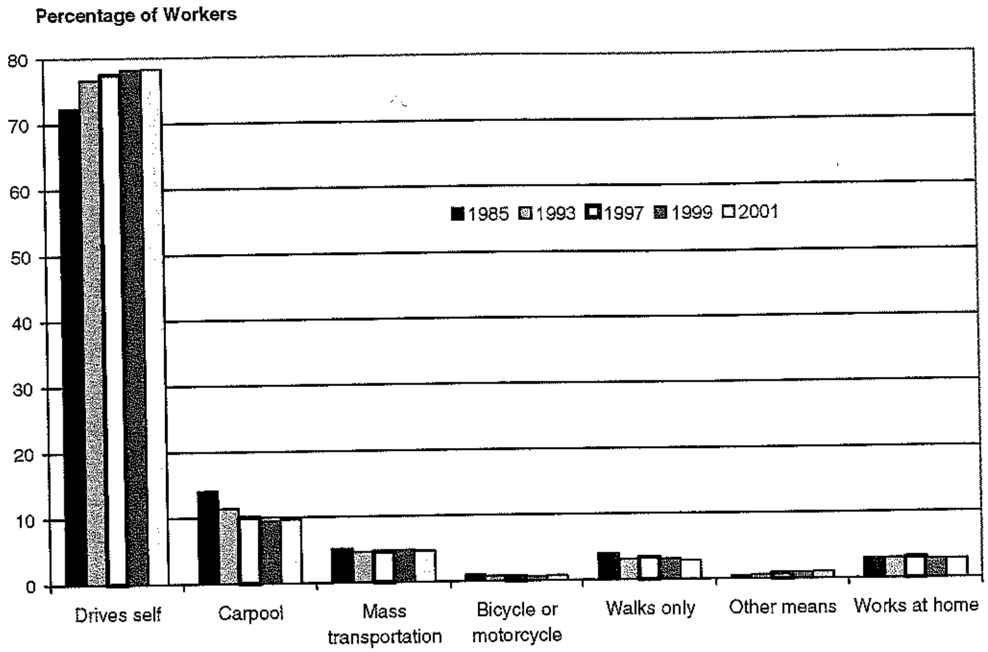

FIGURE 1.14. How people get to work: 1985–2001. Source: U.S. Department of Housing and Urban Development, American Housing Survey, various years.

bile travel is borne not by the user, but by government and by society, including future generations. The NRDC study argues that whereas people perceive transit as being more heavily subsidized than the auto (in that a large portion of the costs of transit are not paid directly by the user), "the subsidies that transit receives are easily scrutinized [because they are generally direct government payments] while the subsidies that automobiles receive are hidden, not easily quantified, and widely dispersed" (1993, p. 67). In fact, the study estimates that about 85% of the subsidies that autos receive are external costs (i.e., not paid for by the user), incurred, for example, by congestion, parking, accidents, and air, noise, and water pollution. The actual estimated cost of travel by auto per person mile traveled (PMT) was between 38 cents and 52 cents, with between 33.5 cents and 42.4 cents of that cost being borne by society rather than by the traveler (Miller & Moffet, 1993, p. 66).

Although increases in automobile ownership and in VMT by car are evident in most countries, the patterns described in this section for the United States are not replicated everywhere; in fact, careful study of travel patterns in other countries (see, e.g., Pucher & Lefevre, 1996) shows that economic efficiency and high levels of personal mobility are possible without the extreme automobile dependency that characterizes the U.S. transportation system. Despite European trends that mimic those in the United States (increases in car usage, reductions in walk, bike, and transit trips) Pucher and Lefevre (1996) report, for example, that public transport is still far more widely used in Western Europe than in the United States, accounting for between 10 and 20% of total urban travel in Europe, but only 3% in the United States; similarly, Europeans are more likely to get places via walking or biking (they make more than one-third of their trips by these modes) than are Americans, who make only 10% of their trips via walk or bicycle. As many of the chapters in this book make clear, public policy plays a vital role in shaping international differences in land use and transportation patterns.

