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Foreword

Economic forecasts, forecasting methods, and the data on which forecasts are based are matters of prime concern today to transportation researchers and planners. The six papers contained in this Record will be of special interest to those highway and transportation researchers and planners concerned with the problems of urban areas. They deal with the basic elements of such problems—people, where they live, the vehicles they own, and why and how they travel. The papers also are concerned with such related matters as trends in vehicle ownership, and the relationships between user-tax earnings and highway income and expenditures in metropolitan areas. Although forecasts are not made in the papers presented here, there is considerable discussion of how the data dealt with can be used in making forecasts and of the strengths and weaknesses of some of the forecasting procedures in common use today.

Bottiny, in "Trends in Automobile Ownership and Indicators of Saturation," deduces from the data examined that the growth of automobile ownership in the United States has followed a normal growth curve, and thus it may be expected that a saturation point will eventually be reached more quickly in some areas than in others. His conclusion is based on analysis of nationwide population, vehicle registration, and sales data from 1910 through 1964, supplemented by intensive analyses of data for the ten states showing greatest ownership growth compared with similar data for the remaining states. Special attention is given to the effects of urbanization on these trends.

Kanwit and Glancy illustrate in their paper, "Use of Metropolitan Area Census Data for Transportation Planning," how some of the extensive information on automobile availability and workers' commuting patterns, obtained for the first time in the 1960 Census of Population, can be applied, along with other data available from the same source, in making some of the forecasts needed for sound urban transportation planning.

Two of the papers deal with different aspects of the same study. Lansing and Mueller, in "Residential Location and Urban Mobility," describe and interpret some of the findings of the study of urban households they conducted for the U. S. Bureau of Public Roads at the University of Michigan. Although Stowers and Kanwit also discuss the findings of the study, the main concern in their paper, "The Use of Behavioral Surveys in Forecasting Transportation Requirements," is with the implications of these findings and the behavioral study procedures which produced them for urban transportation planning.

In "Travel Characteristics of Persons Living in Larger Cities," Bostick and Todd analyze and interpret information obtained by the Census Bureau for the U. S. Bureau of Public Roads on the travel patterns of about 1,300 households located in cities of 100,000 population or over. Home-to-work travel patterns of workers residing in these households are analyzed with special emphasis on the relationship between mode choice and distance from home to nearest public transportation to work, and family income. Also included are analyses of automobile trips designed to indicate the relationship between income and trip distribution by purpose of travel. Attention is also given to the proportion of total automobile trips destined to the downtown area, classified by purpose.

Bielak and McCarthy, in their paper on "Highway Income, Expenditures, and User-Tax Earnings in Standard Metropolitan Statistical Areas," are primarily concerned with determining whether road-user tax earnings from travel in the SMSA equal the amounts of income received for and expenditures made on the highways located in such areas. Their conclusion is that user-tax revenues generated by the travel in such areas are generally of the same order of magnitude as the highway expenditure made.

Contents

Trends in Automobile Ownership and Indicators of Saturation

WALTER H. BOTTINY, Economist, U. S. Bureau of Public Roads

Trends in automobile ownership and the effects of underlying social factors are examined here in a broad perspective for the purpose of developing indicators of potential growth and saturation in the ratio of automobiles to population.

The historical growth of automobile ownership rates for the nation as a whole is recapitulated. The growth rate in automobile ownership for the ten states with the largest increase in automobile registrations is compared with the growth rate in the group of remaining states, indicating the effect of increasing urbanization.

Rates of growth in automobile ownership for selected states are studied in relation to the major determining factors in each state with particular attention to the effect of growing urbanization.

This study is a first step toward development of a model which could be used to gage the potential growth of automobiles and indicate the point at which the ratio of automobiles to population has reached or will reach saturation level in a particular geographic area.

•ECONOMIC INDICATORS serve as diagnostic tools in the examination of the health of the economy. Gross National Product, the Index of Industrial Production and the Rate of Unemployment are a few regularly used indicators of the level of economic activity and its growth rate.

Indicators of automobile ownership may be used by highway researchers and planners to measure the increase in ownership. Some available indicators of the existing levels and trends in automobile ownership are automobiles per capita; autos per household; number of occupied housing units with no car, one car and two or more cars available; automobile registrations per licensed driver; and automobile registrations per potential owner.

Personal ownership is the main consideration of this report. Data on this specific type of ownership are indicative rather than explicit. Therefore, the indicators used here, although not showing the precise number of automobiles owned by individuals, do indicate the level of ownership in one area as compared to another and the growth in individual automobile ownership.

