

# Social Trends and Their Implications for Transportation Planning Methods

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Transportation planners devote most of their effort to analyzing data and formulating mathematical models that estimate current and future travel. The appropriateness of models and validity of data chosen to calibrate them depend largely on the wisdom with which planners recognize and forecast social trends. Just as travel is derived from economic, social, and recreational activity, our methods are derived from perceptions of social, demographic, and economic structures. When these foundations of transportation planning change, we must recognize that change and adjust the methods accordingly.

The pioneering regional transportation studies of the 1950s and 1960s invented techniques that evolved into the transportation planning methods used today throughout the world. Those methods no longer seem adequate to the tasks of the 1980s, and that is the major reason for this conference. But we should not lose sight of the fact that early regional transportation studies devoted most of their effort to the discovery, analysis, and forecasting of demographic, economic, and social trends. The mathematical techniques that they fashioned encapsulated current understanding of relationships between those trends and travel. The extent to which we find their methods obsolete today does not merely reflect our greater mathematical and computational capabilities. To a far greater extent, it is a reflection of profound changes in our understanding of the underlying determinants of travel. The effectiveness of new transportation planning methods will depend far more on our understanding of social and economic trends than on statistical elegance or technical finesse.

Transportation planning methods rest first and foremost on an understanding of the phenomena with which they deal. Methods prove inadequate if they do not correctly or completely represent relationships among travel and urban development; household decisions and economic trends; social changes and trip patterns; and political decisions and transportation options. We use simple observation, statistical hypothesis testing, and analytical models to discover relationships that underlie travel. This understanding is elevated to the level of formal theory through replication and the development of models. The applied models that transportation planners use every day reflect theories, which in turn reflect statistical analyses, which in turn reflect conclusions and, ultimately, even hunches about transportation phenomena. At this conference we want to be practical and to concentrate on the planning methods that we use every day. We do not seek conclusions that are too academic, ethereal, or limited to discussions of statistical tests and mathematical formulations. Yet, we must recognize that flaws in our everyday models can ultimately stem from many sources. First, they can be traced to

poor empirical information on which we try to base useful applications of essentially valid theories. Second, they can reflect the fact that some of our theories are outmoded, incomplete, or just plain wrong in their representations of causes and effects. Third, everyday planning methods are often faulty because they apply analytical techniques to the task of projection for which they were not properly designed. Even though they seemed to fit retrospective time series or cross-sectional data very well, analytical models are often quite useless for projection.

I want to discuss several important changes in social and demographic trends rather than to talk directly about planning methods. I do this because I am convinced that these trends are dominating the changes now taking place in travel patterns and transportation policy, while the everyday practical methods of transportation planning are failing to recognize or incorporate them. They fail to recognize these important trends perhaps because of inadequate data, perhaps because of inadequate theory, and perhaps because we keep applying old analytical techniques to the tasks of projecting a new environment for transportation. If we want to concentrate on the trees that constitute transportation planning methods, I want to at least insist that those trees are located in the right forest. In the final analysis, that seems quite practical to me.

Although major social changes are invariably interdependent with one another, it seems useful to describe recent trends in terms of three major themes. These are (a) changes in the American household, (b) the transition to the post-industrial society, and (c) changes in price structure of transportation and housing. Under each of these headings I will summarize major social changes now under way and discuss their implications for travel and transportation. I will close each section by offering personal interpretations of their implications for transportation planning methods.

## THE CHANGING AMERICAN HOUSEHOLD

### Recent Demographic Trends

The American household is not what it used to be, and the consequences for transportation planners are significant. For more than 20 years, the number of households has been growing more rapidly than the population, and over time the disparity between these growth rates is widening. During the 1970s, the number of households grew at an average rate of 2.2 percent per year, while the population grew by only 0.8 percent per year<sup>1</sup>. The rate of household formation was thus

2.75 times as great as population growth, while in the 1960s new households were formed at a rate only 1.4 times that of population growth<sup>2</sup>. Consequently, while in 1940 the average American household consisted of more than 3.6 persons<sup>3</sup>, today it consists of fewer than 2.8 persons<sup>4</sup>.

There were 10.7 million more households in 1977 than in 1970, but this increase in numbers reflects more dramatic changes in household composition. These changes are so profound that the term "household" itself no longer means what it used to. During those seven years, 44 percent of the growth in households consisted of new single-person households<sup>2</sup>. Single-parent households with children present accounted for another 21.5 percent<sup>2</sup>. By contrast, during the 1960s, single-person households had accounted for 37 percent of the growth in households, while single-parent households had provided 11 percent of the growth<sup>2</sup>. During the 1960s, half of the increase in households was still due to increased numbers of married families, but by the 1970s marriages accounted for only one-quarter of the growth in households. Among households formed in the 1960s, only 1 percent of the growth was due to unrelated individuals living together, but 10 percent of the growth in households during the 1970s was attributed to this mode of living<sup>2</sup>. Today, traditional married families with children constitute a surprisingly small fraction of all households.