In the United States, public policies have helped to create a society in which we use the time saved via technological improvements in transportation to consume more distance (keeping the total amount of time spent traveling relatively constant) rather than reallocating that time from transportation to other activities. Yet one of the reasons we value the convenience, flexibility, and speed of the auto is that we are a society in which people always seem to be pressed for time. As you will see in Chapters 5 and 6, much of transportation planning has been aimed at saving travel time; this emphasis, operationalized by placing a monetary value on the time "saved" by traveling at faster speeds, has pushed the transportation system toward building ever more, and ever wider, roads (Whitelegg, 1993, pp. 94–96), high-speed railways, and airports. How do we break out of this cycle? Should we even try to? Recent policy shifts within the United States suggest a move toward a more comprehensive approach to thinking about transportation issues.

THE POLICY CONTEXT

In the early 1990s the policy context for transportation planning in the United States changed dramatically with the passage of two key pieces of federal legislation: the Clean Air Act Amendments (CAAA, passed in 1990) and the Intermodel Surface Transportation Efficiency Act (ISTEA, passed in 1991). The Clean Air Act of 1970 identified the automobile as a major contributor to the nation's air pollution problems and explicitly enlisted transportation planners in the effort to meet air quality goals. The 1990 CAAA required that the transportation planning process be broadened to integrate clean air planning and transportation planning at the regional level. Specifically, the CAAA set out goals for cleaner vehicles, for cleaner fuels, and for transportation programs to meet air quality standards.

ISTEA allocated funding support and set out institutional processes to meet these goals. As Howe put it, ISTEA embodied "a whole new attitude toward transportation planning" (1994, p. 11). ISTEA stated, "It is the policy of the United States to develop a National Intermodel Transportation System that is economically efficient and environmentally sound, provides the foundation for the Nation to compete in the global economy, and will move people and goods in an energy-efficient manner." As you can see from this policy statement, ISTEA construed the transportation problem far more broadly than had previous policies to include energy consumption, air pollution, and economic competitiveness as goals in addition to increasing mobility. In 1998 Congress passed the Transportation Equity Act for the 21st Century (TEA-21), legislation that continues to support the transportation planning and funding philosophy embodied in ISTEA.

ISTEA and TEA-21 have increased the flexibility of the regional agencies responsible for transportation planning, known as Metropolitan Planning Organizations (MPOs), in their approaches to solving transportation problems. Funds that earlier had been reserved for highway projects can now be used for all surface modes of transportation, including walking, bicycling, and public transit, which the planning process had neglected in the past. Significantly, ISTEA encouraged the building of bicycle and pedestrian facilities and gave priority to managing the existing transportation system more efficiently rather than increasing supply (i.e., building more roads). Under ISTEA and TEA-21, regional planning agencies have enhanced power in the transportation planning arena, and public participation (the involvement of the users of the transportations system) is an integral part of the planning process. Other goals of ISTEA and TEA-21 include preserving the integrity of communities and providing increased mobility for the elderly, the disabled, and the economically disadvantaged.

All this is a far cry from the days, not so long ago, when transportation planning meant highway building. Throughout the remaining chapters in this book you will see how, together, the CAAA, the ISTEA, and its successor act the TEA-21 have had a significant impact on the way planners conceptualize and try to solve urban transportation planning problems.

What are the issues, the problems, the questions that transportation analysts seek to understand and to remedy? Some are evident from the above discussions of recent trends in travel and the contemporary urban context within which travel and transportation planning take place. The increasing separation between home and work and between activity sites in general—together with the growth in population, in households, in the civilian labor force, and in consumption—mean not only that more travel is required for each individual to carry out his or her round of daily activities but also that more and more people are traveling more and more miles. Congestion has long been viewed as the main urban transportation problem to be "solved," mainly by constructing more and more highways with ever greater capacity. Since the 1950s, however, we have learned the ironic lesson that increased highway capacity generally cannot keep pace with the increased travel demand that is attracted by faster movement and lower-cost travel; as a result, even with more highway capacity roads remain congested.

The CAAA, ISTEA, and TEA-21 articulate a range of transportation-related policy concerns—other than traffic congestion—and a number of these are addressed in Part III of this book. Not every major transportation-related problem is accorded a separate chapter in Part III. One example is health. The growing distance between activity sites along with the overwhelming automobile orientation of U.S. society makes travel on foot or by bicycle difficult and often dangerous. In 1995 pedestrian and bicycle travel accounted for only 6.3 % and less than 0.05%, respectively, of all person miles traveled but fully 14% of all traffic fatalities (U.S. Department of Transportation, Federal Highway Administration, 2001). One might argue, therefore, that part of the urban transportation problem is the threat to health and safety posed by the monopoly that motorized vehicles seem to have in urban travel. Air pollution, water pollution, and traffic accidents (some 40,000 traffic deaths per year in the United States) are all health problems that can be related to the current configuration of urban transportation. There is also the question as to whether the current U.S. transportation system discourages physical activity and encourages a sedentary lifestyle; how would you go about investigating that question?

