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PROFILE

OF THE '80's



U.S. Department of Transportation
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In many ways 1990 will look a great deal like 1980. Trends observed in the late 70's are expected to continue or stabilize but major reversals are not projected. The forecasts conservatively assume no unforeseen crisis or chain of events that would lead to a significant change in public attitudes or policies beyond those which have been observed or discussed in the late seventies. Family households will continue to locate in the suburbs of Standard Metropolitan Statistical Areas (SMSA's) so that the suburbs will be the location of the largest segment of the population. The number of single-person households will continue to grow rapidly with a tendency to locate in the central city.

When considering trends over as short a period as ten years, it is necessary to remember that there is a vast investment in existing facilities. Over 80% of the housing units which will be occupied in 1990 are already in place. Over 25% of these households are located in the suburbs of SMSA's and have been developed at suburban densities. These housing units were developed when there was reasonably priced automobile travel.

Even were there a sharp increase in the real costs of automobile travel, the existing suburban housing stock could not be abandoned. These units will continue to be occupied for the foreseeable future. Neither can the density of development be easily changed to respond to new transportation conditions. Physical constraints, such as street patterns and institutional constraints including zoning regulations, building codes and lot sizes inhibit a transition to land use patterns which can efficiently be served by any means other than the private automobile. Small lot development and higher densities along transit corridors could influence the suburban modal split significantly.

Most of the residents of these suburban regions will find ways to cope with rising fuel costs. They will purchase smaller cars, arrange carpools, reduce discretionary travel and devote a higher proportion of their income to transportation. If, however, significant fuel shortages of moderate duration (3-6 months) occur in the 80's, it is quite likely that these suburban residents will form a large constituency urging DOT to "do something" to aid them in maintenance of their life-style. Carpools, vanpools and increased vehicle occupancy, not conventional bus transit, will become the preferred suburban least-cost-to-commute option.

One aspect of life in which the eighties will differ from the preceding decade is the transition to an adult society. The proportion of the population under 18 years of age is declining rapidly. The individuals comprising the post-war "baby-boom" will, by 1990, be in the 25-44 age bracket but will still represent the largest single population group. All observed trends indicate that there will be a significantly lower proportion of households containing children. Rather there will be a majority of households composed of:

- A single person — often elderly — living alone
- Unmarried individuals
- Married couples without children

The residents of these households are likely to be less concerned with schools or child-oriented recreation than with adult-oriented recreation including such items as restaurants, entertainment or social clubs. The results should prove beneficial to central cities which provide an environment more appropriate to an adult culture.

Projections of direct relevance to transportation policy are the following:

- GNP growth will continue at a moderate rate. Neither a deep depression nor a substantial boom are anticipated.
- Population growth will continue at rates close to those of the late seventies. The suburban portions of SMSA's will show the largest growth in population.
- The housing stock will continue to expand but at a faster rate than the population. This is a result of smaller family size and the increase in the proportion of persons living alone.
- Single person households are now found primarily in central cities. If this pattern continues, the largest growth in the number of households in the 1980's will occur in central cities. Older central cities may lose population but gain households.

new
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- U.S. domestic petroleum production is at or near its maximum feasible rate and can be expected to decline in the late 1980's. If imports of oil were ended U.S. reserves would be depleted before 1990.
- Although only 17% of the world's petroleum resources had been used prior to 1975, at projected consumption rates the remaining 83% will be used in roughly 100 years.
- Since 1960 U.S. oil consumption has doubled while world consumption rose by a factor of 3.5. Competition by other nations for available oil will be of increasing importance in the eighties.
- Oil prices will continue to rise sharply in current dollars, but, due to inflation, the rise in real terms will be less severe. Upper income households will be able to maintain existing travel patterns in the face of rising fuel costs, but lower income households may experience restricted mobility.
- Automobile fuel efficiency (miles per gallon) will continue to increase as mandated. The effect of the policy supporting fuel efficiency and the increase in the real cost of gasoline both contribute to making the small car the norm.
- After a transition period in 1980-81 the real cost of automobile operation (in cents per mile) will remain constant or fall slightly for the remainder of the decade. As a result existing and new suburban residents will be able to maintain their chosen life style with only minor economic dislocation. Not shown in this profile, however, is the forecast that real automobile operating costs will rise again in the 90's.
- Carpools and vanpools offer an alternative to the increased cost of individual auto operation yet maintain much of the cultural identification associated with private auto use. In larger cities, car and vanpools account for about 17% of all work trips. Use of these high occupancy modes is expected to increase.
- Several factors will combine to make the growth in travel increase at a faster rate than population. These are:
 - The increase in the proportion of single occupancy households. These households have the highest trip rate per person.
 - The increase in multi-worker households. The total number of trips rises with the number of employed persons. By 1990 fifty-five percent of all women age 16 and over are projected to be in the labor force — up from 49% in 1978.
 - The continued growth of population in the suburbs. Suburban residents make more trips, travel further and spend more time travelling than do other households.
- The elderly population (age 65 and over) will grow in both absolute numbers — from 19 million in 1980 to 27 million in 1990 — and as a percent of the population — from under 10% in 1970 to 12% in 1990.
- The number of transportation handicapped persons is expected to increase by about 2% per year with the largest increase in the over 65 age group.
- Trip rates and mode use by ethnic minorities do vary from those of the general population but this variance appears to relate primarily to differences in income and place of residence. Reducing these differences will tend to reduce variance in travel habits, leading to increased automobile use.
- Lower income households (about 22% of all households have incomes under \$10,000) will have increasing difficulty in meeting the costs of auto travel. Satisfying needs may require such households to devote additional time to travel by other modes.
- Total travel over the next decade will increase approximately 20% in all areas. The largest growth is expected in central cities associated with the increase in the number of single person households. Such households may tend to make more use of public transit because:
 - The automobile offers cost efficiencies only for group travel.
 - Central city households are the most frequent users of transit.
 - Work trips — which are more frequently made by transit — constitute a larger proportion of travel for single person households than for larger family groups.

- The cost and efficiency of transit service is directly related to the density of development. Residential densities less than 5-8 dwelling units per acre (roughly single-family houses on 60 x 100 ft. lots) cannot support a local walk-on bus service.

In summary, during the 80's the demand for travel may be expected to grow at a rate faster than population but slower than households. The rate of travel growth will be slower than that observed over the past twenty years. The largest growth in the number of trips will occur in central cities, paralleling the growth in households. Travel by transit, as a proportion of total travel, is likely to remain roughly constant as the number of central city households grows. The result will be a significant absolute increase in the number of transit trips. Unless there is a substantial redistribution of transit travel from peak to off-peak times this added demand will continue the trend of growing transit deficits.

Vehicle-miles of travel (VMT) will increase about 20% in total but, due to the differential in central city and suburban VMT rates per household, the distribution of VMT by area will be similar to that of 1980.

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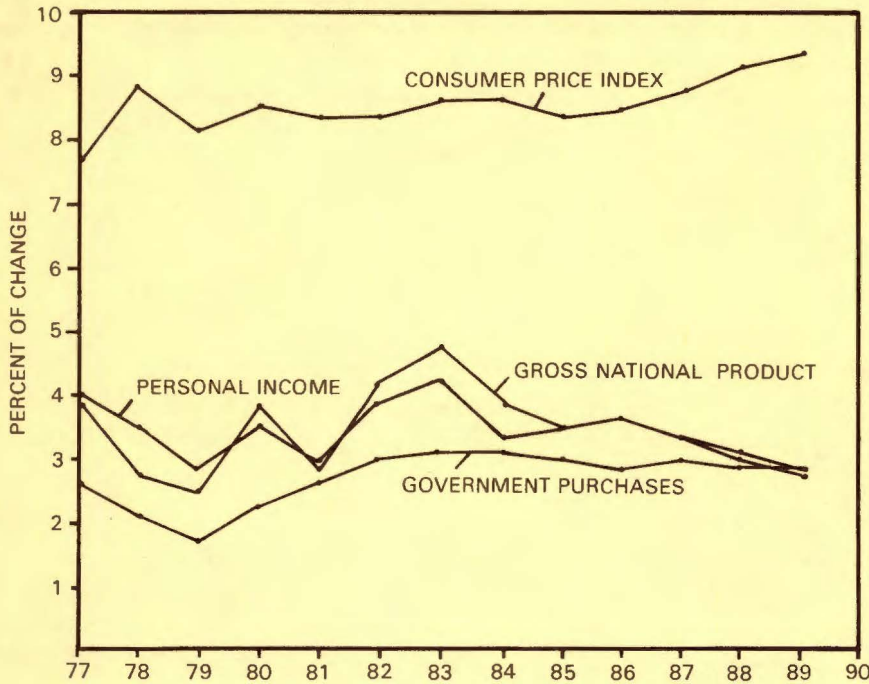
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Projections of the patterns of economic growth during the 1980's are highly sensitive to assumptions about economic policy, behavioral trends, and international developments. Forecasts for the economy as a whole can therefore only be illustrative, designed to show the implications of certain premises. The projections shown here indicate continued growth, though at a somewhat slower rate -- a reflection of a slowing down of population growth and moderate productivity gains.

Per capita incomes are projected to grow in a way that reduce regional income disparities: growth in the South is faster than the national average. Additional evidence on regional investment trends suggests that per capita income will also grow faster in the West, particularly in the Mountain states experiencing the effects of energy development.

These trends are likely to entail more rapidly growing transportation needs in the South and West. To what extent economic growth affects the availability of resources for transportation investments cannot be predicted without making very specific assumptions about policies.

PROJECTED GROWTH RATES FOR SELECTED ECONOMIC MEASURES, 1977-1990



Source: 6

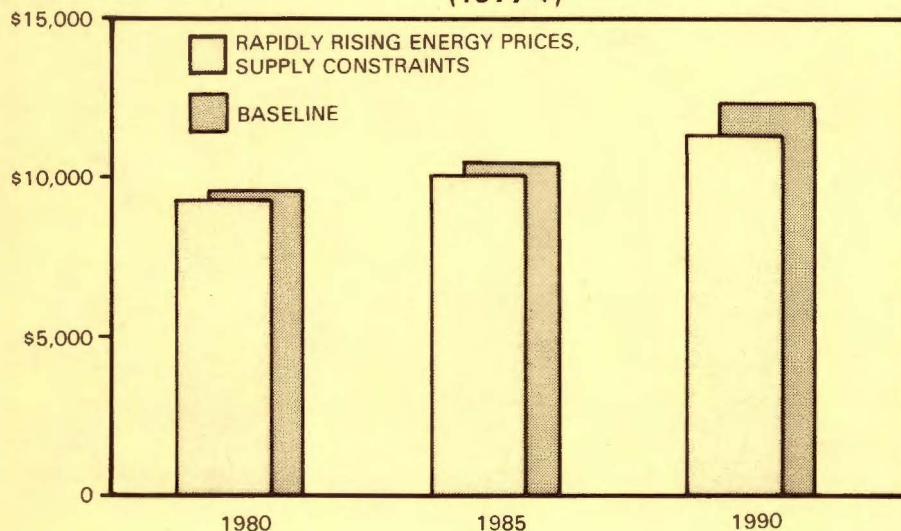
ECONOMIC PROSPECTS

Projections of economic growth and its characteristics typically are no more than attempts to explore the implications of a particular set of assumptions about various key factors. Changes in population, labor force, productivity, hours worked, tax policies and exports are the forces that determine changes in the gross national product, personal income and investments. The chart on the left shows the growth rates for GNP, personal income and government purchases (in constant dollars) derived from a baseline forecast prepared in the Joint Economic Committee of the U.S. Congress that is based on projections by other organizations. **GNP growth rates are expected to fluctuate about the average of 3.6 percent per year.** The growth rates for personal income mirror this pattern.

Government purchases are projected to increase at a slower rate, implying a decline in their share of the GNP. The rate of inflation is expected to stay high; in the light of the experience of the last few years of the 1970's the projected rates may be on the low side.

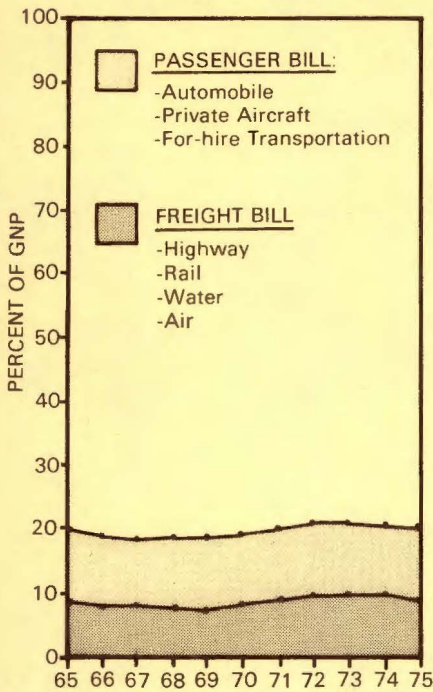
Several alternatives to the baseline projection have been examined. One of them involves more pessimistic assumptions about energy supply and prices -- assumptions that have become more realistic since the projections were prepared. These assumptions result in substantially lower growth, as illustrated by the per capita incomes for the baseline case and the case with higher energy prices. The per capita income for the baseline case is 9 percent higher -- or \$1,000 in 1977 dollars.

PER CAPITA GNP UNDER TWO SETS OF ASSUMPTIONS (1977 \$)



Source: 6

TRANSPORTATION EXPENDITURES AS A PERCENT OF GNP



Source: 24

TRANSPORTATION IN THE ECONOMY

The established definition of industry sectors conceals somewhat the real significance of transportation for the U.S. economy. If all expenditures for transportation purposes are added up, they account for about one-fifth of the U.S. GNP, as illustrated in the chart here. This share has remained remarkably stable over time. It is reasonable to assume that any changes in this measure during the 1980's will be marginal.

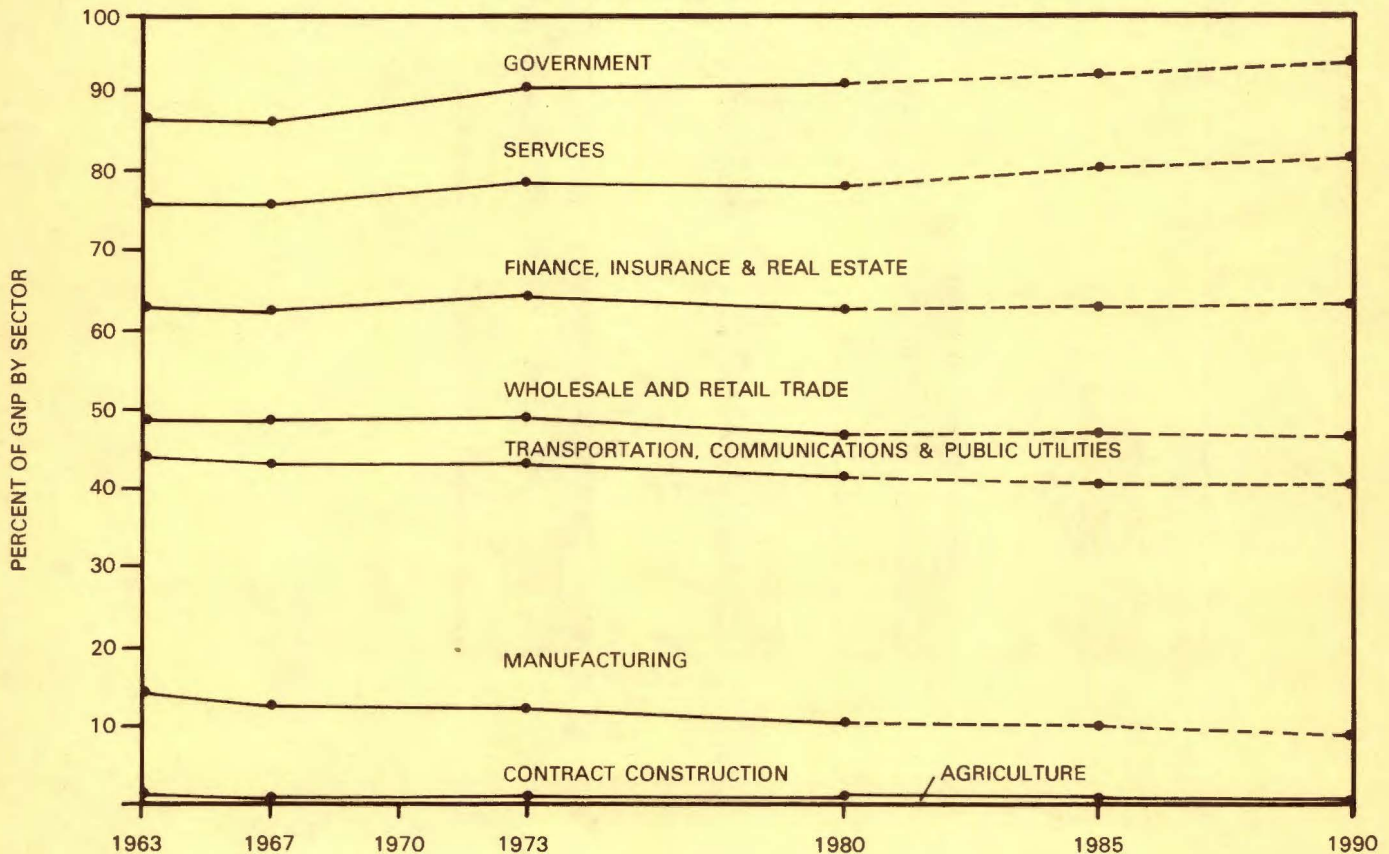
Private transportation accounted for 87% of the total 1975 passenger bill. The lion's share of the for-hire transportation's 13% -- more than half -- goes to intercity travel. Local public transportation (transit, taxicabs, commuter rail and school buses) accounted for only 3.4 cents of the 1975 passenger dollar.

GNP BY MAJOR INDUSTRY SECTOR

Projections by the Bureau of Labor Statistics suggest that current trends in the contribution to the total Gross National Product by individual industry sectors are expected to continue throughout the 1980's. The chart shows the projected sectoral distribution for GNP, defined net of imports. As a result, the mining sector does not show up on this chart, since imports in this sector are expected to outweigh domestic production. (The mining sector's net contribution to the GNP is in fact projected to be negative.)

Otherwise, the projections suggest few surprises. The shares of the primary and secondary sectors are expected to decrease slightly, while the share of the tertiary sector, primarily trade and services, increases marginally.

GNP BY MAJOR INDUSTRY SECTOR



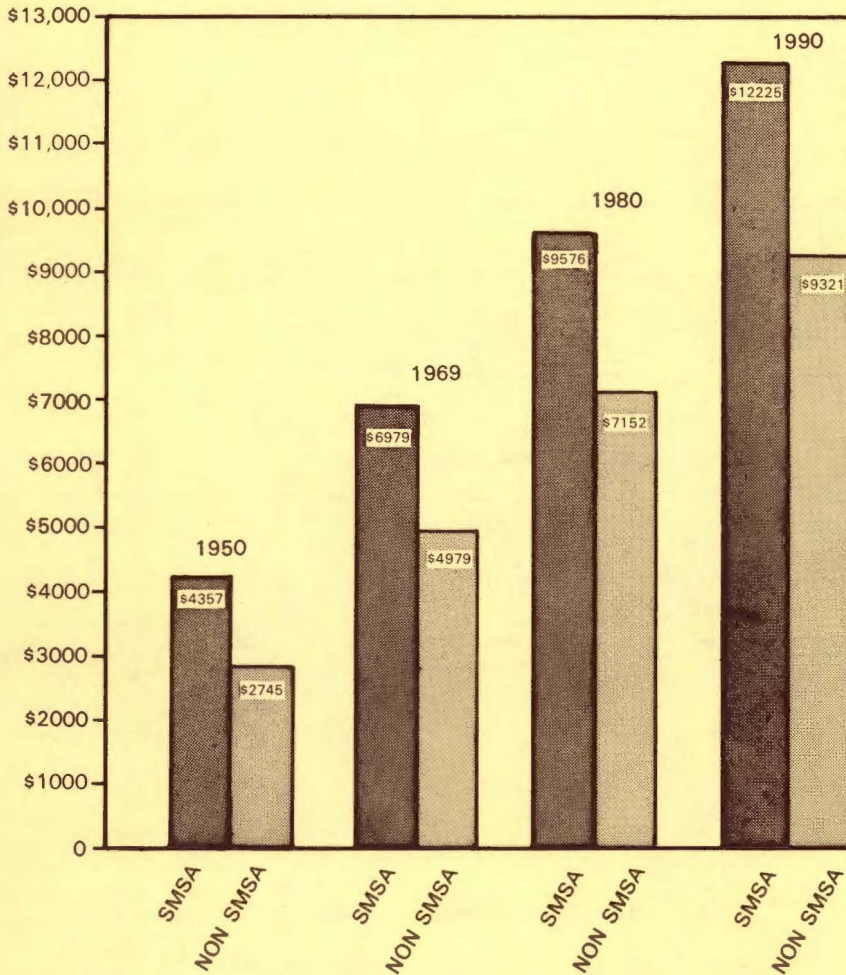
Source: 3

INCOME DIFFERENCES

Historically, per capita incomes have been higher in metropolitan areas than in their nonmetropolitan counterparts. Although this gap has been narrowing, it is projected to persist throughout the 1980's. In 1950, the per capita income for nonmetropolitan areas was 63 percent of that for SMSA's. By 1969, the ratio had increased to over 71 percent: per capita income growth for the nonmetropolitan areas was 3.2 percent, as compared to 2.5 percent for metropolitan areas.

The relative gains of the nonmetropolitan areas are expected to continue, but the gap is closing at a declining rate. In 1980, the per capita income of nonmetropolitan areas is expected to reach 75 percent of the metropolitan level. In 1990, the ratio will be 76 percent. However, in terms of true purchasing power — after allowing for differences in tax burdens and retail prices — the gap between metropolitan and nonmetropolitan areas is less pronounced than the figures here show.

PER CAPITA INCOME
(1977 \$)

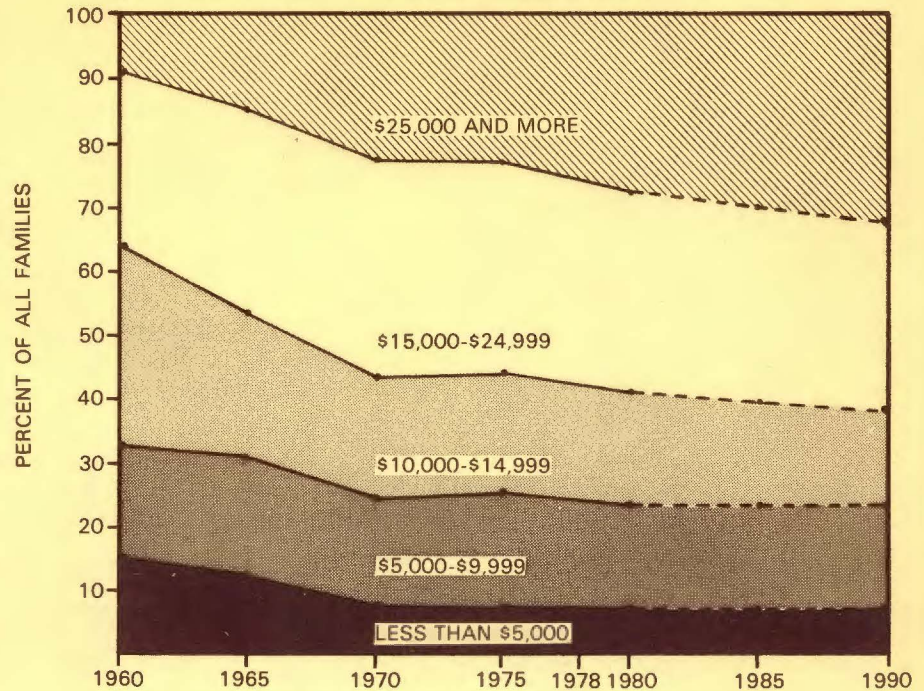


Source: 38

FAMILY INCOME

Significant changes in income distribution occurred in the 1960's. During the 1970's, the relative growth of the upper income brackets had slowed down. Since 1975, there has been an increase in the percentage shares of the two higher income categories. Changes in the lower income brackets were almost negligible. Trends over the last two decades and current economic prospects suggest that the income distribution will change little during the 1980's. The percentage share of the highest income group is likely to increase slightly. Smaller upward shifts should affect the other categories. But overall, the experience of the 1970's appears a better-suited model than the rapid gains of the 1960's. **The income distribution forecast for the 80's shows close to 40% of U.S. families with incomes below \$15,000. These families are apt to be severely impacted by real increases in fuel-costs.** During the 1980's, the per capita income for the poorest region, the South, is projected to grow at an average annual rate of 3.1 percent. In 1980, the per capita income for the South is projected at 92 percent of the national figure; by 1990, it is expected to have climbed over 96 percent.

FAMILY INCOME DISTRIBUTION (IN 1978 DOLLARS)

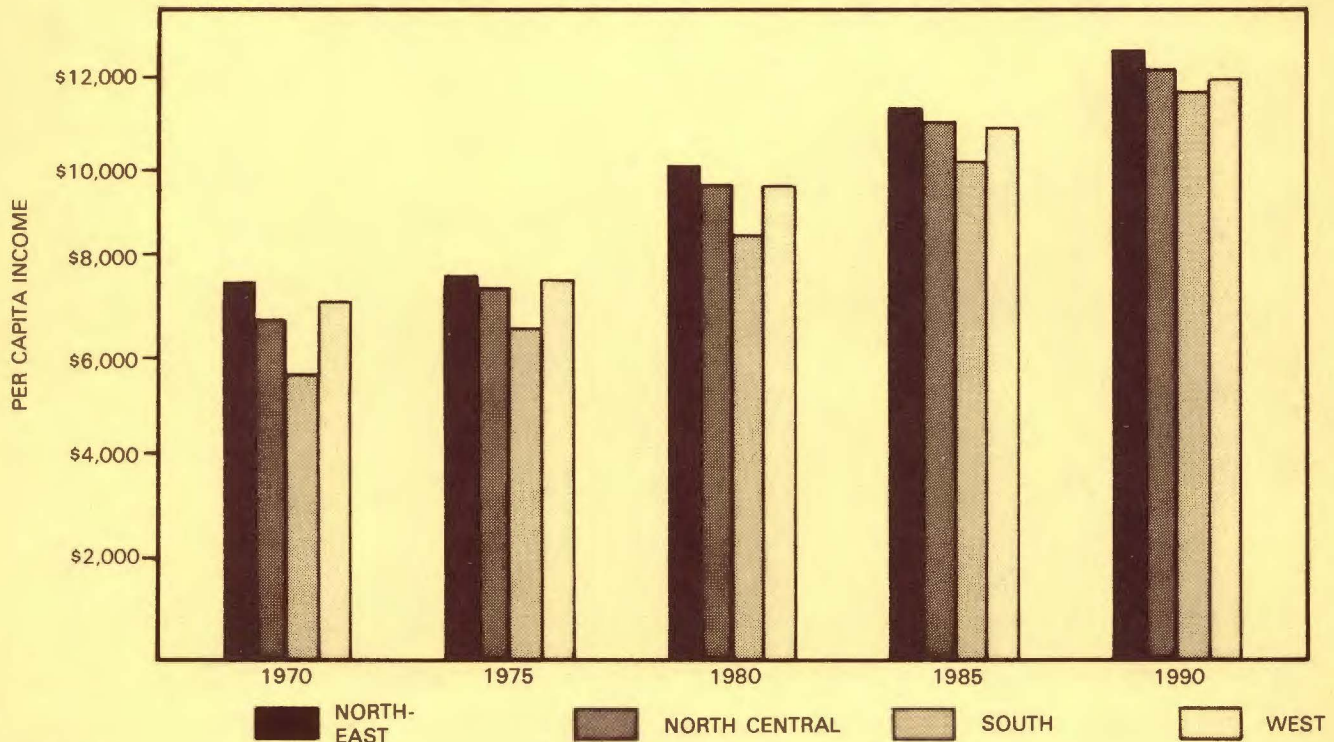


Source: 37

Relative gains are also expected for the North Central region, which is projected to pass the West in 1980 and to continue to close the gap to the leading Northeast throughout the 1980's. The absolute differences

projected for 1990, however, are relatively small among the four major Census regions. Differences tend to be more pronounced among subdivisions within these regions.

PER CAPITA INCOME BY REGION (IN 1977 DOLLARS)



Source: 40

Population growth in the 1980's will continue at the slow rate that has characterized the 1970's. The fertility rate is likely to stabilize after a sustained decline over the last two decades.

The population will grow faster in the South, which has had a positive net migration balance with the other three Census regions. Net immigration to the South holds across different socioeconomic groups. These trends are particularly pronounced for the elderly, a result of retirement migration.

The 1970's have witnessed a reversal of the historical trend toward urbanization: nonmetropolitan areas have been growing faster than urbanized areas. These trends are likely to continue into the 1980's. Even so, population growth in absolute terms is highest in the suburbs, although the rate of growth is projected to decline.

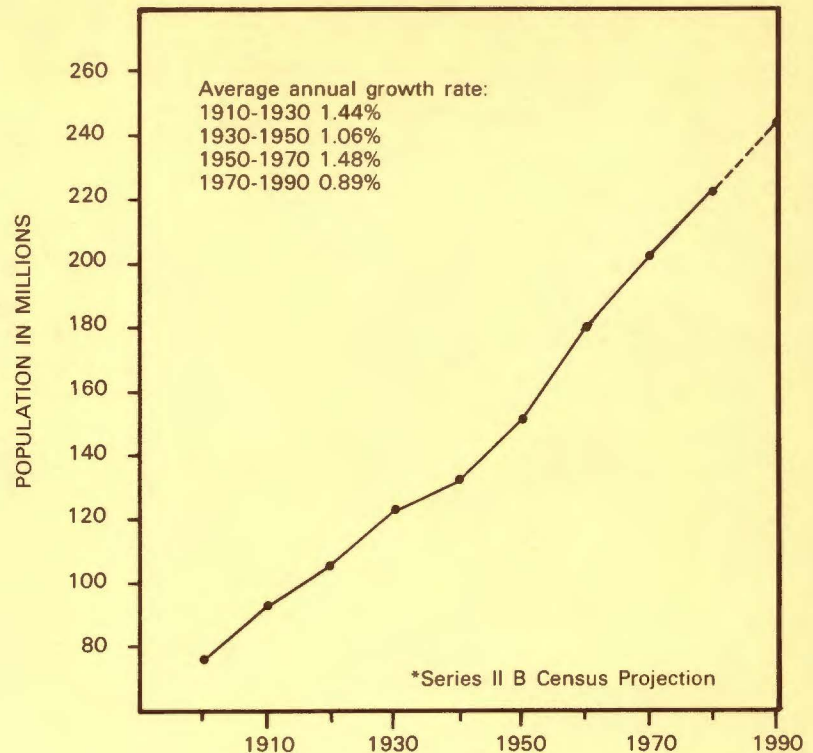
The elderly will grow in importance during the 1980's; their percentage share will increase. In addition, they will be older on the average. Largely as result of this trend, the number and incidence of transportation disadvantaged is projected to increase.

The implications for transportation policy are twofold. First, a larger percentage of the population will live in lower-density areas, increasing the needs of these areas. Secondly, the number and proportion of people with mobility limitations will rise significantly, placing a premium on measures designed to alleviate these problems.

TOTAL POPULATION

The total population of the U.S. will be growing at a modest rate during the 1980s. In the second half of the 1970s, the average annual growth rate was 0.73 percent, a full percentage point below the rate for the late 1950s. Current Census projections for 1990 imply average annual growth rates between 0.6 and 1.3 percent, depending on assumptions about fertility trends. Most experts expect that fertility will rise slightly from its current low to the replacement level--at which the population would exactly replace itself in the absence of net immigration. At that level, the U.S. population is projected to grow at a rate of 0.9 percent per year, from 220.5 million in 1979 to 243.4 million in 1990. **Total travel demand will increase but at a slower rate than in the past.**

U.S. POPULATION



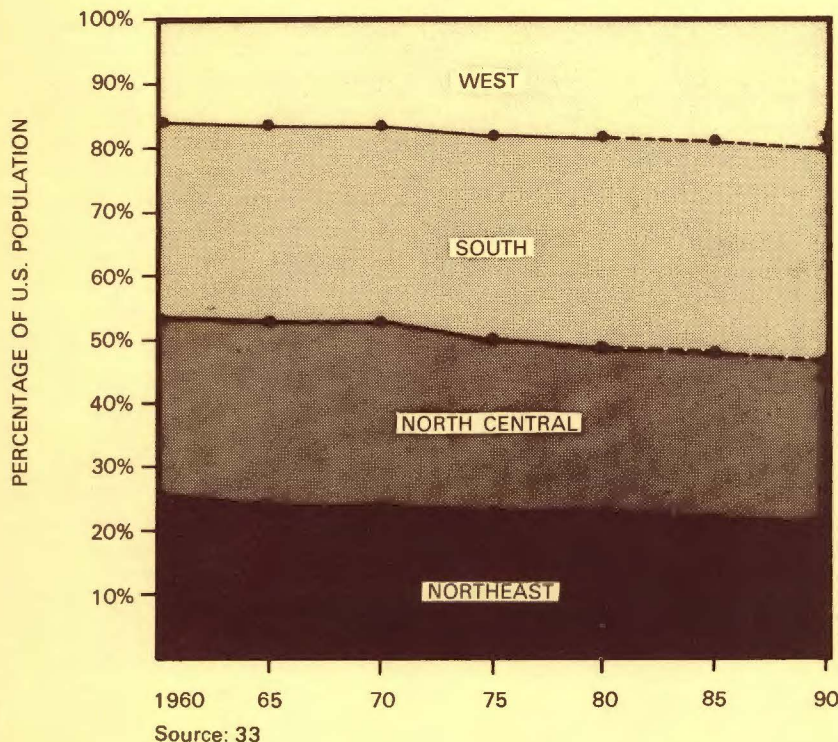
Source: 32

MAJOR REGIONS

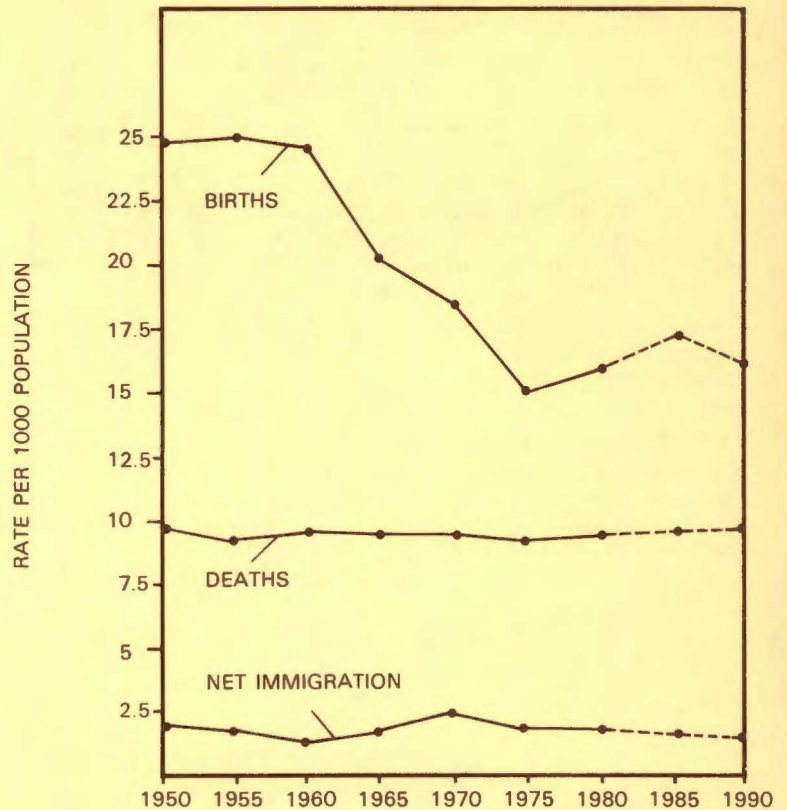
Over the last two decades, the regions of the South and West have increased their share in the total population. Population growth in the North Central and Northeast regions has slowed down relative to the national average. During the 1970s, the South in particular has gained; much of this gain has been the result of return migration of people who had left the South for northern cities. Another factor has been the southward migration of retired individuals and families. In the West, growth has continued. While the rate for the Pacific states has declined, this slowdown has been more than offset by an accelerated growth in the Mountain region, which includes not only some of the major Sunbelt states like Arizona, but also states that play a major role in energy development. If growth in this subregion would continue at the pace set in the early 1970s, the population would double in less than one generation.

Urban areas in these regions tend to have lower densities than in the East and Midwest. Transit systems are less developed. A greater proportion of travel is likely to be by auto.

REGIONAL DISTRIBUTION



COMPONENTS OF POPULATION CHANGE



Source: 34

POPULATION CHANGE

Of the three components of change in the total population -- live births, deaths, and net immigration into the country--fertility trends have been the key to recent growth patterns. Mortality rates have been relatively stable over the last few decades. There has been a recent downturn which has been broadly sustained since 1973. Death rates for persons 35 years old and over (who account for about 90 percent of all deaths) declined much more from 1973 to 1978 than from 1960 to 1973, primarily as a result of a reduction in mortality from major cardiovascular diseases. This change reflects improvements in health care as well as changes in lifestyle.

Net immigration rates are largely determined by public policy. At all times, there are more people abroad who want to immigrate than are allowed in. In comparison to total

immigration, migration from the U.S. is negligible.

The slowdown in population growth reflects the drop in birth rates. This drop is primarily the result of a decline in fertility rates for women across all age categories. There is a general consensus that changing aspirations of women and couples have caused this decline in fertility rates. Greater use of contraceptive practices and improvements in their effectiveness, together with liberalized laws on abortion, have allowed women an increasing degree of control over reproduction.

How fertility decisions are influenced by economic, social and other factors is not well understood. One cannot consider decisions about childbearing in isolation from decisions about marriage or cohabitation, about seeking or continuing work or a

career, or about financial matters. The interactions among these decisions have not yet been fully explored. It is therefore difficult to project what current trends mean for the future. For example, a popular assumption is that the decline in fertility rates in the younger age groups is the result of the postponement of childbearing, and that the birth rate could rise again in the near future as many young women begin to "make up" desired births delayed from previous years. It is doubtful, though, whether the effect would lead to a substantial increase in the birth rate over the next few years. All indications are that fertility rates will increase slightly, approaching the level at which the population replaces itself (in the absence of net immigration). This projection is consistent with most recent survey data of the birth expectations of young married women.

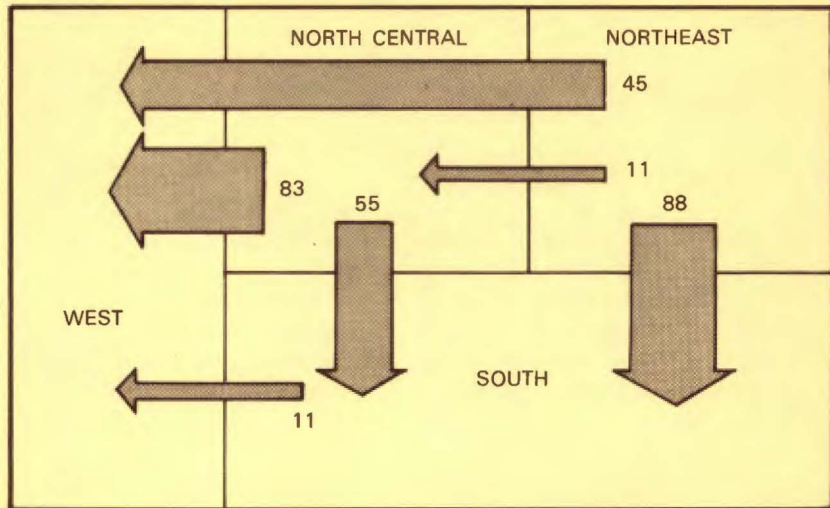
REGIONAL REDISTRIBUTION

The key factor in the regional redistribution of the U.S. population has been migration. Since the late 1960s, there have been pronounced changes in migration patterns among major regions of the country. Net out-migration from the Northeast has increased from an annual average of 144,000 for the period 1965-1970 to 268,000 annually for the first half of the 1970s and 233,000 for 1975-1978. Much of this increase is related to migration to the South, which just about doubled. However, while net migration from the Northeast to the South has declined somewhat between the first and second half of the 1970s, net outmigration to the West has been increasing steadily.

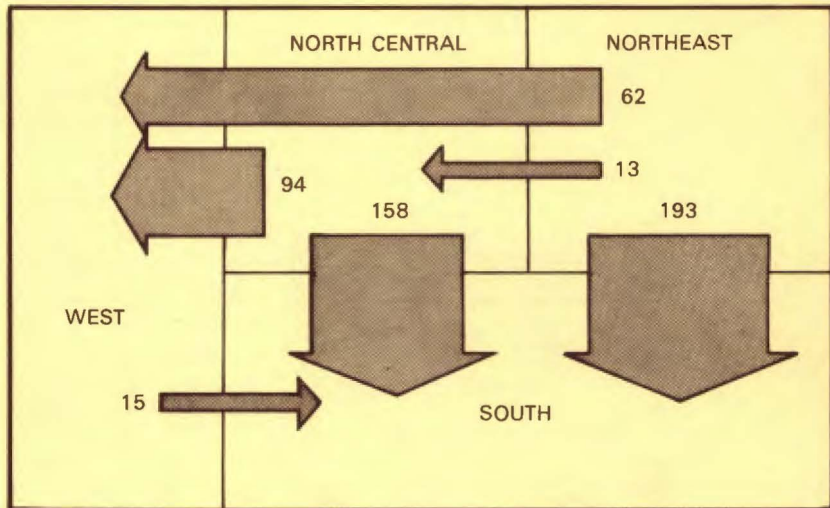
Similar patterns apply to the North Central region. There has been a steady increase in net outmigration to the West, although it is not as pronounced as the changes in the total number of migrants from the Northeast. In contrast, net outmigration from the North Central region to the South jumped sharply between 1965-1970 and 1970-1975, almost tripling from 55,000 per year to 158,000. The corresponding figure for 1975-1978 is somewhat lower at 143,000.