Before analyzing recent data on automobile ownership by state and local area, a brief description is given of the historical growth of automobile production and registrations for the whole nation.

Paper sponsored by Committee on Economic Forecasting.

DISAGGREGATION METHOD

The analytical approach used in this paper is the disaggregation method by which the whole is divided into major components and then subdivided into smaller components. The United States is first divided into two major component areas, the first of which included the ten states having the largest absolute increases in automobile registrations during the 1953 to 1963 period (California, Texas, Florida, New York, Ohio, Pennsylvania, Illinois, New Jersey, Michigan and Georgia). The remaining states comprise the other area. Automobiles per capita in each of the two groups of states are studied in relation to underlying socio-economic factors such as population, personal income per capita, population concentration and existing automobile availability. The ten state group is then broken down into three subgroups made up of the states having high, medium, and low growth rates in autos per capita. Some socio-economic factors are then related to these varying rates of growth in automobile ownership.

Some states are studied individually to analyze the effect on the growth in automobile ownership of such economic and social factors as existing automobile availability, personal income per capita, population density of large cities, population change between central city and suburbs, and the relative use of public transportation for the journey to work.

To demonstrate the use and analysis of these data at the local level, two counties with high levels of automobile ownership are examined with respect to the basic underlying factors (Los Angeles, California, and Nassau, New York).

Data Sources

The key indicators of level of automobile ownership, by state, are developed from data published by the U. S. Bureau of Public Roads and the Bureau of the Census. Automobile registrations and licensed drivers, by state, are published annually by Public Roads in Highway Statistics (1). Population estimates by state are published annually by the Census Bureau in its Current Population Reports (2). Data on automobile availability were compiled by the Census Bureau through a 25 percent sample survey in urban areas (5 percent elsewhere) conducted in conjunction with the 1960 Housing Census (3).

Automobile registration data in this paper are taken from Highway Statistics, Table MV-1. These data are compiled for the calendar year from reports of state authorities. The reported data are supplemented in some instances by information from other sources to represent registrations as uniformly as possible. When the registration year is not more than one month removed from the calendar year, registration-year data are given. When the registration year is more than one month removed, registrations are given for the calendar year.

Registrations of privately and commercially owned automobiles (including taxicabs) are not segregated in Table MV-1. The total number of automobiles (excluding station wagons) commercially owned in fleets of four or more is estimated at 8,200,000 (14). In addition, an indeterminate but large number of automobiles are owned individually, and in fleets of less than four, by small business men and shopkeepers, many of whom use their cars for both business and pleasure. Commercial ownership, while comprising a large segment of private and commercial registrations, is considered a fairly stable proportion of the total and, therefore, does not impair the usefulness of these data in making trend analyses of private automobile ownership.

Automobiles available to a housing unit represent passenger automobiles, including station wagons, and some company cars owned or regularly used and ordinarily kept at home by any of the occupants of the unit. Taxicabs, pickups or

larger trucks, and dismantled or dilapidated cars in an early stage of being junked were not included.

These data are based on results of the 1960 Census of Housing conducted by the Bureau of the Census as of April 1, 1960. Automobile availability data provided cross-section information on household ownership of automobiles for 1960 by state, county and city. Trend information, therefore, is not provided by these data.

Automobile ownership by household at the national level is quoted annually in Automobile Facts and Figures (4). These data are based on sample surveys conducted by Alfred Politz Research, Inc., as part of the National Automobile and Tire Survey sponsored by Look magazine, and are useful for trend analyses at the national level only.

Data on automobile ownership and family expenditures for auto purchase and operation by urban families were collected in the Survey of Consumer Expenditures in 1960-61 conducted by the Bureau of Labor Statistics. Some of these data are compared with those of 1950 in the March 1964 number of the Monthly Labor Review (5). Trend data on automobile ownership and family expenditures for automobile purposes are thus provided for large urban areas.

The registration data are applied to the population data to obtain the autos per capita ratios used to indicate trends in automobile ownership by state. Census data on automobile availability are used to indicate the level of ownership by state and local areas.

HISTORICAL RECORD

Growth of an Industry

Nationally, over the past half-century, automobile registrations have grown to a total of almost 72 million at the end of 1964. Auto production rose to an unprecedented level in 1955 when it attained an output of 7.9 million passenger cars (the 1955 high was largely attributable to the extension of automobile credit from 24 to 36 months) and approached this total again in 1964 with an estimated output of 7.7 million units (Table 1).