The policy concerns that *are* addressed in Part III reflect the range of questions that transportation geographers and planners are grappling with: transit, land use change, energy consumption, transportation finance, equity issues, and environmental impacts. As several chapter authors make clear, politics surrounds decision making in all of these policy arenas. Careful analysis by transportation planners may conclude that a particular plan or policy would best serve the transportation needs of a community. Whether or not that plan or policy is implemented, however, is the result of a political process. Because every transportation-related decision will benefit some people more than others—and because who the "winners" and "losers" will be is often defined by *where they live*—the politics of urban transportation often has a distinct geographic dimension.

One major current transportation issue is the appropriate role for public transport in U.S. cities. In the 1960s and the early 1970s planners (and the public) looked to transit to reduce air pollution, energy consumption, and congestion, as well as to revitalize downtown areas and to promote mobility for the carless. It is now clear that, although public transportation is not a panacea for all these urban problems, transit does fill an important niche in many, if not all, U.S. cities. What are the reasons behind the precarious finances of transit companies in U.S. cities? What is an appropriate role for public transportation in a country as devoted to the private automobile as is the United States?

The intimate relationship between transportation and land use was acknowledged at the outset of this chapter, but what are the policy implications of this close relationship? To what extent are transportation projects responsible for increasing urban land values and for generating urban development? Can urban sprawl be attributed to large-scale transportation improvements? Are certain transportation investments, such as light-rail rapid transit lines, an effective means of changing urban land use patterns (e.g., intensifying urban land use or revitalizing certain parts of the city)?

Transportation is a major consumer of energy, especially energy from petroleum. In 1999, transportation of all types consumed more than one-quarter of the energy used in the United States but about two-thirds of the petroleum consumed (U.S. Department of Transportation, Bureau of Transportation Statistics, 2001, pp. 171, 173). Although the United States has less than 5% of the world's population, it consumes 42% of the world's gasoline (United Nations, 1994). In the 1970s the price of energy rose substantially, and the reality of petroleum shortages forced its way into the American consciousness. What impact have these earlier changes in energy price and availability had upon American energy consumption? How effective can transportation policies be in reducing the consumption of fossil fuels?

Transportation investments involve huge amounts of money; more than 11% of the U.S. economy is tied to transportation (U.S. Department of Transportation, Bureau of Transportation Statistics, 2003). What is the economic rationale for investing public funds in transportation systems? How should public monies for transportation be raised and how should they be allocated? What factors determine how and where that public money gets spent? How can we assess whether or not transportation funds are being allocated equitably across geographic areas and various social groups? How does the history of transportation finance shed light on contemporary transportation systems, especially highways and public transit?

Because social status in the U.S. city is closely related to location, as is illustrated in this chapter in the maps of Worcester, Massachusetts, the placement of different transportation projects will affect various social groups differently. One dimension of the urban transportation problem is, then, who pays for and who benefits from any given transportation investment. Are public transportation costs and benefits, in particular, distributed evenly among transit users? How can transportation services be provided in an equitable manner? Similarly, are various social groups equally or differentially exposed to the environmental costs associated with urban mobility (e.g., noise, air pollution, traffic accidents)?

Because most travel in the United States is conducted in motor vehicles, another dimension of the urban transportation problem is the set of environmental impacts stemming from facility construction and from the use of motor vehicles. Although the amount of air pollution generated per automobile has declined significantly in the past 20 years, increases in VMT mean that transportation sources remain a primary contributor to air quality problems. For example, transportation accounts for 77% of carbon monoxide, 47% of volatile organic compounds, which contribute to ground-level ozone formation, and 56% of nitrogen dioxide released into the air (U.S. Environmental Protection Agency, 2001). Transportation analysts are now federally mandated to play a key role in maintaining air quality standards. How can transportation investments be made so as also to minimize other adverse environmental impacts such as noise and water pollution and wildlife habitat fragmentation?