The most significant change has been the increase of net immigration into the South. This change represents a radical reversal of long-established trends. Through the 1950s, there was net outmigration from the South to the urban areas of the Northeast and North Central regions. The South began to experience net immigration only toward the end of the 1960s. Initially, increased immigration involved almost exclusively the non-poor, in response to emerging job opportunities as well as other factors. Net outmigration continued for the poor in the South. The 1970s witnessed a rise in the number of migrants to the South who fell below the poverty level; there is now net immigration of both the poor and the non-poor. Whether the apparent downturn in the level of net immigration into the South for the second half of the 1970s will hold cannot be determined yet. Census projections assume average net migration rates for either 1965-1975, or for 1970-1975.

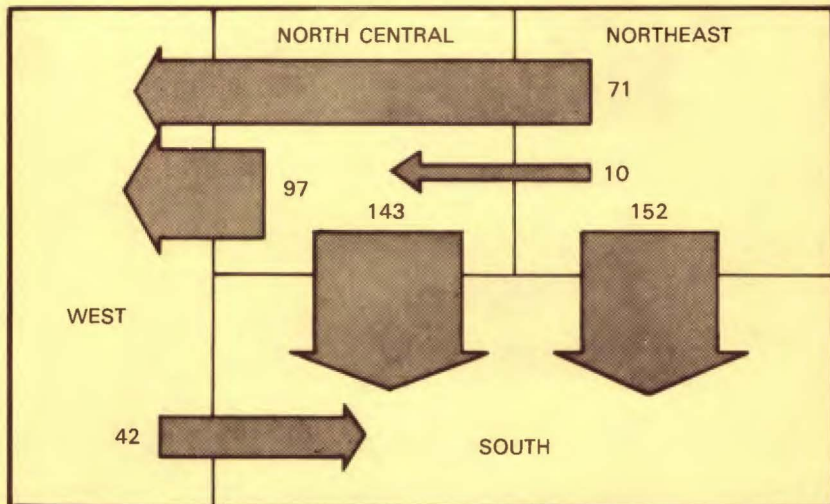
NET MIGRATION AMONG CENSUS REGIONS (Annual Averages, in 1000)



1965-1970



1970-1975



1975-1978

Source: 1, 27

MIGRATION TRENDS

The history of the United States has been a history of expanding urbanization. Each decennial census, up to and including the 1970 count, showed a greater percentage of the population living in urbanized areas. The 1970's have brought a reversal of this trend. For the first time, the number of migrants from urban to nonmetropolitan areas exceeded the number moving in the opposite direction. The migration flows among the three types of residential areas — central cities, suburbs, and nonmetropolitan areas — are illustrated in the charts below for 1970-1975 and for 1975-1978.

Migration between the central cities and suburbs dominates the overall picture in both periods. For the first

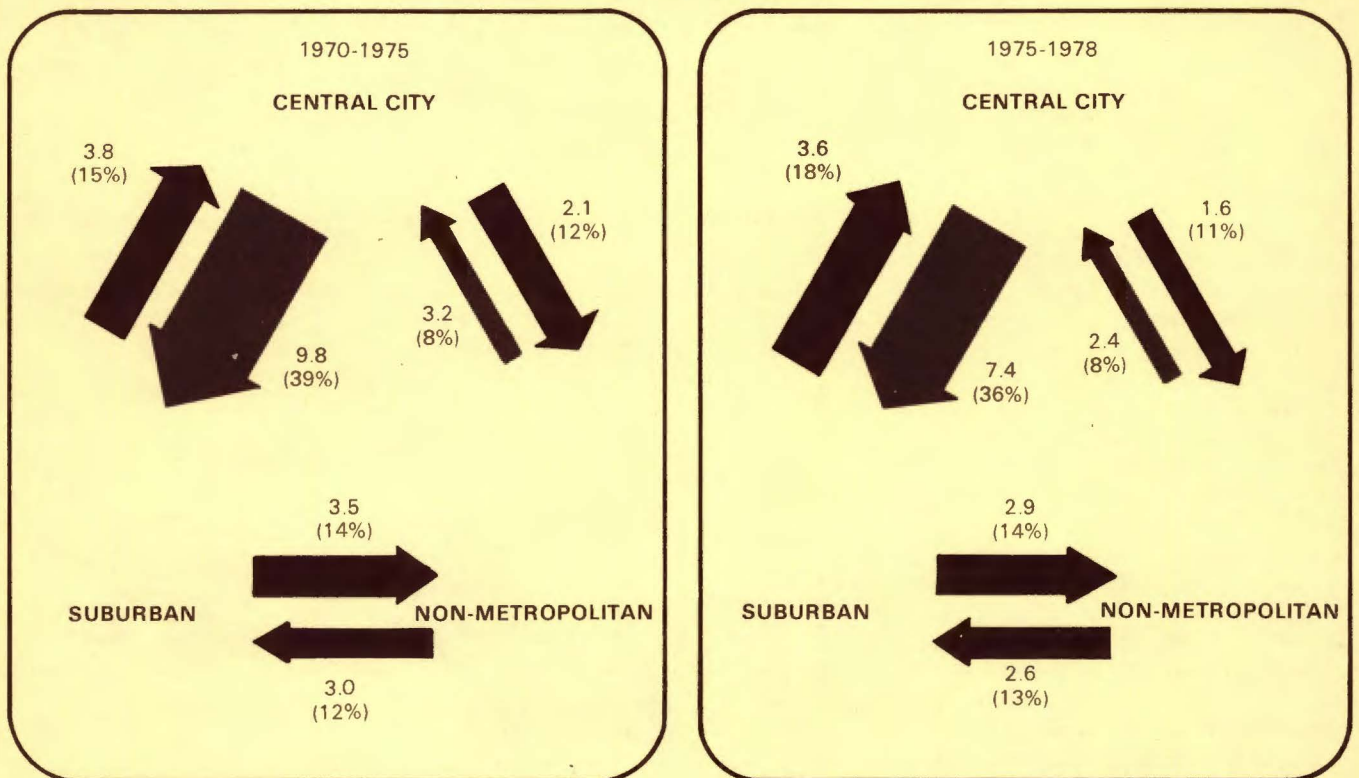
half of the 1970s, almost 10 million people moved from central cities to suburbs, while almost 4 million moved in the other direction. The net flow of 6 million corresponds to more than 10 percent of the central city population for 1970, still living in the U.S. in 1975.

Migration exchanges involving non-metropolitan areas involve smaller numbers. Even so, migrants from both central cities and suburbs to non-metropolitan areas outnumber those moving in the opposite direction, resulting in a net immigration of 1.6 million — 1.1 million from central cities and 0.5 million from the suburbs.

Changing migration patterns char-

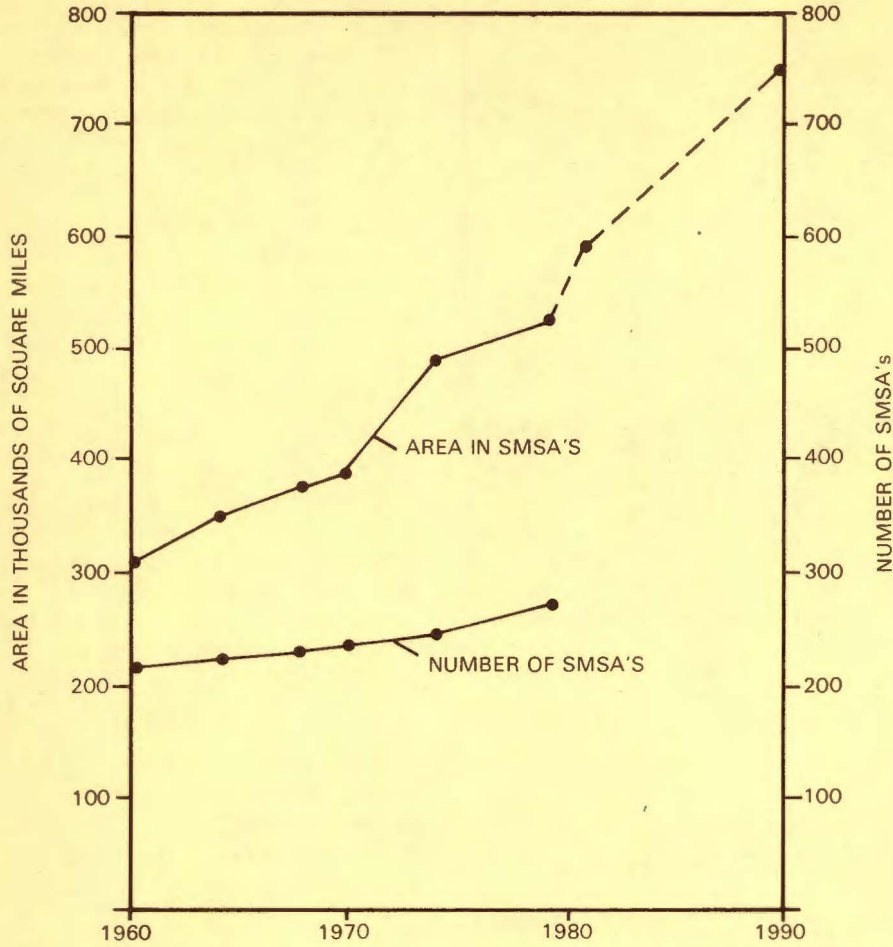
acterized the second half of the 1970's. Since the data cover only a three-year span, the total migration figures are smaller. However, migration from the suburbs to the central cities reaches almost the level for the five-year period 1970-1975 — 3.6 versus 3.8 million. **This relative acceleration may be an indication that the often-cited "return to the city" is more than a series of isolated phenomena.** Given the increasing number of single-person households, the cost and uncertainty of gasoline and the availability of transit in central cities this trend is likely to continue. However, at this point the numbers involved are small and the evidence remains too sketchy to be a base for population projections.

MIGRATION PATTERNS



LEGEND 3.8 NUMBER IN MILLIONS
(15%) PERCENT OF TOTAL MIGRATION

NUMBER AND AREA OF SMSA'S



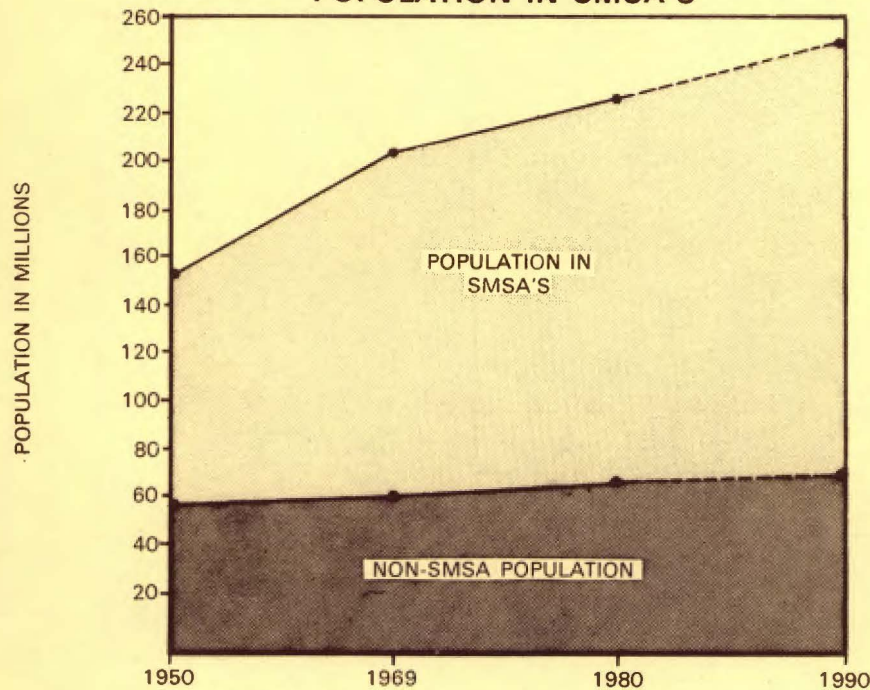
Source: 45

METROPOLITAN POPULATION GROWTH

Population growth in the U.S. has always -- at least until very recently -- favored metropolitan areas. This trend certainly held through the 1950's and 1960's. The 1970's, however, began to deviate from this long term trend, as discussed further in connection with migration patterns. Even so, the overall picture has changed only marginally: the overwhelming majority of the population lives in metropolitan areas. The 1980's are unlikely to see any significant changes in this distribution.

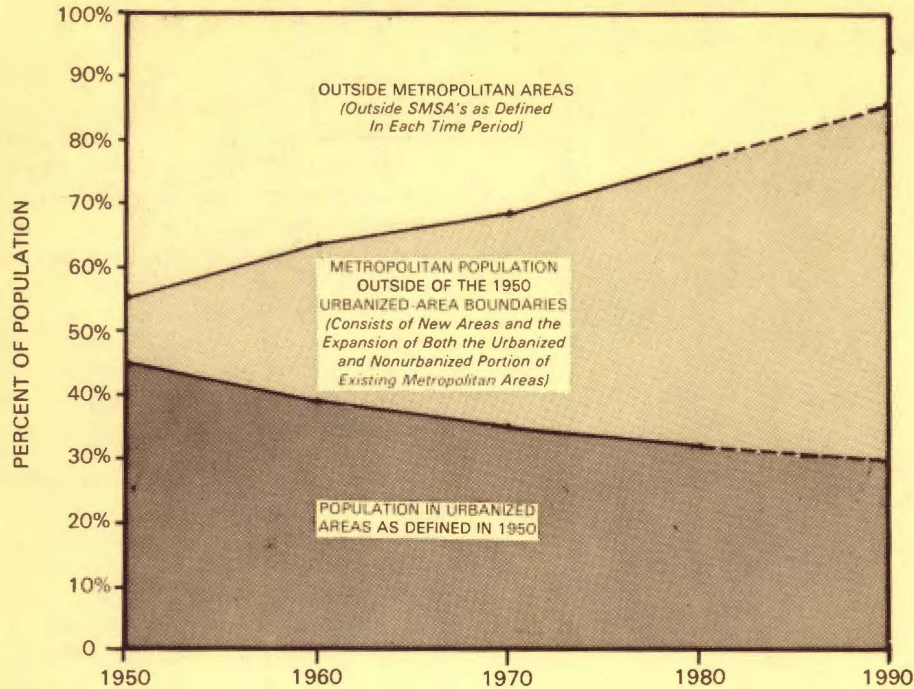
The reasons for faster population growth in metropolitan areas are twofold. First, existing areas registered a net immigration from non-metropolitan areas. Second, fast-growing areas soon assumed metropolitan characteristics and were re-classified. Since 1960, for example, the number of Standard Metropolitan Statistical Areas has grown by over 30 percent; the area covered by SMSA's has grown by more than 64 percent. This trend in terms of land area covered by metropolitan areas is expected to continue throughout the 1980's.

POPULATION IN SMSA'S



Source: 38

SHIFTS IN METROPOLITAN STATUS OF THE U.S. POPULATION 1950-1990

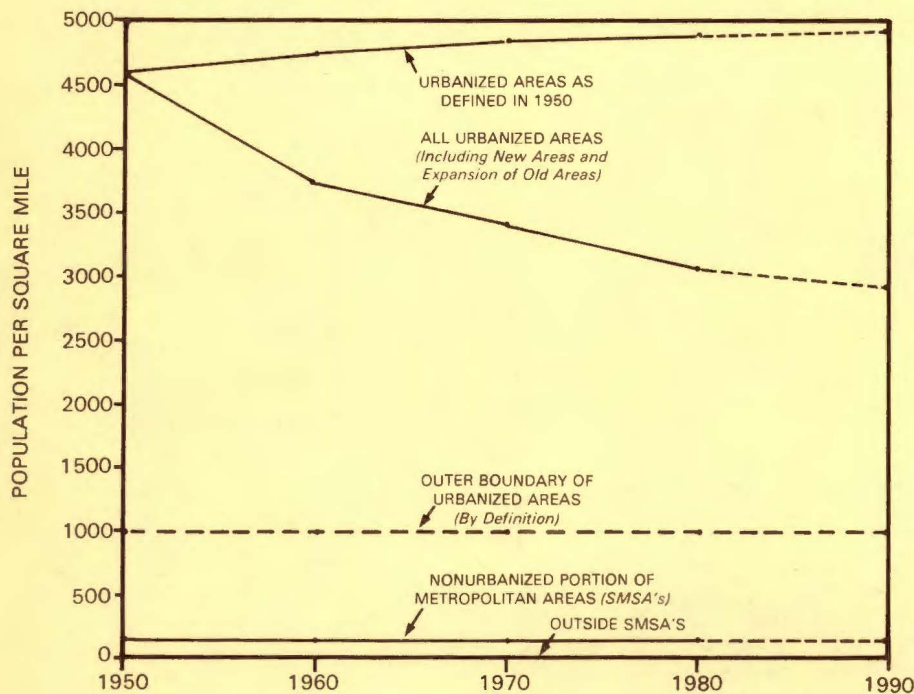


Source: 45

Over three-fourths of local public transportation and almost all local rail passenger transportation occurs in the urbanized areas as defined in 1950. The relative importance of these older dense areas is declining. For the largest cities, the decline is both absolute and relative. Each of the 13 largest cities in 1950 (having a population over 600,000) declined in population from 1970 to 1977. These cities (New York, Chicago, Philadelphia, Los Angeles, Detroit, Baltimore, Cleveland, St. Louis, Washington, Boston, San Francisco, Pittsburgh and Milwaukee in order of their 1950 ranking) lost two million people from 1970 to 1977.

Of the largest 33 cities in 1977 (consisting of the above 13 plus another 20 over 375,000), only 7 had significant gains in population from 1970 to 1977. These seven are in the Sunbelt -- Houston, San Diego, San Antonio, Phoenix, San Jose, Jacksonville, and El Paso (listed in order of their 1977 ranking). Five of the 33 had a relatively small change, plus or minus, from 1970 to 1977 (Los Angeles, Dallas, Columbus, Nashville, and Portland), and the others lost population.

TRENDS IN RESIDENTIAL DENSITY



Source: 45

POPULATION GROWTH BY TYPE OF RESIDENTIAL AREA

Although the parameters of migration among types of residential areas have begun to change, the relative magnitude of migration flows implies a continuation of current growth trends through the 1980's. The full impact of these changes will be felt in the years following the next decade.

The projections shown here identify the suburbs as the key growth area. Population in the suburbs — the non-central portions of metropolitan areas — is projected to increase from about 63 million in 1975 to 86 million in 1990. This growth results in an increase in the share of the suburbs in the total population from less than 30 percent in 1975 to over 35 percent in 1990.

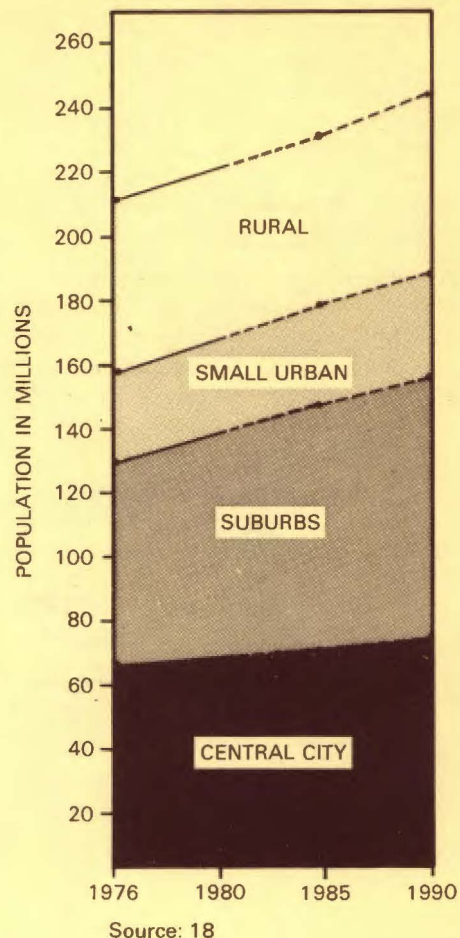
The relative gain of the suburbs is projected to be offset by decreases in the shares of the three other types of areas distinguished here. Central cities are projected to show an absolute increase in the population, from 67 million in 1975 to 72 million in 1990. Their share in the total U.S.

population, however, will decrease slightly, from 31 to 30 percent.

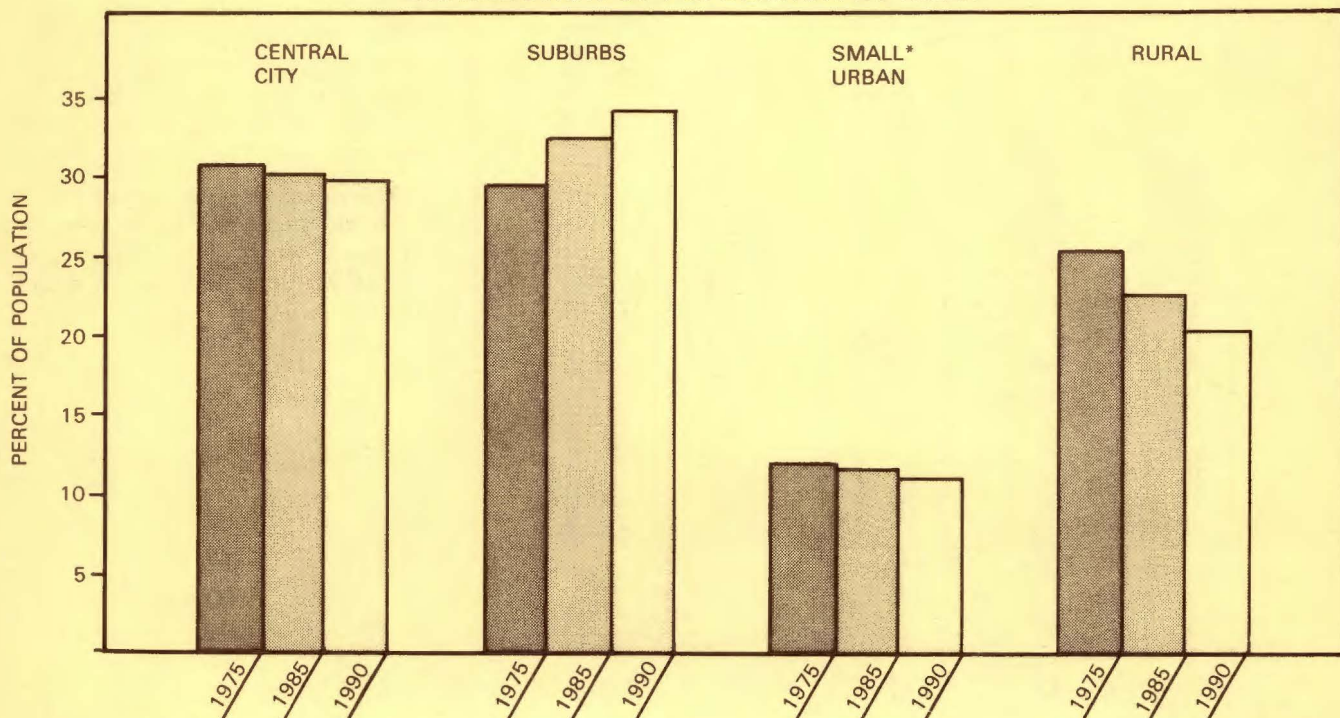
The population living in small urban areas (cities with a population between 2,500 and 50,000 people) is expected to remain stable. Consequently, the percentage share of this category decreases. The rural population, finally, is projected to decrease in absolute terms. The percentage share of rural areas in the total population is projected to decline from over 25 percent to under 22 percent. If recent shifts in migration patterns continue throughout the 1980's, this decline in the relative importance of the rural areas is likely to be milder.

The projections shown here indicate a continuing expansion of the portion of the U.S. population living in low-density areas. **This continuing trend of population to lower density areas reinforces dependence on automobile transportation, because public transit is inefficient in low density areas.**

REAL POPULATION CHANGE BY AREA



DISTRIBUTION OF POPULATION BY AREA



Source: 18

*URBAN AREAS 2,500 TO 49,999

THE GRAYING OF AMERICA

During the 1980's, the number of elderly will grow substantially, both in absolute and in relative terms. By 1990, people 65 and over will account for about 12 percent of the total population, up from less than 10 percent in 1970. At the same time, the proportion of persons under 18 years of age will drop from over 34 percent to under 27 percent of the total.

In spite of the fairly rapid growth of the aged population, the "aged dependency ratio" — the ratio of the retirement age population to the working age population (20-64 years of age) — will increase only gradually over the next decade and beyond.

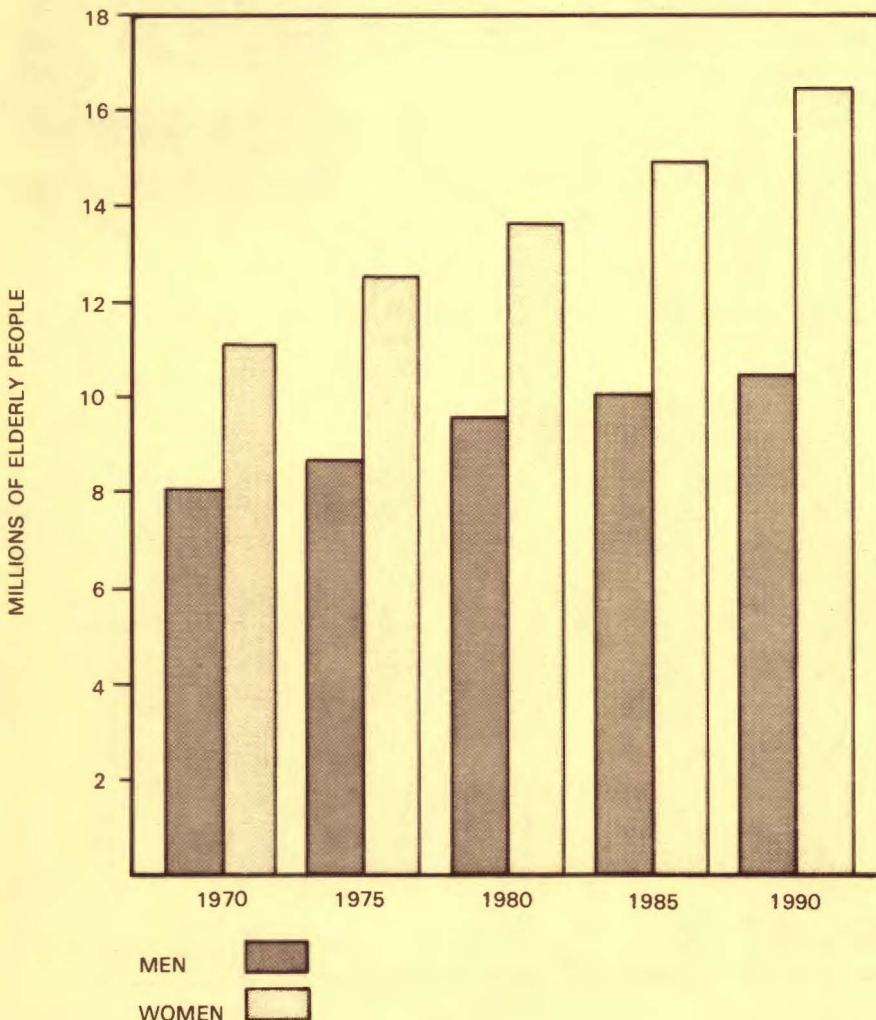
As the post-WWII "baby boom" generation moves through the working age groups, it keeps the denomi-

nator of this ratio sufficiently high.

More detailed projections of the age structure of the U.S. population suggest that the elderly population in 1990 will be older on the average than the corresponding group today. The proportion of the elderly aged 75 and over will be 7 percent greater than in 1977. Women will comprise an even larger proportion of the elderly population than they do today. In 1990, 61.7 percent of Americans aged 65 or over will be women, up from 59.4 percent in 1977.

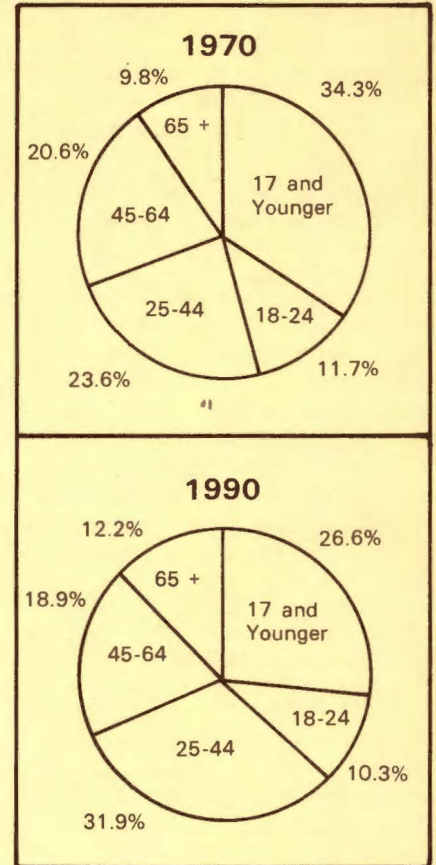
Since dependency and mobility limitations increase with age, these problems will become more critical during the 1980's. In addition, many of the elderly surviving their spouses may face new mobility problems.

NON-INSTITUTIONAL ELDERLY POPULATION 65 YEARS AND OLDER



Source: 33

AGE DISTRIBUTION



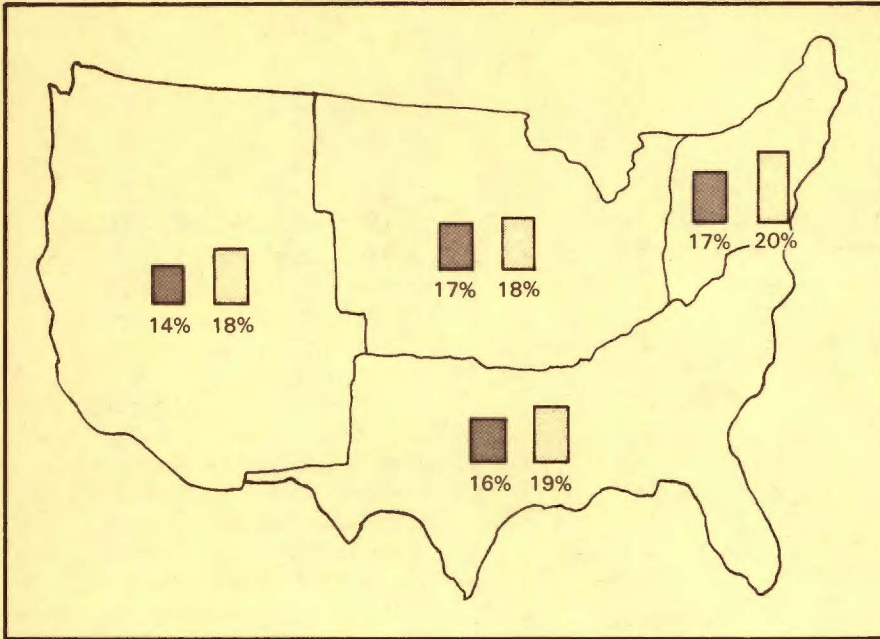
Source: 32

THE ADULT DECADE

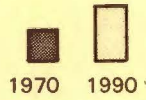
At the same time as the elderly population is growing, the proportion of the population 17 years of age and younger is declining. As shown above the largest single segment of the 1990 population is in the 25-44 age bracket.

This expansion of a stable adult population coupled with the decrease in family size suggests an expansion of adult oriented activities.

LOCATION OF THE ELDERLY



RATIO BY REGION OF PERSONS 65 or OVER TO PERSONS 15-64



Source: 33

THE LOCATION OF THE ELDERLY

The chart on the left illustrates the expected geographic distribution of the elderly population across the major Census regions. The statistic shown is an indication of the relative size of the retirement age population compared with the working age population. The projected ratios for 1990 are based on an extrapolation of 1965-75 net migration rates under the assumption of a medium fertility rate.

In 1970, the aged dependency ratios were highest for the Northeast and the North Central regions. The increase to 1990 for the North Central lies below the national average, as a result of age-selective outmigration. In the other three regions, changes in the aged dependency ratio are more pronounced. These changes are accompanied by a redistribution of the elderly from the Northeast and North Central regions to the South and West. The share of the latter two regions in the total U.S. population aged 65 or over increases from 45 percent in 1970 to 52 percent in 1990. **Given the paucity of transit service in these regions and the rising real cost of gasoline, this fixed income group may face severe mobility restriction.**

REGIONAL CHANGE

The growth of the elderly population exceeds that of the population as a whole in all four Census regions. However, there are significant differences between the Northeast and North Central regions on one side and the South and West on the other: in the Northeast and North Central, the elderly populations are growing at an average annual rate of 1.3 and 1.2 percent, respectively. The growth rates for the South and West are 2.8 and 3.0 percent, respectively.

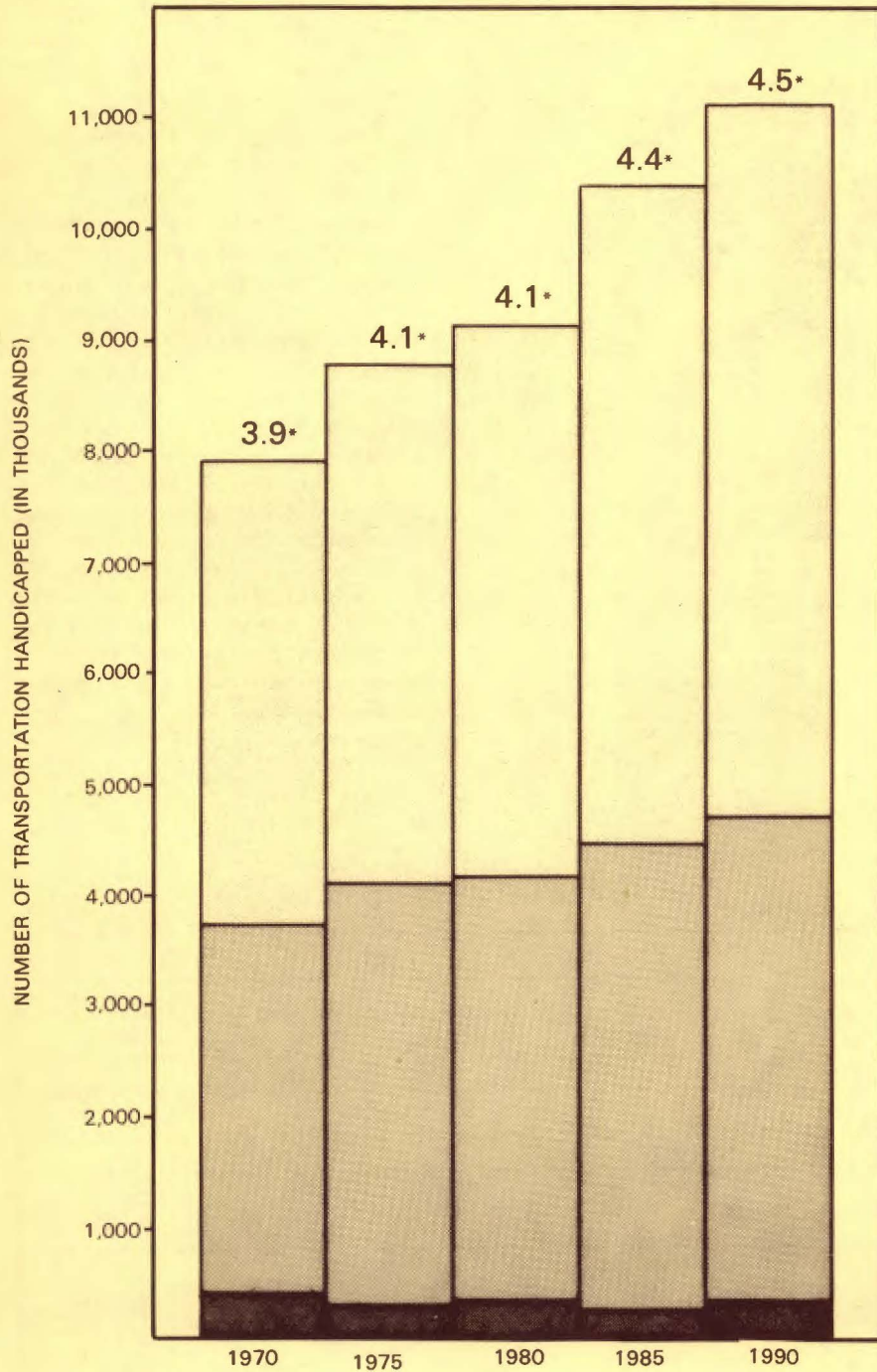
Even so, the highest percentage share for the elderly population in 1990 is projected for the Northeast, followed by the South. **Providing for the mobility needs of the elderly population will exacerbate budget difficulties for cities in these regions.**

REGIONAL CHANGE IN ELDERLY POPULATION

Region	1970		1990	
	People 65 and over (million)	Percent of Population	People 65 and over (million)	Percent of Population
North East	5,176	10.6%	6,718	13.0%
North Central	5,704	10.1%	7,290	11.9%
South	6,018	9.6%	10,391	12.5%
West	3,019	8.7%	5,417	11.7%

Source: 33

TRANSPORTATION HANDICAPPED



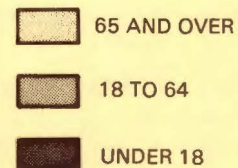
*PERCENT OF TOTAL POPULATION

Source: 43

THE TRANSPORTATION HANDICAPPED

Transportation policies in the 1980's will continue to pay particular attention to the problems of the elderly and handicapped. The size of this market segment depends critically on the definition used. A generally accepted option, defining the transportation handicapped as all the people who cannot use transit or can only use it with difficulty because of physical or mental impairment, yields estimated of the magnitude shown in the chart. Using constant incidence rates for the three age groups shown, the number and percentage of transportation handicapped is projected to increase. This increase reflects primarily the increase in the size and share of the elderly population. The projected increase in the number of handicapped persons in the 18 to 64 age group is a result of applying constant incidence rates to an expanding population.

The percentage of the population that can be classified as transportation handicapped is projected to increase from 4.1 percent in 1975 to 4.5 percent by 1990. In absolute numbers, this increase means a change from 8.9 million handicapped in 1975 to 11.0 million handicapped in 1990.



POPULATION OF SPANISH ORIGIN

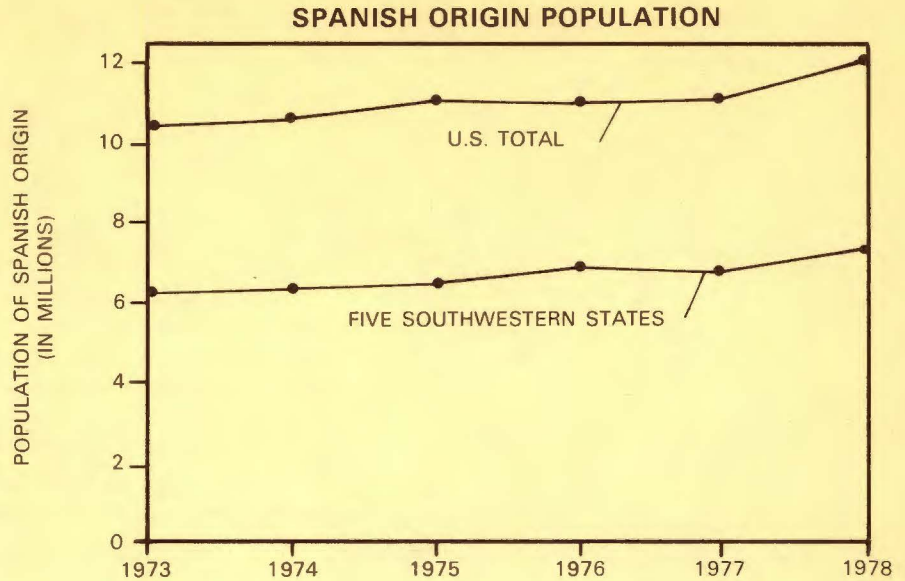
The analysis and projection of the number of Americans of Spanish origin has been hampered by data and definitional problems in the past. The Bureau of the Census has collected only limited time series that employ a consistent definition of this population group, as identified by the respondents.

The population of Spanish origin has been growing in step with the general population during the 1970s. The percentage share for this group increased from 5.1 percent in 1973 to 5.6 percent in 1978.

A large part of this population was concentrated in a few states. Five southwestern states account for about 60 percent of the total. In these states, individuals of Spanish origin account for 17 to 18 percent of the total population. **There will be an increasing need for bi-lingual transportation information.**

ETHNIC BACKGROUND

A special tabulation of the 1977 National Personal Transportation Survey yields data on the incidence of ethnic background by type of residential area.