There is no simple explanation for these interesting trends. The relative increase in single-person households, for example, is partly due to an increase in the elderly population among whom widowhood creates many single-person households. Between 1960 and 1978, the number of persons over age 65 who lived alone grew by a rate 60 percent higher than the rate of growth in all households<sup>1</sup>. Another part of the increase in single-person households can be attributed to the fact that many born as part of the post-World War II baby boom have reached adulthood, and there is a tendency among younger adults to marry at later ages than in previous decades. Many remain single indefinitely, while those who marry have fewer children and at later ages. In addition, divorce has become much more common than it was in previous generations. Many single-person and single-parent families have been formed by the dissolution of marriages. In 1950 there was approximately 1 divorce for every 4.5 marriages; by 1977 there was 1 divorce for every 2 marriages<sup>1</sup>. Eventually, a majority of divorced people do remarry. The rate of remarriage among divorced people in 1977 was about two-thirds the rate of first marriage among unmarried people<sup>1</sup>. Marriage, divorce, and remarriage are major factors in the dynamics of household formation.

A major social trend clearly related to the changing composition of the American household is the economic independence of women, whether in single-parent and single-person households, or in traditional marriages. During the 1970s, the male labor force grew in size by an average of 1.6 percent per year, while the number of female workers increased by about 2.8 percent per year<sup>1</sup>. About one-third of the increase in working women occurred among women who were divorced or never married, but about two-thirds of the increase were attributable to working wives<sup>5</sup>. Today, just about half of the married women who live with their husbands are employed, and among women who have children of pre-school age more than one-third are in the labor force<sup>6</sup>. Until recently, women were more likely than men to hold part-time, clerical, and sales jobs, but

there is now rapid movement into the trades and professions. Women, for example, constituted 4 percent of the enrollment in law schools in 1960, but 19 percent by 1975; they were 6 percent of the medical students in 1960, but 18 percent in 1975<sup>6</sup>.

Another trend of great significance is the aging of the American population. Although life expectancy has not increased dramatically over the last 20 years, birth rates have declined. In 1970 less than 10 percent of the population was over age 65, but today about 11.2 percent of all Americans have passed that milestone<sup>1</sup>. Extrapolation of current trends indicates that about 12.2 percent of our citizens can be expected to be older than 65 by the turn of the next century<sup>1</sup>.

## Implications for Travel

Households are the most basic decisionmaking unit with respect to travel, and changes under way in household structure are having profound effects on travel patterns in the United States. This may be sensed by considering a single dramatic statistical comparison. While Americans in 1979 had, on average, about 0.8 children (under the age of 18) per household, they had about 1.55 automobiles per household, or nearly twice as many cars per household as children<sup>7</sup>. We tend to think of the terms "household" and "family" as synonyms, but in reality only a minority of households consist of traditional families. All, however, make decisions about travel. New automobile registrations correlate more closely with household formation rates than with population growth rates. Similarly, growth in peak-hour commuting, so critical to transportation planning, reflects the economic reality that households—the basic units determining employment and economic consumption—are growing at an increasing rate even as population growth is slowing. The rise of households consisting of single adults, several working adults, and working adults with children is probably the single most important trend influencing travel patterns in America today. It may be the major reason that peak-hour commuting by public transit, carpooling, and vanpooling is increasing in many central cities while automobile commuting volumes hold constant in the face of absolute declines in central-city population.

The increasing economic independence of women, a result of greater entry into the work force, increasing likelihood that they are heads of households, rising educational levels, rising incomes, and fewer children, give rise to the fact that women are now the principal drivers of 42 percent of the country's automobiles<sup>7</sup>. While women still have shorter average journeys to work than men (7.5 miles for women versus 10.5 miles for men) and are more likely than men to commute by public transit, work travel by women is the most important element of growth in peak-hour travel<sup>8</sup>. Numbers and lengths of work trips by women are both likely to continue to increase as women become less transit dependent, less confined to clerical and sales employment, and less likely to work near home in order to be able to conduct childrearing activities.