By adjusting the curve in Figure 1 to overcome abnormal periods, it can be shown that factory sales of automobiles followed a growth pattern characterizing a successful industry, referred to as the law of growth (6). After the experimentation and introduction stage between 1895 and 1910 came the period of public acceptance when production increased rapidly as the product was woven into the social fabric. In the mid-twenties the automobile industry entered the third stage of growth with production increasing at lower rates. The depression, war, and early postwar periods that followed distorted the growth pattern. Thereafter, production resumed the normal growth pattern of the third stage. Production increased more gradually with the approaching fourth stage of stability. Thus, by smoothing the automobile production curve on 5-yr average production figures up to 1930, ignoring the depression, war, and early postwar periods from 1930 to 1950 and extending the curve between the high and low production figures of the fifties, a growth curve is depicted which is common to many industries.

With the exception of the depression and war periods, the ratio of persons per new automobile sold declined continuously to 21 in 1955 (Table 1). Ratios of average annual production to population in each 5-yr period have remained virtually unchanged over the last three 5-yr periods (1950-54, 1955-59, 1960-64), indicating only slightly higher production levels, in relation to population than that of the 1925-1929 period (Fig. 1). In relation to the trend line, production has been somewhat above normal during the last two years.

TABLE 1

TRENDS IN PRODUCTION AND REGISTRATIONS OF AUTOMOBILES SINCE 1900[a]

Year	Population (thousands) July, 1[b]	Automobile Registrations (thousands)[c]	Automobile Production[d]	Persons per Automobile Registration	Persons per New Automobile Sold	Registrations per New Automobile Sold
1900	76,094	8	4,192	9,511.8	18,152.8	1.91
1905	83,820	77	24,250	1,088.6	3,456.5	3.18
1910	92,407	458	181,000	201.8	510.5	2.53
1915	100,549	2,332	895,930	43.1	112.2	2.60
1920	106,466	8,132	1,905,540	13.1	55.9	4.27
1925	115,832	17,440	3,735,171	6.6	31.0	4.67
1930	123,077	22,973	2,787,456	5.4	44.2	8.24
1935	127,250	22,495	3,273,874	5.7	38.9	6.87
1940	132,457	27,372	3,717,385	4.8	35.6	7.36
1945	133,434	25,691	69,532	5.2	1,919.0	369.48
1950	151,868	40,185	6,665,863	3.8	22.8	6.03
1955	165,069	51,951	7,920,186	3.2	20.8	6.56
1960	179,992	61,307	6,674,796	2.9	27.0	9.18
1961	183,057	63,012	5,542,707	2.9	33.0	11.37
1962	185,890	65,649	6,933,240	2.8	26.8	9.47
1963	188,616	P 68,683	7,637,728	2.7	24.7	8.99
1964	191,300	P 71,864	7,700,000(Est)	2.7	24.8	9.33

[a]Data derived from Automobile Manufacturers Association, Inc. Automobile Facts and Figures, 1963, 1964; U. S. Bureau of Public Roads, Highway Statistics, Table MVI; and U. S. Bureau of the Census, Statistical Abstract of the United States, p. 5, 1964.
[b]Excludes Armed Forces abroad. [c]Private and commercial. [d]Factory sales.

Increasing Automobile Registrations and Production Requirements

Automobile production has doubled from an annual average of less than 3 million cars in the early twenties to almost 6 million in the late fifties. During these four decades automobile scrappage rose from less than 1 million to over 4 million. The net addition to total automobile registrations was the same in both these periods (Table 2).

Thus, as the existing fleet grows, scrappage replacement places greater demand on production, causing an increasing pressure on the resources necessary to produce this major consumer durable, accentuated by the annual model changeover. Under near full-employment conditions, competing demand for the labor, raw materials

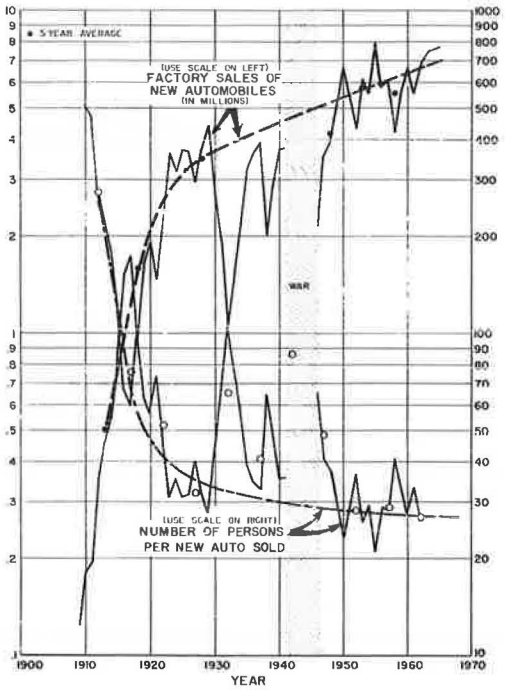

Figure 1. Trend in automobile production.