Source: 26, 28, 30

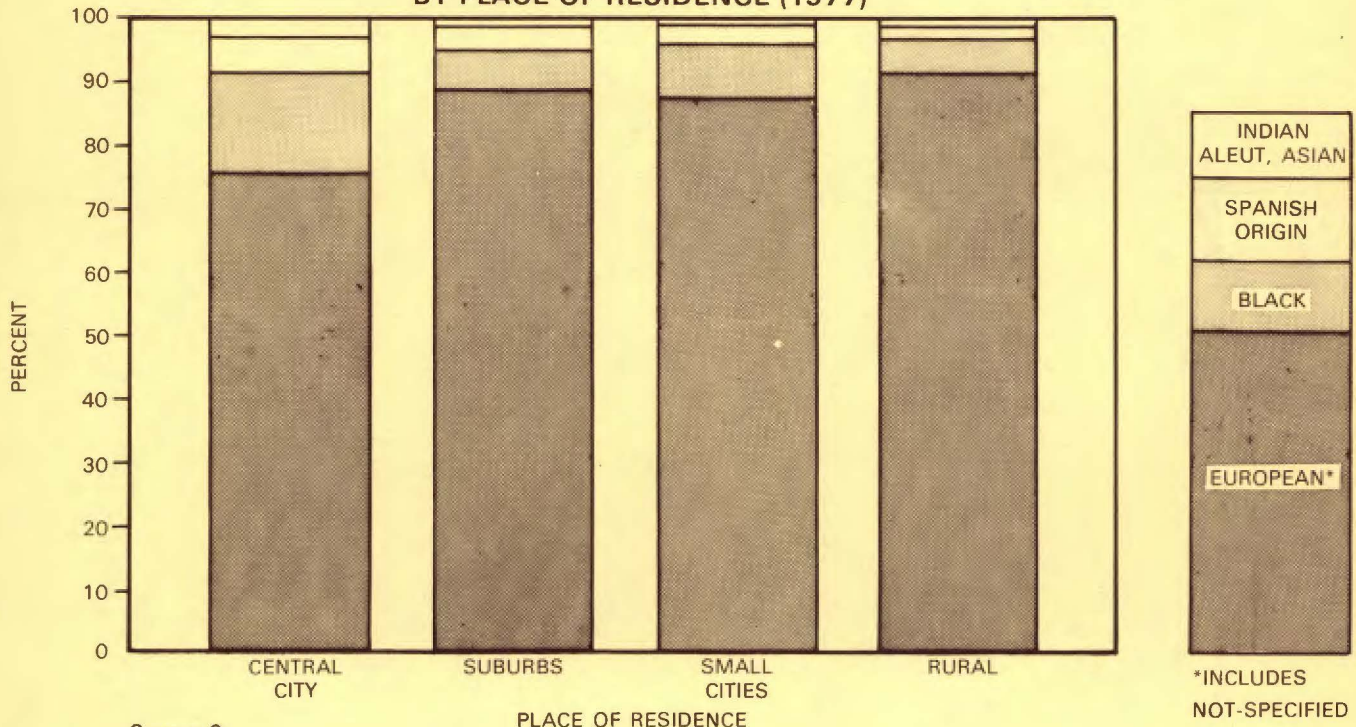
The greatest mix of ethnic backgrounds is found in the central cities of metropolitan areas. This residential category shows substantial percentages for black Americans, Americans of Spanish origin, and Indian, Aleut and Asian Americans.

For the other three residential categories, the percentages show little variation. The percentage of blacks is highest for the small urban areas and

lowest for rural areas. Americans of Spanish origin show a higher percentage for the suburbs.

There are tentative indications that a growing number of minorities are moving from central cities to older, inner suburbs. If this becomes significant there could be an increased need for transit service in these areas.

ETHNIC COMPOSITION OF THE POPULATION BY PLACE OF RESIDENCE (1977)

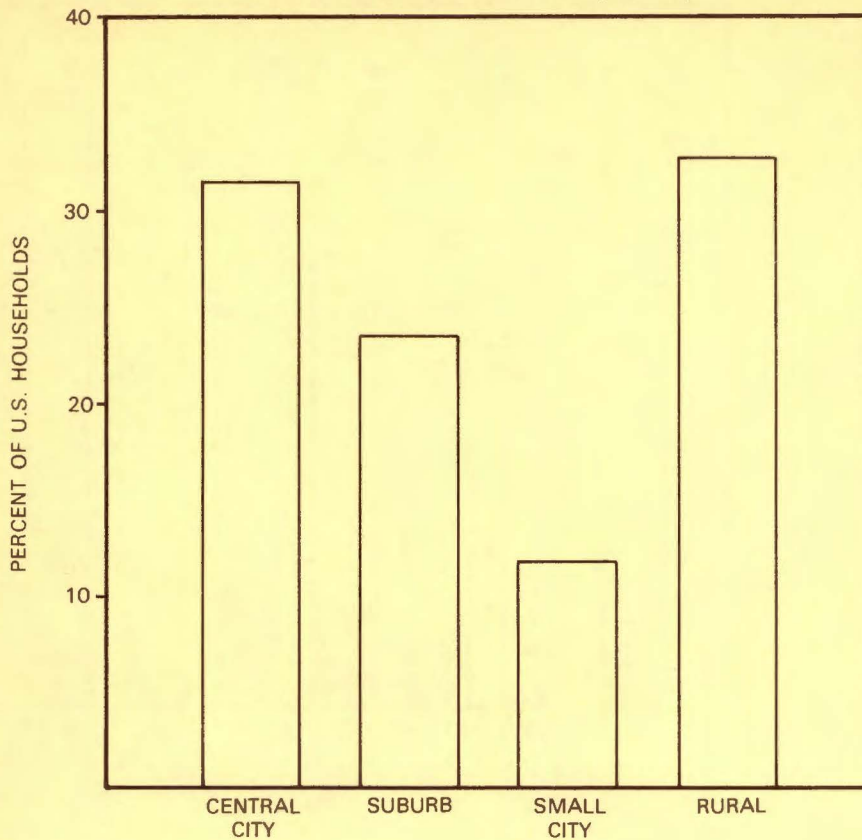


Source: 9

The number of households has been growing faster than the population, an indication of decreasing household size. An important factor has been the growth of single-person households, involving primarily the elderly. The largest concentration of single-person households is in the central cities. However, the household size for other residential areas (suburbs and nonmetropolitan areas) has also been declining throughout the decade.

These trends will continue into the 1980's, largely in connection with the growing importance of the elderly. They require a reassessment of the transportation needs of the "typical" household as a basis for policy planning.

NATIONAL DISTRIBUTION OF HOUSEHOLDS BY LOCATION TYPE (1977)



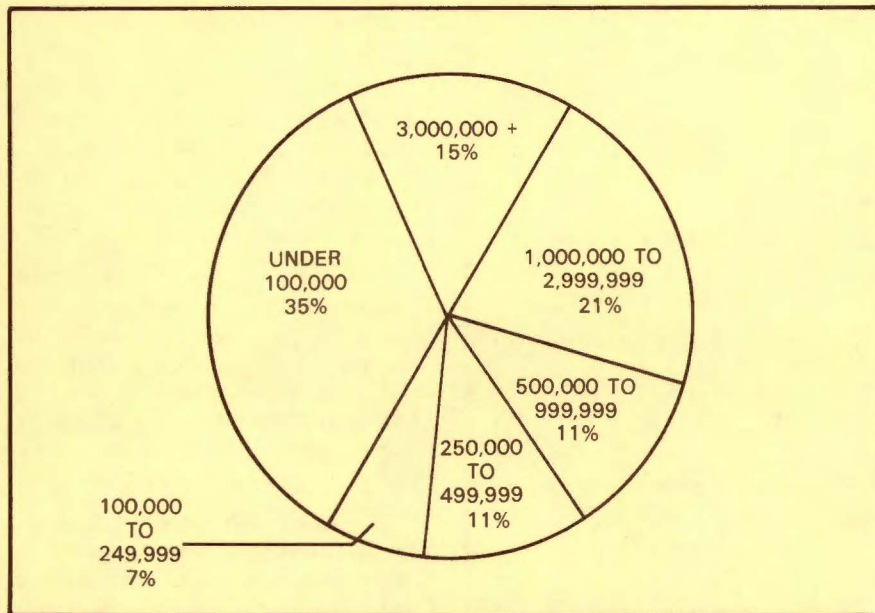
Source: 9

LOCATION OF HOUSEHOLDS

The national distribution of households divides approximately into thirds. One third are rural or small urban; one third are suburban, and another third live in central cities. As a group, suburban and small urban areas now contain the greatest proportion of U.S. households. Population forecasts show that the suburbs will continue to be the largest population growth area in the 80's.

There is a countervailing trend, however, because the distribution of households and of population are not following the same growth pattern. During the 80's, the largest growth in households is expected to be in single-person units. These units have exhibited a strong tendency to locate in central cities. As a result, **the central city will retain its relative share of national households, but the suburbs will contain a larger proportion of the population.**

NATIONAL DISTRIBUTION OF HOUSEHOLDS BY POPULATION OF PLACE OF RESIDENCE (1977)



Source: 9

CITY SIZE

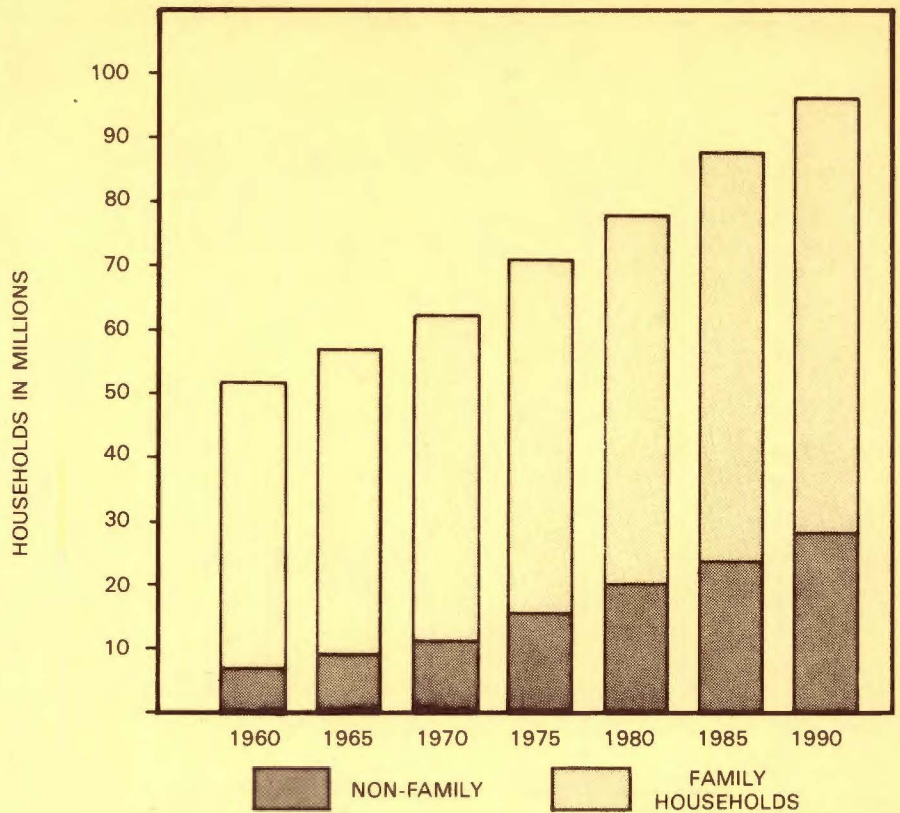
The population that lives in center cities or in the suburbs resides primarily in larger cities. Thirty-six percent of the nation's households are in SMSA's larger than 1,000,000, while 22% live in urban areas with a population between 250,000 and 1,000,000. **Despite uncertainties about auto fuel availability, a major shift is not expected in family residential location decisions.**

FAMILIES AND HOUSEHOLDS

Over the last two decades, the number of households (all persons occupying a single housing unit) has grown at a rate faster than the population itself. The difference between the two growth rates has increased over time. During the 1960's, the number of households grew at an annual rate of 1.8 percent, compared to a population growth rate of 1.3 percent. During the 1970's, the growth rate for households was 2.2 percent, compared to a population growth rate of 0.8 percent. This trend is projected to continue throughout the 1980's. In fact, for the first half of the coming decade, the number of households is projected to grow at an annual rate of 2.4 percent; in the second half, this growth rate is assumed to drop to 1.7 percent. The projected growth rate for the population under the medium-fertility scenario is 0.9 percent per year.

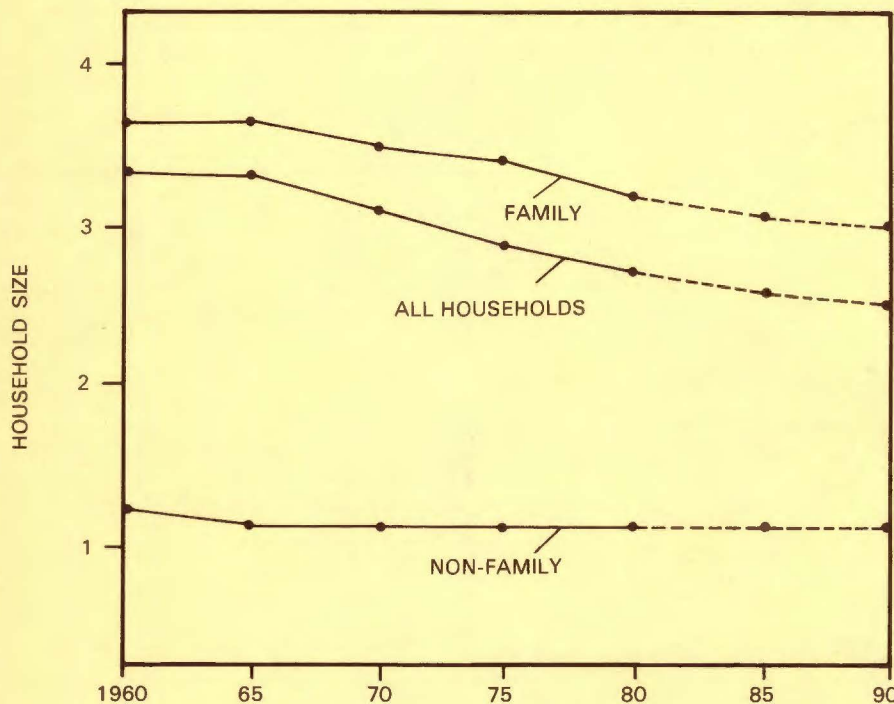
A major reason for the rapid growth in the number of households has been the proliferation of "nonfamily" households. Most nonfamily households (88 percent) consist of individuals living alone. The remainder covers different living arrangements involving two or more unrelated individuals.

NUMBER OF FAMILIES AND HOUSEHOLDS



Source: 29, 35

AVERAGE HOUSEHOLD SIZE



Source: 29, 35

In 1960, less than 15 percent of all households were nonfamily households. This percentage share had increased to 19 percent by 1970. The percentage is projected to reach 26 percent by 1980, and 29 percent by 1990.

The largest proportion of people living alone — about 41 percent in 1978 — are 65 or over. However, the 14-24 year old age group registered the highest growth rate for single-person households.

Although the growth in nonfamily households has been a significant factor in the rapid growth of the number of households overall, it is not the only determinant. The chart at left clearly illustrates the decreasing size of family households, from 3.7 in 1960 to a projected 3.0 in 1990.

The same number of people in a larger number of households means both different travel patterns for work and non-work purposes; and a greater number of trips per person.

REGIONAL DISTRIBUTION OF HOUSEHOLDS

Data from the 1977 Annual Housing Survey highlight differences among regions in terms of the distribution of the population among residential areas and in terms of the relative importance of single-family housing structures. The distribution of households across the three residential areas is surprisingly similar for the Northeast and the West, with slightly over a third of the households in central cities, about 45 percent in the suburbs, and 21 percent in non-metropolitan areas. However, households in the Northeast are much more likely to live in multi-family structures than in the West, particularly in the central cities.

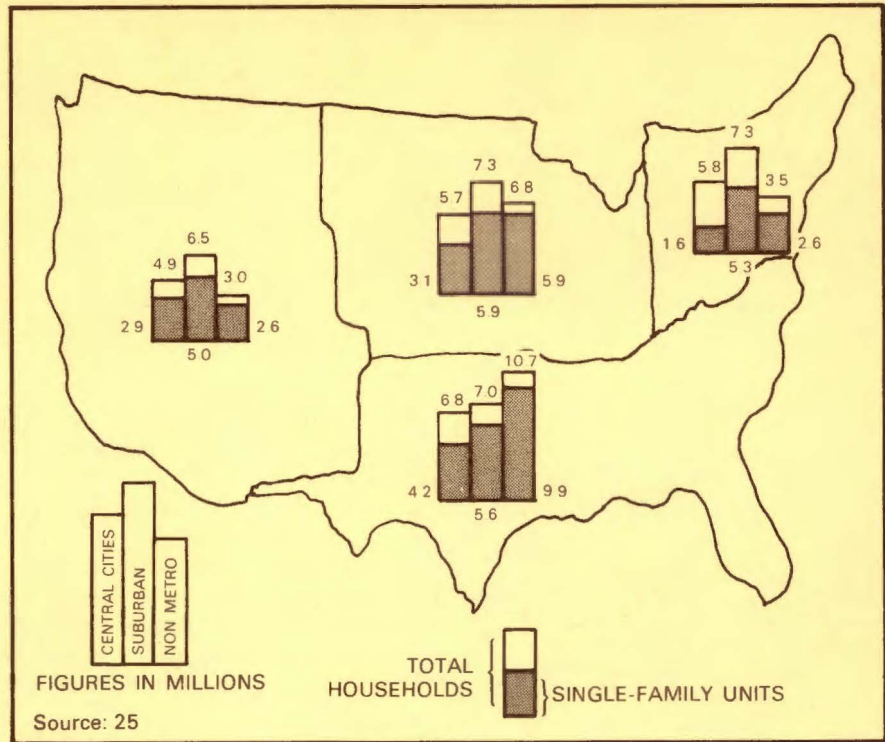
The South shows the highest percentage (44 percent) of households in nonmetropolitan areas. This region also has the highest overall percentage of single-family units.

Given the patterns of migration and projected housing starts, **these regional differences in household location and housing structures are likely to continue throughout the 1980's.**

TRENDS IN HOUSEHOLD COMPOSITION

The percentage of households with married couples with children has declined from 44 percent in 1960 to 32 percent in 1978. Over the same period, the percentage of all households consisting of married couples

DISTRIBUTION OF HOUSEHOLDS, 1977

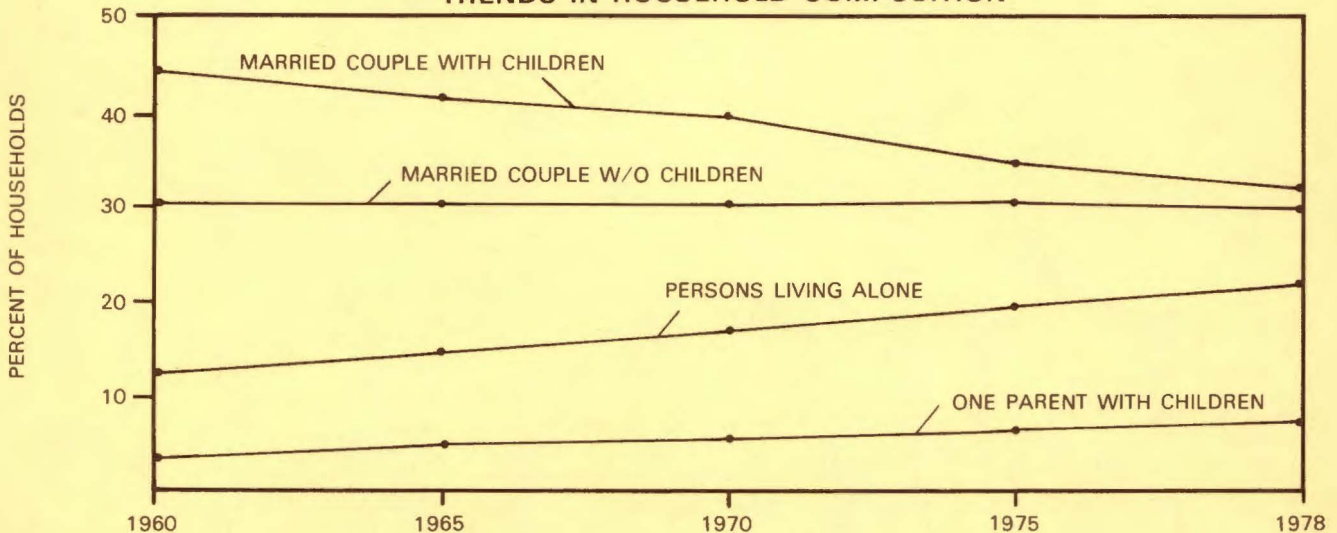


without children has remained constant at about 30 percent. The most significant gain has been in the category of single-person households. In 1960, persons living alone accounted for 13 percent of all households. By 1978, this percentage has increased to 22 percent. In the 1980's, the growth in single-person households is likely to slow down only marginally, because the number and proportion of elderly in the population -- who account for a large fraction of

single-person households -- will continue to increase.

Households without children have increased substantially since 1960 and are expected to represent an even larger proportion of all households by 1990. Such households place less emphasis on schools or the availability of play space in their residential location decisions. Higher density, central living will be more acceptable for this group.

TRENDS IN HOUSEHOLD COMPOSITION*



Source: 29, 35

*EXCLUDES 6-8% OF HOUSEHOLDS IN OTHER FAMILY AND OTHER NON-FAMILY CATEGORIES

The growth in housing consumption basically mirrors the projected growth in households. The mix of dwelling types -- single-family, multi-family and "other" (most mobile homes) -- varies with household size and type of area. Smaller households are more likely to live in multi-family structures. These structures also are more important in areas with a larger population. Much of the growth in the number of households will be due to smaller households in large cities. This suggests that the demand for multi-family structures will rise disproportionately. Current projections of housing starts indicate a dwindling percentage of multi-family starts in the early part of the 1980's -- suggesting the emergence of a serious disequilibrium in the housing market.

NATIONAL HOUSING STARTS

Projecting the number of housing starts for the nation is an exceedingly difficult undertaking. More than perhaps any other indicator of economic activity, housing starts fluctuate strongly in response to general economic conditions — or expected economic conditions. As a result, projections for construction activity in the housing sector are available only through 1984, prepared by the National Association of Homebuilders.

The early 1970's witnessed a boom in new housing starts, both single-family and multi-family dwellings. A reflection of the real-estate boom in that period, housing starts dropped sharply when the real estate market went bust in the 1973-74 recession. Housing starts reached a bottom in 1975, with less than half the 1972 peak value for single-family dwellings and about one-fourth for multi-family starts. Housing starts recovered to some extent in the second part of the 1970's, peaking in 1978.

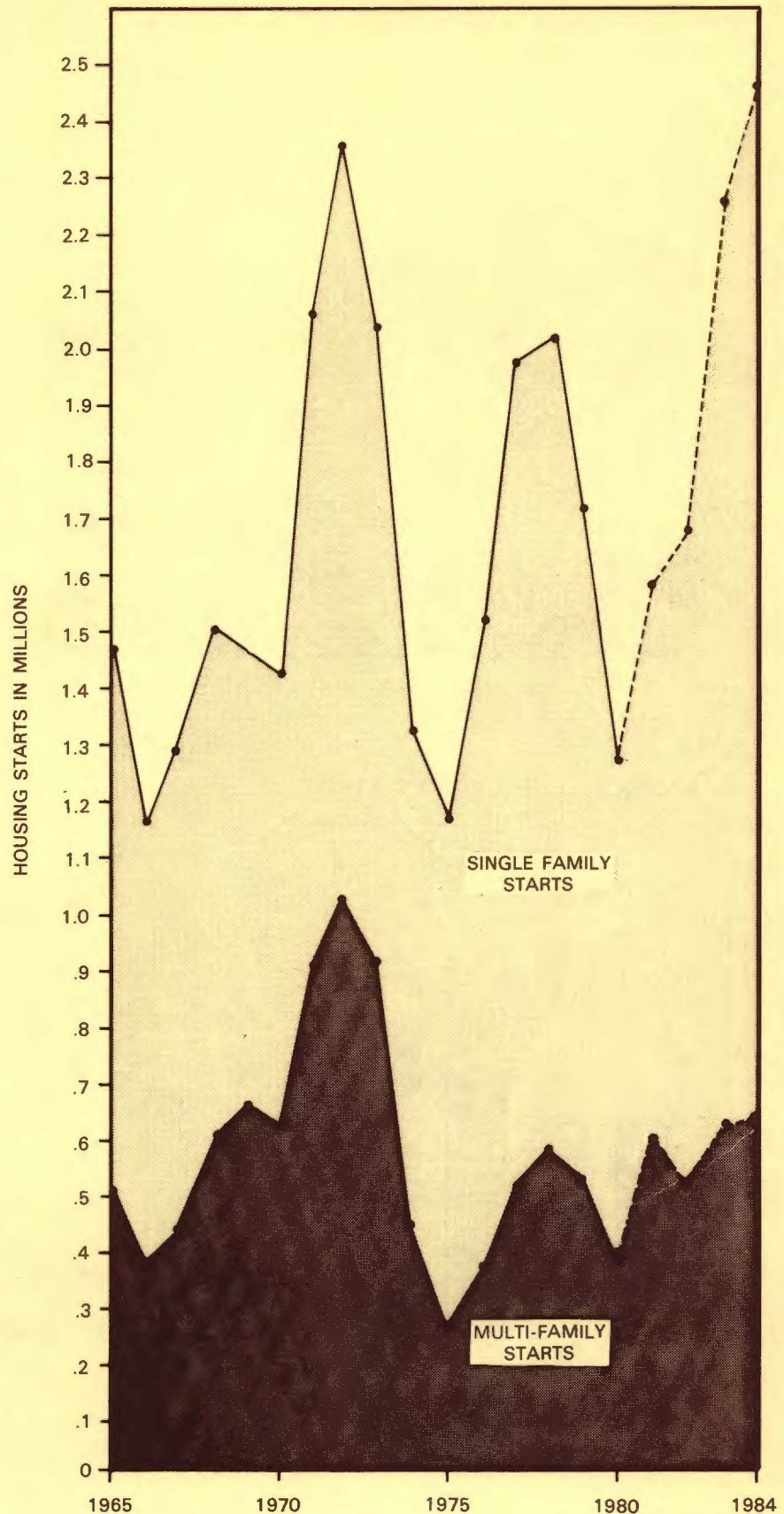
Current economic conditions have weakened the housing market considerably, partially as a result of policy action aimed at inflation. As a result, housing starts are projected to drop sharply, hitting a low in 1980.

The housing industry projects that multi-family starts will increase again slightly, but single-family starts are projected to jump sharply over the first half of the 1980's.

Trends in the proportion of single person households and families without children, however, suggest that much of the housing demand during the 80's will be for units in multi-family structures. The discrepancy between the housing types desired and those projected to be constructed may lead to a softening of the market for single-family units and a shortage of apartments and condominium units.

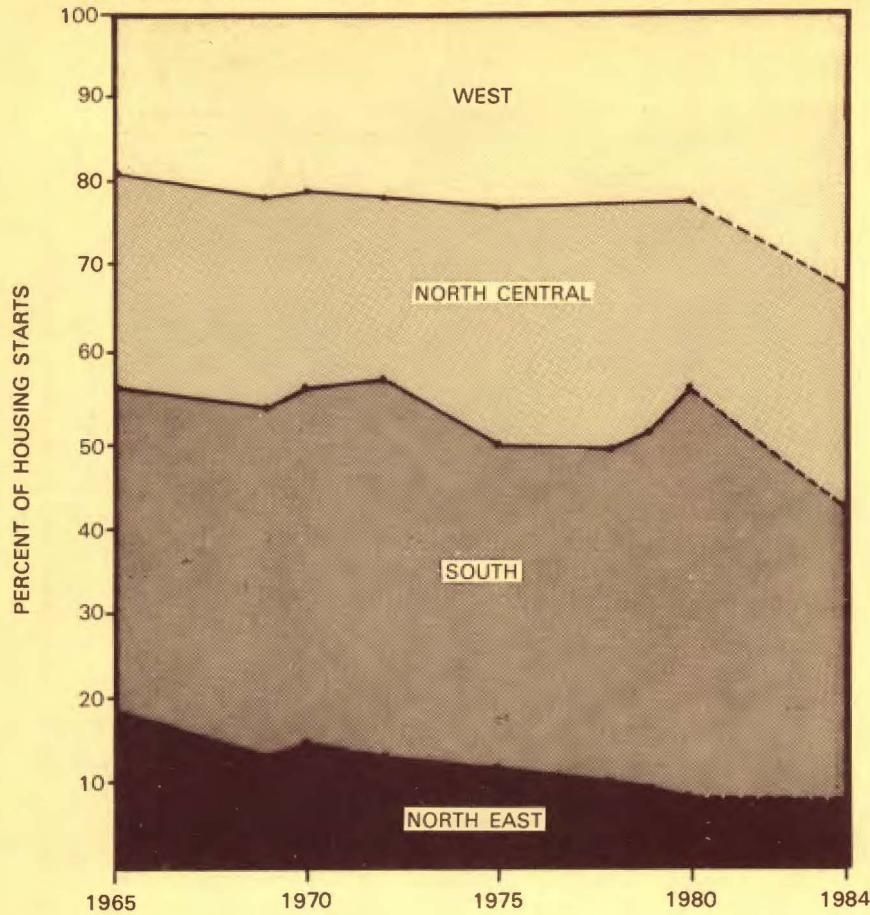
This shortage could accelerate the conversion and rehabilitation of existing structures in central cities and older suburbs.

HOUSING STARTS TO 1984



Source: 8

REGIONAL DISTRIBUTION OF HOUSING STARTS



Source: 8

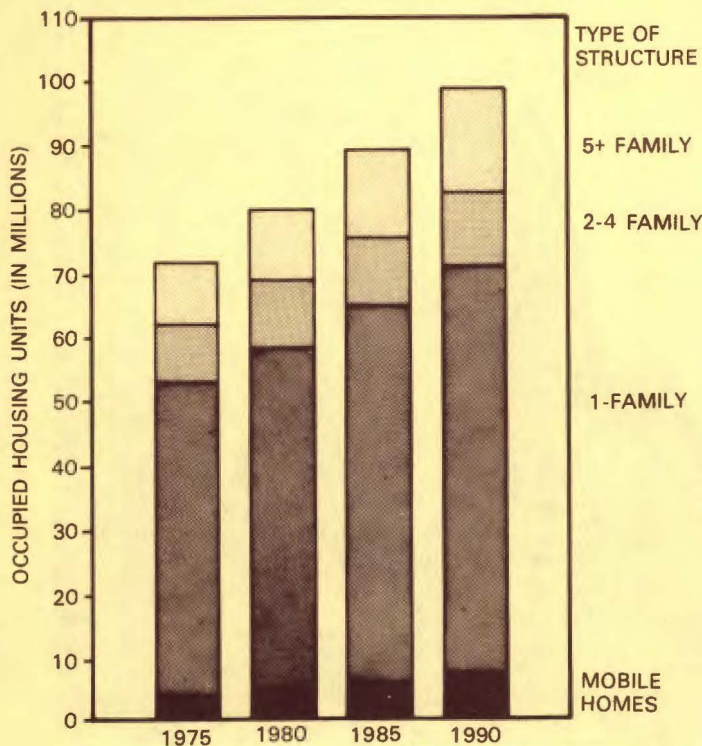
HOUSING CONSUMPTION

Housing consumption reflects not only the growth of the population, but also the rate of household formation. Since the proportion of small households is expected to increase, the growth in housing demand will continue to outstrip population growth. Patterns of household formation also affect the type of housing demanded.

The projections shown here are based on an analysis of the rate of household formation for different age cohorts over time. The figures are the result of an extrapolation of current consumption patterns for each age group. They show a continuation of the overall trend throughout the 1980s. In terms of the total number of housing units occupied, the average annual growth rate for the first half of the 1980's is projected to be slightly greater than for the period 1975-1980, 2.2 versus 2.1 percent. For the second half of the 1980's, this growth will slow down, to 1.6 percent per year, as the reservoir of potential new heads of households shrinks.

Single and family multi-family units are projected to grow at a slower pace than the total. The slack is made up by faster growth in the number of units in multi-family dwellings with 5 or more units, and in mobile homes. The projections imply continued dispersal of the population due to the growth in single-family and mobile homes, but the beginning of a counter trend to higher density living as reflected in the growing preference for multi-family housing structures.

HOUSING CONSUMPTION



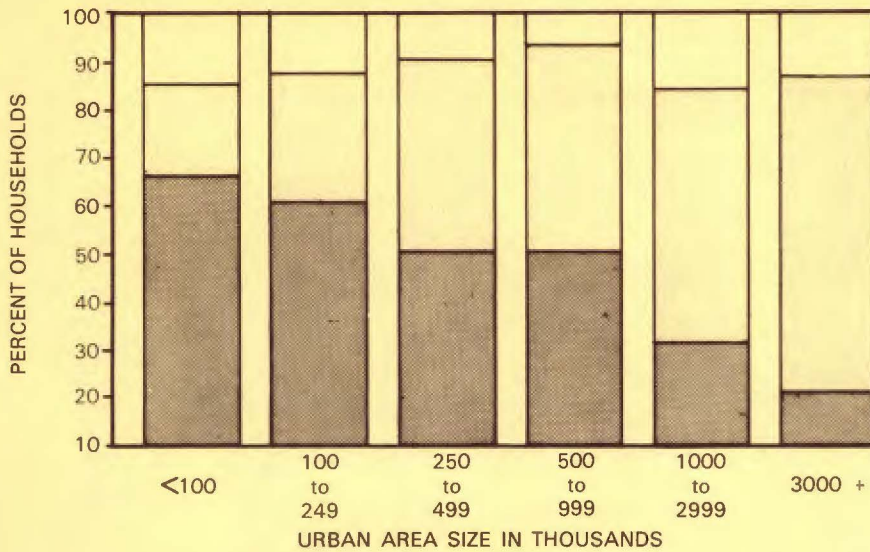
Source: 19

AVERAGE ANNUAL GROWTH RATE

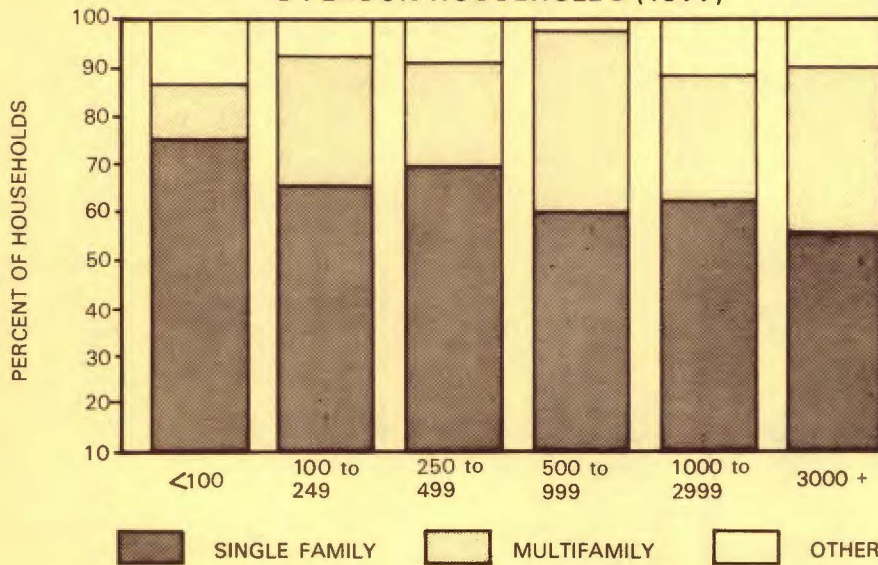
	1975-1980	1980-1985	1985-1990
Total	2.1%	2.2%	1.6%
Mobile Homes	7.3	5.6	3.6
1-family	1.6	1.8	1.5
2-4 family	2.1	2.1	1.4
5+ family	2.7	2.3	1.8

Source: 19

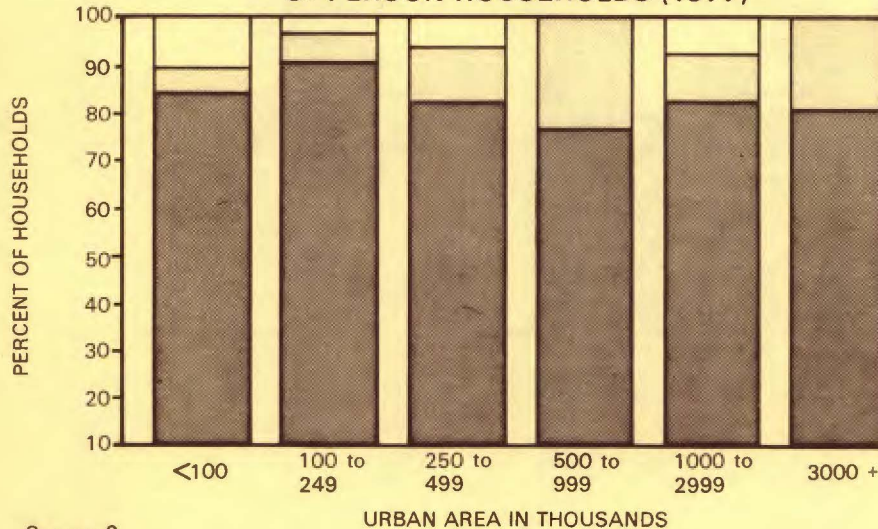
HOUSING STRUCTURE TYPE BY SIZE OF URBAN AREA—SINGLE PERSON HOUSEHOLDS (1977)



2 PERSON HOUSEHOLDS (1977)



3+ PERSON HOUSEHOLDS (1977)



HOUSING STRUCTURE BY TYPE OF URBAN AREA

The housing structure reflects both the preferences of the household -- which depend on its size -- and the availability of different types of housing in different areas. For single-person households, urban areas with a population of less than 250,000 show a dominance of single-family dwellings. As the size of the area increases, single persons are more and more likely to live in multi-family structures. For the larger urban areas, with a population of 1 million or more, multi-family dwellings account for over 50 percent of the single-person households.

Since many of the single-person households are elderly, the housing structure distribution for this group also reflects living patterns that were more prevalent in the past. The elderly in the future may not share the preferences and orientation of the present-day elderly. As a result, the housing structure for single-person households may change.

The incidence of single-family structures increases with household size. For two-person households, multi-family structures continue to play an important role, particularly in the medium and larger-sized urban areas. The percentage share for this type of housing is largest for the areas with a population between 500,000 and 1 million.

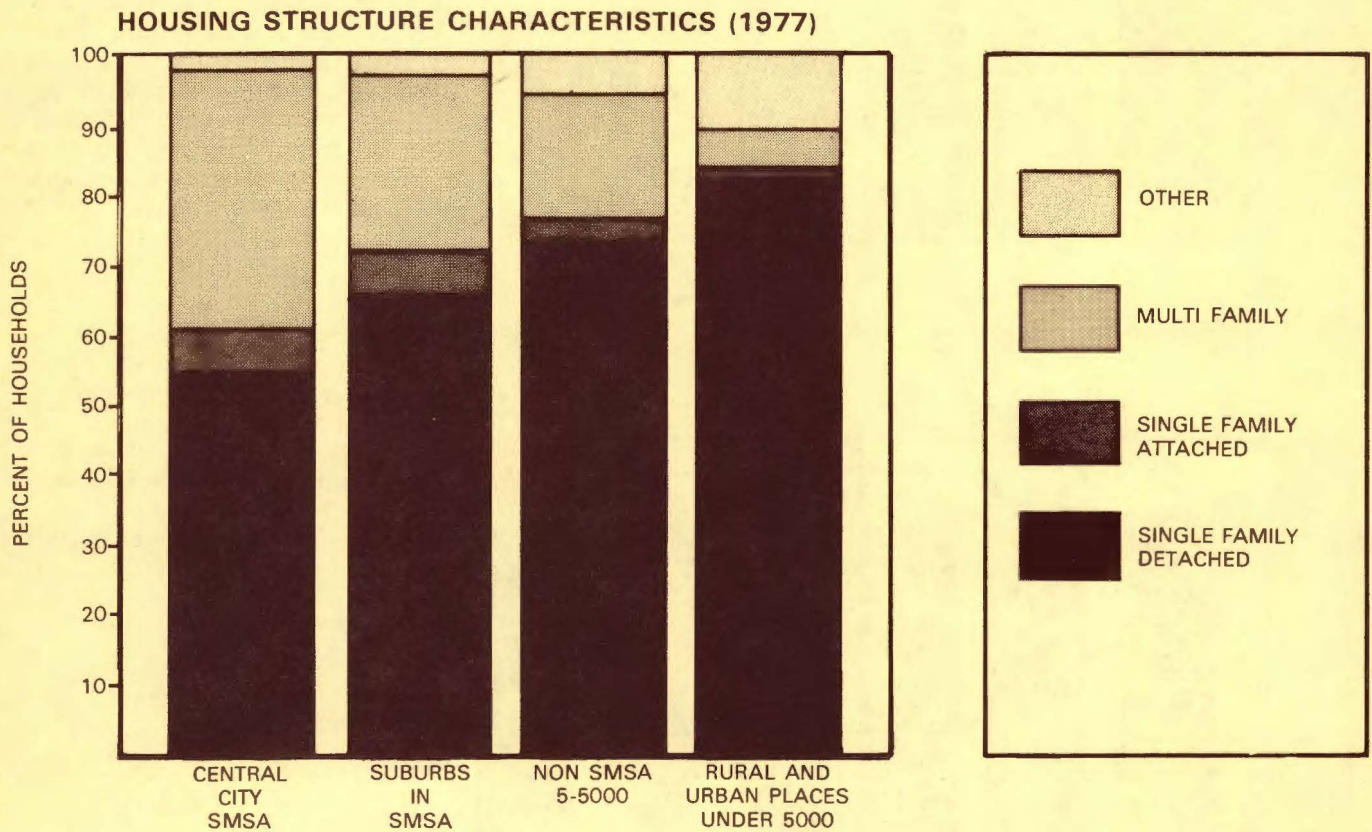
For households with three persons or more, single-family structures account for more than 75 percent in all types of urban areas. The lowest percentage is obtained for the medium-sized cities, with a population between 500,000 and 1 million. With the continued decline in household size an increase in the number of units in multi-family structures may be expected.

Source: 9

HOUSING STRUCTURE CHARACTERISTICS

A special tabulation from the 1977 National Transportation Survey illustrates the increasing importance of single-family structures as we move from the central cities to nonmetropolitan areas. The single-family units are also more likely to be detached buildings. In rural areas, multi-family dwellings account for a smaller percentage than the "other" category, primarily mobile homes.

Overall single-family attached and multi-unit structures are more prevalent in central cities. The increase in demand for this type of housing unit could spur the return to central cities.