The graying of the American population is also having profound effects on travel demand and trip patterns. Persons over 70, the age group in our population growing most rapidly, are licensed to drive at the lowest rates of any group over 18 years of age. Today, less than half of the men and less than one-third of the women over age 70 are licensed drivers<sup>9</sup>. And women,

less likely to be drivers, outnumber men quite significantly in these oldest age groups. However, this is a vestige of the fact that many of our oldest citizens, especially women, never drove at all, having grown up before automobile use became as common as it is today. Each year, as many of our oldest citizens die, those reaching retirement age include larger proportions of people who were weaned at the wheel. Thus, we find rapidly increasing use of automobiles by elderly people. Within 15 years, for example, as high a proportion of women of retirement age are expected to be drivers as men, and the elderly will be licensed to drive in nearly the same proportions as middle-aged people<sup>10</sup>. The absolute number of transportation-handicapped and transit-dependent elderly people will not necessarily decline, since there will be many more old people and disabilities will surely make it impossible for many of them to drive. But, certainly, the number of elderly drivers and car owners on our roads will increase dramatically in the coming decades.

### Implications for Transportation Planning

Household composition, population densities, income, and car ownership have all been treated in transportation models as the most important determinants of trip generation, destination choice, and modal choice. Changes in the meaning of "household" should cause us to question the stability of past estimates of travel and the appropriateness of traditional methods for modeling travel. Some 10-15 years ago, we explained travel in terms of an orderly progression among stages in the family life-cycle. New households were described as composed of single workers; these soon became married couples; they next had children; and after two decades their children formed their own households while the parents remained as older, childless couples. Newly formed households of young adults were often thought to locate in central cities, near employment and entertainment, in smaller, denser housing units. The births of children caused families to move to the suburbs where lower densities and better schools suited the childrearing stage in the family life-cycle. Older couples were thought to return to denser inner cities to take advantage of the services located there. Automobile trip generation rates were highest in the suburbs because of larger household sizes, lower densities, and the higher incomes that were associated with the peak earning years of the heads of households. This picture was neat, understandable, and statistically explainable, but it represented the family of the 1950s and 1960s, which is no longer valid.

The stepwise progression of stages in the family life-cycle has given way to a pattern of much greater diversity. Many single-person households remain intact for decades. Two-person households consist of single adults with children or of unmarried adults living together. Some people have children in their 20s, while other couples defer childrearing into their 30s. Households dissolve, reform, grow in numbers, shrink in size, and shift in location. While suburbs used to mean families with children and a predominance of detached single-family homes, they now as often mean complexes of townhouses and apartments inhabited by singles, couples, or single parents with children. Many single-family units in the suburbs are shared by unrelated individuals, and increasing numbers are

populated by the Levitowners of the 1950s who are now elderly and, in some cases, widowed or divorced.

The traditional variables used by transportation planners to explain travel—income, residential density, household size, automobile ownership, and age—may no longer have the explanatory power they used to have. People now have more choices and fewer constraints. Roles traditionally associated with one stage in the life-cycle are chosen at others; residential environments assumed to be preferred at one stage now characterize many; household income and automobile ownership fluctuate widely as household composition shifts rather than as one progresses up the economic ladder.

A number of transportation planners have grappled with this concept by explaining these changes in terms of the concept of life styles, an analytical construct worthy of much more attention. This concept implies that people make conscious choices of roles and behavior patterns substantially independent of income, educational, and household size variables. Salomon<sup>11</sup> recently collected several different definitions of life style in his doctoral dissertation on new ways of explaining travel behavior. Some of the descriptions he compiled are helpful.

James Coleman<sup>12</sup>, for example, wrote:

The individual's pattern of assumptions, values, and motives lead to consistent ways of perceiving, thinking, and acting, which together constitute a characteristic modus operandi or life style.

Robert Havighurst<sup>13</sup> described life style as the allocation of resources among roles:

a characteristic way of distributing one's time, one's interest, and one's talent among the common social roles of adult life—those of worker, parent, spouse, homemaker, citizen, friend, club or association member, church member, and user of leisure time . . . A life style can be described quantitatively as a pattern of performance in these common social roles.

Rainwater<sup>14</sup> further described life styles in this way:

Life style or subculture is conceived as a description of the way of living a group creates out of the resources available to it—material, social, and intellectual—in terms of the tastes and needs of members of the group. Life style is understood to be constrained by the resources of the group and yet to reflect the group's choices in constructing a way of life within these constraints.

Wind and Green<sup>15</sup> saw life style as a latent variable that might be more useful than traditional concepts for explaining behavior, especially travel behavior:

. . . life style research is designed to account for unit of association (individual, family) differences in some kinds of behavior which cannot be accounted for by physiological, demographic, and socio-economic characteristics.