TABLE 2

AUTOMOBILE PRODUCTION, REGISTRATIONS AND SCRAPPAGE[a]

Period	Cumulated Automobile Production (thousands)	Increases in Automobile Registrations (thousands)	Automobile Scrappage (thousands)[b]
1921-1925	14,288	9,308	4,980
1956-1960	27,711[c]	9,356	20,531

[a]Derived from Automobile Facts and Figures, p. 20, 1964 Ed.; data estimated by Automobile Manufacturers Association.
[b]The amount for the 1921-1925 period is the difference between production and registrations. It does not, therefore, account for the effect of changes in inventories of new and used car dealers. The amount for the 1956-1960 period is estimated by the American Manufacturers Association.
[c]Domestic sales only.

and components will result in rising costs to the automobile manufacturer and his suppliers, who will pass them on to the consumer. Under some conditions, the inflationary push will be especially troublesome; the unnecessary drain on resources eventually is likely to be even more serious.

Underlying Factors

Effective demand, consumers' desire to own coupled with ability to buy, was the economic factor underlying the rapid increases in automobile registrations of the early twenties and the post World War II increases up to the mid-fifties. Demand in the twenties reflected the general public acceptance of the automobile and extensive road improvements enhanced the desirability of having a family car. Family income was sufficient to create a large automobile market.

Because of the low incomes during the depression and suspended production during World War II, the desire of many of these people was frustrated. The rise in income during the war, along with increased personal savings resulting from wartime spending restrictions, provided the ability to buy. These factors were behind strong effective demand of the postwar period which saw production and registrations increase rapidly until they caught up to the growth level similar to that of the early 1920's when the automobile had already established itself as a popular mode of travel (Fig. 2).

By the late forties and early fifties, the number of consumers desiring to own automobiles had greatly increased. There were those persons whose wartime savings put them in a position to buy cars; something they could not afford before the war. Many others wanted to replace their wornout prewar models with new cars. This large pool of effective automobile demand lay dormant during the war because production had been suspended. In addition, there were the many newly licensed young drivers, as well as many elderly people who were now able to buy cars.

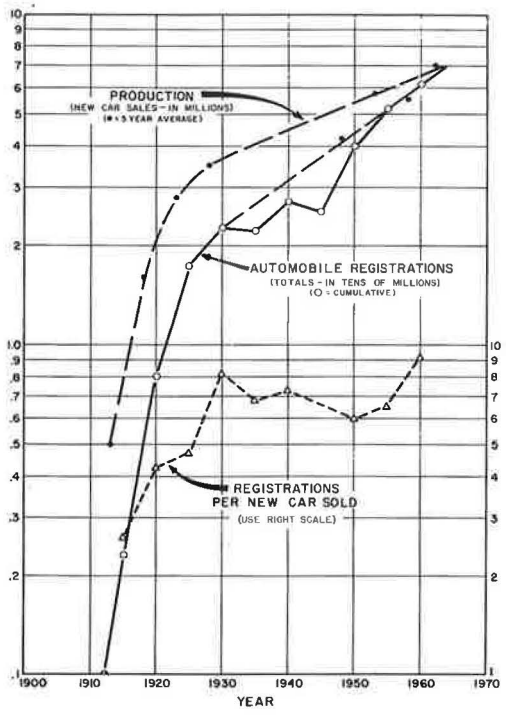

Figure 2. Trends in automobile production and registrations, 1912-1960.

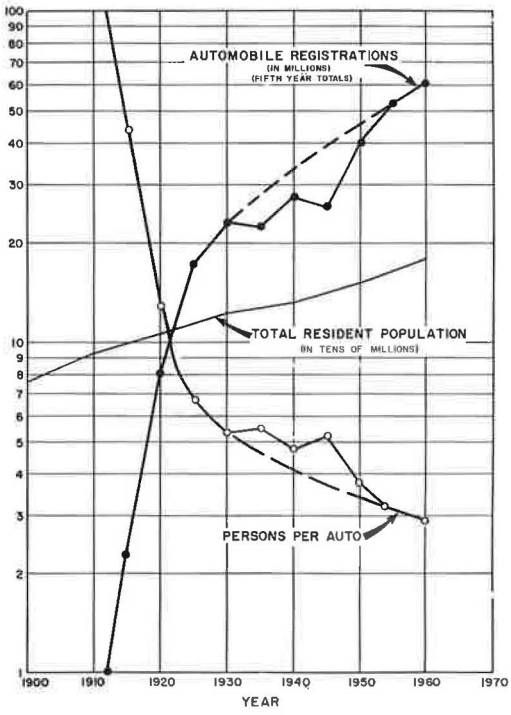

Figure 3. Trends in automobile registrations and population.