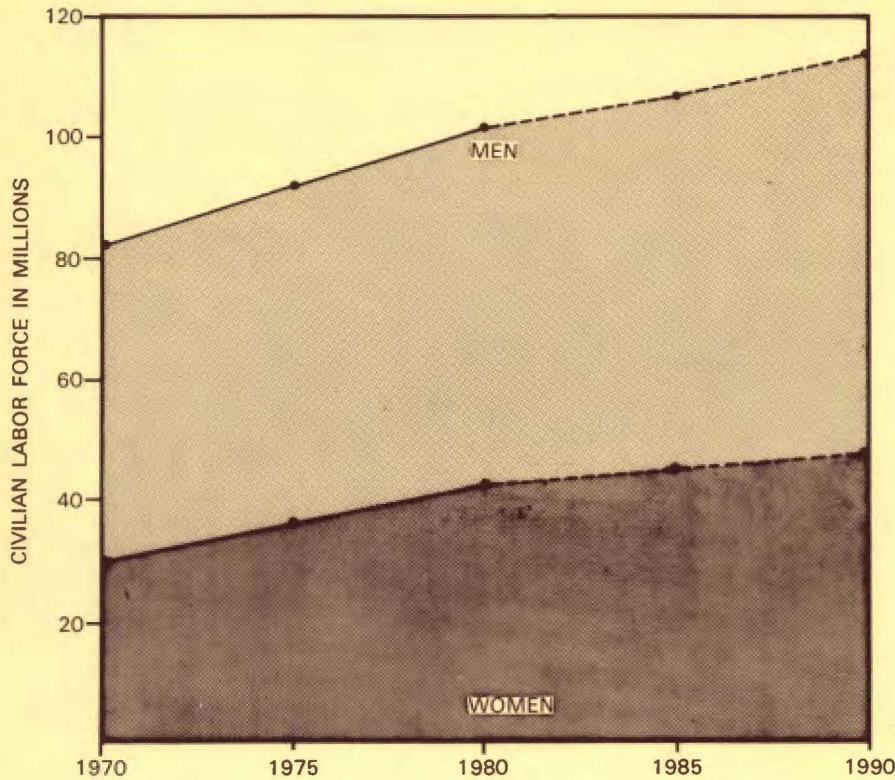


Key to the continued growth of the labor force throughout the last two decades has been the increasing labor force participation by women. This parameter is projected to rise further in the 1980's, resulting in more than half of all women in the labor force in 1990. At that rate, women will account for about 40 percent of the total labor force.

More women in the labor force also produce a greater number of workers who are employed voluntarily on a part-time basis. Together with the spreading acceptance of flextime, this trend is likely to spread peak-hour loads.

The central cities of the largest urban areas have experienced an outflow of jobs; most of these jobs have moved to smaller urban centers rather than the suburbs or nonmetropolitan areas. These developments are closely related to the continuing decentralization of the population. Transportation planning for smaller urban areas has to account for the increasing share in jobs and total work trips through the 1980's.

CIVILIAN LABOR FORCE



Source: 41

LABOR FORCE

The total U.S. labor force is projected to increase from 102 million in 1980 to 114 million in 1990, corresponding to an average annual growth rate of 1.1 percent per year.

The major driving force behind this increase in the total labor force is the growth in the female labor force. Over the period 1970-1980, the male labor force has been growing at an average annual rate of 1.6 percent. Over the same time period, the female labor force has been growing at a rate of 2.8 percent per year. Labor force growth is expected to slow down for both groups during the 1980's — to a rate of 0.8 percent per year for the men and 1.5 percent for the women.

The fast overall growth in the past decade was largely attributable to the entry of the "baby boom" generation. This group no longer plays a role in labor force growth. **Significant growth in the 1980's is primarily due to the increased labor force participation by women.**

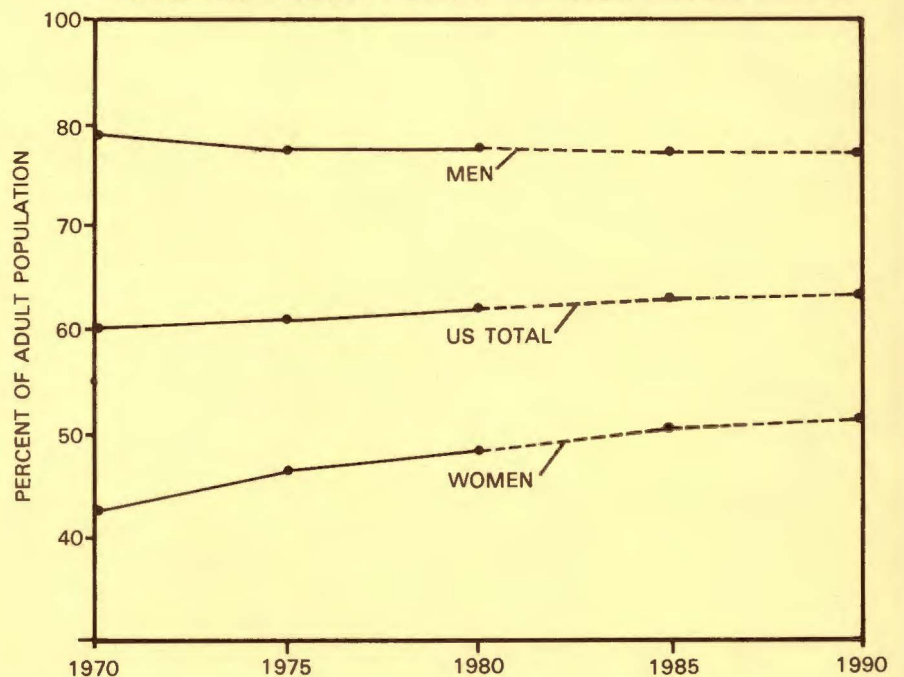
LABOR FORCE PARTICIPATION RATE

The long-term decline in the labor force participation rate of men is expected to taper off in the 1980's. This rate is projected to stay virtually constant.

In contrast, the labor force participation rate for women is projected to continue its recent climb throughout the first half of the 1980's and to level off somewhat during the second half. **By 1990, over 51 percent of all women are expected to be in the labor force, up from 43 percent in 1970.**

The growth of female labor force participation is the result of a series of complex factors. The implications for the social and economic fabric of our society and for changing demands on public services are only partially understood. The addition of another wage earner in existing households and the continued formation of small households as a result of greater economic independence of women require a reassessment of current notions about the travel behavior and transportation needs of households.

CIVILIAN LABOR FORCE PARTICIPATION RATE



Source: 41

LABOR FORCE CHARACTERISTICS

Trends in labor force participation rates shape the composition of the labor force. The percentage share of women is projected to continue to grow throughout the 1980's.

The changing age composition of the labor force is largely an effect of the post-WWII "baby boom" and the subsequent decline in fertility. Members of this generation have swelled the ranks of the middle age groups, reducing the share of the workers at either end of the age spectrum. The share of young persons (24 and under) in the labor force is projected to fall throughout the 1980's as is that of older persons (55 and older).

The growing percentage of women and the growing percentage of prime age workers are the key labor force trends for the 80's.

EMPLOYMENT

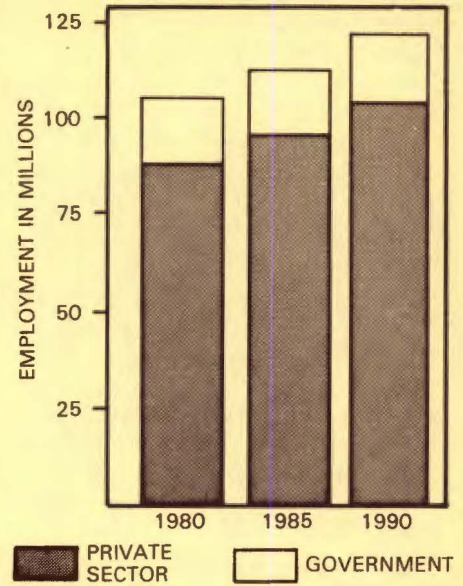
The Bureau of Labor Statistics projects a steady growth in total employment throughout the 1980's -- from 104 million in 1980 to 121 million in 1990. This projection constitutes an increase of 16 percent or 1.5 percent per year, slightly faster than the projected growth of the labor force (1.1 percent per year).

The discrepancy between the two growth rates means that more workers are expected to hold more than one job. This development would be consistent with past trends.

The share of the government sector in total employment is projected to decline somewhat over the next decade, from 16 percent in 1980 to 15 percent in 1990.

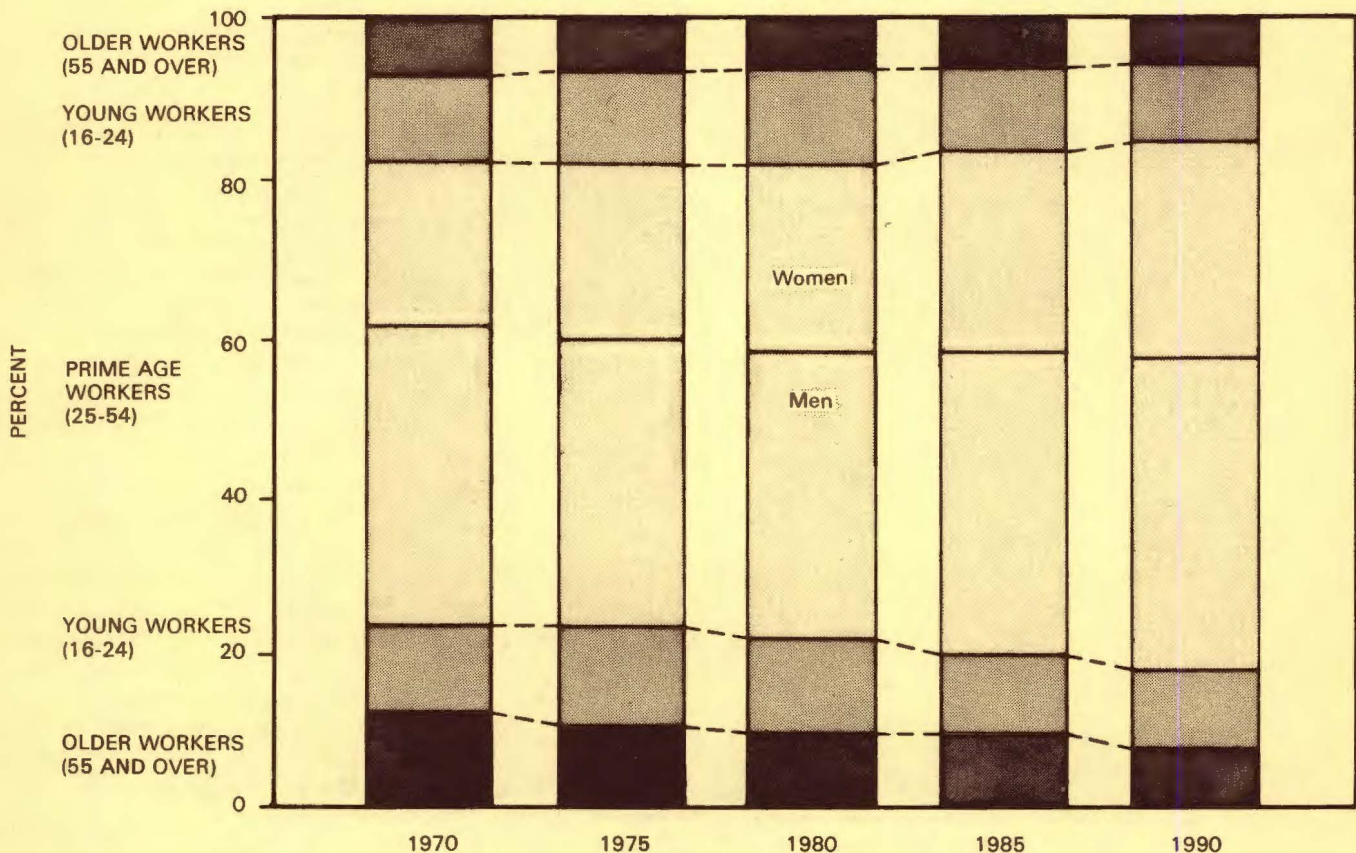
An increase in total employment suggests an increase in peak hour travel.

EMPLOYMENT PROJECTIONS



Source: 3

DISTRIBUTION OF CIVILIAN LABOR FORCE, BY AGE AND SEX



Source: 4

EMPLOYMENT DISTRIBUTION

In 1990, seventy-three percent of the nation's population will live in SMSA's, compared to 64% in 1950. The greatest rural to urban shift occurred in the 1950's, and that trend is continuing, but at a slower rate. SMSA's will have 75% of national employment in 1990, growing in proportion to population from a 67% share in 1950. **The implication of added employment in SMSA's is that the demand for peak hour travel in SMSA's will not abate.**

Per capita income has and will continue to grow steadily, with non-SMSA income rising faster than SMSA income. Non SMSA per capita income will be 76% of SMSA per capita income in 1990, compared to only 62% in 1950.

PART-TIME EMPLOYMENT

Part-time employment has emerged as an increasingly attractive option, particularly for persons who are trying to combine work and taking care of the home. From 1965 to 1977, the number of workers on a voluntary part-time schedule increased from

4.9 million to 7.6 million. **This increase was three times as rapid as that for the labor force as a whole.**

As the chart shows, most of this increase in the number of part-time

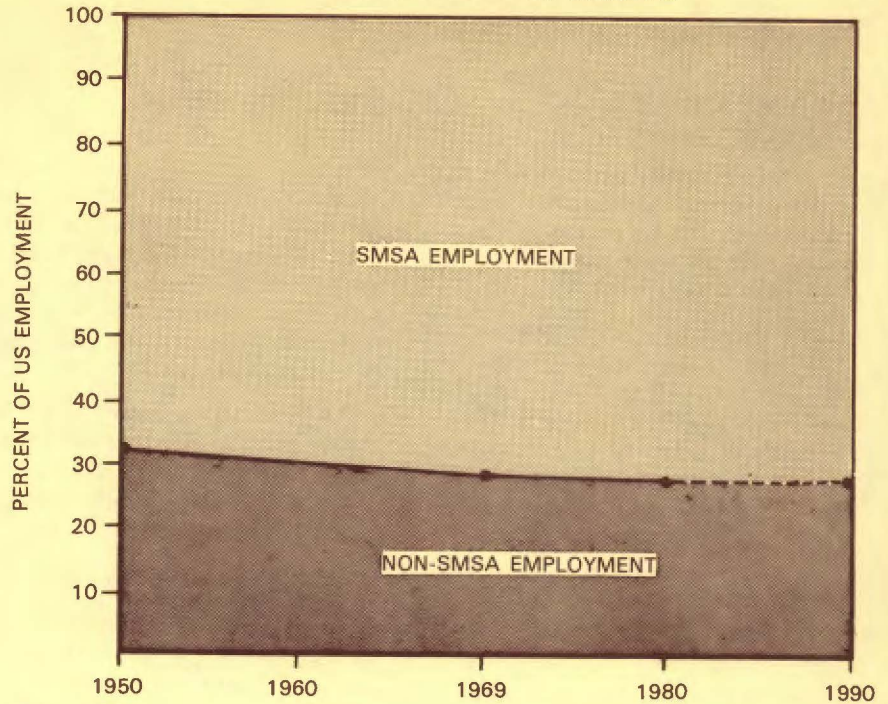
workers was limited to the female labor force. It can be attributed directly to the increase in labor force participation among the group most likely to work part time, married mothers. As a result, many of the female part-time workers are in the prime labor force age groups, while a substantial percentage of male part-time workers tend to be under 22 years of age or over 55.

As work schedules become more flexible, there may be an increase in the number and percentage of part-time workers. At the same time, the decline in fertility may reduce the incentive to sacrifice career prospects to reserving more time for the home. With fewer children, women would seek more full-time employment. Predicting the impact of these divergent trends on transportation needs is speculative.

Metropolitan Employment Trends

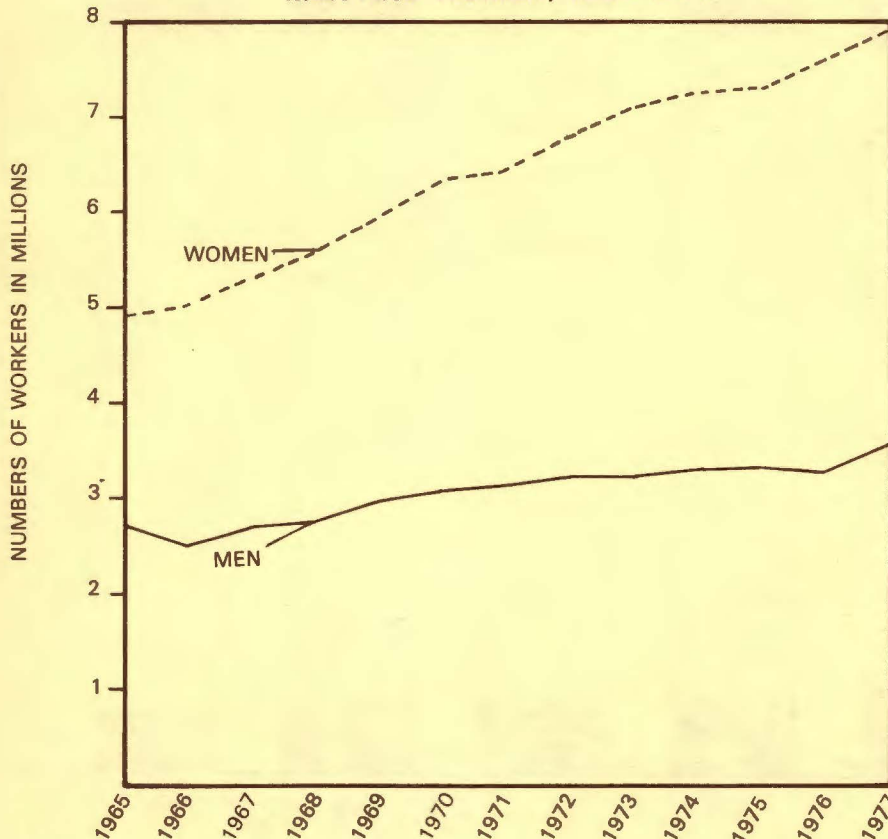
Employment growth patterns for metropolitan and nonmetropolitan areas correspond closely to population growth patterns. Growth has concentrated in metropolitan areas. Current projections foresee a slowdown in total employment growth, with non-SMSA employment maintaining roughly a 25% share of total U.S. employment.

EMPLOYMENT IN SMSA'S



Source: 38

THE GROWTH IN PART TIME EMPLOYMENT FOR MEN AND WOMEN, 1965-1977



Source: 22

WORK FORCE MIGRATION

Information on the geographical shifts in job opportunities is limited. Available data on moves by companies paint only an incomplete picture. An alternative is to examine changes in the location of employment for a sample of workers covered by the Social Security System (the Continuous Work History Sample). The chart shows net job migration figures for the periods 1970-73 and 1973-76; these figures are simply the difference between the number of workers who changed the location of their job to the respective county from outside, and those who changed from the county to other areas.

In both periods, heavily populated areas -- the central counties of metropolitan areas with a population of 2 million or more -- experienced a net outmigration of jobs at a rate of almost 100,000 per year. The situation was different for the smaller central counties. Those with a population of 1 to 2 million people experienced a net immigration of workers

from other areas. Between 1970 and 1973, central counties with a population between 500,000 and 1 million registered substantial job immigration; by 1973-76, this situation had changed to net outmigration.

The primary beneficiary of this change was the category of central counties with a population under 500,000. The net immigration of jobs almost tripled from 1970-73 to 1973-76, to a rate of about 50,000 workers per year.

The remaining two categories, non-central counties in metropolitan areas and nonmetropolitan counties show a net immigration of jobs in both periods. In both cases, total net immigration increased. The relative increase is particularly significant for the non-metropolitan counties.

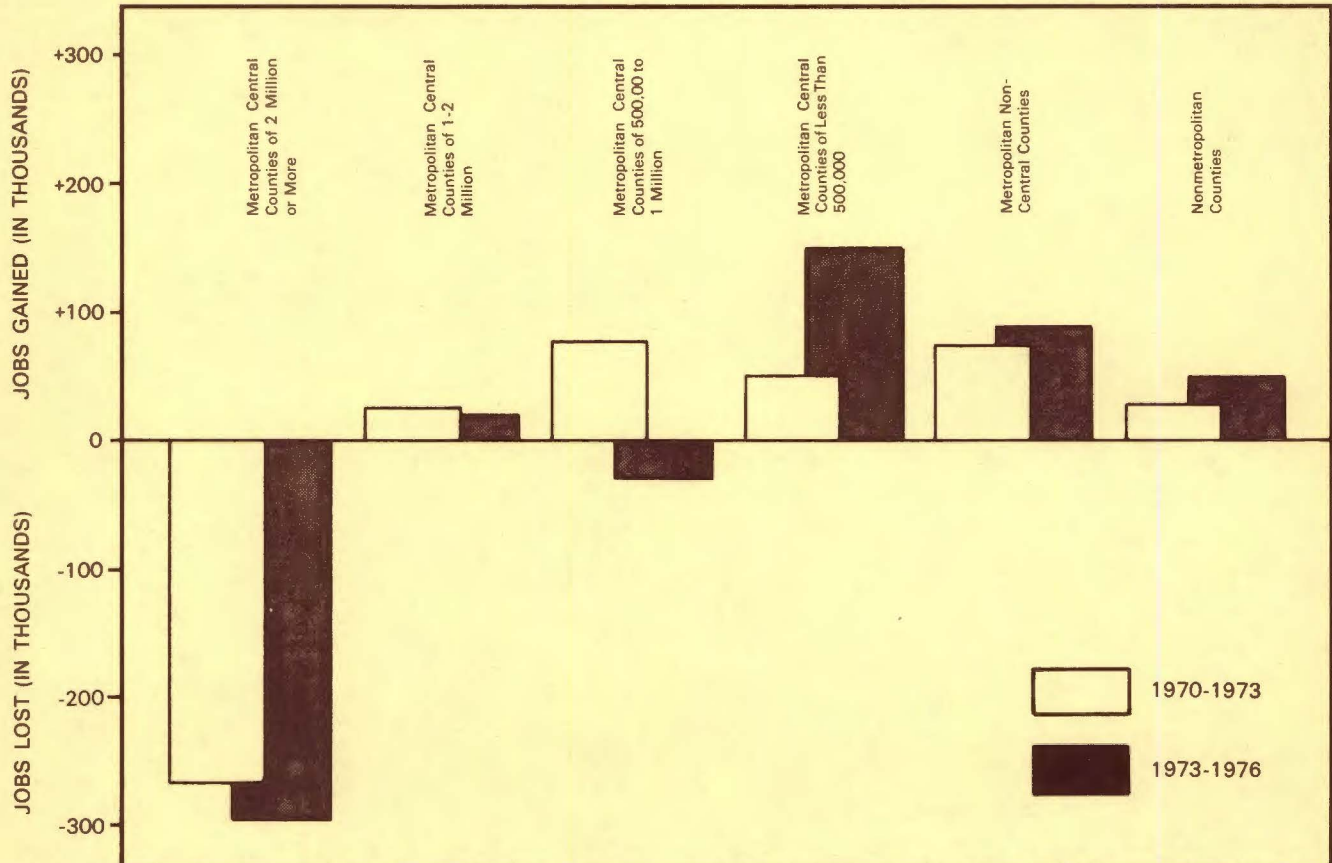
These trends in geographical changes in job location are likely to continue into the 1980's. The dispersal of residential location has been followed by the dispersal of the location of the place of work. Although this

change is gradual (less than 1/2 of 1% of the total labor force) it could begin to affect work travel patterns. The centers of metropolitan areas could continue to lose importance as a destination for the work trip.

As the costs and uncertainty of auto travel increase, employers will face two choices. Work locations may be relocated to suburbs of metropolitan areas or smaller cities. This would reduce work trip length for some employees but reduces the available labor market. Further, public transit is a far less satisfactory mode for travel to work in these locations. Alternately, the employer could choose a central city location, where workers can be drawn from the entire metropolitan area. In a central city, public transit can be used in lieu of autos for the journey to work.

The location choices made by individual employers will have a major impact on travel needs.

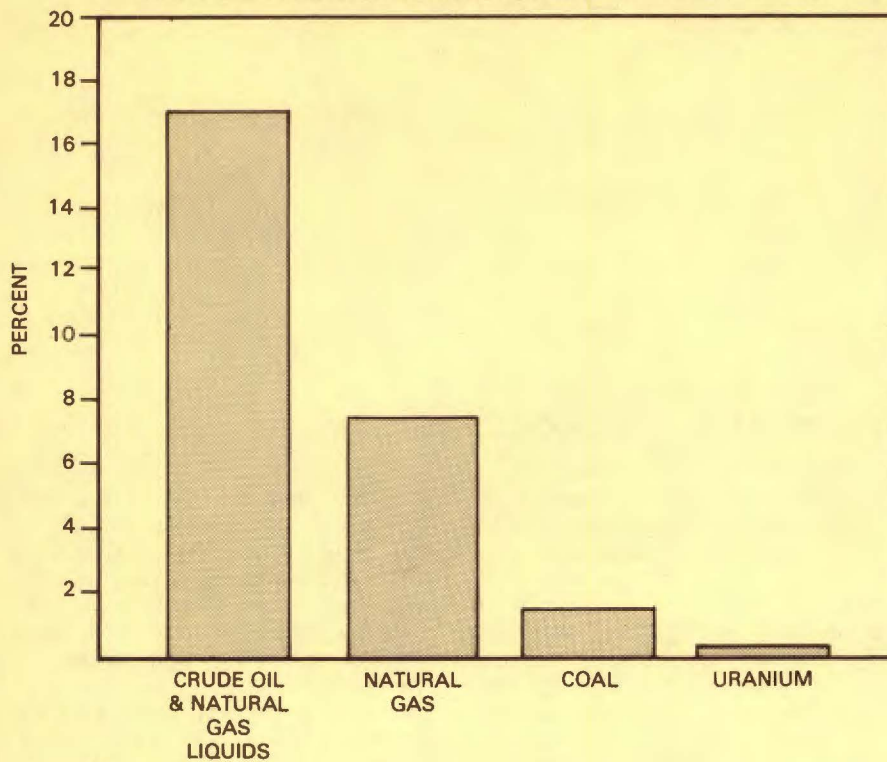
NET JOB MIGRATION 1970-1976



The United States now uses 35% of all non-communist world oil production; one barrel in seven of free world production is burned in the United States as motor fuel. These figures are dramatic, but even more dramatic when one realizes that the United States has doubled its petroleum use between 1960 and 1980 and the remainder of the free world increased petroleum usage 3.5 times. In order to satisfy the demand for petroleum products, both the United States and the free world are producing petroleum at a rate near the peak of the bell-shaped historical production curve. The implication is that production levels will stabilize during the 1980's and begin to drop near the end of the century.

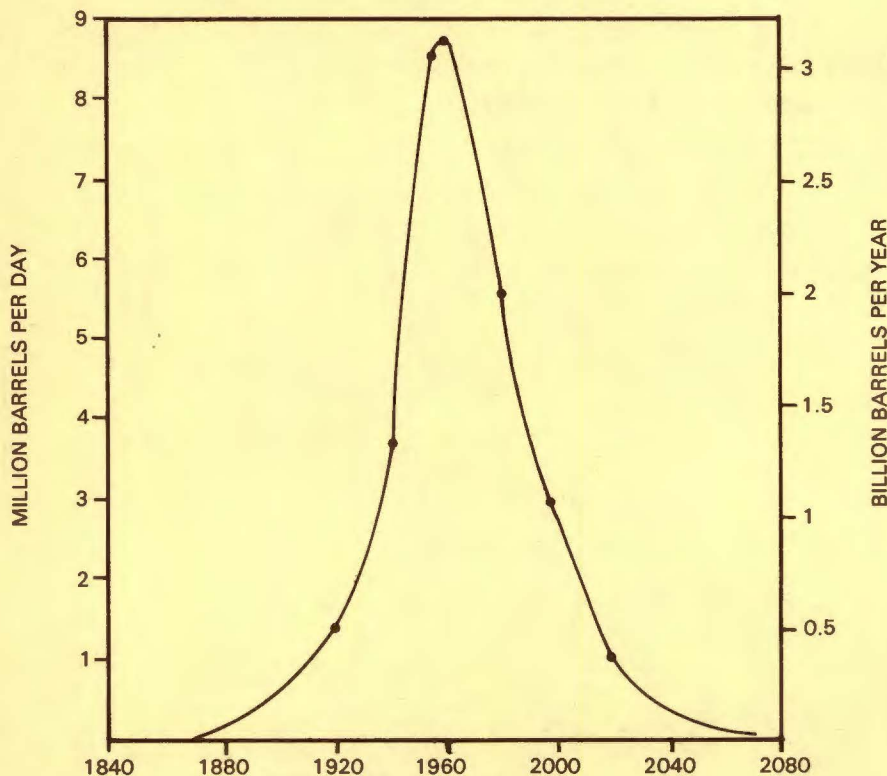
A 1975 estimate indicates that only 17% of the world's estimated recoverable crude oil had been consumed through that time. World energy reserves are far from depleted. At present and forecast consumption levels, however, that resource could be totally consumed within 100 years. From the United States perspective, U.S. petroleum reserves could be largely depleted by 1990 if current consumption continues and imports are not increased. Using the grace period of the 1980's to conserve petroleum and develop alternative energy sources must become a national priority.

PERCENTAGE OF ESTIMATED WORLD TOTAL RECOVERABLE RESOURCES CONSUMED PRIOR TO 1976



Source: 63

ESTIMATED CYCLE OF CRUDE OIL PRODUCTION IN COTERMINOUS UNITED STATES*



*Includes continental shelf but excludes Alaska. This estimate was prepared in 1972, based on total recoverable petroleum reserves of 170 billion barrels.

Source: 65

WORLD ENERGY RESOURCES

Despite the "energy crisis" environment of the late 1970's, the majority of the world's estimated energy reserves have not been tapped. The figure shows that as of 1976 only 17% of the estimated recoverable oil in the world had been consumed, 7.4% of natural gas, 1.2% of coal and 0.3% of uranium. These apparently optimistic estimates must be tempered, however, by the uncertainty in estimating total recoverable resources. The range of uncertainty for oil supply, currently the resource of greatest interest, is on the order of 1.3 trillion (10¹²) barrels. In other words, the uncertainty in estimating recoverable resources is almost four times greater than the cumulative world production of oil up to 1976. The percentages reported here assume a middle range value of recoverable resources.

Although the evidence suggests a substantial world energy reserve, the rate of world use is increasing as advanced technology becomes more prevalent around the globe. In this increasingly energy-competitive world, the key issue for the 80's from the U.S. perspective is not world resource depletion but the location of energy supplies, the price that must be paid to obtain them, and the political realities of the world situation.

U.S. PETROLEUM PRODUCTION

The chart shows a theoretical production curve for United States petroleum, based on historical production and estimated total recoverable petroleum resources of 170 billion barrels. Historical variations in production have been smoothed for presentation. Production declines have been estimated based on a reduced rate of discoveries per foot of exploratory drilling.

The implication of this chart is that petroleum production in the coterminous United States and continental shelf is at or near maximum and could be expected to fall off during the late 1980's. Total U.S. production will actually increase slightly during the next 10 years, however, as Alaskan oil continues to come into production.

Alaskan crude oil and natural gas liquids are estimated at 48 billion barrels, about 20% of the theoretical total for the coterminous United States and Alaska.

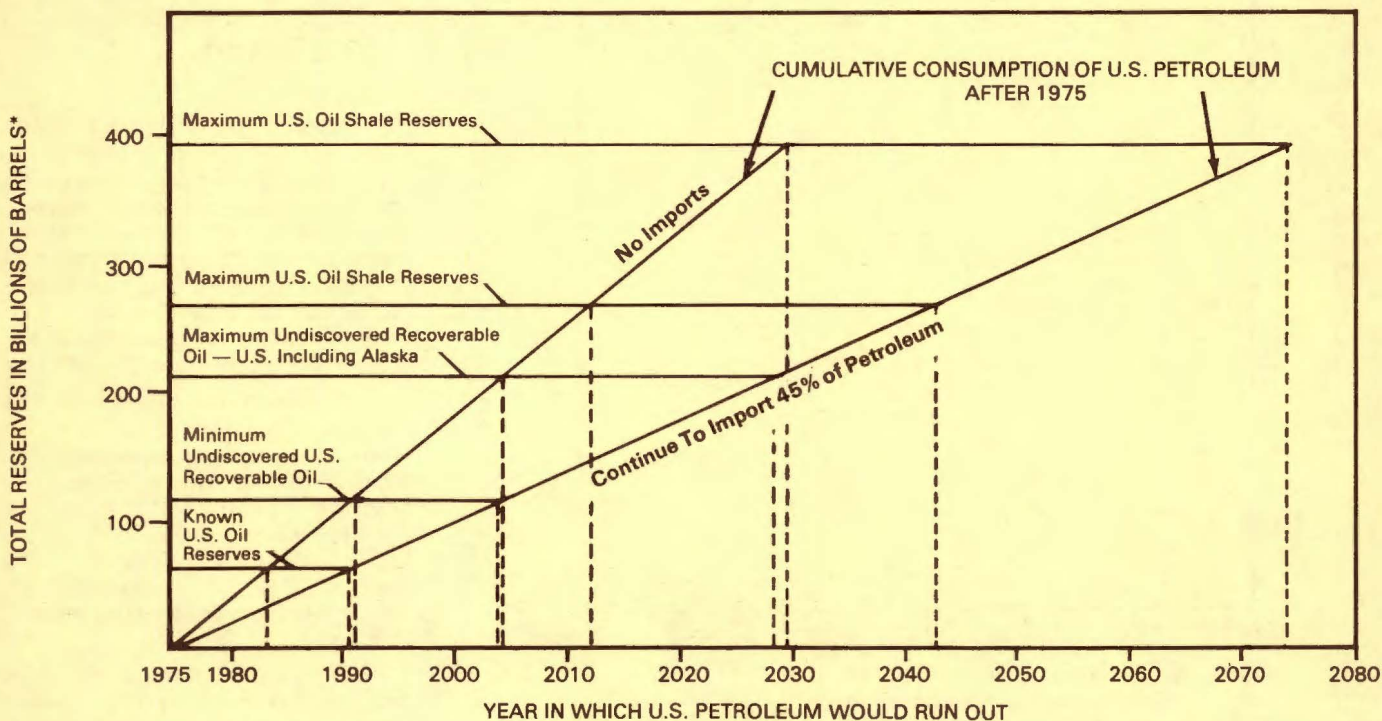
UNITED STATES PETROLEUM DEPLETION

This chart shows estimates of how long domestic petroleum fuel reserves will last under varying assumptions. On the supply side, cumulative estimates of known reserves, estimated undiscovered oil reserves and oil shale are shown. High and low values of undiscovered reserves are shown to lend perspective to the range of uncertainty involved in these estimates. On the demand side, two scenarios are shown, assuming U.S. consumption remains at the level forecast for the 1985 to 1990 period. This is the period in which consumption is forecast to stabilize at 19.6 million bbls per day

(7.2 billion bbls per year) as conservation and motor fuel economy measures take hold. One scenario shows no foreign oil imports at all, and the second scenario shows a continuation of the current percentage of oil imports.

If the United States were to cease importing oil today and continue at present consumption levels, known domestic reserves would be depleted by 1984. At current import levels, known U.S. reserves would be depleted by 1990. Even given a range of uncertainty in these estimates, the need to develop alternate fuel sources is clear.

UNITED STATES PETROLEUM DEPLETION AT 1985-1990 CONSUMPTION RATES



*The levels of U.S. petroleum supply shown are cumulative.

Source: 46, 64, 65

WORLD OIL DEPLETION

The historical production curve for world oil increased sharply after 1960. Between 1960 and 1980 the United States nearly doubled annual consumption, from 3.5 to 6.7 billion barrels. During the same period, the rest of the non-communist world increased annual consumption from 3.4 billion barrels to 11.7 billion barrels; a 3.5-fold increase in annual consumption. These rapid increases result in a steep production curve as shown in the figure.

Forecasts of future production vary, but are likely to follow a path similar to the shaded area in the figure. The price of oil will be directly affected by the degree of restraint shown in world consumption and, therefore, in world production. The United States certainly feels the economic pinch, and developing nations may simply not be able to afford continued oil imports at 1978 levels.

It is revealing to note that even if

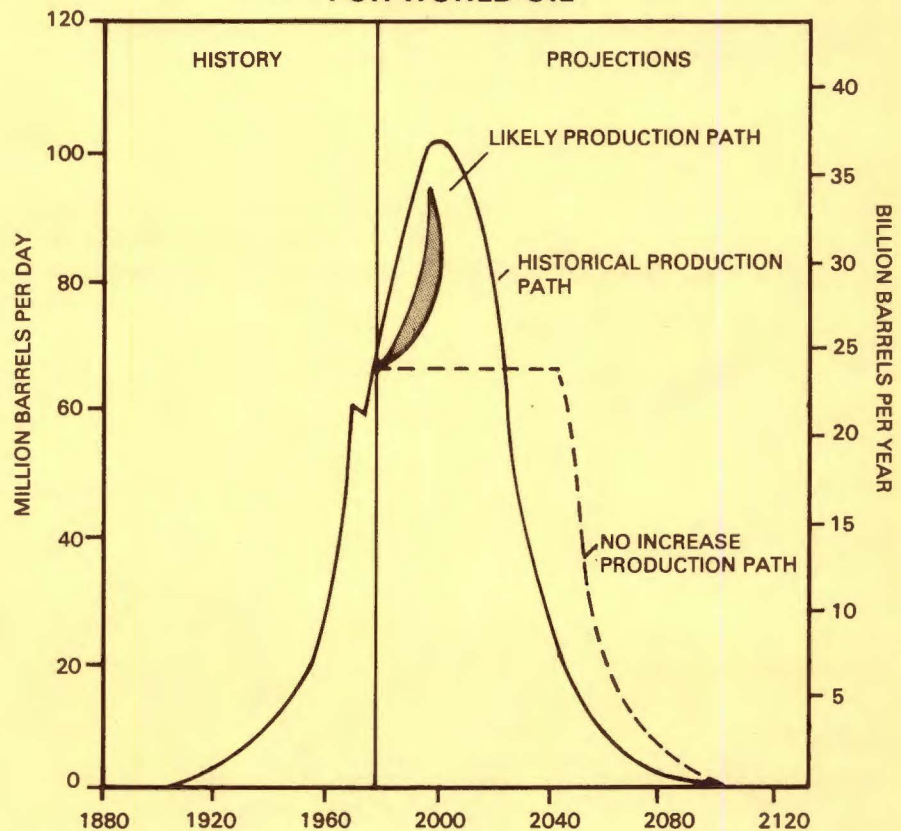
production were to stabilize at the 1978 level, the supply would not last significantly longer. The "no increase" production path is a continuation of the current level of production until depletion effects cause production to fall. To significantly extend world reserves, production would have to drop back to something like the 1960 level. This would mean that the U.S. would have to cut petroleum use in half and the rest of the world would have to reduce by a factor of six.

Pursuing this thought, it is unlikely that such a disproportionate reduction would occur. If world consumption did return to 1960 levels, but the U.S. maintained its current 35% share of annual world production instead of the 50% share it enjoyed in 1960, U.S. consumption would have to drop to 2.4 billion barrels per year. This would be a return to 1950 U.S. consumption levels. In 1950, the U.S. used about one-third as much petroleum as it

does today. The impact of such a reduction on the U.S. standard of living given the population increases since 1950 would be dramatic. **One must conclude from this chart that holding world oil consumption at current levels or modestly reducing it will not have a major impact on extending the life of the world oil supply.**

A caveat on this statement, of course, is the uncertainty in estimating recoverable oil resources. This chart is based on a middle range estimate. A second caveat is the price of oil. This chart was based on \$20 per barrel in 1976 dollars. The price is now about \$30 per barrel. A very rapid price increase should accelerate conversion to other known fuel resources which are in substantial reserve in both the U.S. and the world, thereby extending the life of the petroleum supply.

POSSIBLE PRODUCTION PATHS FOR WORLD OIL*



*Based on a mid-range estimate of recoverable crude oil and natural gas liquids — 2.1 trillion barrels — and a price per barrel of \$20 (1976 \$).

PETROLEUM AND MOTOR FUEL

In the period from 1960 through 1975 the use of motor fuel increased at about 5% per year — slightly faster than vehicular travel. Although it is projected that automobile travel in the United States will increase by at least 20% between 1980 and 1990, motor fuel use is expected to remain roughly constant. This is a result of the increase in automobile fuel economy.

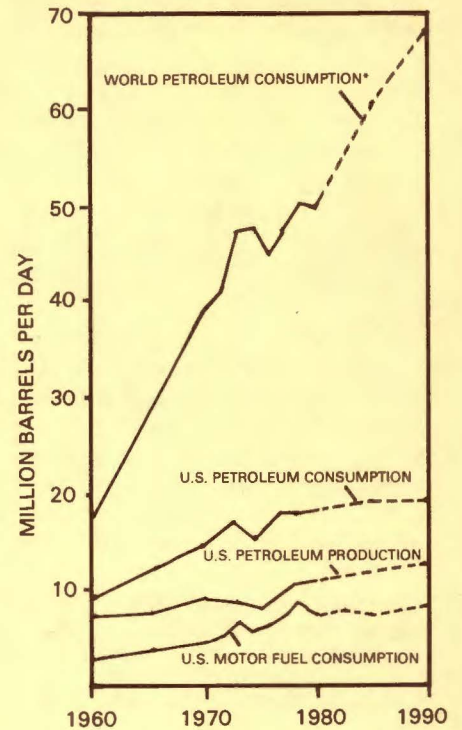
This leveling-off in motor fuel demand will be a major achievement. Nonetheless, U.S. motor fuel use will continue to consume a substantial proportion of world supply. As shown in the figure, daily free-world petroleum consumption and production are forecast to increase steadily through the 80's at a rate of 2.5% per year, reaching 68.4 million bbls. per day in 1990. This equates to about 25 billion bbls per year in 1990 compared to 19.4 billion bbls. per year in 1980. During the same period U.S. production is forecast to increase at 0.8% per year and total U.S. consumption at 0.6% per year.

Motor fuel demand now represents 42% of total U.S. consumption and 14.7% of total free world consumption.