The most comprehensive description of the applicability of life style to transportation planning is provided by Reed<sup>16</sup>:

There is clearly a great deal of evidence now which shows that in many instances behavior patterns (life styles) vary as much within income classes as between them. The same holds true for age (or stage in life cycle), education, occupation, regions or neighborhoods, and now even for some ethnic groups. These various social traits, in other words, are insufficient by themselves to account adequately for patterned behavioral variations . . . For some purposes, then, it is conceivable that life style may

have as much or more explanatory value than any of the single variables which help to shape it . . . While the literature is replete with studies using multivariate statistical methods to identify interactive effects of a set of social variables, it is suggested that life style may be an empirically . . . synoptic manifestation of certain social characteristics and conditions acting in concert. If life style is viewed as a composite of role behaviors, distinctively chosen and differentially emphasized and performed, these behaviors must be selected from among the set of those potentially available to persons of specified social characteristics, and life style may be considered to be bounded by, but not otherwise determined by . . . these characteristics and conditions.

If life style can be thought of as the result of choices people make among homemaking, career, social, and recreational roles, and physical environments that they choose, it follows that the statistical measurement of life style differences is promising for the forecasting of travel, automobile ownership, and other variables of interest to transportation planners. Recent research into family time budgets and travel<sup>17</sup>, the development of the household activities and travel simulator (HATS) to examine how individuals within households assign and accept responsibilities and activities in space and time<sup>18</sup>, and recent applications of space-time geography to transportation planning<sup>19</sup> seek to discover just how life styles differ and how choices of life style influence or explain travel. Salomon<sup>11</sup> used life styles in a disaggregate model to successfully explain travel choices, and Wachs<sup>10</sup> used the concept in an aggregate analysis to show that there were dramatic differences between the travel patterns of the elderly of different life styles. It would appear that this concept is worthy of further investigation and testing.

It seems reasonable to hypothesize that a working mother or single parent with household responsibilities would choose work destinations and travel modes on the basis of different priorities than a male worker whose wife is at home. I would contend that our trip generation, destination choice, and mode choice models encapsulate an economic rationale more appropriate to the male worker who is the head of the household than to a single mother. If so, existing models explain travel patterns less well each year, as single mothers and working wives become a larger proportion of travelers, and male heads of households with wives at home decrease even more rapidly as a proportion of tripmakers. Similarly, if the psychological and economic reasons for travel among retired people differ from the determinants of travel among employed people, it might be necessary to develop methods that explicitly recognize these differences. The inclusion of age, sex, and income as independent variables, or as the basis of classification of tripmakers, may be quite inadequate to specify travel demand models in an era of diverse life styles.

## EMERGENCE OF THE POST-INDUSTRIAL CITY

The American city, like the household, is not what it used to be, and changes in our urban economy are having profound effects on transportation. We are all aware of the population losses that have occurred in most of the largest cities, but these changes are matched by more profound shifts in the location and mix of employment and capital investment. These shifts are so dramatic that the economic function of the city can

be said to have been transformed. In the past three decades, the traditional American industrial city has given way to the "post-industrial" city. I question whether we have yet recognized the effects of this transformation on urban travel patterns or represented the transformation in transportation planning methods.

## Recent Trends in Urban Economic Structure

Half of the standard metropolitan statistical areas (SMSAs) with more than a million inhabitants lost population during the 1970s, and the other half—with only a few exceptions in the sun belt—grew at a generally lower rate than the U.S. population as a whole. We have been conditioned to think that "growth is good," so this phenomenon is usually described as "a decline." Yet, all of the SMSAs, with the single exception of New York, experienced real increases in total personal income during the same period, and, of the 35 largest metropolitan areas, 31 experienced absolute increases in employment<sup>20</sup>. Economic decline, it would seem, is too simplistic an explanation of what is going on in our cities. Rather, we should be describing these changes as a transition to a different sort of city—the post-industrial city.

Central cities are no longer manufacturing centers. The abandonment of cities by manufacturing industries, reported and measured many times since World War II, accelerated during the 1970s. This trend is so pronounced that in the past decade even the suburbs of our largest cities experienced net declines in manufacturing jobs<sup>20</sup>. No longer critically dependent on immediate access to ports and railheads, and increasingly dependent on lower wage rates, manufacturers have moved to rural areas, to smaller cities (especially in the South), and, at an accelerating rate, to foreign countries. Our largest cities have become service centers and are now the locations of financial, information processing, communications, and many other white-collar industries.

But that is only part of the transformation. It is now clear that while shifts to the services have more than made up for losses in manufacturing employment in most of the larger metropolitan areas, the bulk of the net growth in service employment has occurred in the suburbs rather than in central cities. For a selected group of 10 metropolitan areas, for example, Black found that suburban service employment increased 10 times as much as central-city employment in this category during the 1960s and 1970s<sup>20</sup>. Retailing, similarly, has shifted from central cities to suburbs over 30 years. Only a few central cities have maintained their absolute levels of retail sales, while virtually all have lost retailing when measured as a proportion of total metropolitan area retail sales. Growth in retailing has almost all occurred in suburban shopping centers<sup>21</sup>.