Between 1947 and 1956 registrations jumped 74 percent, about the same rate as during the twenties. In the more recent period, 1956 to 1963, the increase in registrations was 31 percent, half that of the earlier period (Fig. 3).

Automobile Ownership by Household

Multicar ownership has steadily become more important and has been a major factor in the market for some time. Households owning two, three or more cars have more than doubled in the past ten years. From 4.2 million households in 1954, they have increased to 8.7 million in 1963 (Table 3). In 1954 multicar households owned 23 percent of the automobiles; now they own approximately 35 percent. Households having one car increased slightly from 30.1 million to 34.6 million during this period while the number of those with no car remained unchanged. Had multicar households increased at the same rate as one-car households, the total number of automobiles now in use would be approximately 10 percent less than its present total (Fig. 4).

Rising multicar ownership coincides with the rapid growth of suburban population as indicated in Table 4.

Members of families who move to the suburbs find their mobility limited by the lack of transportation. Often the head of the household uses the family car to get to work or on the job, leaving his wife without means to carry out important errands, keep medical or dental appointments or visit persons several miles distant. As children come of age and acquire drivers' licenses, they, too, desire to own automobiles—a demand supportable by steadily rising family real income. States with high proportions of their population residing in large central cities, such as New York, Illinois and Pennsylvania,

TABLE 3

AUTOMOBILE OWNERSHIP BY HOUSEHOLD, 1954-1963[a]

Year	Total Households	Cars per Household			
		None	One	Two	Three or More
	(a) Millions				
1954	47.0	12.7	30.1	3.8	.4
1955	47.9	12.8	30.3	4.3	.5
1956	49.0	13.0	30.4	4.9	.7
1957	49.9	13.4	30.3	5.4	.8
1958	50.5	12.9	31.2	5.7	.7
1959	51.4	13.2	31.2	6.4	.6
1960	52.3	12.8	32.4	6.4	.7
1961	53.7	13.0	33.3	6.6	.8
1962	54.5	12.5	34.1	7.2	.7
1963	55.9	12.6	34.6	7.5	1.2
	(b) Percent				
1954	100.0	27.0	64.0	8.1	0.9
1955	100.0	26.7	63.3	9.0	1.0
1956	100.0	26.6	62.0	10.0	1.4
1957	100.0	26.9	60.7	10.8	1.6
1958	100.0	25.5	61.8	11.3	1.4
1959	100.0	25.7	60.7	12.4	1.2
1960	100.0	24.5	62.0	12.2	1.3
1961	100.0	24.2	62.0	12.3	1.5
1962	100.0	22.9	62.6	13.2	1.3
1963	100.0	22.5	61.9	13.5	2.1

[a]Data quoted in Automobile Facts and Figures, Automobile Manufacturers Association.

TABLE 4

MULTICAR OWNERSHIP AND GROWTH OF SUBURBAN POPULATION

Area	Households in Each Group Owning 2 or More Cars (%)	Total Multicar Households (%)
Metropolitan area		
In central cities:		
500,000 or over	8.4	9.1
Under 500,000	13.1	13.9
Metropolitan suburbs	21.3	38.8
Outside metropolitan area:		
Non-farm	15.8	31.0
Farm	14.9	7.2

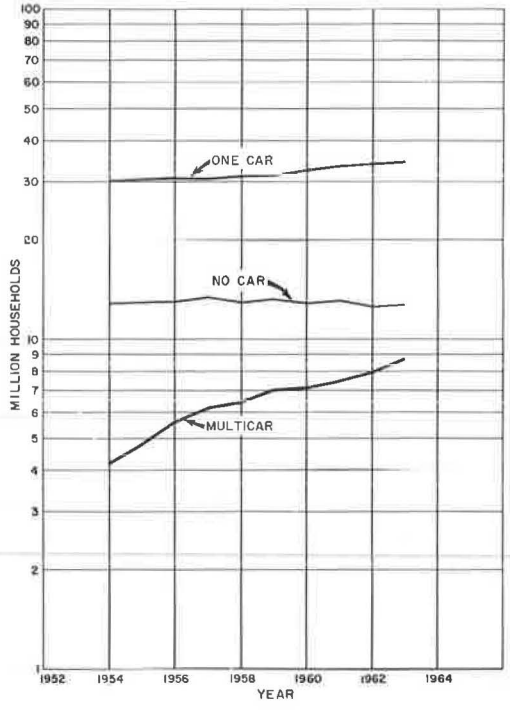

Figure 4. Trends in automobile ownership by households.