Adjusting for net free world imports, constant demand for motor fuel in the 80's implies that roughly 1 in 7 barrels of petroleum produced in the non-communist world in 1980 will be used in vehicles in the United States, declining to 1 in 9 by 1990. At \$30 per barrel, over \$80 Billion will be spent on motor fuel each year during the 80's.

In general, the United States will use a decreasing proportion of the world's oil supply each year, because non-communist world consumption is increasing three times faster on an annual basis than is U.S. consumption. The gap between U.S. production and U.S. consumption as a percent of free world consumption had been steadily widening until 1975. This gap should begin closing during the 80's, reflecting increased U.S. production and the impact of conservation measures. Imports of petroleum by the United States should stabilize during the 1980's. The improving fuel economy of the nation's auto fleet will permit an increase in travel without a significant increase in motor fuel use. U.S. motor fuel consumption will decline as a percent of non-communist world productions and remain stable at 70% of U.S. production.

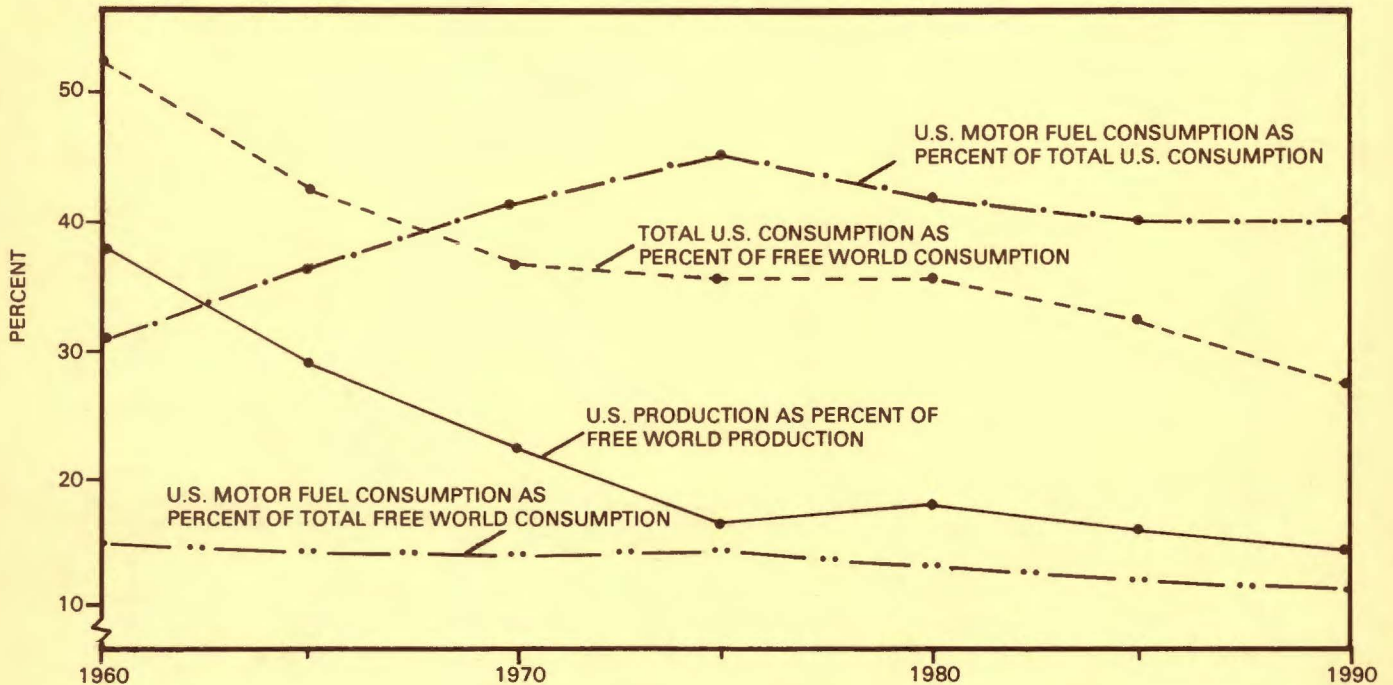
PETROLEUM PRODUCTION AND CONSUMPTION



*Consumption is equal to Total Free World Production plus net imports from Communist countries. Net imports were about 4% of consumption in 1978.

Source: 2, 7, 18, 63, 64, 65

U.S. PETROLEUM CONSUMPTION AND PRODUCTION IN RELATION TO THE FREE WORLD



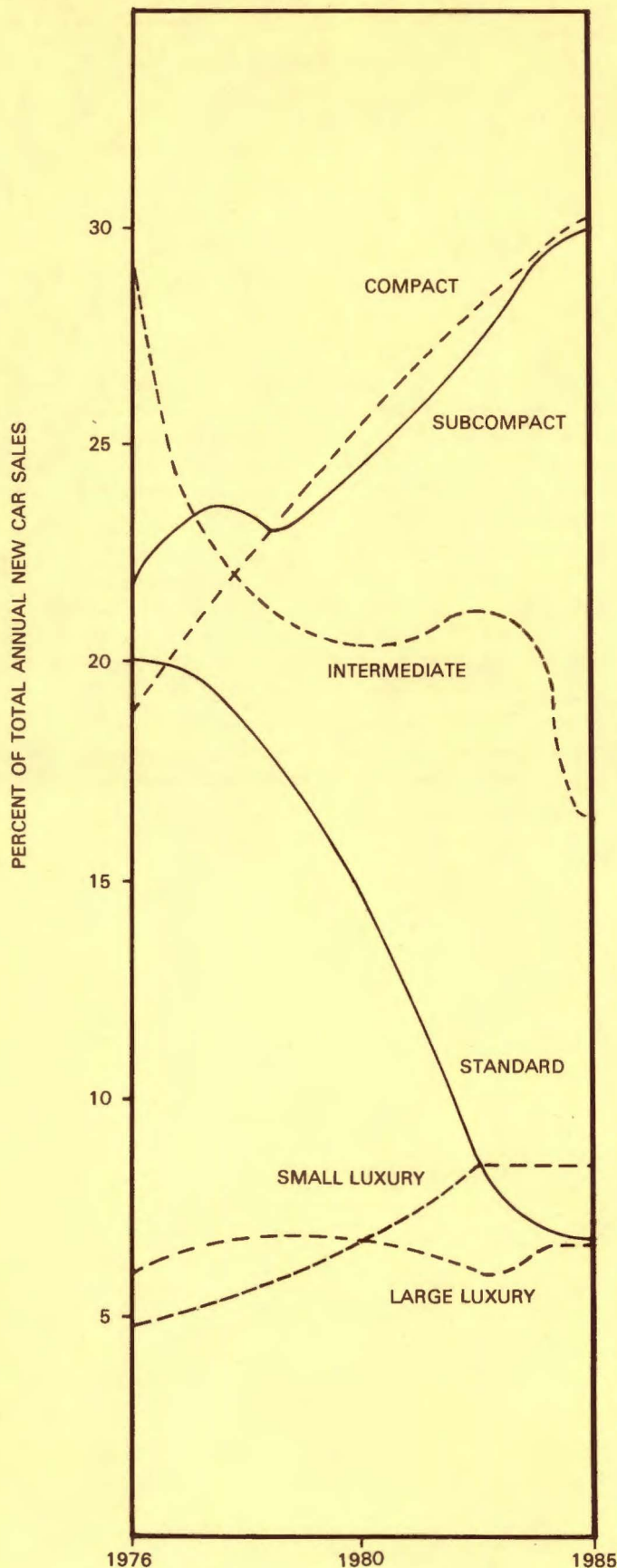
Source: 2, 7, 18, 63, 64, 65

New car sales in the 80's will reflect a sharp adjustment in the nation's auto buying habits, responding to increases in fuel costs. Smaller cars will become the norm. The trend to smaller cars began in the 1970's, however. In 1976 compact and subcompact autos held about 40% of the new car market. By 1985 these two groups are projected to capture 60% of new car sales, at the expense of intermediate and standard size autos.

The energy impact of this shift plus the mandated improvement in fuel economy for all new cars will be a stabilization of petroleum use, despite the fact that there will be 22 million more cars in 1990 than in 1980, 20 million more drivers, and tripmaking will be up 20%. Motor fuel demand should stabilize at roughly 122 billion gallons per year, and diesel fuel will increase to 33% of motor fuel consumption.

Auto emissions will be greatly reduced in the three primary categories — carbon monoxide, hydrocarbons, and oxides of nitrogen. This again, reflects reduced fuel consumption per automobile and technological improvements to engines.

DISTRIBUTIONS OF NEW CAR SALES BY SIZE-CLASS



Source: 18

NEW CAR SALES

The most significant change in automobile sales during the 1980's will be the increasing dominance of the compact and subcompact car. By the latter part of the decade they will compose 69% of new car sales, as opposed to 46% in 1976. This shift in consumer preference is largely a reaction to increasing fuel costs, encouraging the purchase of more fuel-efficient small cars.

The victim of the trend toward smaller cars is the standard family car. Sales of standard cars will fall from 20% to about 8% of new car production by 1985. Intermediate size cars suffer a similar drop, but still retain about an 18% share of new car sales.

The net result of this trend to smaller cars as well as industry efforts to increase fuel efficiency of all new cars will be a gradual improvement in the overall fuel efficiency of the nation's auto fleet.

While the fleet fuel efficiency improves, however, the total number of automobiles will also increase, from 95 million in 1975 to about 128 million in 1990. The impact of a smaller, more fuel-efficient auto fleet is that current driving habits can continue, because greater auto fuel economy partially offsets the household budgetary burden caused by rapidly increasing fuel costs. These economies permit continued growth in automobile usage.

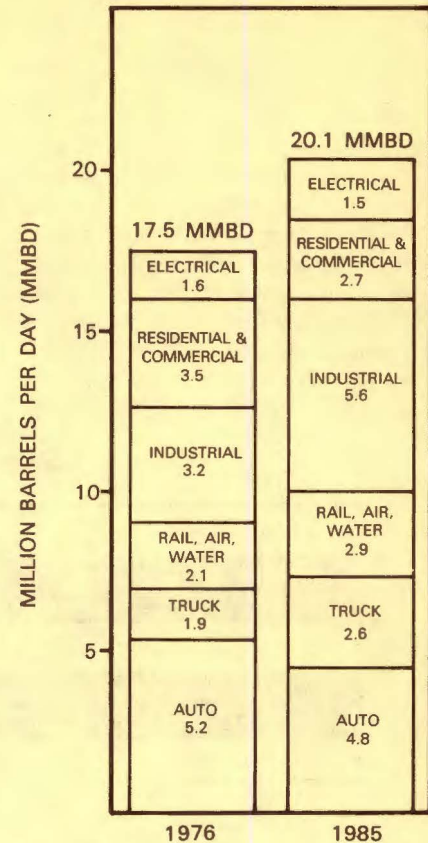
TRUCKS

A popular trend that is not reflected in automobile sales is the increase in personal use of trucks. Total single unit truck registrations increased by 8 million between 1972 and 1979, totaling 28.3 million in 1977. Approximately 40% or 11.3 million trucks are registered for personal, non-commercial use. There is also evidence the people are purchasing trucks for special uses and that they are not used in the same driving cycle as automobiles. While truck registrations increased 40% (8 million registrations) between 1972 and 1977, truck VMT only increased 25%. This indicates that new purchasers of trucks are not driving them as much, perhaps due to the poorer fuel economy of trucks.

PETROLEUM DEMAND

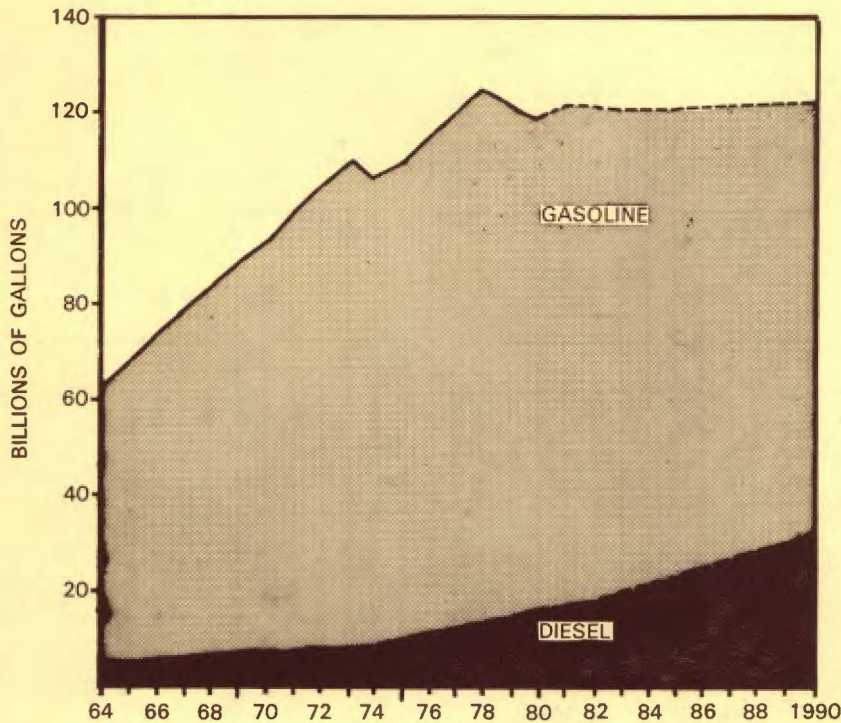
The demand for petroleum as a fuel for cars and trucks is shown to increase from 7.1 to 7.4 million barrels per day between 1976 and 1985, but automobile petroleum usage declines roughly 8% during the same period. This forecast reflects the trend toward smaller, fuel efficient automobiles that began in the latter half of the 1970s, and assumes that new cars will attain a fleet average of 27.5 miles per gallon by 1985. The evidence indicates that gains in automotive fuel economy will offset the growth in automobiles during the next decade, such that net automotive use of petroleum during the 80's will not increase substantially. It should be noted, however, that the approximate doubling in fuel efficiency that will occur in the 1980's probably cannot be redoubled in the 1990's, and all evidence indicates that both the number of autos and auto use will continue to grow. The real impact of gasoline shortages may be felt in the 1990's, rather than in the 80's.

U.S. PETROLEUM DEMAND



Source: 18

MOTOR FUEL DEMAND - CARS AND TRUCKS 1964 - 1990



Source: 2, 7, 15, 16

MOTOR FUEL DEMAND

Despite growth in the number of automobiles during the 80's, motor fuel consumption is forecast to be essentially constant at the level of the late 1970's. Total consumption is expected to increase only slightly more than 1% between 1977 and 1990, even though there will be 33 million more cars on the road. The combined consumption of gasoline and diesel fuel will fluctuate over the period between 120.8 and 122.2 billion gallons.

A trend that began in the 1970's and will continue into the 80's is the increasing use of diesel fuel for passenger cars and small trucks. Diesel fuel accounted for 9% of all motor fuel consumption in 1977 and is forecast to account for 27% by 1990. Fully 15% of new cars and light trucks are expected to have diesel engines by 1990, up from 1% in 1978. The trend to diesel engines is a corollary to the small car trend. Both reflect increasing consumer preference for more fuel efficient vehicles.

EMISSIONS

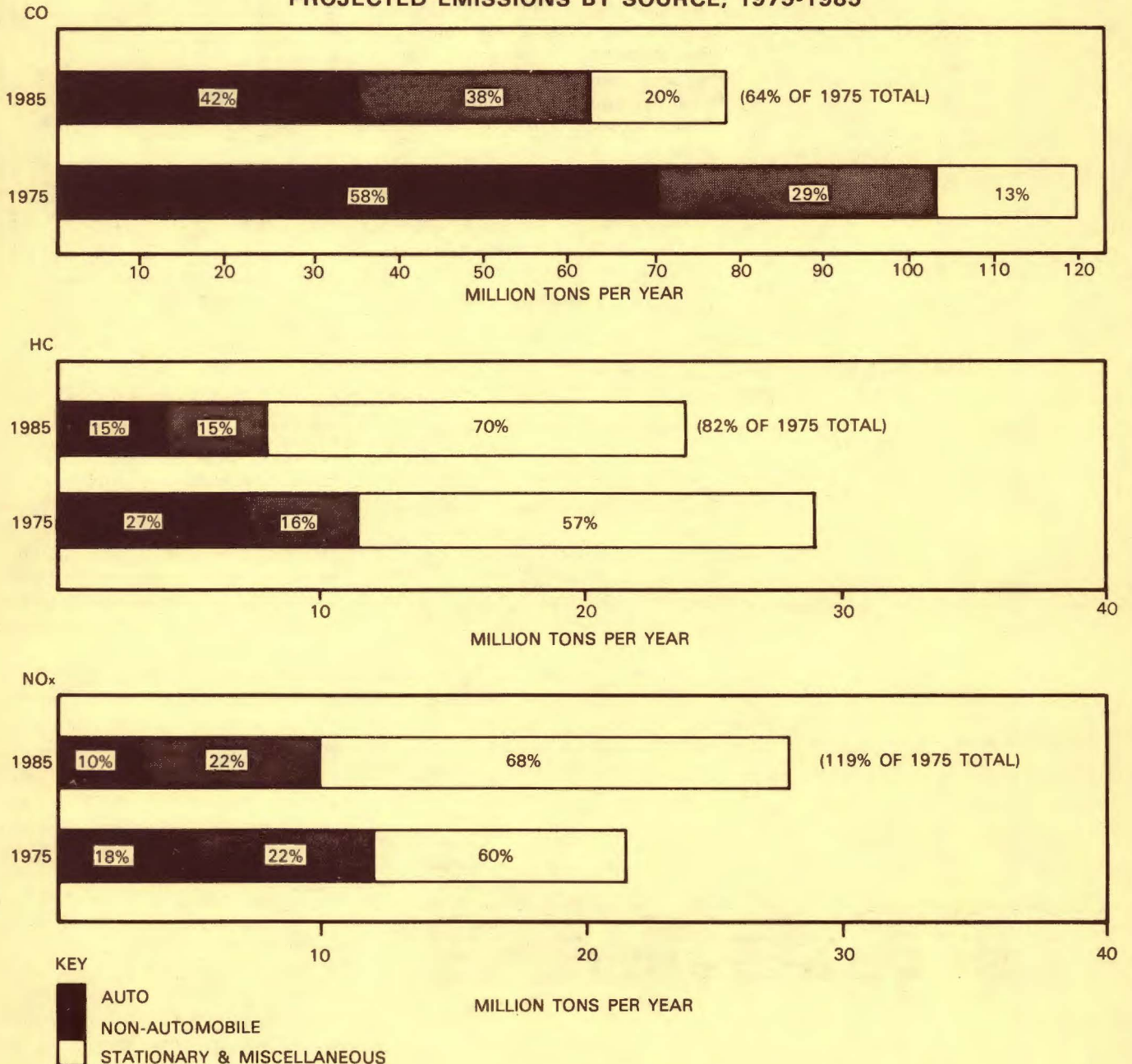
The emissions picture for the 80's shows reduced quantities of carbon monoxide (CO) and hydrocarbons (HC) being released into the atmosphere, but a steady increase in the release of oxides of nitrogen (NOx). In all categories, however, the automobile will be producing fewer emissions in 1985 than at present. Carbon monoxide emissions from automobiles is expected to drop from 70 million tons per year to 35 million tons, a reduction of 50%. Similarly, hydro-

carbon emissions from automobiles will decrease from 8 to 4 million tons per year, constituting only 15% of total HC emissions in 1985. Oxides of nitrogen released from automobiles will drop by roughly one million tons per year.

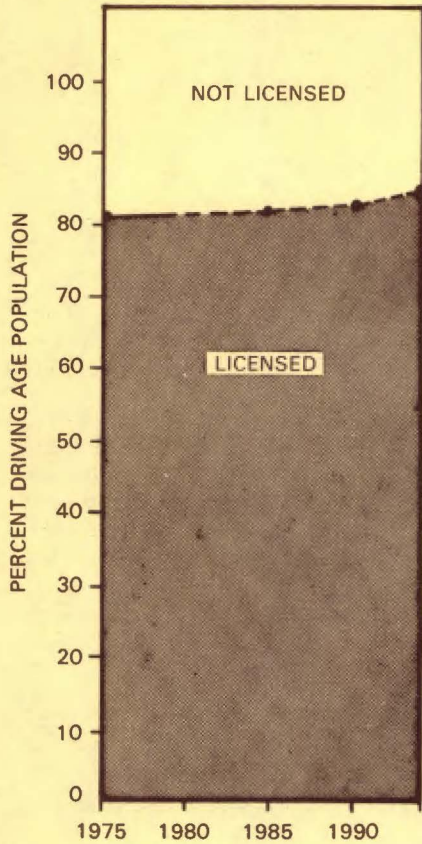
These dramatic drops in net emission of pollutants from automobiles are forecast to occur despite increasing numbers of automobiles and increasing vehicle miles of travel. These improvements in automobile

emissions can be attributed both to more stringent emissions control regulations for new cars and to improvements in fuel economy. **The 80's will be a decade in which we reap the environmental benefits of technical improvements in automobile design.** It is unlikely, however, that further modifying existing automobile technology can repeat improvements of this magnitude in later decades.

PROJECTED EMISSIONS BY SOURCE, 1975-1985



LICENSED DRIVERS



Source: 18

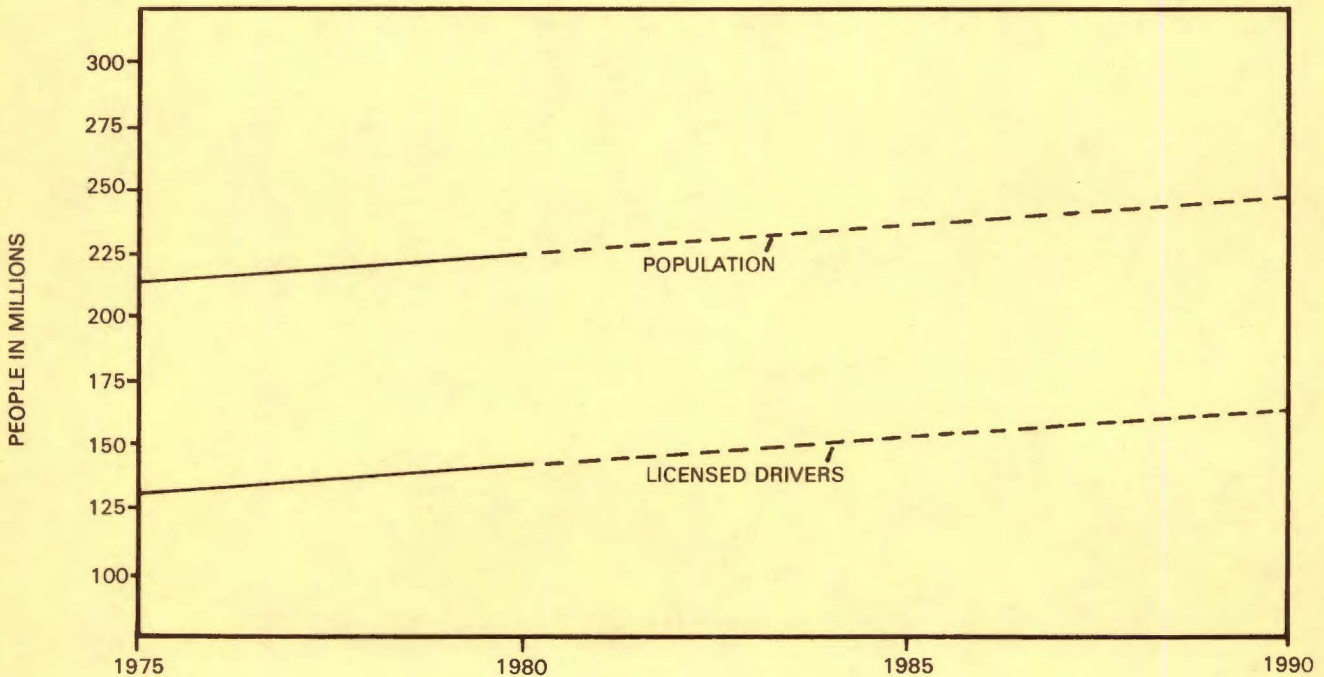
LICENSED DRIVERS

While the 80's will see improvements in automotive technology that support national air quality and energy goals, increased demand for auto travel will be a countervailing force. Increased demand will be, in part, a function of population growth.

Population will increase by 28 million between 1975 and 1990, as will the driving age population. The percentage of the driving age population that is licensed to drive will increase from 81% to 85% by 1990. This increase can primarily be attributed to women. In 1990, 79% of the female driving age population will have a drivers license, as opposed to only 71% in 1975. For men, the rate is forecast to fall slightly from 92% to 91% of the driving age population.

The result of these trends will be a net increase of 30 million licensed drivers by 1990. This is a 23% increase over 1975, due to the fact that the driving age population is increasing faster than the population as a whole and that a greater number of persons in the driving age bracket are obtaining licenses.

POPULATION AND LICENSED DRIVERS



Source: 18

The proportion of personal consumption expenditure devoted to transportation remained remarkably constant between 1950 and 1975. The cost per mile of travel in real terms fell dramatically through most of this period, while miles travelled increased at an equivalent rate.

During the eighties the real price of gasoline is expected to increase at a rate substantially faster than the Consumer Price Index. During this same period, however, the overall efficiency of the automobile fleet is projected to improve at an even faster rate so that the average cost per mile of auto travel will be stable. By switch to smaller, more efficient vehicles Americans, on average, will be able to travel much as they do today without significant increases in their transportation budgets. Individual households — lower income groups and those who have already switched to smaller cars — will face rapidly increasing costs and limitations on mobility.

Households living in areas served by public transit — in both small and large metropolitan areas — are able to satisfy their travel needs with gasoline expenditures 75% of households without transit service. Those households with transit available will be better able to adapt to the transportation cost changes of the 80's.

REAL COST OF GASOLINE

In the absence of any new crises such as those in Iran total petroleum production during the 1980's is projected to increase from about 50 million barrels per day. The gap between world production and demand is projected to be small--about 200,000 barrels per day in 1980 but to rise steadily through the decade. Sporadic restriction of supply should also be expected during the 80's.

With demand exceeding supply the price of a barrel of oil will continue to increase reaching almost \$70 per barrel by 1990. The price differential between domestic and imported crude

will be eliminated by 1982.

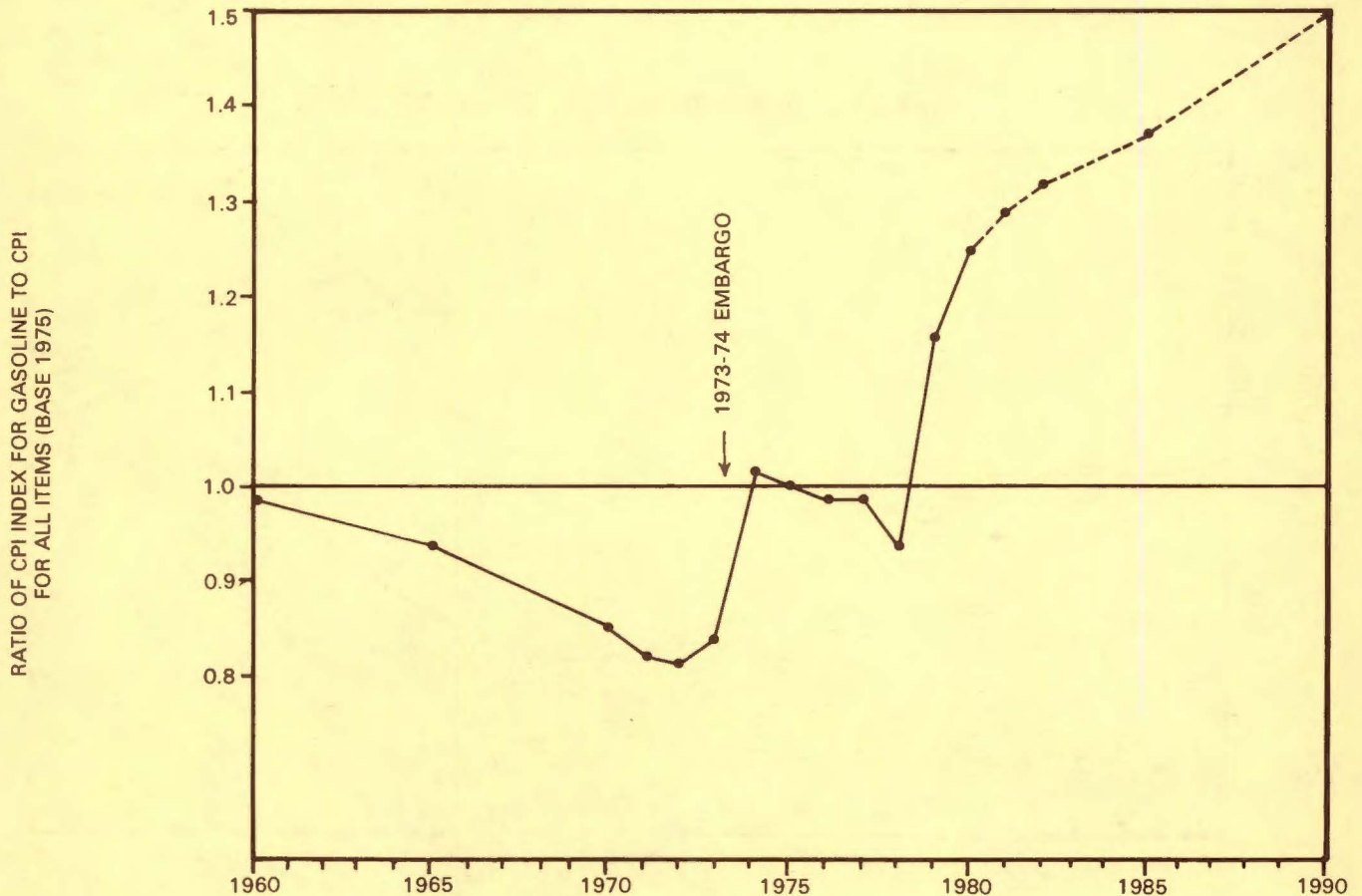
The increase in petroleum prices, however, is expected to be accompanied by continued inflation. In the early fall of 1979 it was projected that the 1990 barrel price, in 1979 dollars would be on the order of \$32. Subsequent events suggest that this projection might be low.

As shown below the cost of gasoline relative to all items declined significantly between 1960 and 1973. During the 1973-74 embargo the cost rose sharply but then once again declined slowly in real terms until the

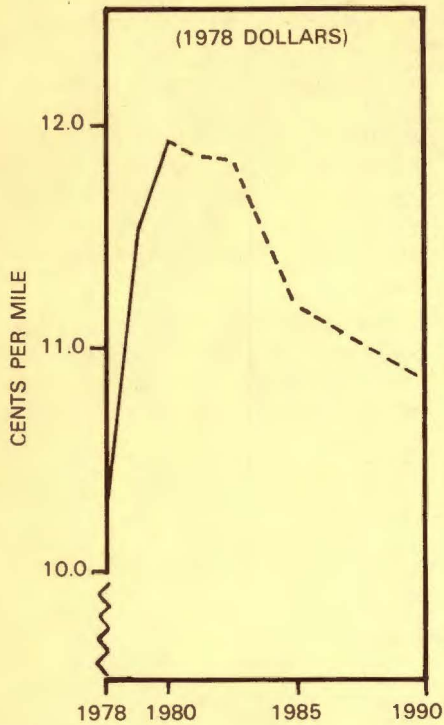
sharp price increases of 1979. Due to the continued increase in the real price of crude oil the price of gasoline relative to all items is expected to continue its real increase through the eighties although the rate of increase will slow in the later half of the decade. By 1990 the real cost of gasoline is projected to be approximately one-and-a-half times the 1979 cost.

This forecast indicates that trends to smaller cars will continue in an effort to maintain existing life style in the face of rising fuel costs.

PRICE OF GASOLINE RELATIVE TO ALL ITEMS



AUTOMOBILE OPERATING COSTS PER MILE



COST OF AUTO OPERATION

The cost to a household of automobile operation depends on both the cost of gasoline and the fuel economy of the vehicles available. The fuel efficiency of the U.S. automobile fleet declined from about 14.5 mpg. in 1960 to a low of about 13.5 mpg. in 1975. Mandated improvements in the fuel efficiency of new cars have begun to increase fleet average efficiency. By 1980 the efficiencies of the early 60's will be surpassed. The continued increase in new car efficiency coupled with the retirement of older vehicles will result in fleet efficiencies of 19 mpg. by 1985 and almost 23 mpg. by 1990.

It is projected that the rate of increase in fleet efficiency will be greater than the rate of increase in the real price of gasoline for the 1980's. Although the real cost of gasoline may rise more rapidly than shown in these projections, increases in fleet efficiency would compensate for price increases of 4% per year.

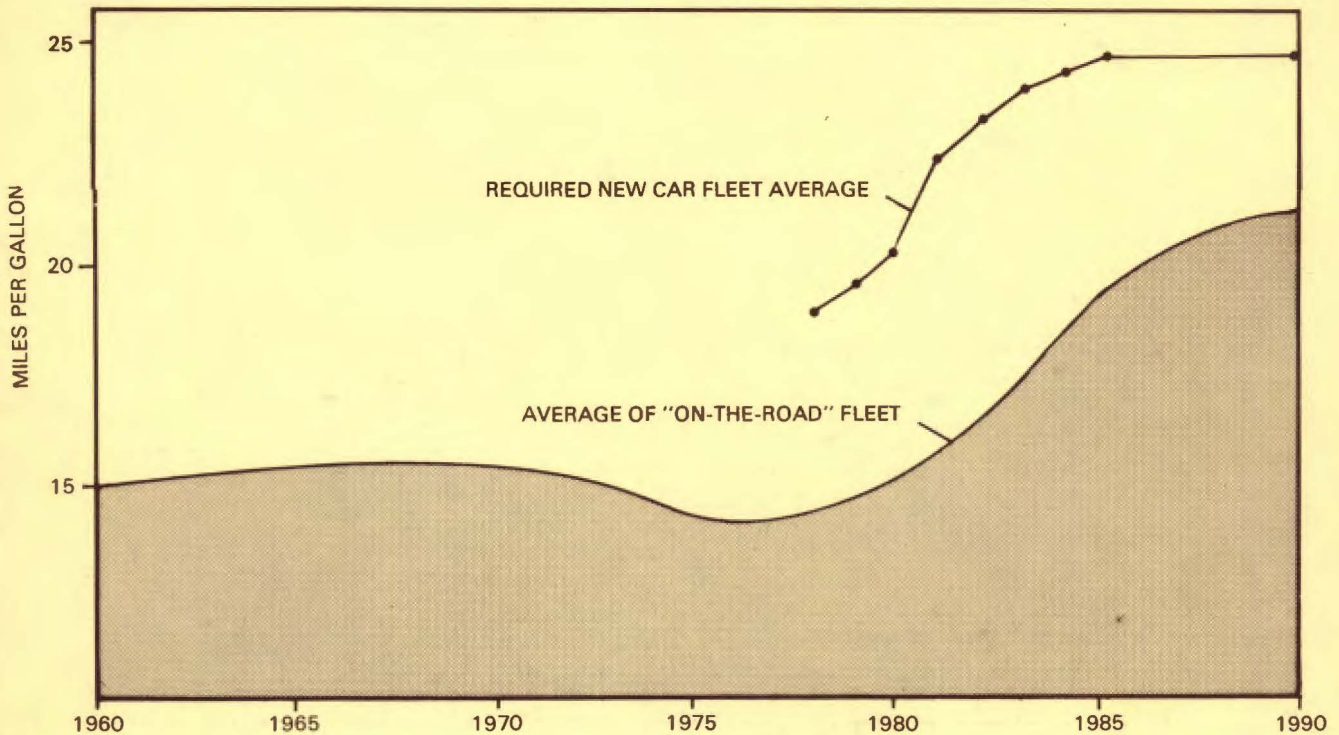
The combined effect on automobile operating costs will be an increase through 1980 followed by stabilization in 1981-82 and a decline in real terms for the remainder of the decade. Real operating costs per mile in 1990 may be slightly less than in 1979.

While not shown in the charts auto operating costs in the 1990's will again increase. By 1985 new cars will have achieved the fuel economy standards which can be easily implemented. Major technological innovation will be required to obtain additional efficiency. The gap between petroleum demand and production is also expected to widen more rapidly in the nineties leading to either higher real prices or supply restrictions.

Although the 80's may be a period of relative stability actions taken during the 80's must recognize the likely problems of the next decade.

Source: 2

AUTO FLEET AVERAGE FUEL ECONOMY (MPG)



Source: 18

TRANSPORTATION BUDGET

Between 1950 and 1970 the proportion of personal consumption expenditure devoted to transportation declined only slightly (from roughly 13% to 12%) even though the cost of travel in real terms fell substantially. A slight rise in the budget proportion devoted to transportation in 1974 was followed by a major increase in the period 1975 to 1977, reaching a twenty-year high of 14.3 percent.

How transportation expenditure will change in the 80's is unclear. The conjecture shown on the accompanying figure suggests that **there will be a slight decline in household travel expenditures during the 80's with households seeking to re-establish the historical values of 12-13%**. This conjecture is based upon the following:

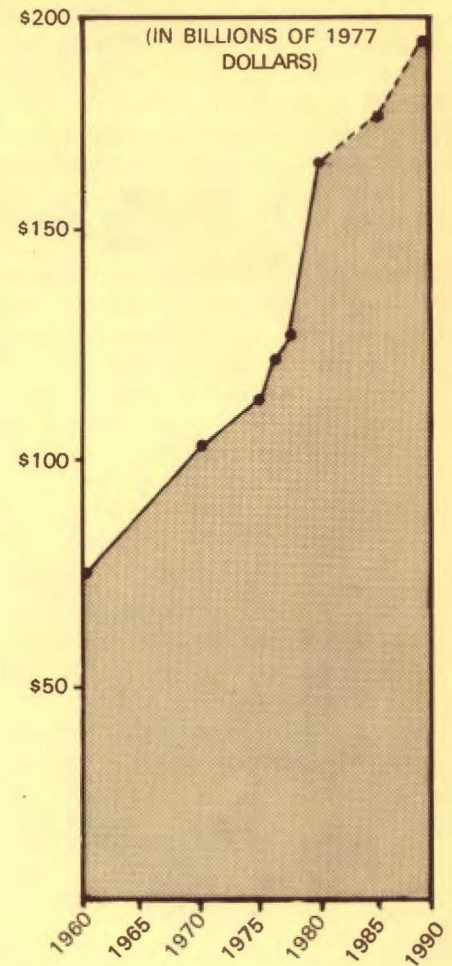
- Studies have suggested that households over a wide range of urban areas and living conditions have a cost-budget for transportation.
- While the cost of gasoline will increase in real terms during the eighties, the cost per mile of auto travel will decline slightly as fleet efficiency improves.

The post-1974 increase in the transportation budget reflects the fact that households require some time to change dwelling locations and trip patterns. During the eighties long term residential location and activity pattern decisions will be made which reflect travel costs.

However, 80% of the housing units which will exist in 1990 are already in place. The availability and cost of certain types of transportation was implicit in the development of this housing. The residents of this housing will be forced to live with the economic and mobility consequences.

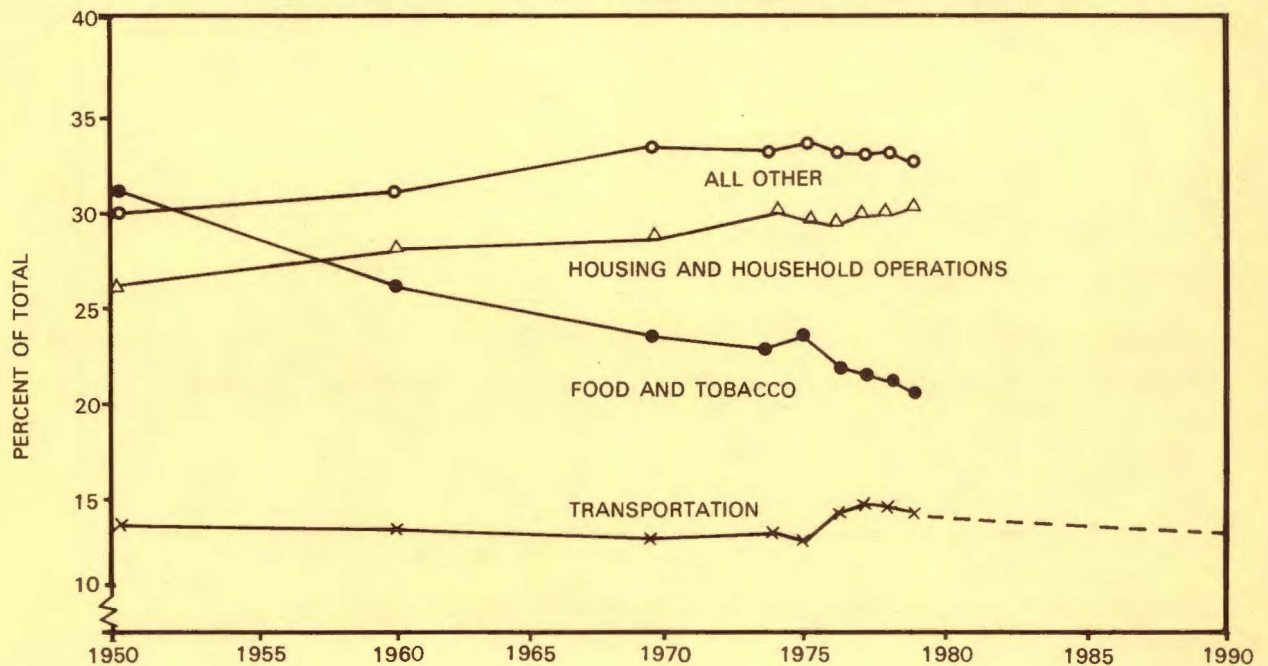
Nominal price increases or occasional supply restrictions during the 80's may lead to some household adjustments. Households which do not change patterns in the 80's should be able to maintain their transportation budgets within the historic range if household income keeps pace with inflation. Beyond 1990 with real operating cost increases these households will either need to increase the proportion of income devoted to transportation or reduce travel. Within limits the latter option is easier and more likely to be chosen. Some trips, however, must be made and in the nineties a growing proportion of households will be seeking cheaper travel alternatives.