While transportation planners continue to think of the suburbs as white-collar dormitories for central-city jobs, it is now clear that for 20 years suburban employment has actually been increasing more quickly than suburban residential population. Footloose white-collar industries have followed their labor markets and retailers have followed their customers to the suburbs. Inner cities have held their own in relatively few areas. Many have experienced absolute increases in office construction, although these rates of increase are far below those of the suburbs. Entertainment, cultural, artistic, educational, and medical activities have also continued to favor

inner-city locations<sup>22</sup>. But overall, concentrations of office and service employment have shifted to the suburbs while manufacturing capital has gone to rural areas, particularly in the South, and has also left the United States in search of cheaper labor abroad.

I would prefer to describe these changes as a transition rather than a decline in the metropolitan economy. There have been painful consequences, however, that are only now being grasped although the transition has been under way for decades. The shift of capital investment from older urban centers to rural areas and suburbs has simultaneously placed the pressures of growth on some parts of metropolitan America and the pressures of decline on others. Suburbs have had to expand investments in streets, highways, educational and recreational facilities, and public services, just as inner cities have found it infeasible to maintain their aging capital plants and networks of services. On top of this, increasing suburbanization of service and retailing jobs has placed pressure on the suburbs for the development of additional housing. Gradually, suburbs are increasing in density as moderate-density townhouse and garden apartment developments now outnumber traditional single-family developments among new housing starts. Heavy investments of public and private capital have renewed the very central cores of many cities, while inner-city areas outside the central business districts have declined for lack of economic investment. Simultaneously, inner cities have not served their indigenous labor forces very well. White-collar, skilled, and professional labor has suburbanized along with service and retailing jobs. Inner-city populations, increasingly black and Hispanic, have not seen substantial increases in employment for which they are qualified. Thus, while the suburbs are often booming, unemployment and dependency increase in the inner cities, the housing stock there ages, and the quality of education, public, and social services declines in the face of real declines in the municipal tax base<sup>22</sup>. Metropolitan America remains viable in the large, but New York, Cleveland, St. Louis, Newark, and many other core cities struggle to survive. Collectively, we speak wistfully of the potential renewal of these cities, but in reality we continue to transfer population and capital to the suburbs and to smaller urban areas outside metropolitan centers.

### Implications for Travel

As a consequence of the dramatic transformation of the urban economy, the heaviest concentrations of travel are shifting systematically from inner cities to suburbs. A recent report to the U.S. Department of Transportation estimated that vehicle miles of travel (VMT) in the suburbs will increase by more than 40 percent between 1977 and 1990, while central cities can expect increases during the same period of less than 5 percent<sup>1</sup>. In part, this enormous disparity in anticipated growth rates is due to the fact that jobs as well as residences have been suburbanizing. For an increasing proportion of Americans, travel to and from work means travel from suburb to suburb. In addition, incomes are higher in the suburbs, and travel continues to be correlated with income. Also, households in the suburbs still have larger average sizes, and larger households generate more trips than smaller ones. Finally, the spatial dispersion of activities in the suburbs requires more VMT to accomplish activities that could be served by fewer

VMT in the inner cities. Thus, the 1977 National Personal Transportation Study showed that the average licensed driver living in the suburbs drove about 10,400 miles per year, while inside the central city the number of miles driven per licensed driver was only about 9400 miles<sup>9</sup>.

In many metropolitan areas, transit service is being expanded in suburban areas and decreased in the inner cities in response to these overwhelming changes in population and employment. But most of the suburban improvements in transit serve peak-hour commuters to and from downtown, while dispersed work sites often depend exclusively on automobile access. Thus, while suburban transit ridership grows, it does so more slowly than travel in the aggregate. Furthermore, maintenance of traditional flat fares makes these transit improvements very costly. Service to lower-density areas involves fewer boardings and alightings per mile of service and longer transit trip lengths. Flat fares produce lower revenues per passenger mile in low-density areas, while operating costs are higher per passenger mile, since in the suburbs the ratio of vehicle miles to passenger miles is higher than in the central city<sup>23</sup>. Carpooling and vanpooling are economically efficient alternatives to single-occupant automobiles but they require concentrations of commuters at least at one end of the trip and shared work hours. Ridesharing is growing among work trips between suburban residences and downtown work centers, but, like public transit, ridesharing is growing more slowly for suburban-to-suburban work trips than are trips made by singly occupied automobiles.