TABLE 5

HOUSEHOLD OWNERSHIP OF AUTOMOBILES RELATED TO UNDERLYING POPULATION FACTORS IN 1960

State	Occupied Housing Units		State Population in Central Cities of over 400,000 (%)	Persons/Sq Mi in Central Cities of over 400,000 (No.)
	No Car Available (%)	Two or More Cars Available (%)		
New York	47.0	12.0	49.5	23,456
Illinois	23.5	16.6	35.2	15,836
Pennsylvania	23.4	17.7	23.0	13,612
Texas	17.6	27.2	23.0	2,871
California	15.7	31.0	28.7	5,675

where the population density (persons/sq mi) is high, have high percentages of households with no car available and low percentages of households with two or more cars available (Table 5).

Thus, households without cars are most prevalent in large, densely populated central cities where public transportation is available. Of course, households without cars, in which there is no person qualified to drive, or in which income is extremely low, can be found in both urban and rural areas.

ANALYSIS OF INDICATORS OF AUTOMOBILE OWNERSHIP AND SATURATION

Commentaries on Saturation

Most analysts anticipate that eventually the rate of ownership will reach some point of stability or a saturation level. Are we approaching it at the present time anywhere in the United States?

In the article Need We Fail in Forecasting? Kanwit, et al. advised that

> Most highway economists and planners are conservative enough to believe that a saturation point in the ownership of motor vehicles will be reached eventually, after which further increases in registrations will depend on further increases in total population, and shifts from segments having lower saturation points to those having higher ones. What are these saturation points? No one can safely predict yet, what they may be, but the long-term trend lines appear to be stabilizing in some areas of high-density registrations. [Emphasis added.]
>
> It has been believed in some quarters that a practical limit will have been reached when there is one motor vehicle registered for each operator licensed. (10)

Schmidt and Campbell in Highway Traffic Estimation stated

> As to the saturation point and its data, one can only surmise. California now (1955) registers a vehicle for each two and two-tenths residents and a passenger car for each two and four-tenths residents. There has been some thought that the limit for passenger cars will be reached with two cars per household. On this basis the limit would be one and seven-tenths persons per passenger car. (11)

In Future Highways and Urban Growth, Wilbur Smith and Associates, after comparing ownership rates in some urban study areas, concludes

> If this is the case it would appear that an ownership ratio of about one car for every 2.5 persons represents a normal saturation level.

Relating licensed drivers to family income and car ownership the same report concludes

> Thus where cars are few, the ratio of drivers to cars is high; where cars are many, the ratio to cars tend to approach one. It would appear, therefore, that high-income families may be gradually approaching an upper limit of car ownership (one licensed driver per car owned). (12)

These and other specialists in the field of highway research generally agree that saturation will be attained when the automobile ownership rate remains stable for a reasonable period of time. An acceptable period of stability, perhaps 3 to 5 years, may be determined by the historical rate of change in the automobile-population ratio under social and economic conditions peculiar to the geographical areas under study. This period would take into account the effect of normal business-cycle patterns.

Group of Leading States vs Group of Remaining States

During the 10-yr period from 1953 to 1963, automobile registrations in the country as a whole increased 50 percent from 46 million to 69 million. At the same time, population increased 24 percent, from 152 million to 189 million.

More than half of the increase in automobile registrations was concentrated in the 10 states having the largest absolute increases in automobile registrations from 1953 to 1963, as indicated in Table 6.

Use is sometimes made of 10 leading states to illustrate relatively large increases in state automobile registrations. The U. S. Bureau of Public Roads, for example, in its annual press release on motor vehicle registrations by state, comments on the degree of concentration of registrations in the 10 states having the largest number of registrations.