PERSONAL CONSUMPTION TRANSPORTATION EXPENDITURE



Source: 2, 16, 46

TRANSPORTATION EXPENDITURES AS A PERCENT OF TOTAL PERSONAL CONSUMPTION EXPENDITURES



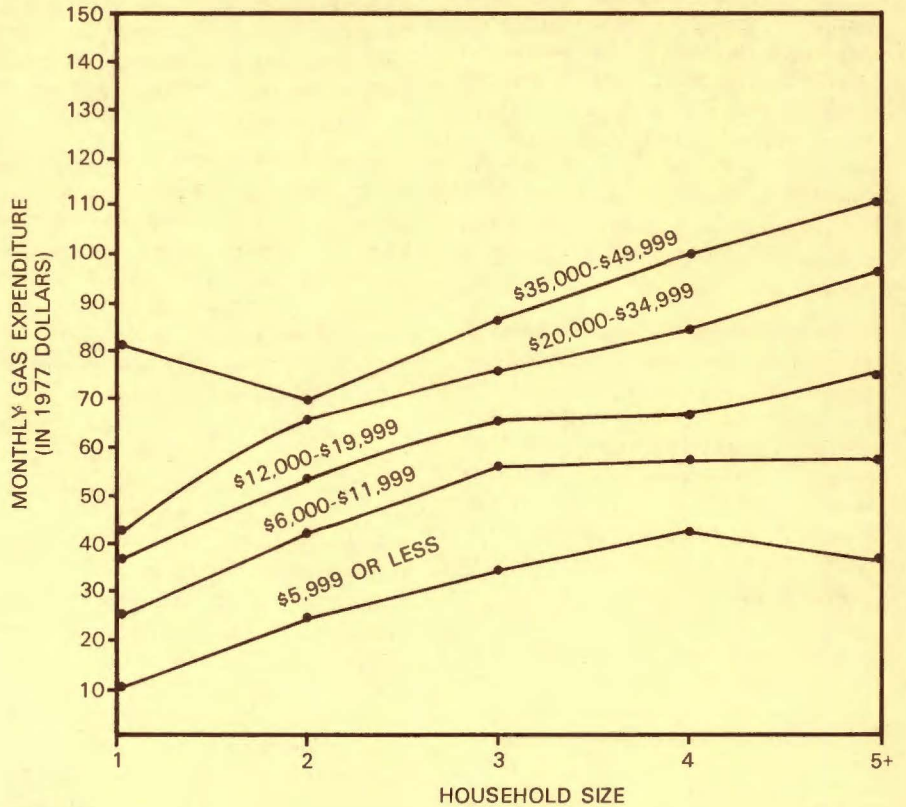
Source: 16, 23

GASOLINE EXPENDITURES

The amount of money spent on gasoline is a direct function of travel. As would be expected larger households make more trips and, therefore, have higher gasoline expenditures. Similarly, higher income households travel more and spend more on fuel, although the percent of income devoted to gasoline expense shows a rapid decline with increasing income. Above the median income gasoline expenditure increases more slowly than income. Other factors, such as the amount of time available to travel serve to constrain trip rates. These higher income households could absorb significant real increases in gasoline prices without exceeding the average amount of the budget devoted to transportation.

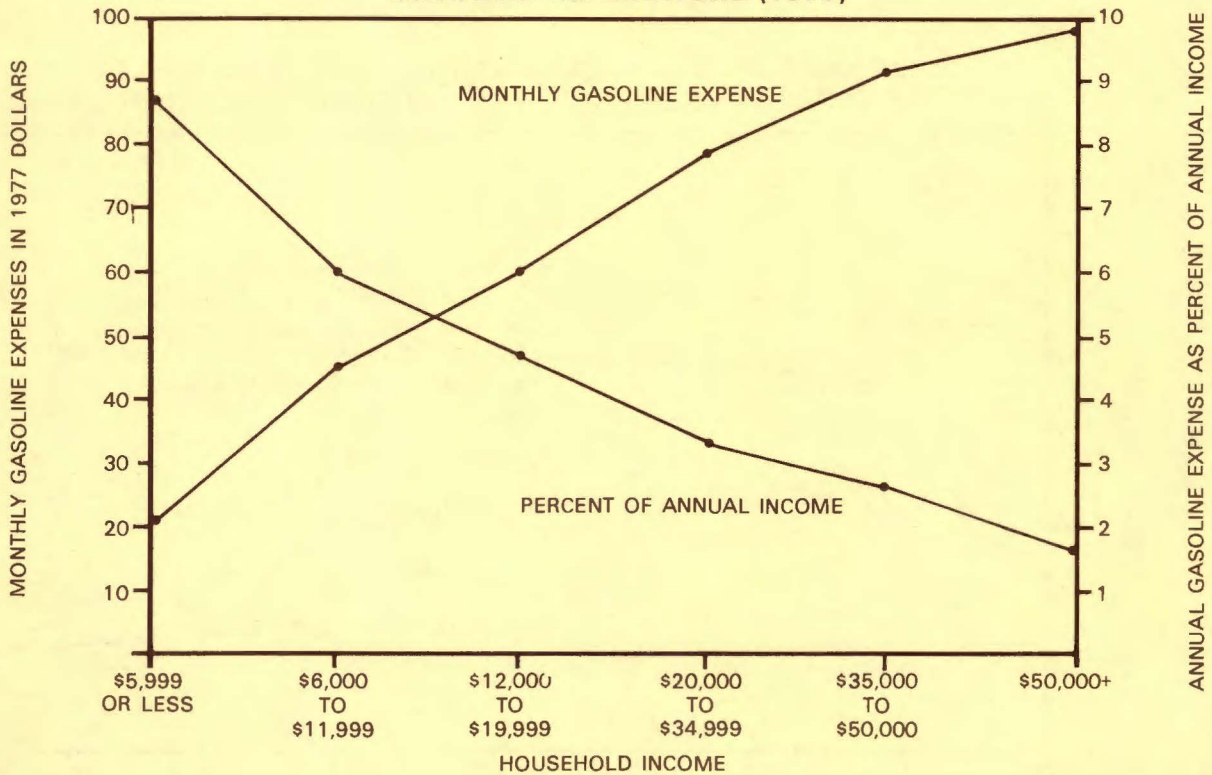
The evidence, however, also suggests that lower income households are already constrained by the cost of operations. The mobility of this group could be even more restricted as real costs increase.

MONTHLY GASOLINE EXPENDITURE BY HOUSEHOLD SIZE AND INCOME (1977)



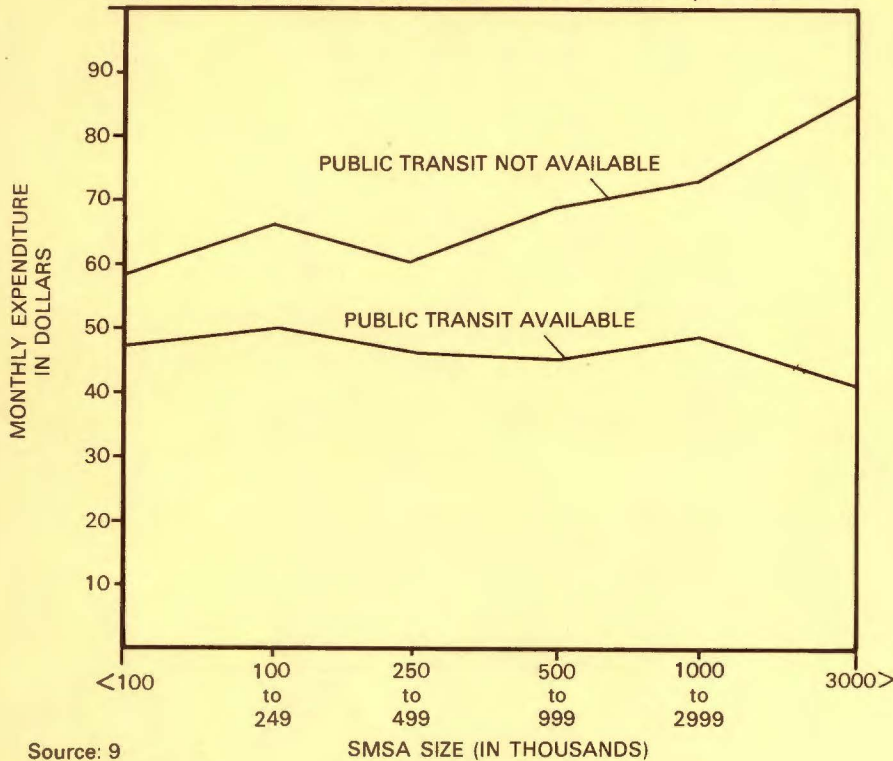
Source: 9

CHARACTERISTICS OF HOUSEHOLD GASOLINE EXPENDITURE (1977)



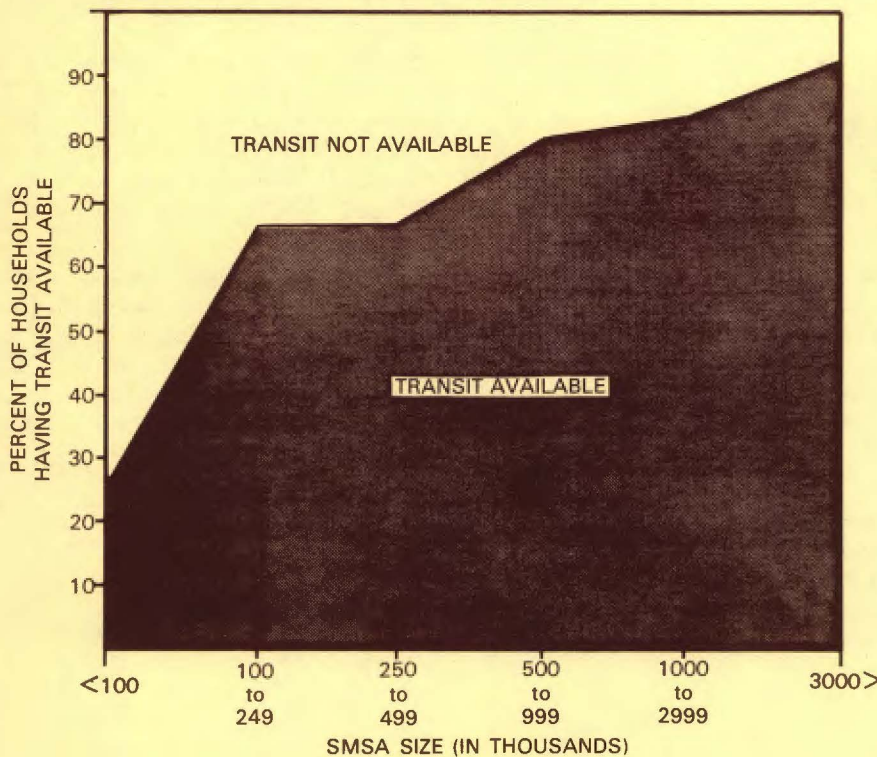
Source: 9

**MONTHLY GASOLINE EXPENDITURE
BY AVAILABILITY OF PUBLIC TRANSIT (1977)**



Source: 9

**PERCENT OF HOUSEHOLDS BY SMSA
SIZE HAVING TRANSIT AVAILABLE (1977)**



Source: 9

TRANSIT

On a national average 62% of the U.S. households reported in 1977 that transit was available for use. In small areas, under 100,000 population, less than one-third of the households considered transit to be available. For all other size metropolitan areas transit was available to over two-thirds of the households reaching a high of 92% for the largest SMSA's.

For a variety of reasons there are differences in the travel patterns of households with transit availability. This is true in all size urban areas. These households make greater use of transit (0.28 vs 0.05 transit trips per household per weekday), make more trips to the CBD (1.06 vs 0.74 trips to the CBD per household per weekday) and likely live in areas having a greater density of opportunities. Transit available households make a slightly larger number of total trips (5.62 vs 5.52 per weekday).

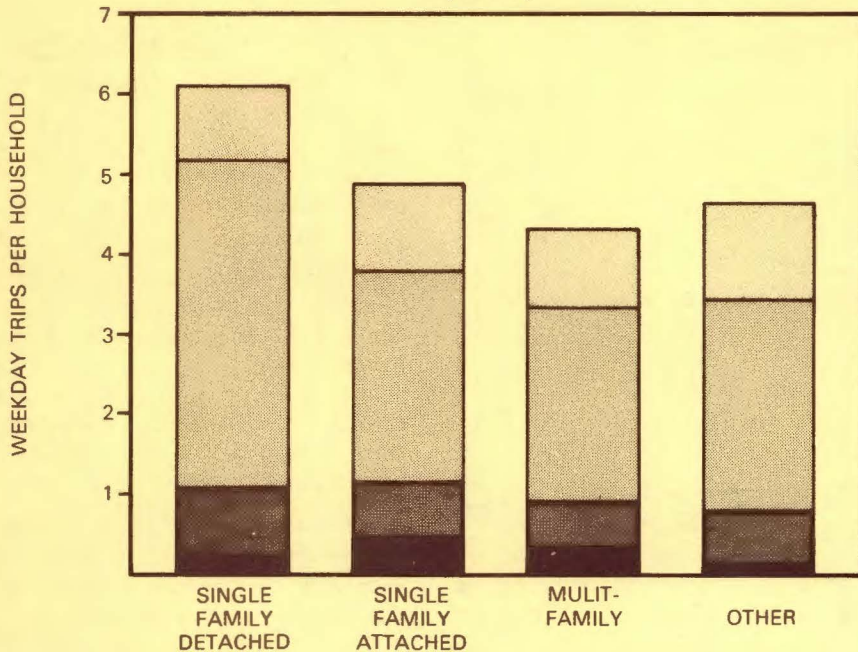
In spite of the higher total trip rate, however, transit available households had a monthly gasoline expense of just under \$45 while those without transit spent over \$61. While the availability of transit service is only one element in the different travel habits it is clear that those persons choosing to reside in the types of area served by transit can fulfill their travel needs with significantly less use of gasoline.

The quantity, location and orientation of personal travel in the 80's will reflect the summation of individual decisions by over 80 million households. These decisions include not only such day-to-day choices as mode use and shopping location but also long term choices of residence and work place. Given the proposition that travel is closely related to household characteristics the best guide to projecting travel in the 80's is the observation of travel in the late seventies.

In addition to changes in demographic characteristics, changes in mode use and even in the necessity for personal travel are in the offing. Use of mass transit is projected to increase during the 80's, particularly if urban development policies encourage denser use of land in a manner conducive to the provision of transit service. Paratransit, bicycles and mopeds will also play a role in transportation during the 80's. Substitution of telecommunications for personal travel is another trend that will develop more fully during the 80's, but will not likely have a significant impact on either tripmaking or energy consumption.

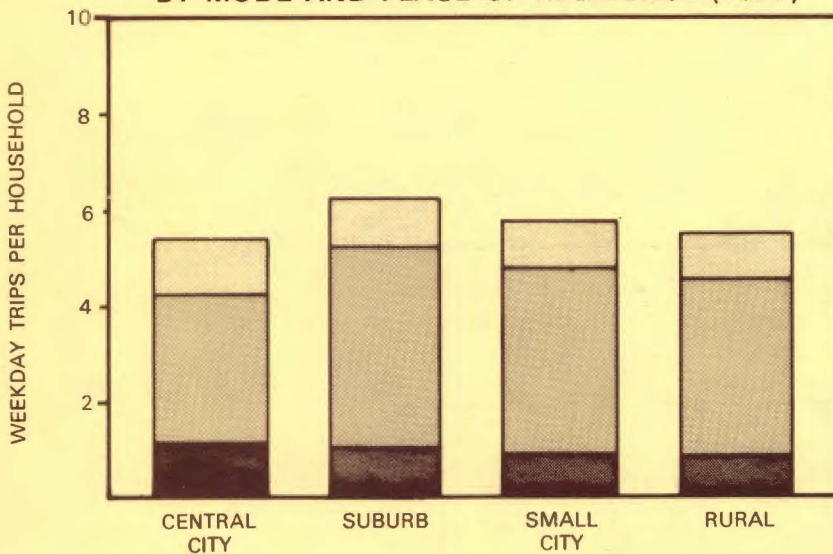
The following charts and tables have been prepared from the National Travel Survey included as part of the 1977 Census of Transportation conducted by the Bureau of the Census. The reader should note that the materials presented are based on preliminary tabulations of unweighted data and are subject to change. However, partial analysis suggests that the degree of such change is likely to be small.

**WEEKDAY TRAVEL CHARACTERISTICS
OF HOUSEHOLDS
BY MODE AND STRUCTURE TYPE
(1977)**



Source: 9

**WEEKDAY TRAVEL CHARACTERISTICS
OF HOUSEHOLDS
BY MODE AND PLACE OF RESIDENCE (1977)**



Source: 9

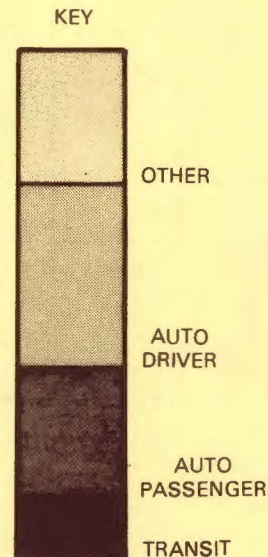
HOUSEHOLD TRAVEL

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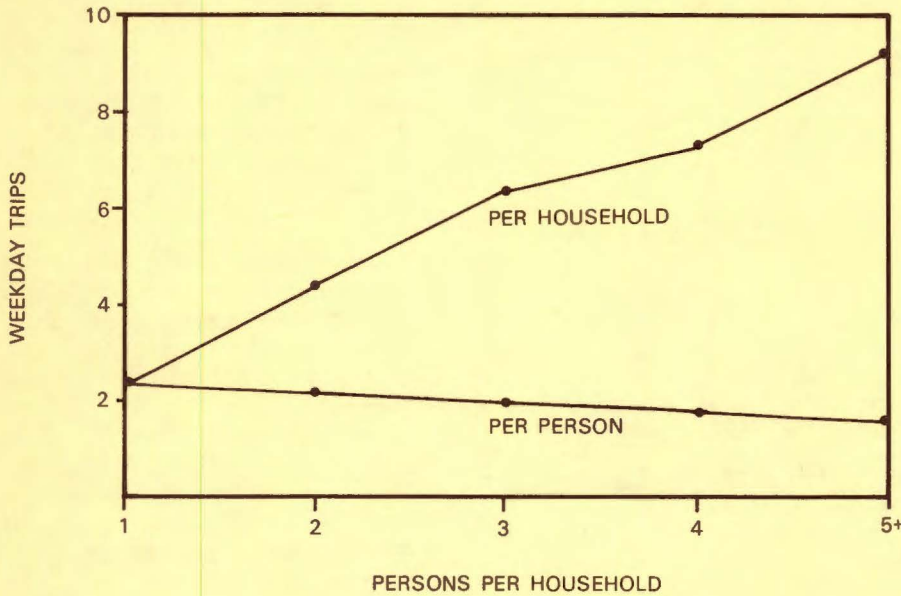
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The majority of all household trips are made by auto drivers. Auto passenger travel is greatest for households in single family detached houses which also have the largest family size. Transit trip rates are largest for those in attached dwelling units, either single or multi-family. For no group do transit trips reach 10% of total travel.

Central city households exhibit the lowest rate of auto driver travel and the highest rate of transit use.



WEEKDAY TRIPS BY HOUSEHOLD SIZE (1977)



Source: 9

EFFECT OF HOUSEHOLD SIZE ON TRIP MAKING

One of the trends identified as being significant in the 80's is the decline in household size and the increasing proportion of single person households.

As shown in the figure, weekday trips are directly related to household size. The increase in trip making, however, is not directly proportional to the number of persons in the household. Weekday trips per person show a slight decline with increasing household size.

The reason for this trend may be that a certain amount of travel is necessary to maintain a household (e.g., shopping trips) and that such trips must be made regardless of the number of persons in the household.

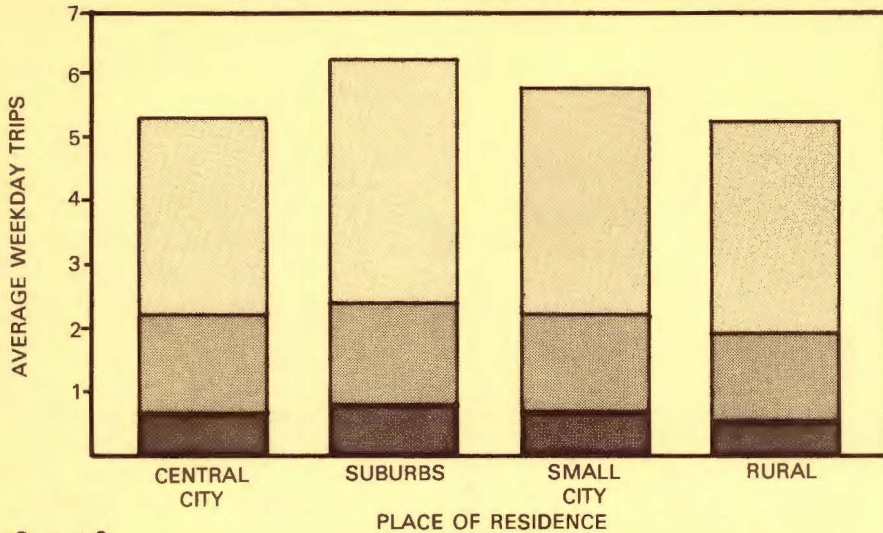
The implication for the 80's is that the rate of trip making will increase at a faster rate than the growth of population.

WEEKDAY TRIPS BY HOUSEHOLD SIZE (1977)

PERSONS PER HOUSEHOLD	1	2	3	4	5+
WEEKDAY TRIPS PER HOUSEHOLD	2.39	4.33	6.21	7.59	9.02
WEEKDAY TRIPS PER PERSON	2.39	2.16	2.07	1.89	1.76

Source: 9

WEEKDAY TRAVEL CHARACTERISTICS OF HOUSEHOLDS BY PLACE OF RESIDENCE AND PURPOSE (1977)

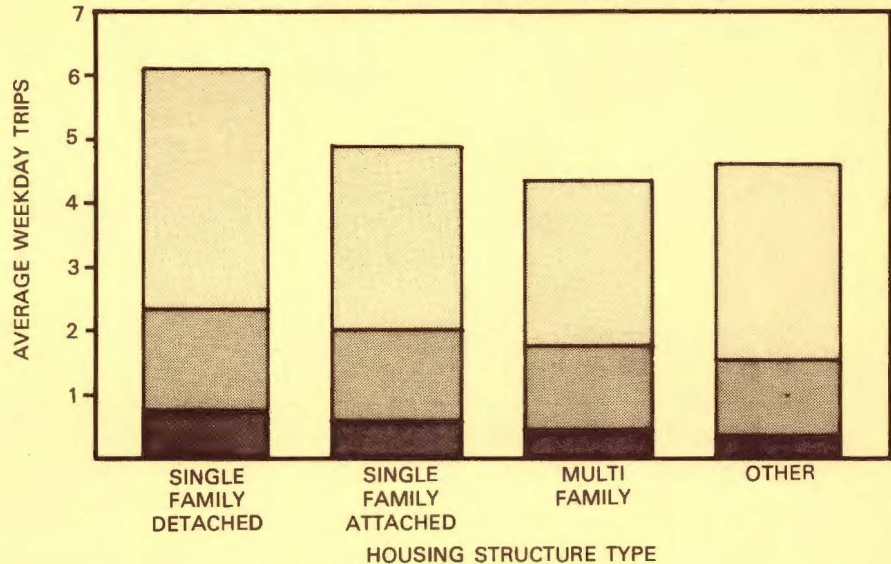
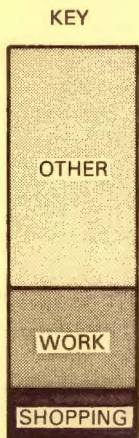


Source: 9

EFFECTS OF PLACE AND TYPE OF RESIDENCE ON TRIP MAKING

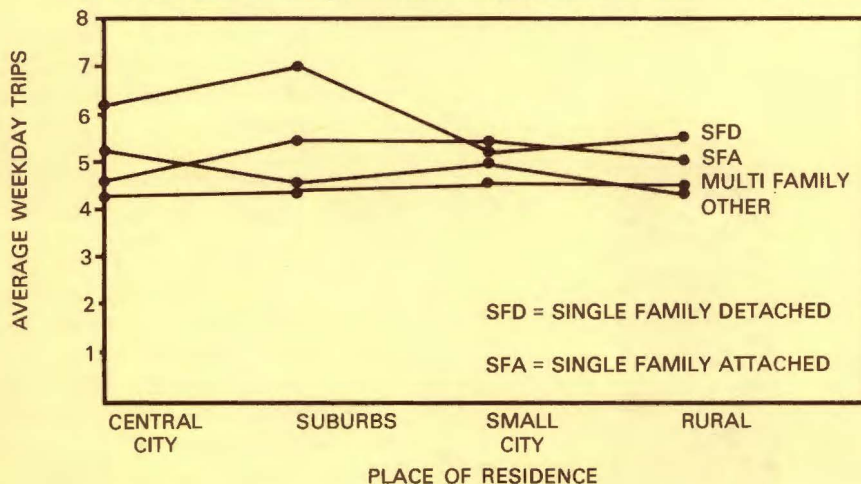
Household trip making is affected by family size, stage in the life cycle, activity patterns, and location. On average, trip rates for work and shopping tend to be relatively constant by area type although exhibiting some variation by structure type. The largest difference in trip rates occurs in the number of discretionary trips (i.e., neither work nor shopping).

WEEKDAY TRAVEL CHARACTERISTICS OF HOUSEHOLD BY PURPOSE AND STRUCTURE TYPE (1977)



Source: 9

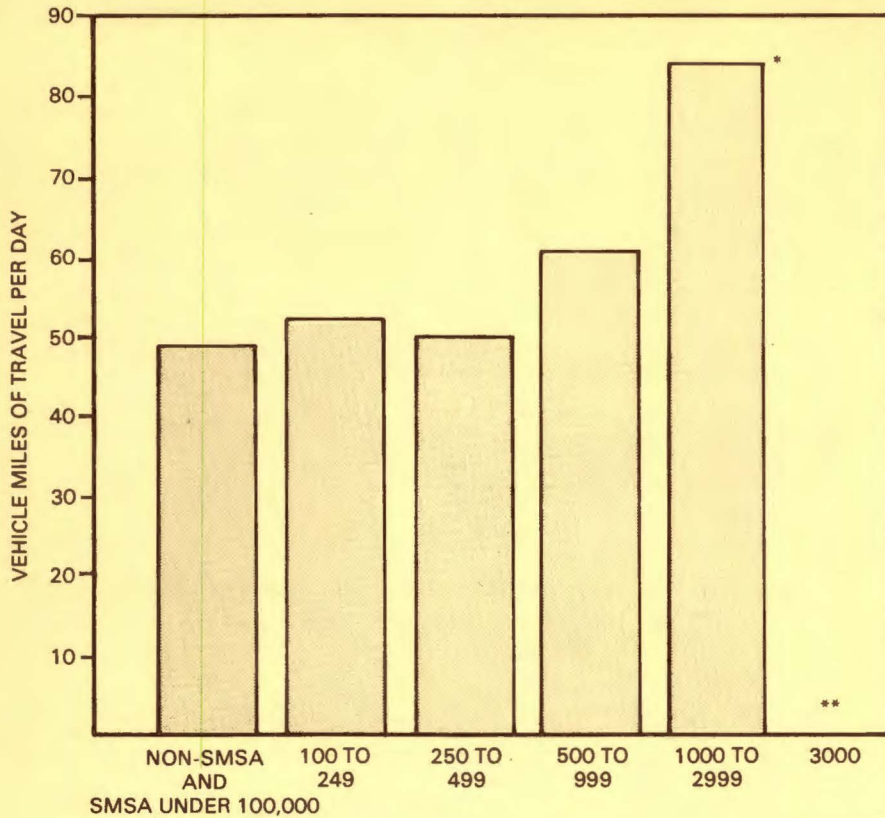
WEEKDAY TRAVEL CHARACTERISTICS OF HOUSEHOLDS BY PLACE OF RESIDENCE AND STRUCTURE TYPE (1977)



Source: 9

As would be expected the greatest number of trips are made by households occupying single family detached structures and by suburban households. Central city and rural households have the lowest trip rates. Trip rates range from a low of 4.20 per weekday for central city households in multifamily structures to a high of 7.01 for suburban households in single family detached houses. **The notable feature in this chart is the large difference between the suburban, single-family household trip rate and the rates for all other categories.**

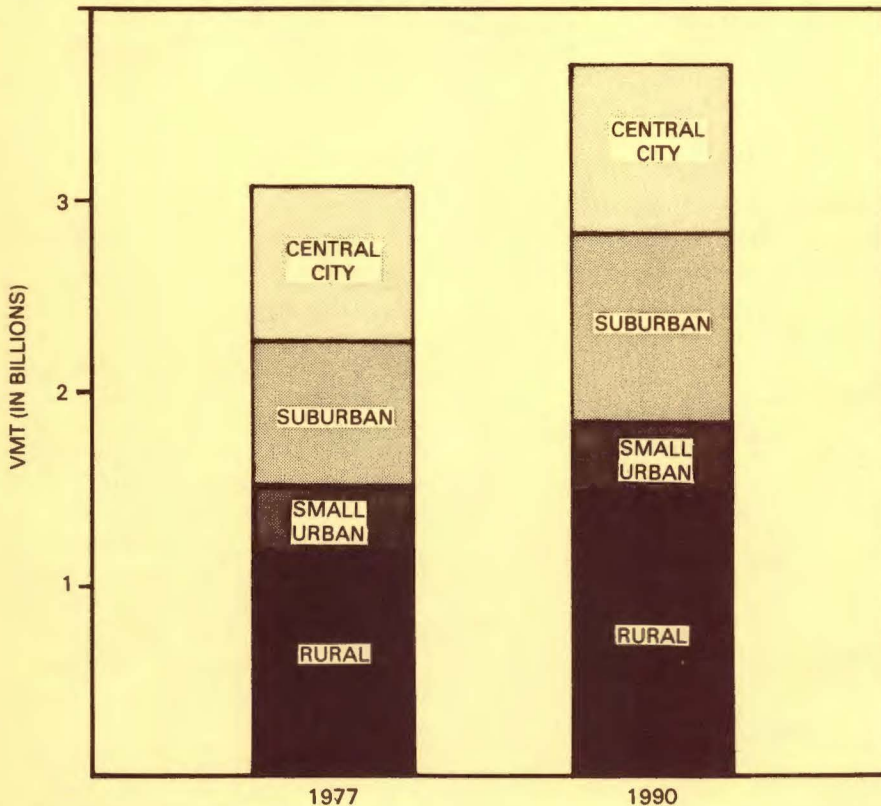
TRIP LENGTH OF RURAL HOUSEHOLDS



*BASED ON SMALL NUMBER OF OBSERVATIONS
 **INSUFFICIENT DATA

Source: 9

WEEKDAY VEHICLE-MILES OF TRAVEL BY RESIDENCE OF TRIP MAKER



Source: 9

HOUSEHOLD VEHICLE-MILES OF TRAVEL

Daily vehicle-miles of travel by households shows a significant difference (about 43%) between the suburbs and the central city. This difference by location within an SMSA is far greater than the difference by SMSA size. The figure on the following page illustrates that the average suburban household generates approximately 46 vehicle-miles of travel per weekday, and that this rate is relatively constant by SMSA size. Except for the central cities of the largest SMSA's household travel in central cities also is relatively stable at about 35 miles per day. The low daily VMT for central cities in SMSA's over 3 million population likely reflects the fact that these are primarily older cities which originally developed at higher densities. The rates observed for the smaller SMSA's are those which should be expected for new households in the 1980's.

In this report suburbs are defined as being within the urbanized portion of an SMSA. The non-urbanized portion of an SMSA is characterized as rural even though it is within the SMSA.

During the 1970's there was increasing movement of households to these areas. Both metropolitan rural counties — those adjacent to SMSA's — and non-metropolitan rural counties — those not adjacent to SMSA's — experienced large percentage gains in population.

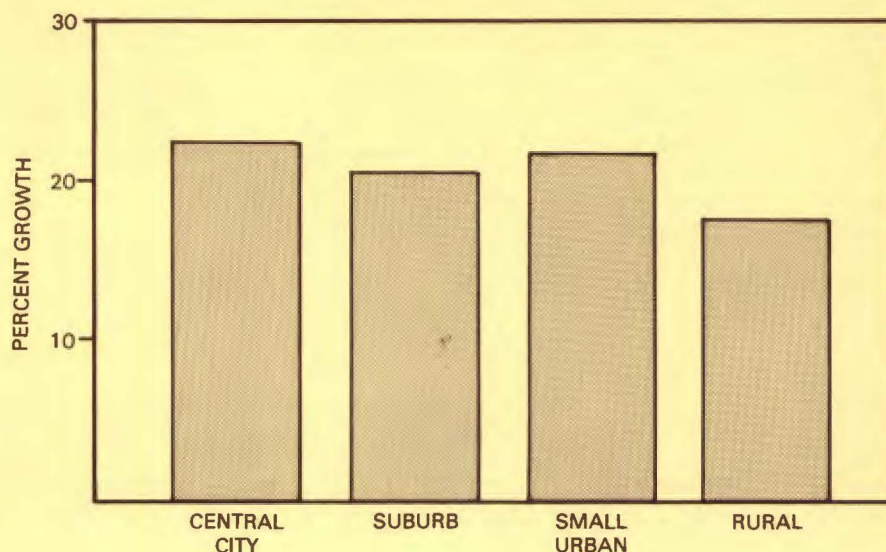
The data show that rural households produce more vehicle-miles of travel than suburban households but that the difference is small when the SMSA size is under one million. Rural residents in SMSA's over one million population produce from 40 to 75 percent more vehicle-miles of travel than do suburban residents. While the absolute number of households locating at the rural fringe of large SMSA's is small they generate a demand for auto travel substantially more than their number would indicate. Continued growth at the rural fringe of large urban areas could lead to a substantial increase in auto travel and, therefore, growing energy consumption in rural areas. Growth of population in non-metropolitan counties would result in travel growth similar to growth in suburban population.

GROWTH IN VEHICLE-MILES OF TRAVEL

The sector of greatest growth in VMT over the next decade will be central cities. Vehicle-miles of travel in central cities is forecast to grow more than 23% during the period. Rural VMT, on the other hand, is expected to show the least growth at 17.5%; suburban and small urban areas should both see roughly a 21% increase in VMT. Although different, the variation in projected growth rates is quite small. **The similarity in growth forecast for all sectors of VMT suggests that there is little to be gained by shifting Federal policies aimed at reducing VMT from one sector to another. All VMT is going up at about the same rate, therefore Federal policies for the 80's must address growing VMT in all the sectors.**

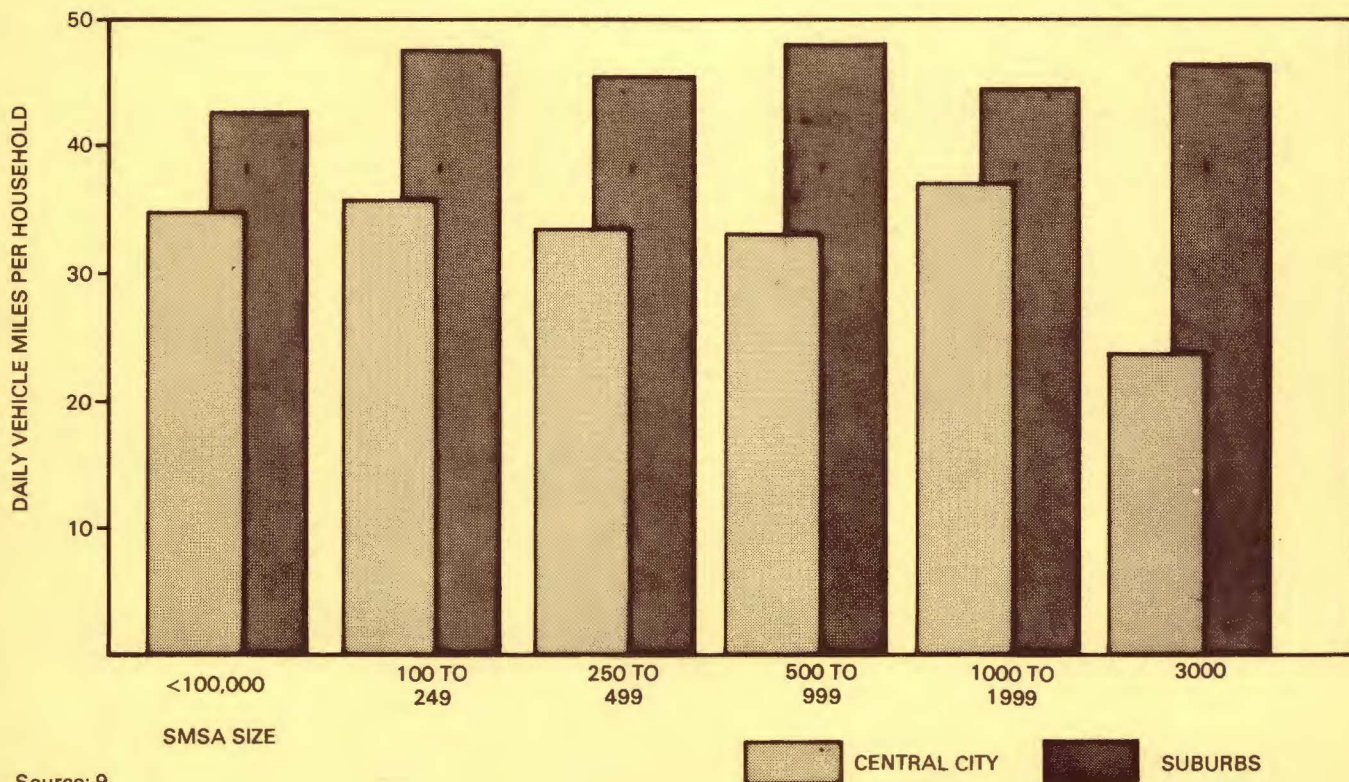
GROWTH IN VEHICLE-MILES OF TRAVEL BY HOUSEHOLD LOCATION

1977-1990



Source: 9

HOUSEHOLD DAILY VMT BY SMSA SIZE AND AREA TYPE (1977)



Source: 9

HOUSEHOLD TRIP RATES

The effect of increasing female employment on trip rates has been an open question during the 70's. It had been suggested that the result of devoting many hours each day to employment would be to reduce the overall household trip rate. Data from the 1977 NPTS suggests that **the result of increased labor force participation by married women is an absolute increase in travel.** It appears that devoting time to employment does not suppress work travel - rather, roughly 1.65 trips per weekday are added. This is almost exactly the number of work trips expected per employed persons.

EFFECT OF FEMALE EMPLOYMENT ON HOUSEHOLD TRIP RATES (1977)

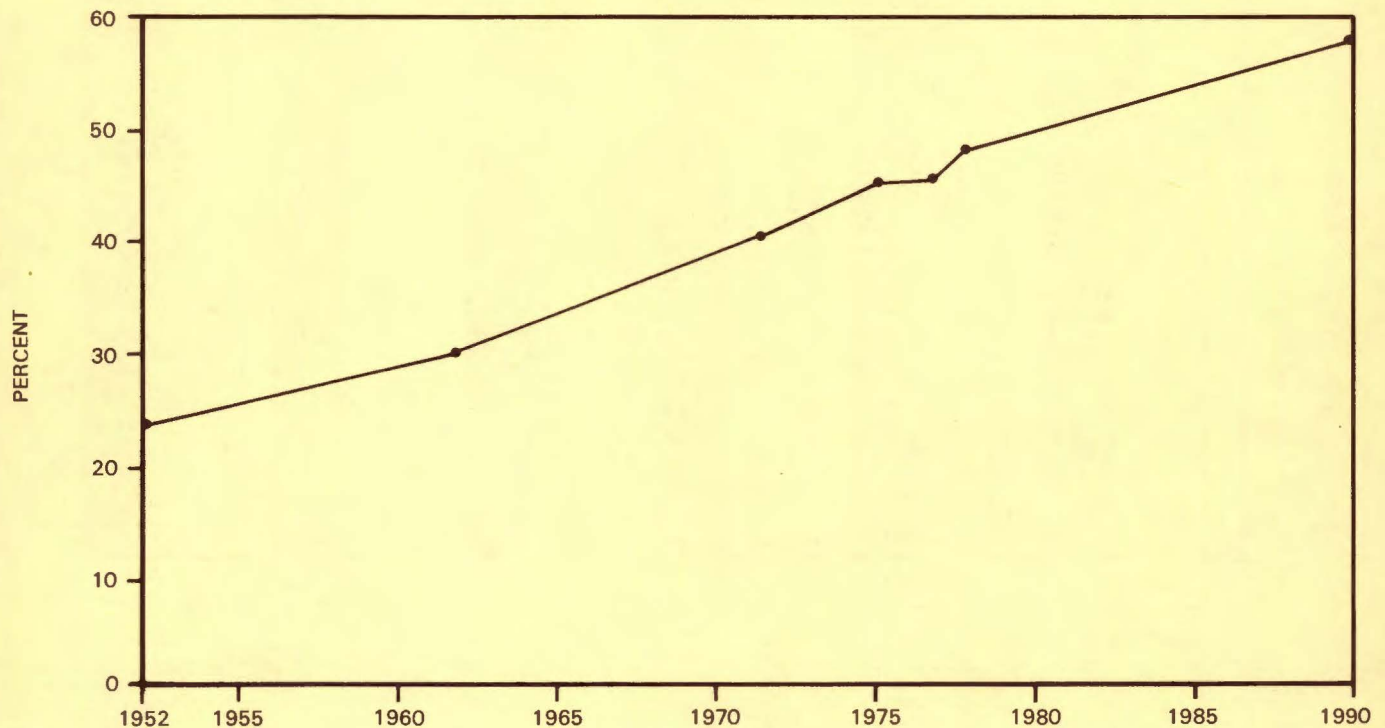
HOUSEHOLD SIZE	EMPLOYED PERSONS		WEEKDAY TRIPS PER HOUSEHOLD	INCREASE IN TRIP RATE
	MALE	FEMALE		
2	1	0	4.33	1.65
2	1	1	5.98	
3	1	0	5.73	1.64
3	1	1	7.37	

Source: 9

WORKING WIVES

It is projected that an increasing proportion of married women will enter the labor force. This trend results not only from a change in attitudes regarding working wives but also economic reasons including an expanding economy, equal opportunity laws, increased female educational levels and a corporate climate which provides women with improved wages and seniority.