Inner-city streets, highways, and bridges are aging quickly and will need enormous maintenance expenditures in the coming years just to maintain service at acceptable levels. But the tax base needed to provide for that maintenance has moved to the suburbs, where competition for funds will be provided by the need to increase highway capacities to accommodate dramatic growth in suburban-to-suburban travel.

### Implications for Transportation Planning

Early regional transportation planners looked at the city and theorized about the economic functions they observed. The models they devised encapsulated an understanding of urban form and function appropriate to their day. The Lowry and EMPIRIC urban development models, for example, treated the location of "basic" employment as exogenously determined, and they allocated growth in services and residential areas as functions of accessibility to basic employment. Because of the shifts in urban economies described above, these models now seem incredibly obsolete. Basic employment, largely manufacturing, has abandoned the city and no longer determines its form. Service employment, having taken on the central role once played by manufacturing, is footloose and often follows residential employment, reversing the direction of causality represented in earlier models. Those models allocated growth but paid scant attention to the redistribution of existing employment, capital, and population, which seem to be so much more important today. They were insensitive to the social, economic, and ethnic differences of the populations that they located in different zones, but today these seem to be among the most important policy variables to transportation planners. More recent urban development models have dealt more effectively with redistributive questions and have more

effectively accounted for the differential patterns of growth on different economic and social groups. Still, it seems fair to say that urban development models remain a weak link in the transportation planning process. Transportation planners fail to represent the dynamics of urban economic change in their methods and give far less attention than they should to the shifting nature of urban employment and the shifting economic base that is one of the most critical determinants of travel.

Transportation planners continue to urge huge capital investments in increased capacity for movement between central cities and suburbs. In part, we are operating on the basis of models that were calibrated in an era of growth in travel of this type and have not yet caught up with the reality that the growth in travel is to be concentrated in the suburban-to-suburban pattern. We need methods to deal more explicitly with suburban highway and transit needs and are contributing to further problems by failing to reorient our work in this direction. Proposals for increased capital investment in transportation as a strategy for revitalizing city cores seem naive, politically motivated, and self-serving. They display shocking ignorance of urban economic trends. They continue to be made and, when implemented, contribute substantially to the transportation problems of the next decades. We are creating a huge capital plant that will have to be maintained for decades to come, without reversing economic trends that have a momentum scarcely affected by these investments. At the same time, we are ignoring the growing need for capital investment in transportation facilities in the suburbs and are failing to develop new kinds of transportation options specifically tailored to suburban markets. These might involve different technologies, different pricing structures, and different locational criteria than those employed in planning for radial travel between suburbs and the central business districts.

New theories and causal models must encapsulate an understanding of the current urban economy. Methodologists today focus on disaggregate choice models and multivariate statistics and are seemingly less interested in linking metropolitan economic trends to the demand for travel. Recent equilibrium models contain relatively weak representations of the dynamics of urban economies. Models of destination choice and trip distribution, like urban development models, should reflect the changing relationships between urban form and travel as well as implications for travel of new patterns of household composition. We need a new generation of theories and methods relating urban form and function to travel, and the methods we seek barely resemble the methods of the sixties.

## CHANGES IN PRICES OF TRANSPORTATION AND HOUSING

Transportation planners, like most citizens, have taken note of recent price increases in gasoline. It has been claimed that a long-term pattern of cheap fuel has been permanently ended, and that during the rest of the 20th century more expensive fuels will cause major changes in American life. Reduced driving, declining car ownership, burgeoning demand for public transit, and the reversal of suburbanization in favor of more central locations have all been prophesied. Most of these forecasts have been naive, and some even panicky.

## Recent Trends in Prices

At the end of May 1981, the Consumer Price Index (CPI) for gasoline stood at 414.8, while the index for all goods and services was 269.0<sup>24</sup>. Since 1967, the price of gasoline had risen 1.54 times as much as the average for all goods and services. Notably, most of that increase occurred in relatively recent years. It would be a mistake, however, to leap from this single dramatic fact to conclusions about future travel behavior. Gasoline represents only a part of the cost of transportation, and we must also consider the influence of other components of travel cost. Furthermore, travel is so dependent on household location that prices of housing and transportation must be considered jointly in speculations about future travel.

One recent estimate of the total cost of driving showed that a new compact car kept by its owner for 10 years and driven 10,000 miles per year, cost in 1980 a total of 27.9 cents/mile to operate. An intermediate car, kept the same length of time and driven the same yearly mileage, cost 31.0 cents/mile. If the same new cars were kept only 3 years and sold with 30,000 miles on their odometers, the cost per mile driven rose to 39.75 cents for the compact and 43.99 cents for the intermediate car, since depreciation of the resale value of a new car is most rapid in the early years. These figures are averages for 20 large cities<sup>25</sup>.