TABLE 6

INCREASE IN AUTOMOBILE REGISTRATIONS, 1953-1963

State	Number	Percent
California	3,019	64.3
Texas	1,381	52.7
Florida	1,289	119.0
New York	1,245	33.9
Ohio	1,209	43.8
Pennsylvania	1,123	38.8
Illinois	1,020	39.6
New Jersey	837	52.5
Michigan	730	30.2
Georgia	592	69.9
Total - 10 states	12,445	49.5
Remaining states[a]	9,949	47.1
United States	22,394	48.4

[a]Includes Hawaii and Alaska in 1963 only.

In Automobile Facts and Figures, 1962, the Automobile Manufacturers Association ranks the states according to: (a) the total number of passenger car registrations; (b) increase in passenger car registrations, 1952 to 1962; and (c) percent increase in passenger car registrations, 1952 to 1962.

In America's Needs and Resources, Wilfred Owen discusses the growth of automobile ownership in the United States. He uses the 10 states with the largest increases in automobile registration from 1941 to 1952 to demonstrate the concentration of registrations (13).

It is interesting to compare the ranking of the 10 states used by Wilfred Owen in his study to those used in this study. Owen chose the 10 states having the largest increases in automobile registrations from 1941 to 1952. Nine of

TABLE 7

CHANGES IN POPULATION DISTRIBUTION AND AUTOMOBILES

States	1953		1963	
	Population (%)	Automobile Registration (%)	Population (%)	Automobile Registration (%)
Ten-state group	52.3	54.4	54.0	54.8
Remaining states	47.7	45.6	46.0	45.2
Difference in percentage points	4.6	8.8	8.0	9.6

these states remained in the top 10 for the 1953 to 1963 period. Georgia replaced North Carolina in tenth place and there was some reshuffling in rank among the other nine.

California and Texas retained first and second positions respectively, while Florida moved up from eighth to replace New York in third place. New York, Ohio, Pennsylvania and Illinois remained in the middle of the group while Michigan fell from sixth to ninth place to join New Jersey and Georgia at the lower end. Population increases and migration explained much of relative increases in automobile registrations in these states.

Effect of Urbanization

Population in the United States is heavily concentrated in this small number of states, and is becoming more so. Automobiles, too, are heavily concentrated, but the movement toward greater concentration is slower. The 10 selected states had the largest increases in the numbers of automobile registrations over the past 10 years.

These 10 states are highly urbanized, containing 92 of the nation's 212 standard metropolitan statistical areas in 1960: California, 10, Texas, 21, New York, 7, Florida, 7, Ohio, 13, Pennsylvania, 12, Illinois, 7, New Jersey, 5, Michigan, 10, and Georgia, 6.

TABLE 8

RECENT TRENDS IN AUTOMOBILE REGISTRATIONS AND RELATED DATA, 1953-1963[a]

State	Population			Automobile Registrations			Automobiles per Capita			Personal Income per Capita		
	1953 (thousands)	1963 (thousands)	Change 1953-63 (%)	1953 (thousands)	1963 (thousands)	Change 1953-63 (%)	1953	1963	Change 1953-63 (%)	In 1963 Dollars 1953	In 1963 Dollars 1963	1953-63 (%)
California	12,157	17,590	44.7	4,693	7,712	64.3	0.39	0.44	12.8	2,478	2,974	20.0
Texas	8,417	10,323	22.6	2,619	4,000	52.7	0.31	0.39	25.8	1,773	2,068	16.6
Florida	3,289	5,653	71.9	1,083	2,372	119.0	0.33	0.42	27.3	1,757	2,111	20.1
New York	15,470	17,708	14.5	3,673	4,918	33.9	0.24	0.28	16.7	2,458	3,013	22.6
Ohio	8,553	10,173	18.9	2,761	3,970	43.8	0.32	0.39	21.9	2,310	2,470	7.1
Pennsylvania	10,632	11,424	7.4	2,897	4,020	38.8	0.27	0.35	29.6	2,177	2,452	12.6
Illinois	9,010	10,182	13.0	2,574	3,594	39.6	0.29	0.35	20.7	2,515	2,948	17.2
New Jersey	5,148	6,470	25.7	1,594	2,431	52.5	0.31	0.38	22.6	2,537	2,915	14.9
Michigan	6,868	8,116	18.2	2,419	3,149	30.2	0.35	0.39	11.4	2,443	2,541	4.0
Georgia	3,570	4,140	16.0	847	1,439	69.9	0.24	0.35	45.8	1,418	1,864	31.5
10 state total	83,114	101,779	22.5	25,160	37,605	49.5	0.30	0.37	23.3	2,279	2,647	16.1
Remaining states	75,842	86,837	14.8	21,129	31,078	47.1	0.28	0.36	28.6	1,776	2,214	24.7
U. S. total	158,956	188,616	18.7	46,289	68,683	48.4	0.29	0.36	24.1	2,039	2,447	20.0

[a]U. S. Bureau of the Census, Statistical Abstract of the United States, 1964.
U. S. Bureau of Public Roads, Highway Statistics, Table MV-1. U. S.
Office of Business Economics, Survey of Current Business, Apr. and Aug. 1964.