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Each of the chapters in Part III takes up an issue that is closely linked to questions of sustainability. Because transportation is so completely intertwined with all aspects of urban life, sustainable transportation has to be at the core of any effort to promote sustainable development. While difficult to define, *sustainable development* involves meeting current needs in ways that improve economic, environmental, and social conditions while not jeopardizing the ability of future generations to meet their own needs (Brundtland Commission, 1987). Strategies for sustainable transportation include those that reduce overall vehicle trip frequencies and trip lengths and those that facilitate walking, bicycling, and using public transportation (Deakin, 2002). As Deakin points out, "What makes sustainable transportation planning different from past practice is that social and environmental objectives are an integral part of sustainable transportation planning, rather than constraints or the focus of mitigation efforts" (2002, p. 9). With the U.S. transportation sector estimated to be the "the single largest source of greenhouse gas emissions in the world" (U.S. Department of Transportation, 1998, cited in Deakin, 2002, p. 3), current transportation practices in the United States are far from sustainable. Will transportation become more sustainable through reduced travel or through further technology improvement, or through some of each? We invite you to think carefully about how citizens and transportation professionals might improve the sustainability of urban transportation.

Each of the policy chapters examines the evidence that bears upon an issue related to sustainability. An interesting theme that emerges from these chapters is that careful empirical analysis often yields results that challenge long-held ideas. Some of these established, accepted notions emerged from microeconomic theory; others came from earlier, less carefully controlled empirical work. But the message that comes through again and again in Part III is that we cannot assume that an assertion is true simply because it has been accepted and unquestioned for a long time. So, we invite you to read critically and to think about how *you* would go about improving transportation in cities.

NOTES

1. Calculated from the 2000 National Household Travel Survey.
2. In 1960, 67.2% of Worcester's MSA labor force worked in the City of Worcester, and in 2000 the percentage was 32.2. The MSA boundaries changed over this period as well; in 1960, the MSA included 20 towns, and by 2000 it included 35 towns. Although the number of workers in the city increased slightly in these four decades (from about 81,500 to 82,800), suburban employment grew at a far greater rate.
3. Temporary work is growing rapidly in the United States While aggregate nonfarm employment grew at an annual rate of 2% between 1972 and 1995, employment in temporary services grew 11.8% per annum during the same period (Segal & Sullivan, 1997). One-fifth of all new jobs creation since 1984 was through temporary agencies (Capelli et al., 1997).
4. Between 1990 and 2000, population and workforce both grew at 11.6%.

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CHAPTER 1

The Context of Urban Travel

Concepts and Recent Trends

SUSAN HANSON

Many trace the dawn of the modern civil rights movement in the United States to events that transpired on a city bus in Montgomery, Alabama, on December 1, 1955, when Rosa Parks refused an order from a municipal bus driver to give up her seat to a white man. Her arrest and the subsequent Montgomery bus boycott (1955–1959), in which blacks refused to patronize the segregated city bus system, proved the power of collective action and brought Martin Luther King, Jr., to prominence. That the civil rights movement should have been born on a city bus is just one measure of how urban transportation is woven into the fabric of U.S. life.

Can you imagine what life would be like without the ease of movement that we now take for granted? The blizzards that periodically envelop major cities give individuals a fleeting taste of what it is like to be held captive (quite literally) in one's own home (or some other place) for several days. With roads buried under 6 feet of packed snow, you cannot obtain food, earn a living, get medical care for a sick child, or visit friends. As recent earthquakes in California and floods in the Midwest have illustrated, the collapse of a single bridge can disrupt the daily lives of tens of thousands of people and hundreds of businesses. The blackout that enveloped much of the U.S. Northeast and Midwest for a few days in August 2003 brought life to a standstill.

Transportation is vital to U.S. urban life and to life in other places as well because it is an absolutely necessary means to an end: It allows people to carry out the diverse range of activities that make up daily life. Because cities consist of spatially separated, highly specialized land uses—food stores, laundromats, hardware stores, banks, drugstores, hospitals, libraries, schools, post offices, and so on—people must travel if they want to obtain necessary goods and services. Moreover, home and work are in the same location for only a few people (about 3.3% of the U.S. workforce in 2000), so that to earn an income as well as to spend it one must travel.

Although people do occasionally engage in travel for its own sake (as in taking a Sunday drive or a family bike ride), most urban travel occurs as a by-product of trying to accomplish some other (nontravel) activity such as work, shopping, or mailing a

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