Interestingly, of these totals, gasoline, maintenance, and oil represent a very small cost in relation to the fixed costs of depreciation, interest, insurance, and registration fees. If the compact car were to be sold after being driven for 3 years at 10,000 miles per year, gasoline and oil will have cost only 8 cents/mile, and maintenance only 2.3 cents/mile, while the fixed costs amounted to 29.5 cents/mile. Fixed costs then amount to 75 percent of the costs of ownership, if a compact car is kept 3 years and driven 10,000 miles per year. Driving the same car 10 years drops the fixed costs to 60 percent of total cost, still a significant proportion<sup>25</sup>. In the short run changes in the variable costs of travel can surely have a pronounced effect on travel decisions, but in the longer run the entire price structure of transportation and housing will influence travel patterns through locational decisions and automobile purchase patterns. We have yet to represent the complexity of these price structures in transportation planning methods.

It is difficult to believe that in the long run gasoline price rises will have so great an effect on travel as some people say they will. Table 1<sup>24</sup> shows that the price indexes of new cars, used cars, and automobile maintenance all rose much more slowly than the price of gasoline, so that the total index of prices for private transportation stood at 274.7 at the end of May 1981<sup>24</sup>. This index was virtually the same as the CPI for all goods and services (269.0). Despite rises in gasoline prices, then, the total cost of automobile transportation rose far less dramatically.

We travel because of the spatial separations between homes and workplaces, stores, and recreational facilities, so to a certain extent costs of housing will dictate travel patterns along with the costs of travel itself. It is interesting to note that the CPI for home ownership stood at 345 at the end of May 1981<sup>24</sup>. This includes mortgage payments, taxes, and maintenance of the structures in which we live, but not the furnishings. Thus, home ownership costs have risen much more in the last 13 years than the costs of private transportation.

**Table 1. Consumer price index as of May 1981 (1967 = 100) for selected items.**

Item	Index
All	269.0
Shelter	308.4 (includes home ownership, rental rates)
Home Ownership	345.0
Transportation	276.5 (includes all following categories)
Public	297.7
Private	274.7 (includes all following categories)
Used cars	242.3
New cars	190.1
Maintenance and repair	290.2
Gasoline	414.8

Furthermore, Table 2<sup>26</sup> shows that housing, depending on family income, accounts for 20 to 25 percent of household budgets, while transportation accounts for only 7-9 percent, and that these percentages have proven remarkably stable over time<sup>26,27</sup>. They are expected to change slowly in the future and, in fact, home ownership is now rising in cost more rapidly than transportation.

#### Implications for Travel

In 1979, VMT were 3.5 percent below the levels of 1978<sup>7</sup>, but in 1979 there was a period of several months during which gasoline was in short supply. I find it hard to believe that the price rise was nearly as significant a determinant of the reduced travel volumes as the temporary reductions in supply. During the 1980s, I expect that drivers will be sensitive to the joint price structure of transportation and housing, and not

**Table 2. Annual budgets and expenditures for housing and transportation for an urban family of four, 1970 and 1979.**

Budget Type	Lower Budget	Inter-mediate Budget	Higher Budget
1970 total annual household budget	\$6,960	\$10,664	\$15,511
Transportation component	7.3%	8.6%	7.6%
Housing component	20.5%	23.3%	24.4%
1979 total annual household budget	\$12,585	\$20,517	\$30,137
Transportation component	8.0%	9.0%	8.0%
Housing component	19.1%	22.3%	23.1%

merely the pump price of fuel. With housing costs rising faster than transport costs and family housing budgets more than three times their travel budgets, we should continue to see households choosing less expensive houses at locations that require more driving rather than more costly houses at central locations.

In the short run, drivers can compensate for the rising variable costs of travel (gasoline and oil) by lowering the fixed costs. This can be done by keeping an older car longer or purchasing a used car rather than a new one and avoiding capital outlays and interest payments. In the longer run, people will reduce both fixed and variable travel costs by purchasing smaller, more fuel-efficient automobiles. This, of course, will allow VMT to increase without necessarily increasing aggregate fuel consumption. A recent opinion survey, for example, showed that about 90 percent of the Automobile Club members in southern California expected the next car they purchase to be smaller than their current one<sup>28</sup>.