PERCENTAGE OF HUSBAND-WIFE FAMILIES WITH A WORKING WIFE



Source: 37

CHANGES IN TRAVEL BY WOMEN

Few national data exist on the changing travel patterns of women. Data from two New York cities — Buffalo and Rochester — have been developed which provide insights into the changes in female travel patterns which occurred in the eleven years from 1962-63 to 1973-74. These changes resulted from the increase in family income, increased suburbanization, and growth of suburban retail as well as the changing role of women. The trends illustrated are likely to continue into the 80's as a greater proportion of women enter the labor force.

The charts on the right illustrate that while the modes of travel for men remained relatively stable through the period, there was a major change in women's mode use. In the early sixties the primary mode for travel by women was as an auto passenger. By 1974 women were auto drivers on over 50% of their trips. Bus use by women was one-and-a-half to two times the rate of men but declining more rapidly.

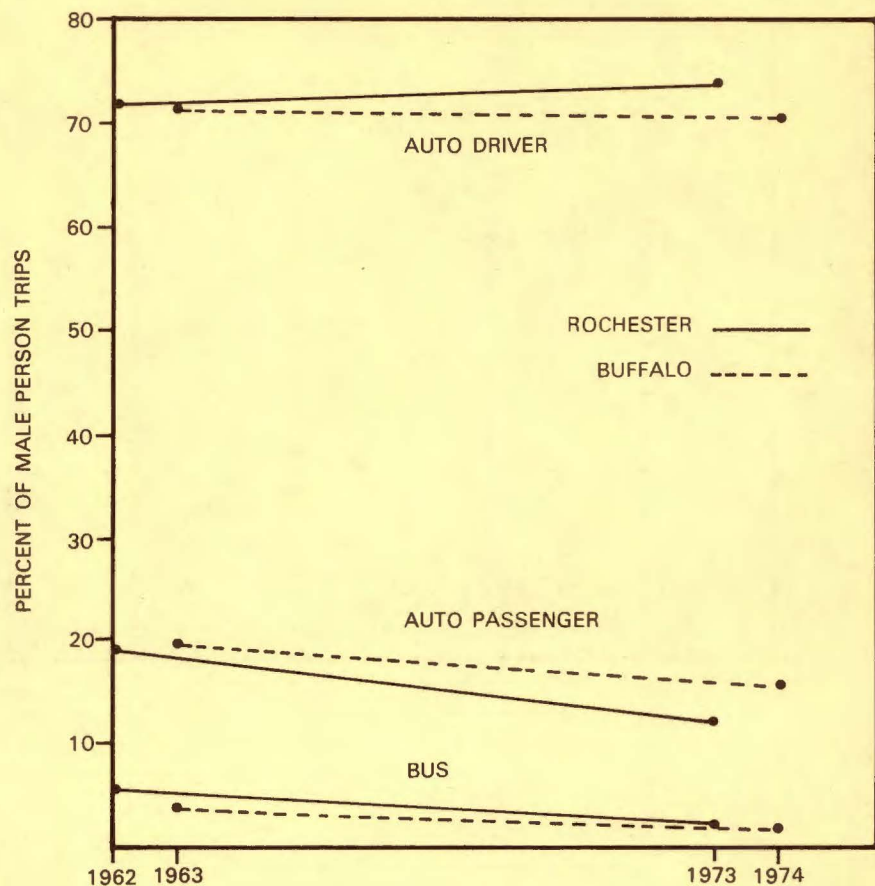
Other changes in the relative travel habits of men and women were also observed. In both cities travel by men which comprised 54 to 57 percent of all travel in the early sixties had declined to 51% of the total in 1973-74. In all cases men comprised less than 50% of the population.

Work travel by men remained stable during the period representing roughly 35% in Buffalo and 40% in Rochester of non-school travel. Work travel by women increased by 3 to 4 percentage points (14 to 18% in Buffalo and 17 to 21% in Rochester). Travel by women also increased significantly for the purpose of "serve passenger" corresponding to the increasing availability of automobiles and the woman's role as a driver.

Continuation in the 80's of travel trends by women would suggest:

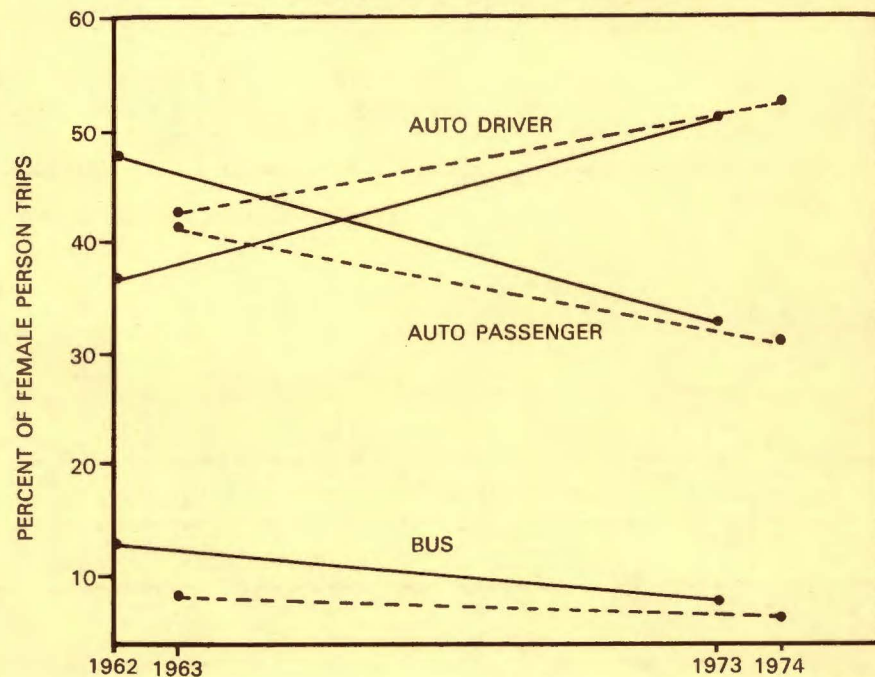
- an increase in the percentage of auto driver travel as women's travel habits continue to approach those of men.
- an increase in peak period demand as a greater proportion of women's travel is related to work.

PERSON TRIPS — MALE



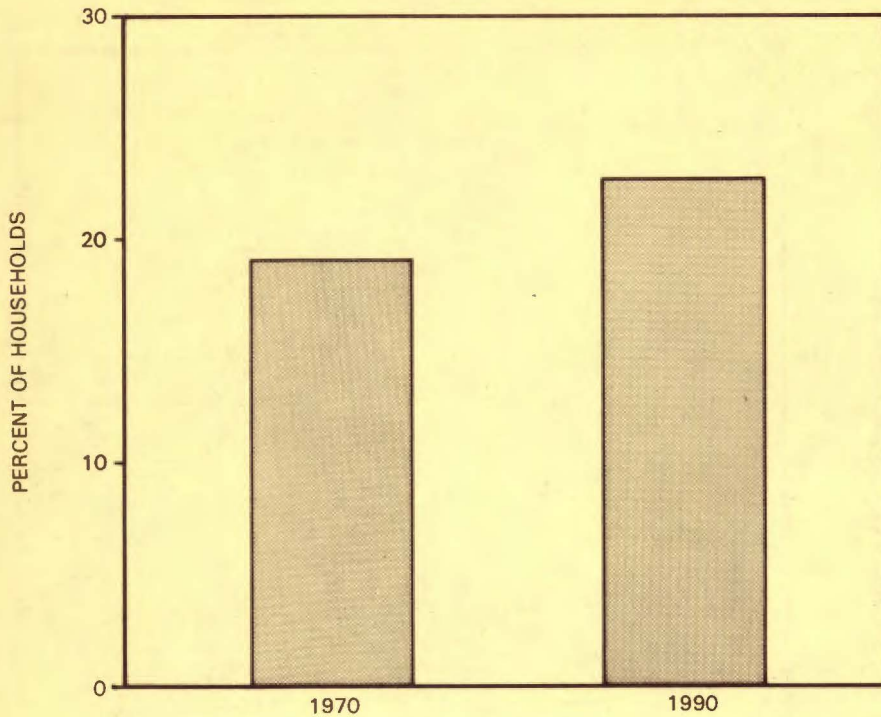
Source: 5

PERSON TRIPS — FEMALE



Source: 5

HOUSEHOLDS WITH AT LEAST ONE ELDERLY PERSON



Source: 43

TRAVEL BY THE ELDERLY

The number of elderly persons in a household has an effect on trip rates. For households with no residents over age 65 the average weekday trip rate is 6.37. For households with one or more elderly the rate is close to 3. For households comprised entirely of elderly persons the daily trip rate is roughly half of the rate for households without elderly.

An interesting sidelight is that 56% of the households with one elderly person represent elderly living alone and 86% of the households having two elderly persons have no members under age 65.

in the 80's, as the elderly population increases, travel in areas with concentrations of elderly residents will also grow but at a far slower rate than would be expected. However, as the elderly are unlikely to have assistance from younger members of the households greater public efforts will be needed to maintain mobility.

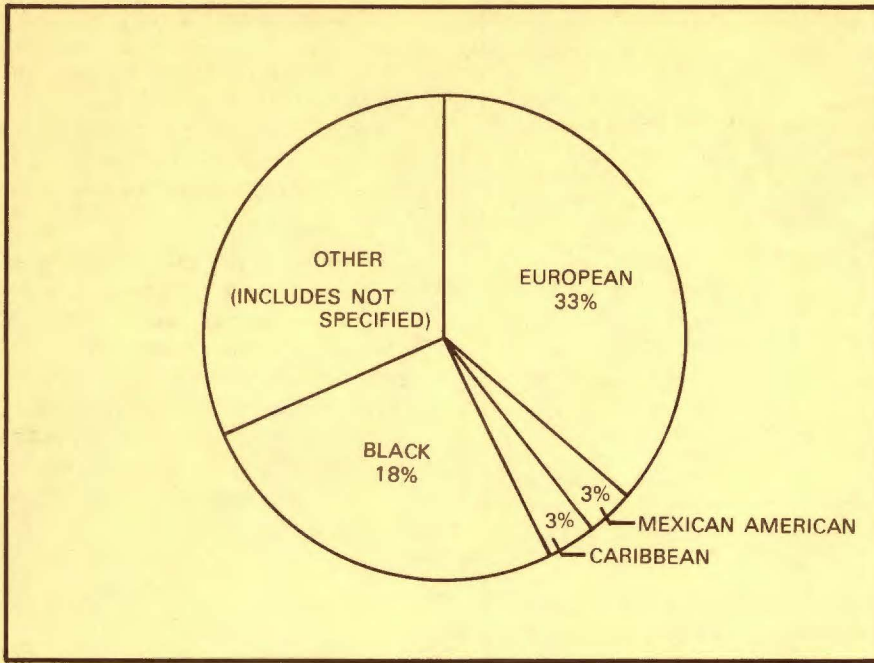
WEEKDAY TRIPS PER HOUSEHOLD BY PERSONS PER HOUSEHOLD AND ELDERLY (1977)

NUMBER OF PERSONS 65 AND OVER	TOTAL NUMBER OF PERSONS PER HOUSEHOLD							
	1	2	3	4	5	6	7+	ALL
0	3.13	5.02	6.44	7.67	9.03	10.24	10.75	6.37
1	1.42	3.21	4.91	6.02	9.71	9.61	11.22	2.81
2	—	2.64	4.20	6.40	5.10	*		3.00
ALL	2.39	4.33	6.21	7.59	9.02	10.13	10.32	5.56

*INSUFFICIENT DATA

Source: 9

TRANSIT TRIPS BY ETHNICITY OF HEAD OF HOUSEHOLD (1977)

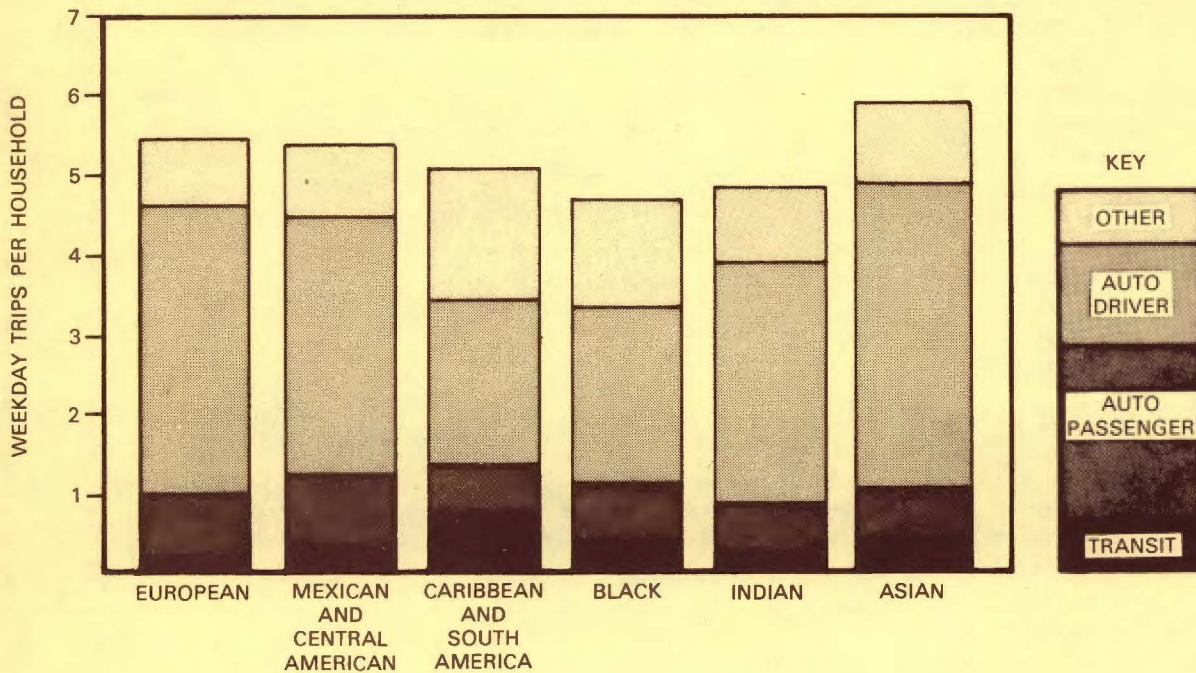


Source: 9

THE EFFECT OF ETHNICITY ON TRIP MAKING

Data on trip making by race indicates some variation, but it appears that these differences are a result of income and housing location. The Spanish origin population in New York and the Spanish origin population in Los Angeles have different travel patterns due to area characteristics rather than country of origin. **To the extent that differences between ethnic groups are minimized, travel by all groups will approach the norm.**

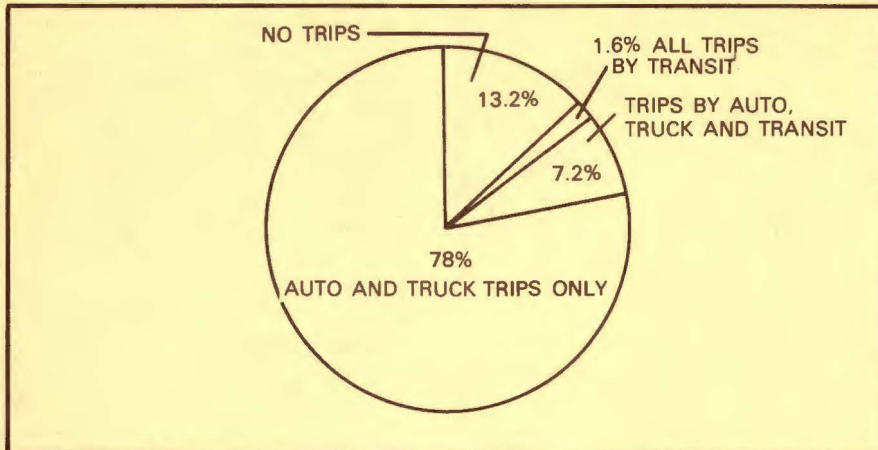
WEEKDAY TRIPS BY ETHNICITY OF HEAD OF HOUSEHOLD (1977)



Source: 9

TRANSIT TRAVEL

TRAVEL BY HOUSEHOLDS (1977)

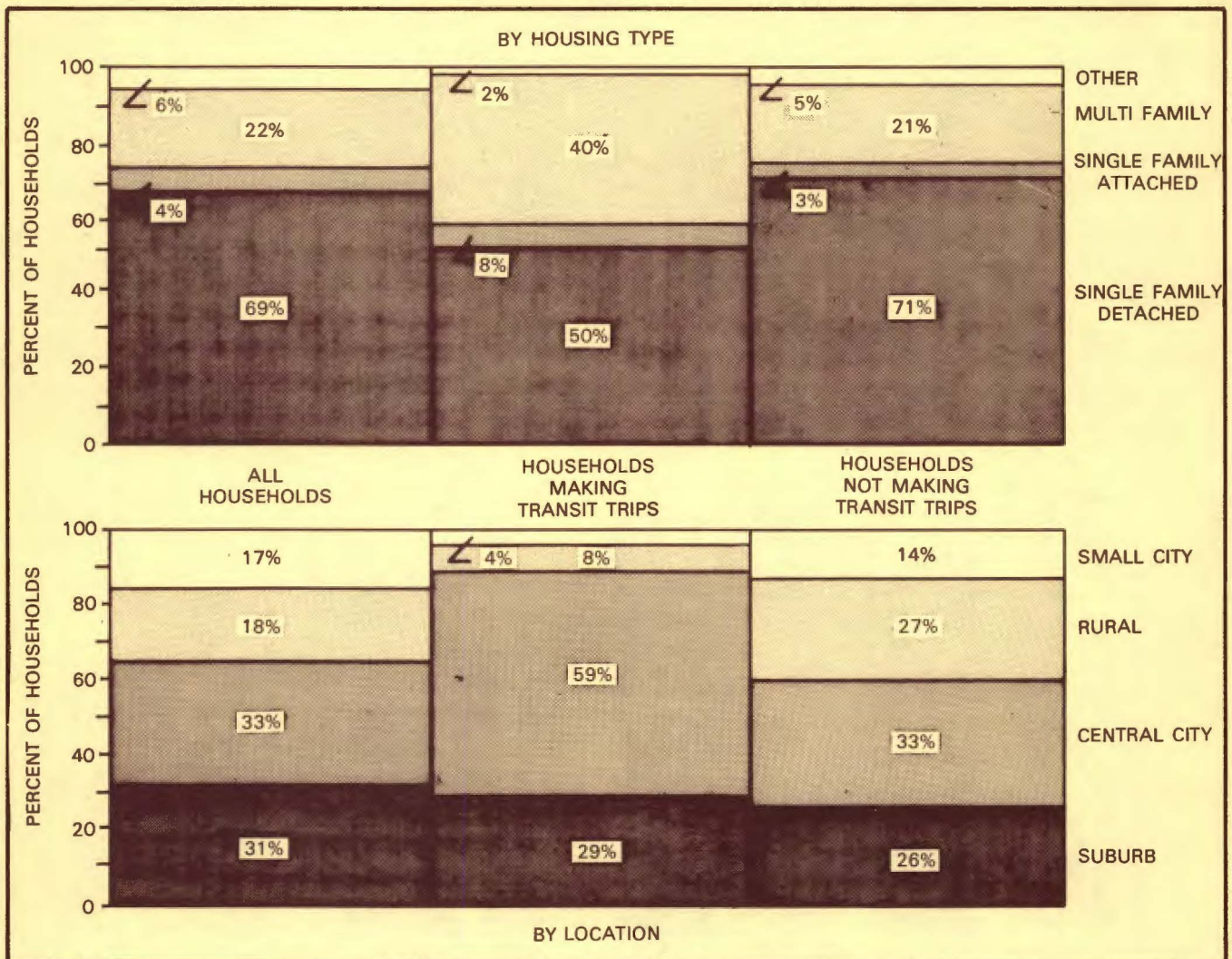


Source: 9

On a typical weekday in 1977 13.2 percent of U.S. households made no trips, 78 percent made trips but did not use public transit and 8.8 percent made at least one trip by transit. Of the households using transit less than 20% used transit for all of their trips.

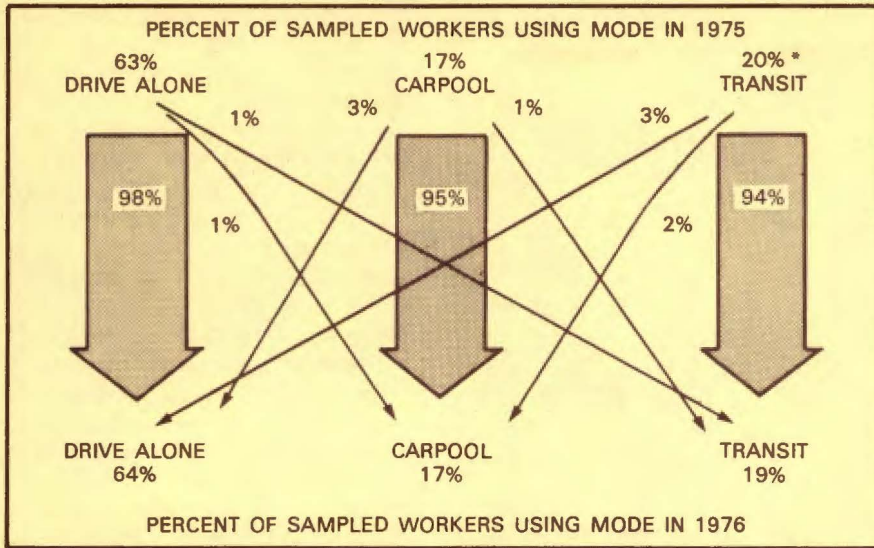
Of those households using transit almost half were residents of multi-family or single-family attached units even though these units comprise only 26% of the housing stock. Fifty-nine percent of the households making transit trips were located in the central city although only one-third of all households reside in central cities.

CHARACTERISTICS OF HOUSEHOLDS MAKING TRANSIT TRIPS (1977)



Source: 9

1976 MODE USE AS PERCENT OF 1975 MODE USE



* Sample includes New York City. Average transit share without NYC is 6%.

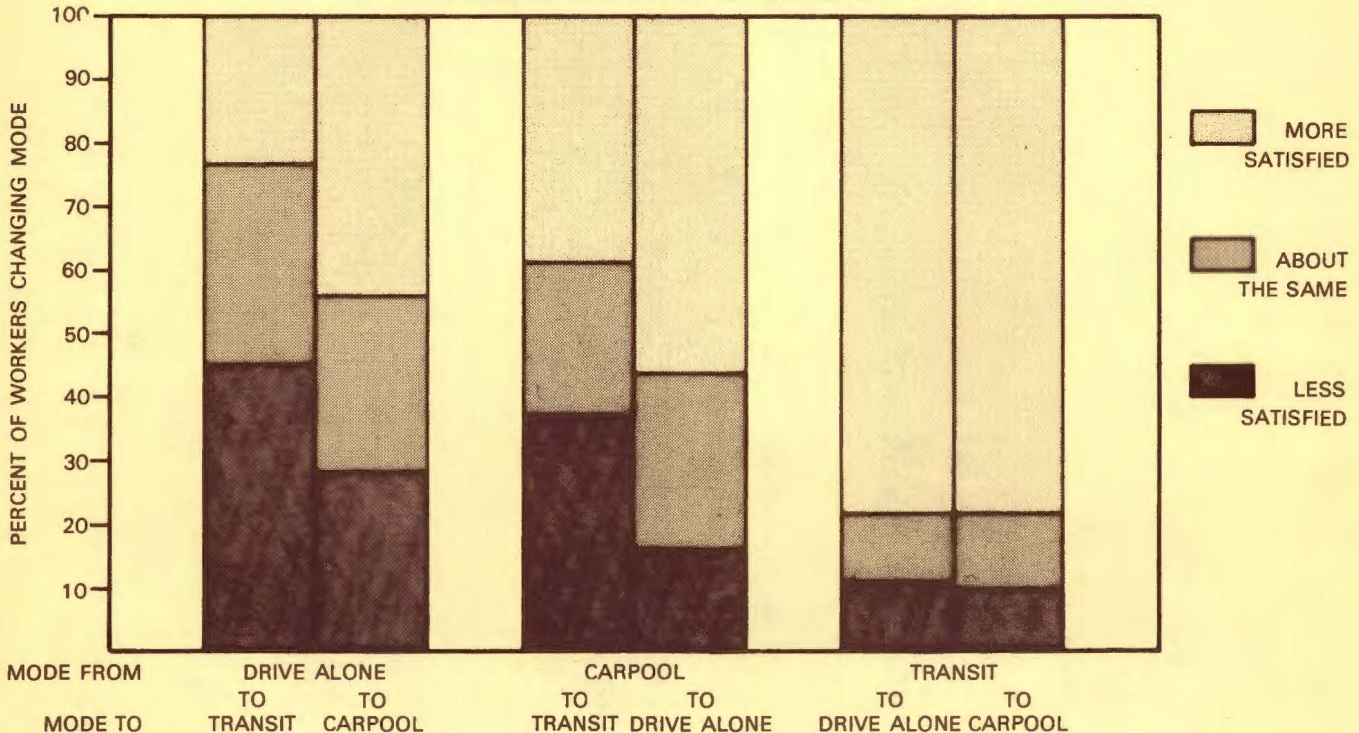
Source: 31

SATISFACTION WITH MODE CHANGE

Strategies designed to reduce gasoline consumption and to moderate the demand for new highway capacity frequently encourage travelers to change their mode of travel from driving alone to transit or carpooling. Such strategies can only be successful if, over a period of time, individual trip makers are satisfied with their mode of travel.

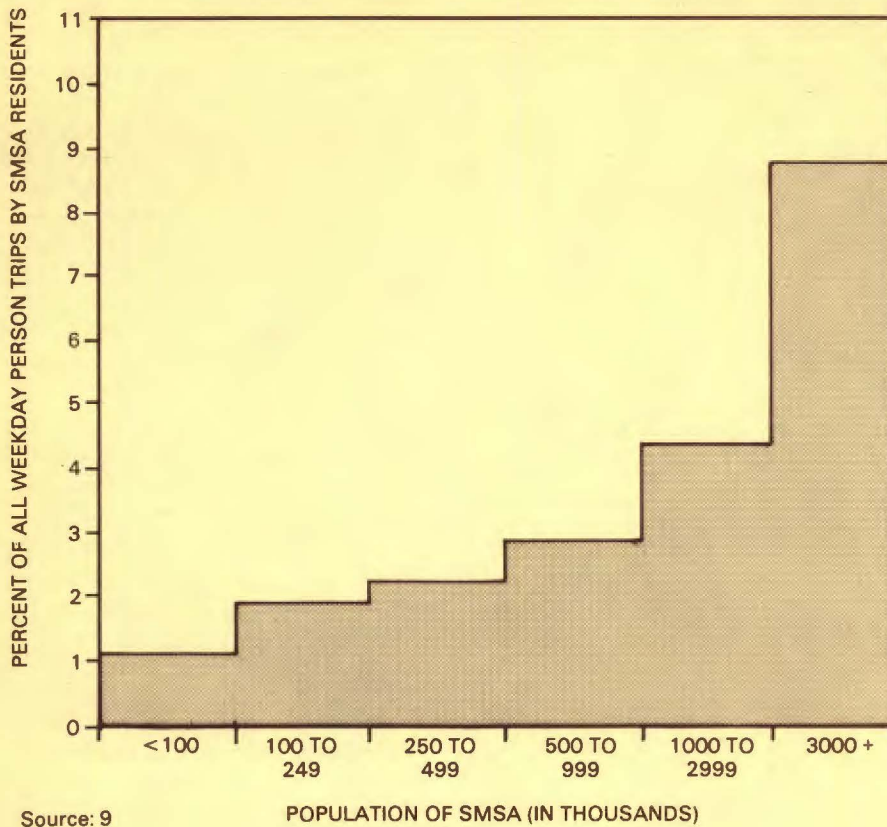
Data from workers who changed their travel mode between 1975 and 1976 suggest that existing transit systems do not satisfy new users. Almost one-half of those changing from drive alone to transit and over one-third of those changing from carpool to transit were less satisfied. Conversely, almost 80 percent of those switching from transit to either drive alone or carpool were more satisfied. It is also important to note that almost one-third of those switching from drive alone to carpool reported less satisfaction.

SATISFACTION WITH MODE CHANGE FOR WORK TRIPS: 1975 TO 1976



Source: 31

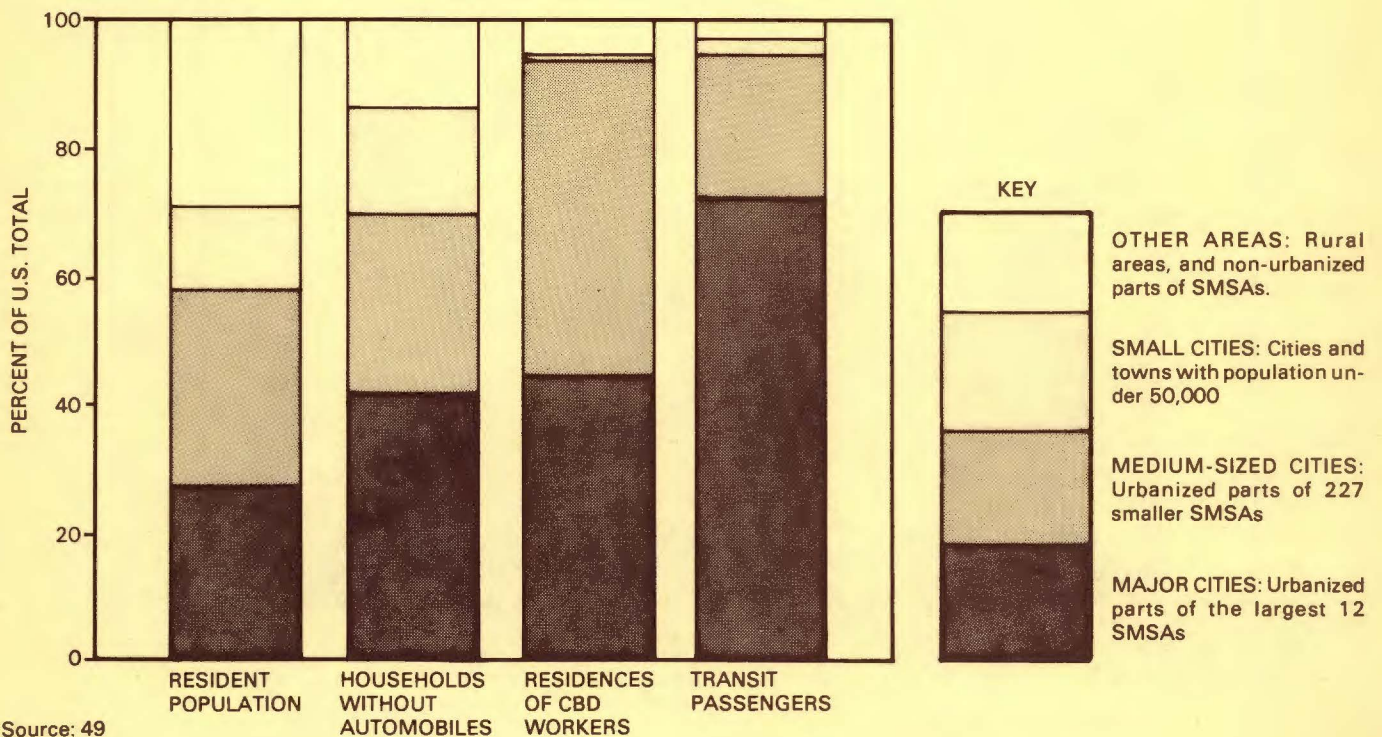
TRANSIT'S SHARE OF WEEKDAY TRIPS BY SMSA RESIDENTS



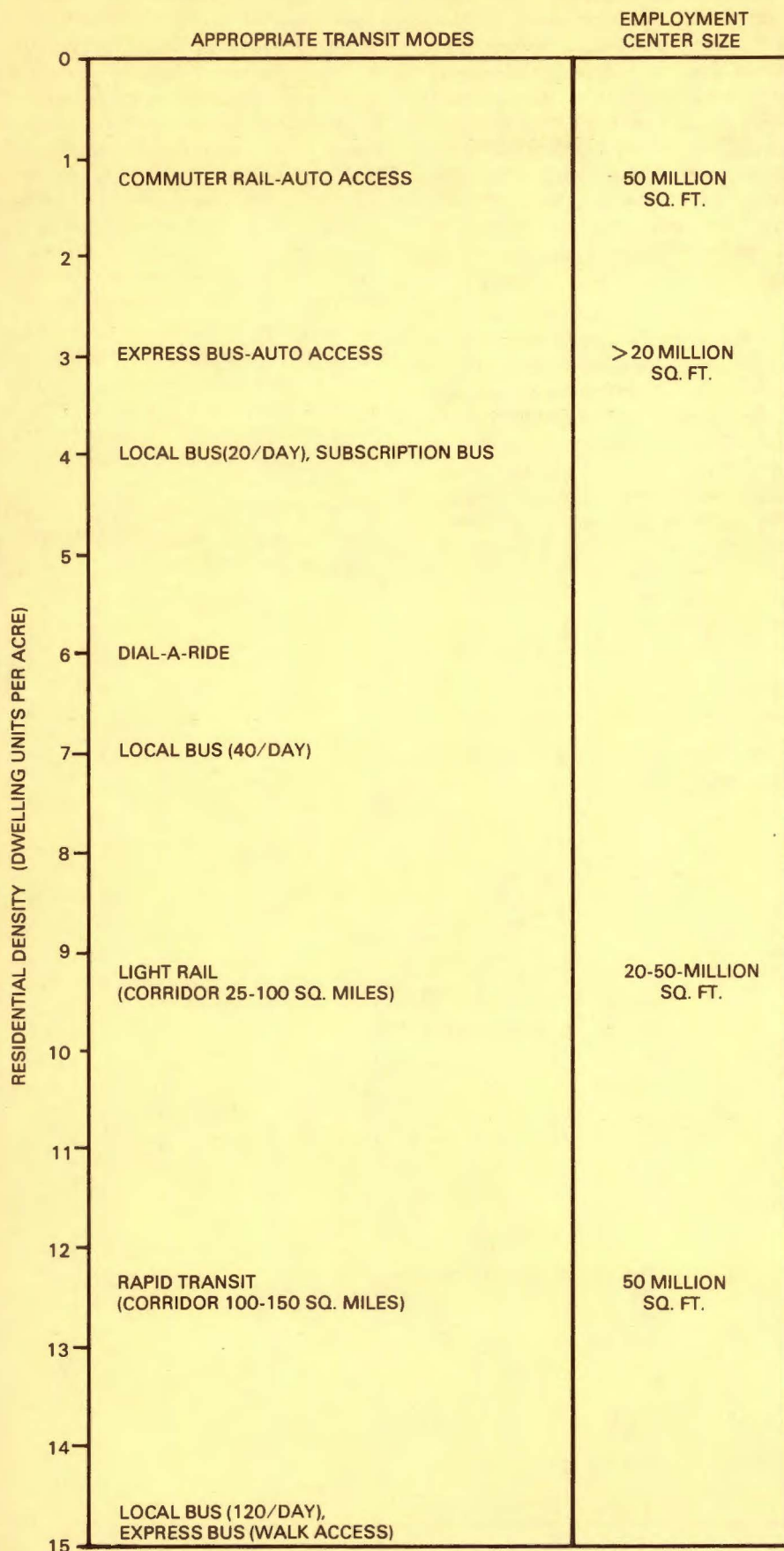
URBAN TRAVEL IN DIFFERING TYPES OF CITY

The importance of conventional transit services varies markedly with city scale and density. In 1970, 27 percent of the nation's population lived in the urbanized parts of the 12 largest SMSAs; by contrast, 72% of the national transit ridership was accounted for by those cities. The proportion of weekday person trips made by transit increases quite strongly with city size. **Studies have also shown that variations in transit patronage across cities are associated quite strongly with variations in residential density and central area commercial floor space.** New York City, which accounts for almost a third of the nation's transit patronage, obviously influences these relationships strongly, but the associations are still significant when New York City data are removed from the reckoning.

TRANSPORTATION CHARACTERISTICS OF DIFFERENT-SIZED METROPOLITAN AREAS (1970)



TRANSIT MODES APPROPRIATE FOR VARIOUS DEVELOPMENT DENSITIES



TRANSIT USE AND DEVELOPMENT DENSITY

Many factors affect the decision by individuals to use transit. While there is no single valued relationship between the density of development and transit use, it is clear that the two are connected. Dense development generates a larger trip market for offered transit services while the availability of transit permits high-density areas to function. Confounding factors include the tendency for automobile travel to be more costly to high-density employment areas, the tendency for existing transit service to offer the highest service levels in areas of highest density and the tendency for the lowest income groups to live in the highest density areas.

For transit service to be effective sufficient density must occur at both ends of the trip (i.e. both the residential and employment areas). Further medium to high density cannot occur in insolated pockets but must include a reasonable area if it is to have an impact on transit use.

The types of public transit services appropriate for residential areas as suggested in one study are shown in the accompanying figure.

Provision of public transit will not, of itself promote higher density, but adequate public transit is required for high density areas. Similarly, high density alone will not lead to high rates of public transit use, but a reasonable concentration of people and jobs is required for efficient transit operations. Typical suburban densities of 3 to 4 dwelling units (d.u.'s) per acre do not provide a concentration of population large enough to support walk-on bus service. Services which are oriented to park-and-ride to a large downtown can work. **Densities of 5-8 d.u.'s per acre (roughly single-family on 60 ft. x 100 ft. lots) are the threshold for local walk-on bus service.** Ten d.u.'s per acre will support good bus service. Rail systems can be appropriate if this density is found throughout a corridor. At higher densities the variety of effective services is more extensive.

PARATRANSIT MODES

The term "paratransit" is applied to forms of intraurban, highway-based, passenger transportation services which are intermediate in service quality between the private automobile and conventional scheduled transit. The most important examples are taxicabs, jitneys, dial-a-ride (DAR) services, rental vehicles, subscription buses, and car pools. Unfortunately, the data available to describe the present and past national role of these services are quite sparse. On the basis of most recent evidence, the national fleet taxicab industry in 1975 operated some three times the number of vehicles (including rail cars) used by the U.S. transit industry. Gross revenues of about \$3.4 billion were realized, over 80 percent greater than the transit industry's revenues in that year.

There are thought to be at least 400 dial-a-ride systems in existence throughout the country, both California and Michigan being the states where such systems have been most encouraged.

The majority are operated for the general public, although many systems are restricted to target markets, most often the handicapped and elderly. DAR services are frequently provided with special vehicles (usually small buses), but shared-ride taxicabs account for roughly a quarter of the systems. While the number of systems has increased substantially during the seventies, national totals for patronage and revenues are not known.

Paratransit services vary widely in their characteristics, in the types of organization providing them, and in the markets they serve. All of these factors influence costs, making generalizations hazardous and comparisons with other modes meaningless unless the market being served is specified. For the home-to-work market, "prearranged ride-sharing" in carpools, vanpools, and subscription buses is usually comparatively inexpensive. The most successful cases are those in which the payment for driver time is

low or zero. Speaking broadly, the "hail or phone" group of services tends to be the most expensive to provide. In areas of relatively dense demand their costs per passenger mile can be reduced somewhat by increased route deviation to obtain higher vehicle occupancies, but service quality is then degraded and the demand may be reduced. Except in isolated situations, therefore, taxicab and dial-a-ride services are not very important for home-to-work trips, but depending on the demand levels and the driver remuneration they may be able to serve off-peak or low-density markets at a lower economic cost (and at a lower or zero level of public-subsidy) than conventional transit. The paratransit modes can also provide a cost-effective means of enhancing the mobility of those people unable to use scheduled public transport services.