Shoup and Pickrell<sup>29</sup> have shown that three-quarters of all cars driven to work in America are parked free in employer-provided spaces, and when free on-street parking is added in, about 93 percent of all commuters park free at work. The influence of free parking is quite dramatic, and indeed it may cause many workers to drive alone to work despite recent increases in the price of gasoline. This is true because the median round-trip journey to work is about 14 miles, so a car that gets the national average of 14 miles/gal of gasoline would use just 1 gal of gasoline for a daily work trip. Thus, according to Shoup and Pickrell, free parking is a larger subsidy than free gasoline for the trip to work for those whose real daily cost of parking exceeds the price of a single gallon of gasoline. In most downtown areas, of course, the market price of daily parking is far larger than the price of a gallon of fuel. Furthermore, if one uses the bus or rides in a carpool, one saves the price of fuel. When switching to another mode, however, one must pay the fare for a bus or train or share the cost of a carpool, while giving up the subsidy derived from the use of a free parking space. It would seem, therefore, that parking routinely provided free or at subsidized rates provides an incentive to drive alone that far outweighs any disincentives resulting from recent gasoline price increases. If parking subsidies can outweigh gasoline prices in the decision to drive, house prices, wage differentials, and the fixed costs of automobile ownership will in combination certainly be more significant determinants of travel than pump prices of gasoline.

Where public transit provides a possible alternative to commuting by automobile, it is also critically important to consider the price of transit in comparison with the price—particularly the variable price—of the automobile. The July 1981 CPI report showed that double-digit inflation had returned and singled out price increases in public transit as among the most critical price increases in recent months<sup>24</sup>. Public capital and operating subsidies caused transit prices to rise very slowly in real terms during the 1960s and early 1970s, but now they are rising dramatically. The retention of flat fares has caused many makers of short trips to abandon transit and return to their automobiles in the face of fares that approach a dollar, while flat fares continue to favor longer tripmakers. In Los Angeles, a recent increase in the base fare from 65 cents to 85 cents was associated with a decline in daily ridership of 11 percent, approximately twice the decline anticipated<sup>30</sup>. The fact that this price increase came at precisely the same time as



an oil glut and falling gasoline prices helps to illustrate the importance of the interrelationships among the various elements of the transportation price structure.

## Implications for Transportation Planning

Urban transportation planning models are known for their detail and complexity, but they contain surprisingly simplistic representations of the many prices that influence travel. This probably arises from the fact that standard planning methods were perfected when the price of travel was relatively stable. Whether one used time series or cross-sectional models, it was difficult in 1960 to find statistical associations between travel and prices because there was little variance in prices over time or across space. We have recently been forced to discover that price is important, having experienced dramatic shifts in the structure of prices. But, the press and even transportation planners have oversimplified the importance of price variables in determining travel behavior. I hope that my little excursion into a discussion of house prices, free parking, transit fares, and component costs of automobile ownership convinced you that we will continue to misspecify transportation models by hastily adding the price of gasoline as a single independent variable. The price of gasoline is only one component of the complex web of housing and travel costs influencing travel behavior. The structure of relationships among the many components of price is changing constantly, and their associations must be taken into consideration in long-range planning.

Relationships between the price structures and the demand for travel should become critical ingredients in transportation methods not only because they contribute to the traditional objective of forecasting traffic flows by mode. As fuel consumption drops and VMT continues to rise, there are many implications for trust fund economics. Revenues from gasoline, property, and sales taxes will all have to be scrutinized and anticipated in both highway and transit planning during the coming decades, as transportation planning becomes increasingly constrained by limited resources. Here again, home ownership prices, travel expenditures, and disposable income are tied together, since transportation budgets are increasingly drawn jointly from several tax sources and the mix of support changes from time to time as a matter of policy.

## CONCLUSION

Three major trends have been highlighted and illustrated in this paper. First, demographic and functional changes in American households are giving rise to the possibility that travel will no longer be statistically associated with traditional predictive variables. More complex notions of life style hold promise as ways of explaining and predicting travel in relation to household structure. Second, urban economies are changing, and the transition to the post-industrial metropolis is transforming the nature of labor markets and urban form from which travel patterns are also drawn. Finally, the price structure of housing and private and public transportation is also changing in ways that have not yet been fully appreciated or understood, but which also are bringing about substantial shifts in travel

patterns. Although I presented these trends individually, they certainly are not independent of one another, and their interaction increases by orders of magnitude the complexity of the phenomena we must confront.

As in the past, transportation planners will continue to be called on to forecast and analyze travel patterns, the social and environmental impacts of travel, and fiscal and economic consequences of alternative transportation programs. Comparing our capabilities today with those of the 1960s, it is clear that we know much more about the applicability of statistical techniques and are much more facile with computer methods and data processing. We may, however, understand the underlying social and economic determinants of travel only a little better than did our predecessors who developed early transportation planning methods. Without greater understanding of these factors, our advanced techniques can fool us with their apparent precision and sophistication.

Transportation planning will continue to be a highly political, emotionally charged, and value-laden area of public policy, as it has always been. In such a setting, technical experts can be supportive of public policymaking only by understanding the social, demographic, and economic determinants of travel.

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