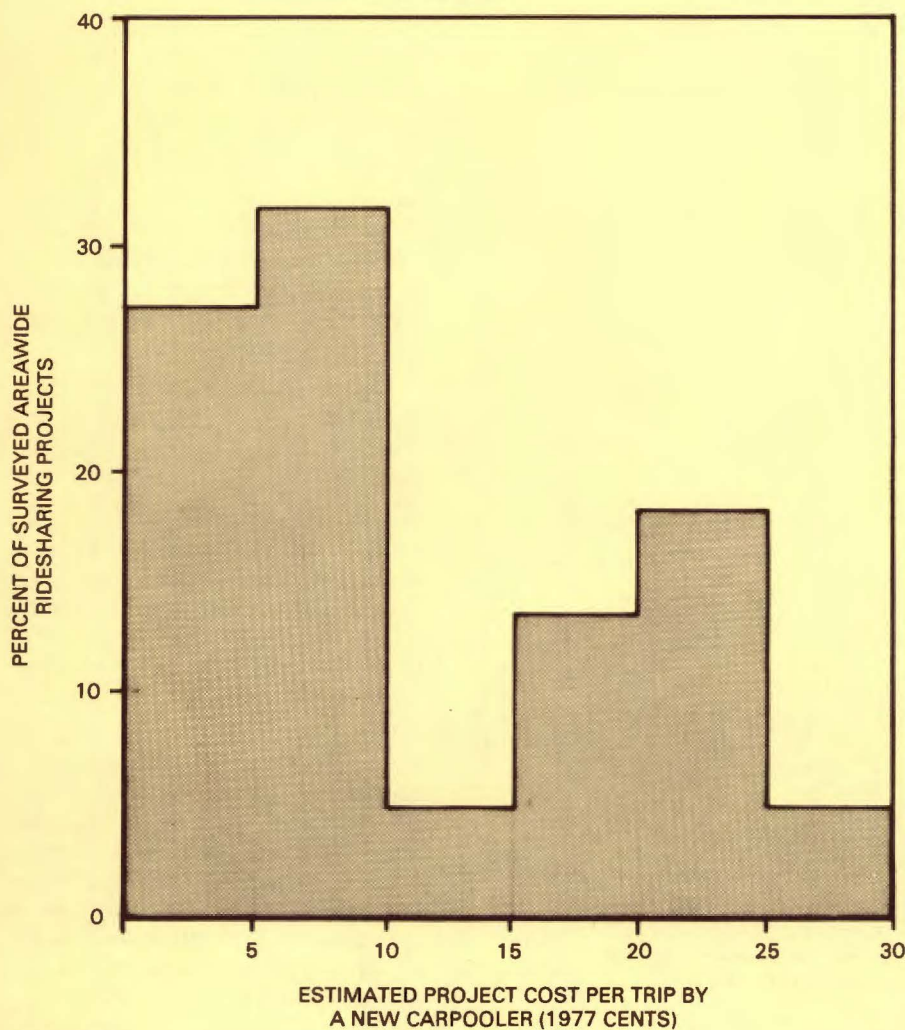
CATEGORIZING PARA-TRANSIT MODES BY COST AND PERFORMANCE CHARACTERISTICS

	Hire and drive services		Hail or phone services			Prearranged ride-sharing services		Conventional bus
	Private auto	Daily rental car	Taxi	Dial-a-ride	Jitney	Car pool	Subscription bus	
Vehicle potential	M	M	L	M	M	M	H	H
Output	L	L	L	L	M	M	M-H	M-H
Utilization	L-M	L	L	L	M	H	M-H	M
Cost/Passenger trip/mile	M	M	H	H	M	L	L-M	M

Definition of Terms:

	Low(L)	Medium (M)	High (H)
Vehicle potential (V) (seat miles/vehicle-hour)	$V < 100$	$100 \leq V \leq 500$	$V > 500$
Output (Q) (Passenger trip miles/ vehicle-hour)	$Q < 50$	$50 \leq Q \leq 250$	$Q > 250$
Utilization (U) $\left(\frac{100 \times \text{output}}{\text{vehicle potential}} \right)$	$U < 25$	$25 \leq U \leq 50$	$U > 50$
Cost/passenger trip mile (C) (1972 cents)	$C < 5$	$5 \leq C \leq 25$	$C > 25$

COSTS OF RIDESHARING PROMOTION PROJECTS (1977)



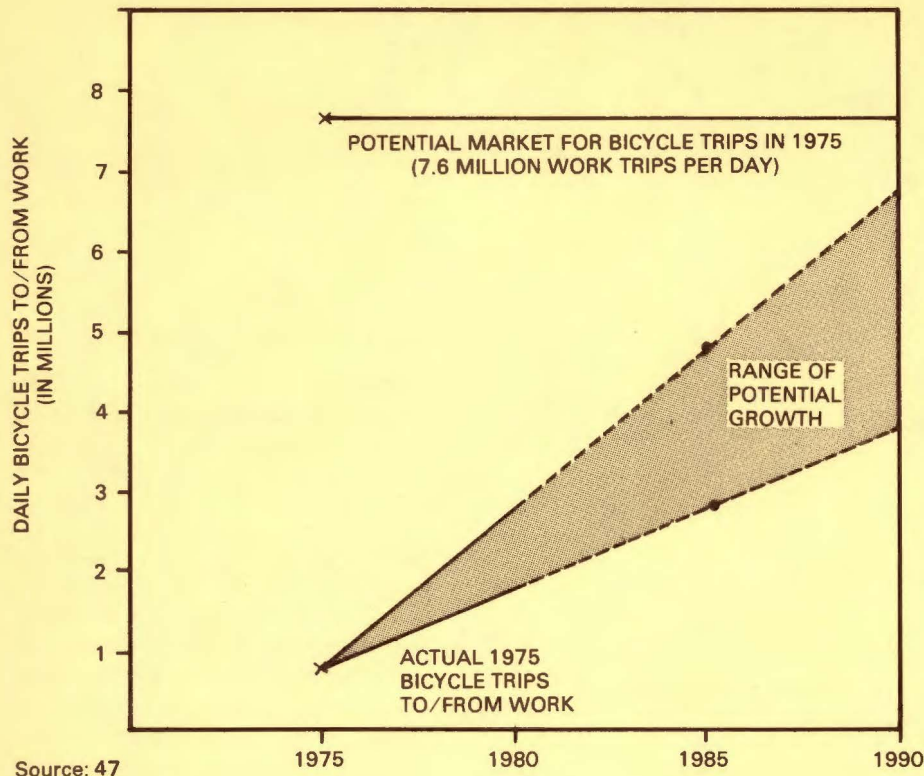
Source: 66

RIDESHARING TO WORK

In 1975, about one in five U.S. workers traveled to work by carpool (that is, more than one person per vehicle), while about two out of three workers drove alone. However, a significant amount of variation in the percentage of multiple-occupant trips exists between and within metropolitan areas reflecting population density, geography, transit availability, and other factors. Since a typical commuter automobile would seat four people comfortably, billions of passenger seat miles each day appear to be unproductive during the peak periods when transit is usually operating at full capacity: estimates range between 2 and 4 billion seat miles. However, numerous personal and tripmaking characteristics affect the propensity for ridesharing, including variations in working schedules, the need for business use of a car, relatively short commute distances, plentiful parking, and social attitudes.

The experience to date with programs to promote increased ridesharing has been mixed. While carpool or vanpool promotion and matching programs at larger employment sites have produced significant percentage shifts from single driver automobiles to pooling, the experience with areawide programs has been more modest, typically affecting about 1 to 2 percent of the areawide employment. But in most cases, the commuter ridesharing stimulated by these programs has cost the agencies funding them only ten to 20 cents per passenger trip while the vehicle miles of travel saved have cost only a few cents. **Thus while the impact of ridesharing programs has been modest when compared to the potential for ridesharing, the benefits of these programs have been achieved at relatively low costs compared to other options for reducing automobile travel.**

USE OF BICYCLES FOR TRAVEL TO WORK



BICYCLES AND MOPEDS

Bicycles and mopeds (motorized bicycles) are extremely energy efficient forms of transportation. Movement by bicycle requires only human power and is more energy efficient than walking. Mopeds are capable of 100 miles per gallon or more. Substitution of bicycle or moped for single person automobile travel yields substantial savings in energy consumption per trip.

There are constraints upon the use of either mode. It has been theorized that the bicycle could be an acceptable travel mode for work trips which are less than 6 miles in length and for which the current travel speed is 15 m.p.h. or less. When this market is adjusted to reflect older workers, auto dependency, physical limitations and environmental conditions the resultant estimate is that 3.8 million workers (about 4% of the total labor force) could commute by bike. This yields a potential of 7.6 million bicycle work trips per day.

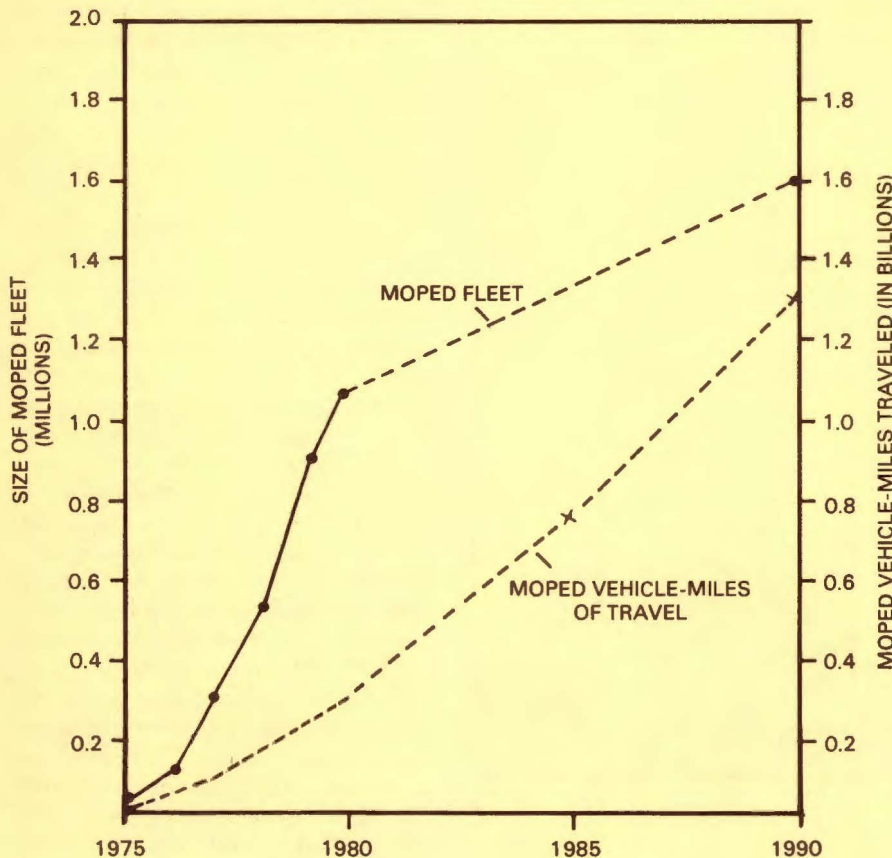
The potential for work travel by moped is larger as longer trips may be made, the environmental constraints are reduced and there is far less physical exertion. Moped sales have increased from 50,000 in 1975 to a projection of 400,000 in 1980. Although the rate of growth in sales appears to be leveling out the size of the moped fleet will continue to grow with over 1.5 million units in use by 1990.

Current use statistics suggest that the market for all bike and moped travel is 20-30 times the work trip potential.

Barriers to bike and moped use include lack of awareness of the potential (personal and institutional) and a general perception of lack of safety arising from both personal inability to properly handle the vehicle and fear of conflicts with automobile traffic.

In 1975, bicycle commuting accounted for 0.6% of all work travel. Programs to increase awareness and the provision in the most hazardous locations of road space designated for bike and moped use could result in a sharp increase in use. Even so, it would be surprising if more than 4% of all work travel were by bike or moped by 1990.

MOPED FLEET AND USE



TELECOMMUNICATIONS IN THE 1980'S

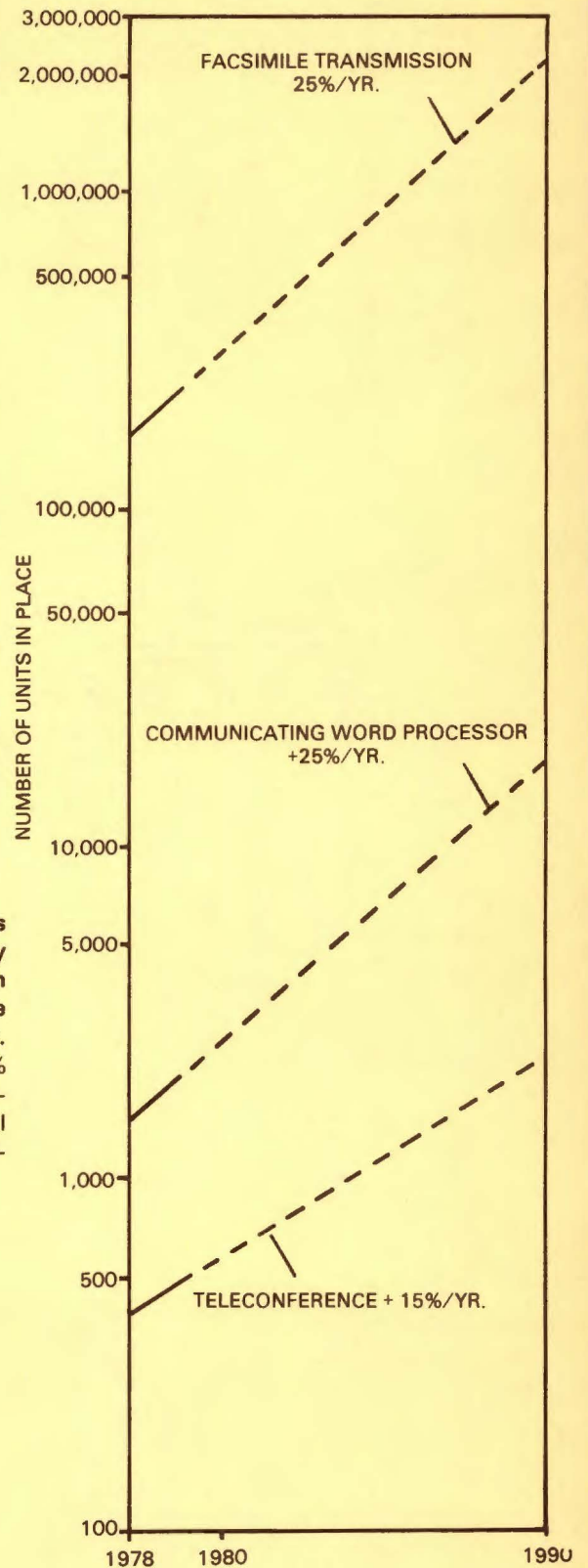
Substitution of telecommunications for travel is not likely to have a measurable impact on either energy usage or travel during the 1980's. The technology is available and costs are declining, but no major movement toward travel substitution is seen. Picturephone Message Service (AT&T Trademark) has been available since the mid 1960's for corporate teleconferencing. Approximately 400 units are now in service, primarily in large corporations. The market growth is estimated at 10-15% per year, but primarily among Fortune 500 firms. This will not make a substantial dent in business travel overall. Restructuring of work styles in favor of neighborhood work centers or work-at-home arrangements are not likely to have a major impact on travel in the 80's either. The seeds of such a movement are present, however. Large corporations now spin-off functional units to satellite locations away from the corporate center, e.g. computer divisions, but have not taken the further step of decentralizing operations to the neighborhood work center level. This would require a major social change in the way work is performed, and it will require an adjustment period to develop appropriate management procedures. Since the potential for decentralization with instant communication is only now becoming realizable, it will take a period of experimentation for it to become common practice. **The likelihood of major travel substitution in the 80's is low.**

There are facets of the telecommunications industry that are forecast to grow at a rapid rate during the 1980's, but they primarily replace mail service rather than personal travel. Reports from 1978 show:

- 170,000 facsimile transmission units are in place, growing at a 20-25% per year rate. There are about 114,000 Telex/TWX terminals in place as well, but this is a no-growth industry. Facsimile units will fast replace Telex as costs fall at a 22% per year pace.
- 14,000 communicating word processors are in place, growing also at a rate of 25% per year.
- Data communication is growing 18% per year.
- Electronic mail could replace 25-40% of first class mail by 1985. The Post Office currently handles 91 billion pieces of mail annually.
- Electronic Funds Transfer Systems (EFTS) are also growing. 80% of first class mail is business mail, and 70% of that is transaction-oriented, and thus amenable to EFTS.
- 20% of U.S. homes have cable TV and the growth rate has been 9-10% in the late 70's. This could accelerate to as high as 50% by the mid 80's if regulation permits 2-way cable TV with attendant add-on capability.

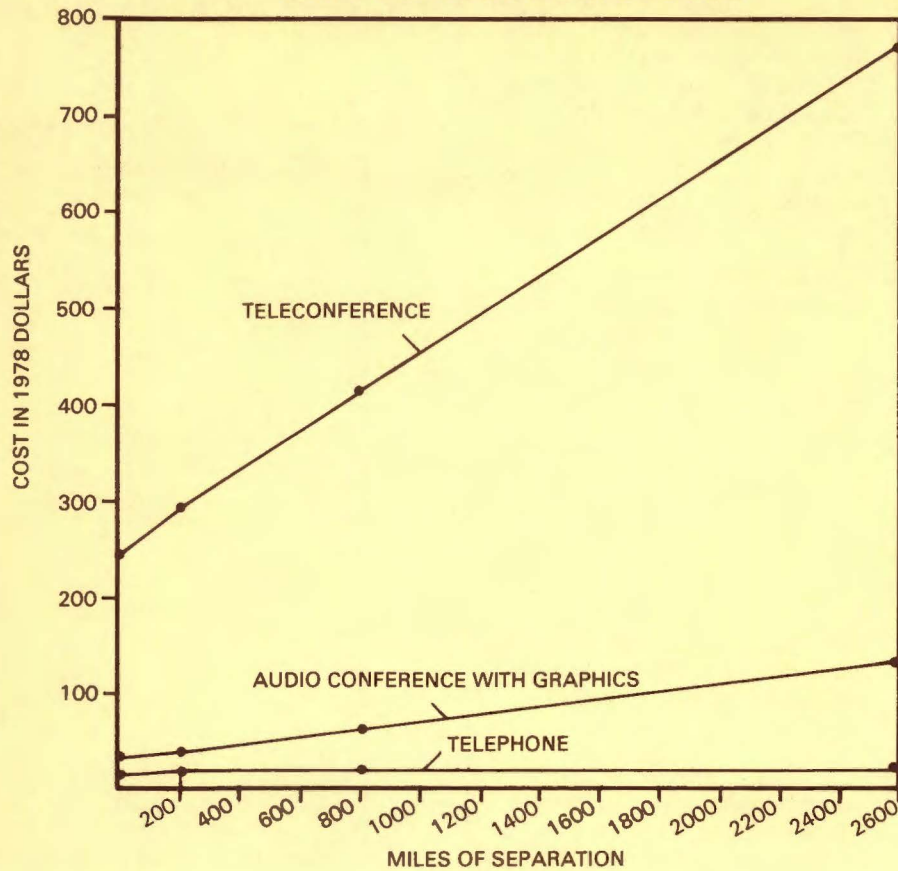
For the 80's, the growth segments of the telecommunications industry appear to be in data transmission and business mail. This will not have a significant impact on energy usage. The mail now accounts for only 0.1% of domestic highway and freight tonnage, so the potential for substantial energy savings by reducing mail volume is not great.

PROJECTED MARKET FOR TELECOMMUNICATIONS DEVICES



Source: 58

REMOTE CONFERENCING COSTS FOR TWO HOUR CONFERENCE



Source: 55, 58

COSTS OF TELECOMMUNICATION

The costs of video telecommunication are still quite high when compared to travel costs. A coast to coast conference costs about \$390 per hour, and a conference between New York and Washington costs about \$150 per hour. In the early 1970's, the capital cost of a Picturephone was about \$14,000.

Costs for an audio system with graphics are less than 20% the cost of Picturephone, and the capital cost is one tenth the cost at \$1400 per unit. Business conferences that are amenable to video transmission can largely be handled by an audio system at lower cost.

With respect to large scale distribution of Picturephone units in the home, costs are still prohibitive. A network of 5 million subscribers would require \$70 billion in initial capital. Currently, video transmission requires a band width 1000 times wider than audio transmission, so current transmission capacity would have to be vastly expanded.

Costs are coming down for telecommunications devices, however, and fiber optics may provide the transmission capacity required by wide-band systems. **At present, however, costs are still too high and transmission capacity inadequate to support a large-scale move to working at home.** Video teleconferencing could replace some business travel, but corporations have been slow to adopt the technology, because of cost, difficulty in connecting more than two conference rooms at a time, new communication skills required, and a feeling that it is not really necessary.

POTENTIAL FOR TRAVEL SUBSTITUTION

Estimates of the potential for travel substitution by telecommunications vary considerably, ranging from 16% of urban vehicle miles as shown (7% of U.S. Petroleum Demand) to only 1% of urban commuting (0.09% of petroleum demand). The range is primarily due to assumptions about the ability of the work force to decentralize to neighborhood work centers or to a work-at-home arrangement. The most optimistic forecast states that 85% of urban travel is for the exchange of information or ideas, and is therefore theoretically amenable to travel substitution. Social change is a larger issue than technological capability when forecasting the likelihood of a major move to travel substitution.

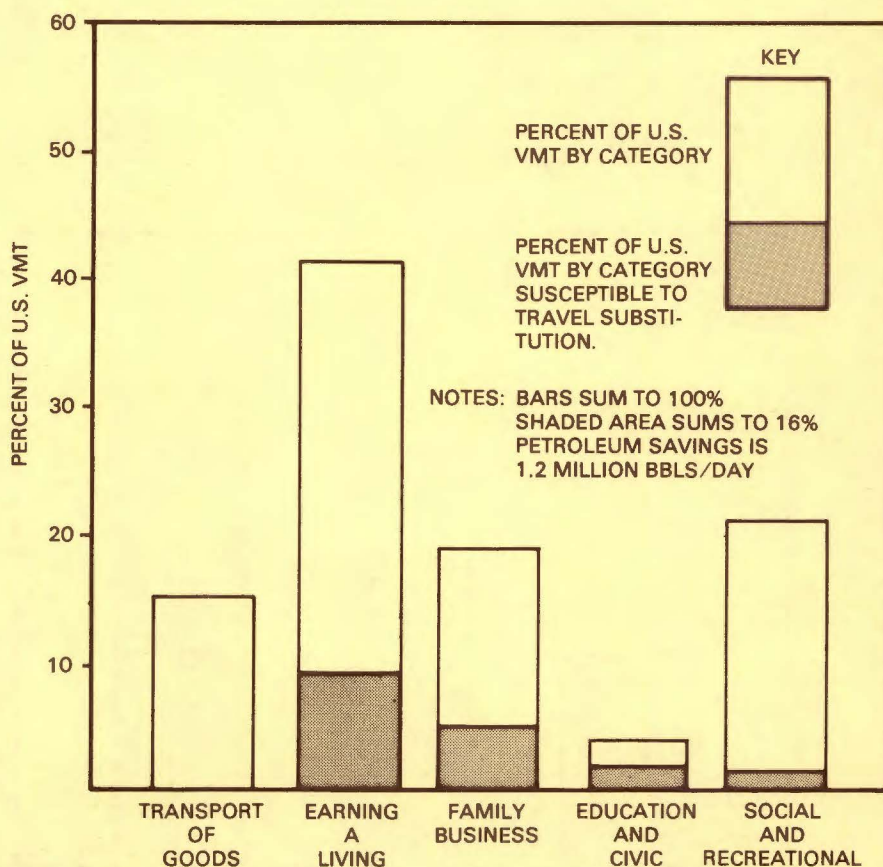
The most realistic estimates of travel substitution are stated as theoretical limits, recognizing that much business and social activity will always require face to face contact. Maximum substitution levels are:

- 20% of Business Air Travel (69,000 BBLs/DAY Saving)
- 20% of Business Auto Travel (115,000 BBLs/DAY Saving)
- Work travel by 50% of the office work force (470,000 to 640,000 BBLs/DAY Saving)

If these theoretical maximum rates of substitution were achieved in 1985, petroleum consumption would

be reduced by 3.5% or 824,000 barrels per day. This is a small reduction in petroleum consumption considering the social changes implied in shifting 50% of the nation's office work force to a work-at-home environment. Changes even approaching this magnitude are not likely during the 80's, since a movement has not begun in industry at this time and the capital investment is not in place to support it. A continuation of the trend toward establishing functional sub-groups of large corporations at satellite centers will continue in the 80's, gradually paving the institutional way to greater travel substitution, but not having an appreciable impact on travel or energy use in the 1980's.

LIMITS OF TRAVEL SUBSTITUTION POTENTIAL



Source: 50, 51, 56, 58, 61

COMPARATIVE GROWTH

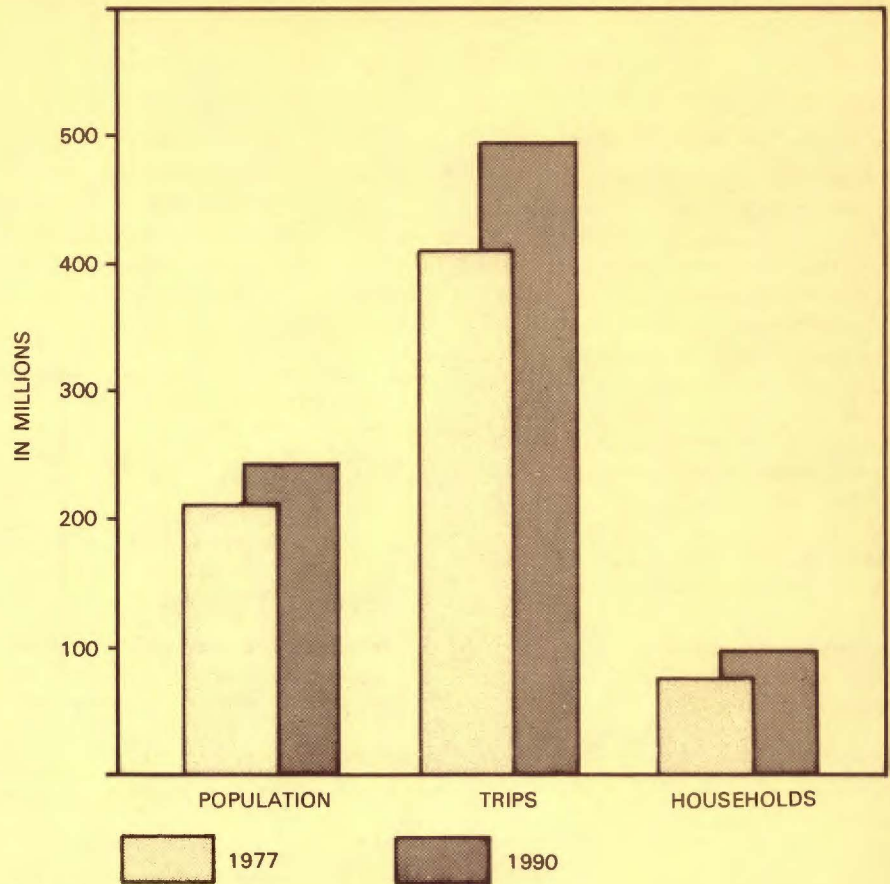
Between 1977 and 1990 the total U.S. population is expected to grow by 13% reaching approximately 242 million by 1990. During this same period the proportion of single person households will increase and the size of family households will decrease, resulting in an average of 2.5 persons per households in 1990. Households will increase at a much greater rate than population - 30% between 1977 and 1990.

Two factors combine to suggest that the growth in travel will be less than the growth in the number of households.

- 92% of the growth in households is expected to be in 1 and 2 person households
- 35% of the growth in households is expected to be in central cities.

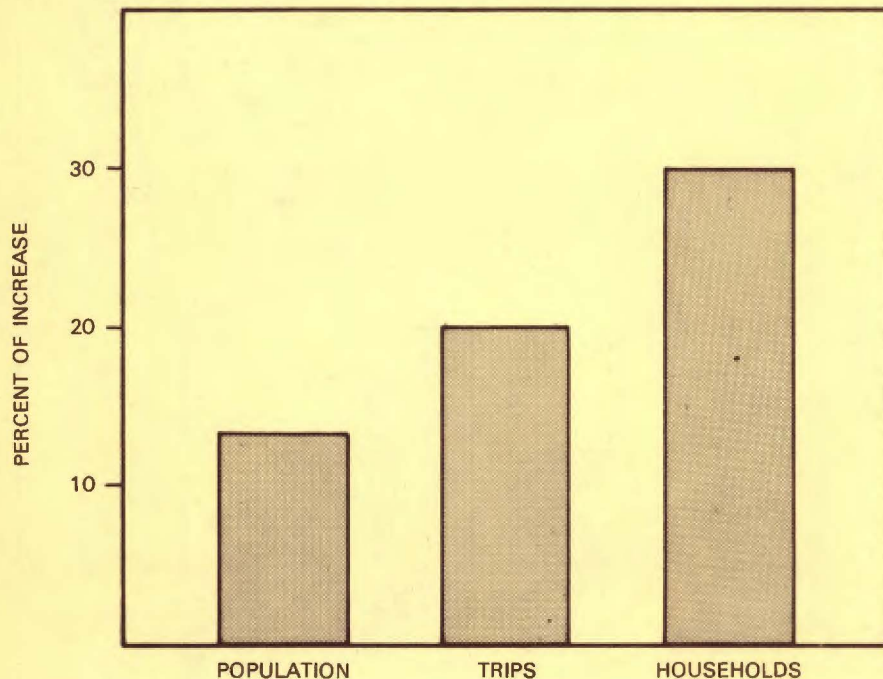
Households having these characteristics have lower rates of trip making than average. As a result, travel over the period of 1977-1990 is projected to increase by only 20%, even though the number of households will increase by 30%.

GROWTH IN POPULATION, HOUSEHOLDS AND TRIPS



Source: 9, 29, 33, 35, 46

PERCENT OF INCREASE (1977-1990)



Source: 9, 29, 33, 35, 46

TRIPS BY AREA

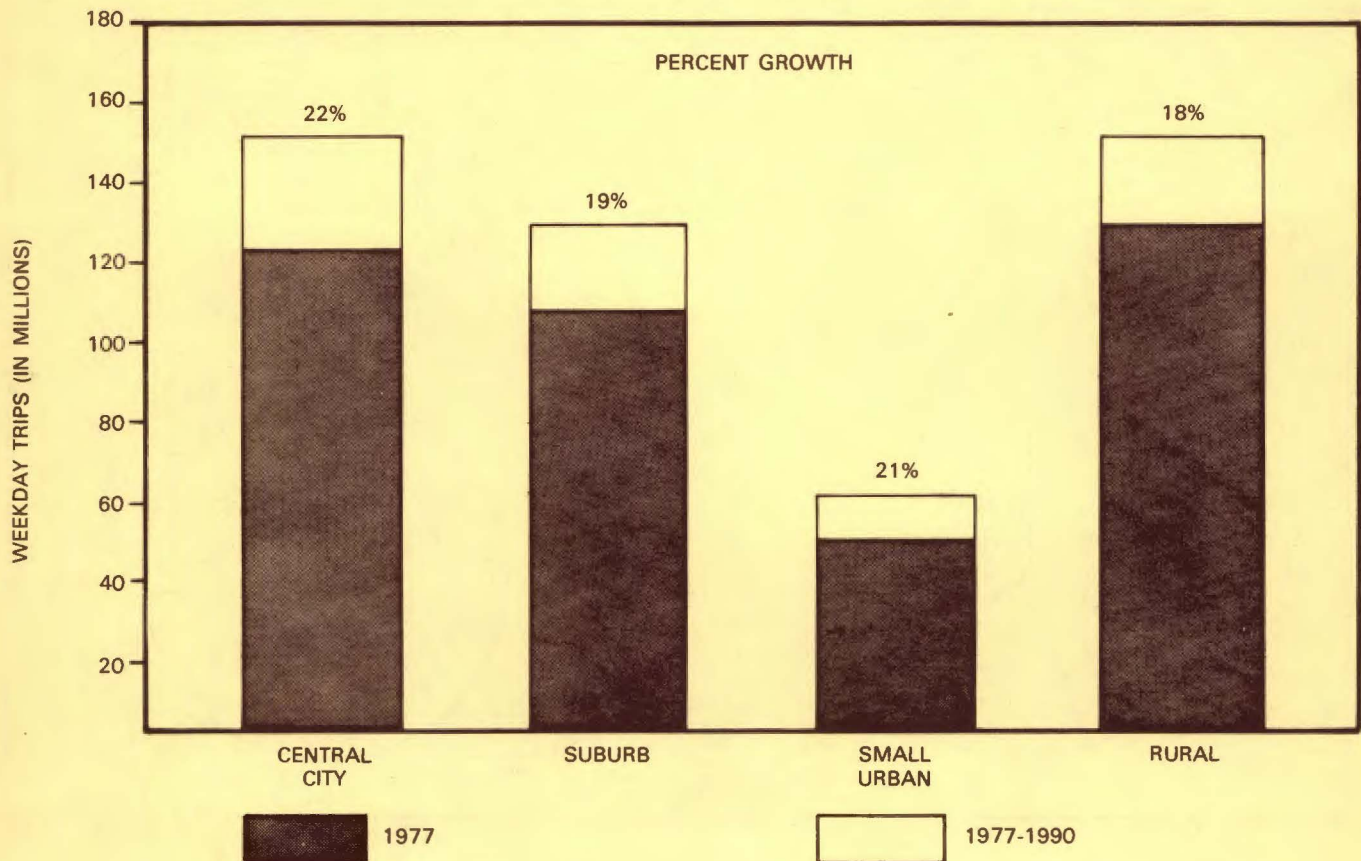
During the 80's all areas will experience a growth in the number of daily trips, which is a function of the increase in population and households. Although the largest increase in population is projected to occur in the suburbs of SMSA's the trend to single occupant households suggests that the largest absolute growth in the number of households will occur in central cities. As a result, the **greatest growth in the number of trips made will be by residents of central cities closely followed by residents of small urban areas.**

Central city residents will make over 152 million trips each weekday—30% of the national total. Trips by rural residents will be of equal magnitude. Trips by residents of SMSA's will comprise over 56% of the national total while trips by residents of urbanized areas between 5000 and 50,000 population make up only 12%.

Transit travel in central cities should grow at a rate similar to that for total travel. Factors favoring increased use of transit are:

- The growth in single person households which tend to locate in central cities and in multi-family structures. Persons living alone are less likely to travel in groups, thus increasing the effective cost of automobile use. Further, a larger proportion of trips by one-person households tend to be to or from work. These trips are more likely to be attracted to transit.
- An increasing number of elderly persons who are offered reduced fare transit travel
- Existing transit services are best in the central cities—the area in which the largest trip growth is expected.

WEEKDAY TRIP GROWTH BY RESIDENCE OF TRIP MAKER (1977-1990)



TRAVEL BY AREA

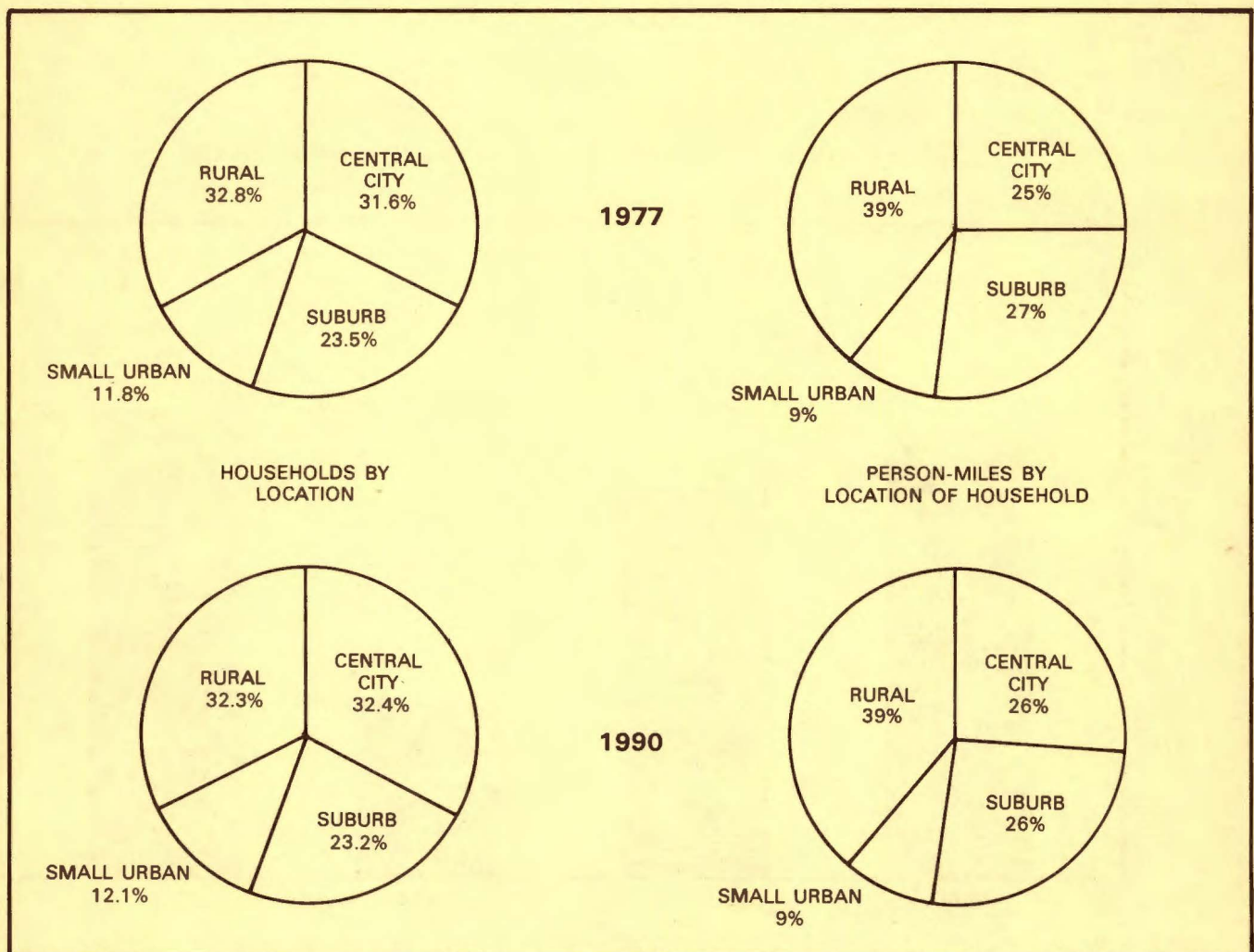
Expressed as proportions of national totals, changes in household location and travel are expected to be small between 1977 and 1990. The proportion of households in central cities and small urban areas will grow slightly as will the person-miles of travel associated with these households.

During the 80's weekday person-miles of travel will increase by roughly 20%. In few locations will the growth in transportation system supply (i.e.,

lane-miles of roadway, vehicle-miles of transit service) keep pace with this growth. While both highway and transit facilities have spare capacity in off-peak hours neither system has room for substantial peak growth.

Central city households comprise roughly 32% of the national total but generate only 25% of the person-miles of travel. Suburban households represent 23% of the total but contribute 26% of the travel.

DISTRIBUTION OF HOUSEHOLDS AND TRAVEL 1977-1990



GEOGRAPHIC TERMS

Standard Metropolitan Statistical Area (SMSA) An area qualifies for recognition as an SMSA if:

1. It has a city with at least 50,000 people within its corporate limits.
2. It has a U.S. Bureau of the Census urbanized area of at least 50,000 people and a total metropolitan statistical area population of at least 100,000.

urbanized area The U.S. Bureau of the Census defines urbanized area as having a population of at least 50,000 people and the boundary is based primarily on a population density of at least 1,000 persons per square mile.

central city Every metropolitan statistical area has at least one central city, which is usually the largest city. Smaller cities are also identified as central cities if they have at least 25,000 population and meet the following commuting requirements:

1. There must be at least 75 jobs for every 100 residents.
2. At least 40% of the resident workers must be employed within the city limits.

In addition, any city with at least 250,000 population or at least 100,000 persons working within its corporate limits qualifies as a central city. Finally, places with population between 15,000 and 25,000 also qualify as central cities if they are at least one-third the size of the metropolitan statistical area's largest city and meet the two commuting requirements above.

suburb Urbanized area within an SMSA but not within a central city.

small city Any urbanized area exceeding 5,000 population but not in an SMSA.

rural Any non-urbanized area whether or not included in an SMSA plus any urbanized area under 5,000 population not included in an SMSA.

nonmetropolitan area Any area outside of an SMSA.

census regions

- Northeast — Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania
- North Central — Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas
- South — Delaware, Maryland, Virginia, District of Columbia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas
- West — Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, Hawaii

SOCIOECONOMIC TERMS

household All persons occupying a housing unit, such as a house, apartment, or rooms that form separate living quarters. The household is the basic sampling unit used by the Bureau of the Census.

family household Persons living in a housing unit who are related by birth, marriage or adoption.

non-family household Single-person households or household units of two or more unrelated persons.

personal consumption: transportation Includes all expenditures on motor vehicles, gasoline, oil, and other transportation.

labor force participation rate Percentage of population (male, female and total) aged 16 and over either employed or actively looking for work.

aged dependency ratio Ratio of population 65 years of age or older to the working age population, 20 to 64 years of age.

MIGRATION TERMS

inmigration Total migration into an area from other parts of the country, usually expressed as the number of people over age m living in an area who lived in another area n years ago.

outmigration Total migration from an area to another part of the country, usually expressed as the number of people over age m who lived in that area n years ago and are now living elsewhere.

net migration Difference between inmigration and outmigration.

net immigration Number of people legally entering the U.S. from abroad minus the number of people leaving to live in other countries.

TRANSPORTATION TERMS

average auto occupancy The number of automobile passengers plus drivers divided by the number of automobile drivers making a certain type of trip, e.g. average work trip auto occupancy.

person trip All travel by an individual that involves a change of address. Travel from home to work and a return from work-to-home is counted as two person trips.

household trips The sum of all person trips made by members of a household.

Vehicle Miles of Travel (VMT) The sum of the mileage traversed by all vehicles in a certain class over some period of time. One typically speaks of annual VMT by autos, annual truck VMT, etc.

Person Miles of Travel (PMT) The sum of the miles traveled by all persons in a category over a certain time period. One typically speaks of annual PMT for the nation, for women, etc.

transit, public (mass transit) Passenger transportation service, usually local, that is available to any person who pays a prescribed fare; it operates on established schedules along designated routes with specific stops (e.g., bus, light rail, rapid transit).

paratransit Forms of public transportation services that are more flexible and personalized than conventional fixed-route, fixed-schedule service. Vehicles are usually available to the public on demand, by subscription, or on a shared-ride basis.

transportation handicapped Persons who cannot use transit or can use transit with difficulty because of physical or mental impairments that do not allow them to carry out required functions (e.g. negotiate grade change, understand directional information) under current physical configurations.

ENERGY TERMS

barrel Liquid volume measure equivalent to 42 U.S. gallons or 5.8 million BTU's.

British Thermal Unit (BTU) The amount of heat required to raise the temperature of one pound of water 1° Fahrenheit under stated conditions of pressure and temperature.

million 1×10^6

billion 1×10^9

trillion 1×10^{12}

quadrillion 1×10^{15} ; the short-hand term "Quad" is used to refer to 1 quadrillion British Thermal Units (BTU's). Total energy reserves or consumption is generally expressed in Quads, because it is a common unit that expresses the energy content of a fuel regardless of its source, e.g. coal, crude oil, uranium.

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