Changes in percent distribution of population and automobiles in this 10-state group, compared with the group of remaining states, illustrates the relative shifts in concentration (Table 7).

Resulting changes in the ratio of automobiles per capita over the 1953 to 1963 period and changes in personal income per capita are shown in Table 8. The higher rate of increase in income in the group of remaining states has reduced the disparity between the two groups from $503 to $433 per capita, one important reason why autos per capita shows a higher rate of growth in the remaining state group.

The ten selected states represent the most populous sections of the country. The Middle Atlantic and Midwest account for six of the ten states. California is the only Pacific state included and Texas the only southwestern state. Two states, Florida and Georgia, represent the southeast.

These 10 states contain 20 of the 24 largest urban complexes with over 1 million inhabitants. The 20 urban areas are characterized by a wide range in population size and density as well as in income and automobile availability. The dominance of urban population in some states, e.g., New York, Illinois, and California, largely determines these factors for the whole state, in California the urban dominance is offset by its low urban population density.

Automobile Ownership

The 1960 Census provides detailed data on automobile availability, by state and local area, that may be used in conjunction with the autos-per-person ratio. In a given state, for example, the rate of increase in the autos-per-capita ratio may be analyzed in relation to the percentage of occupied housing units with no cars available. A relatively low percentage of housing units without cars in 1960 implies extensive automobile

TABLE 9

FACTORS UNDERLYING GROWTH IN AUTOMOBILE OWNERSHIP IN 10 LEADING STATES, RANKED BY PERCENTAGE INCREASE IN AUTOMOBILES PER CAPITA, 1953-1963[a]

State	Change-Automobiles per Capita (%)	Change-Personal Income per Capita[b] (%)	Percentage of Total Occupied Housing Units in 1960 with		Central Cities with Population > 400,000 in 1960[c]					Workers Using Public Transportation, 1960 (%)
			No Car Available	Two or More Cars Available	Population (thousands)	State Total Population (%)	Persons/Sq Mi	Population Change 1950-1960		
								Central Cities	Outside Central Cities	
High group:	30.0	16.1	21.0	22.3	5,753	19.3	4,689	21.5	32.6	-
Georgia	45.8	31.5[d]	25.8[d]	22.3	487	12.3	3,802[d]	47.1[d]	33.9	7.0
Pennsylvania	29.6	12.6	23.4	17.7	2,604	23.0	13,612	-5.2[d]	30.0[f]	16.0
Florida	27.3	20.1	18.7	23.6	456	9.2	3,235[d]	106.1[d]	68.4[d]	5.8
Texas	25.8	16.6	17.6	27.2	2,206	23.0	2,871[d]	53.4[d]	32.0	5.5
Medium group:	22.0	13.1	20.2	20.4	5,805	22.4	10,224	-0.3	62.3	-
New Jersey	22.6	14.9	19.8	22.6	405	6.7	17,161	7.7	30.7[d,g]	18.9
Ohio	21.9	7.1	16.9	23.1	1,850	19.1	6,167[d]	3.1	57.9[d]	10.1
Illinois	20.7	17.2	23.5	16.6	3,550	35.2	15,836	-1.9	71.5[d]	20.3
Low group:	12.6[e]	14.5[e]	15.3[e]	29.2[e]	14,489	35.9	11,251	3.2	76.1	-
New York	16.7	22.6	47.0	12.0	8,315	49.5[d]	23,456[d]	-1.9	69.7	37.1
California	12.8	20.0	15.7	31.0[d]	4,504	28.7	5,675	21.2	75.4	7.7
Michigan	11.4	4.0[d]	14.4	25.3	1,670	21.3	11,964	-9.7	79.3	7.3
10-state group	23.3	16.1	22.3	21.7						
Remaining group	28.6	24.7	23.5	19.6						
U. S. total	24.1	20.0	21.5	21.5						

[a]Data derived from U. S. Bureau of the Census, U. S. Summary of Population, 1960-PC (1) 1A; U. S. Summary of Social and Economic Characteristics PC (1) 1C; Census of Housing HC (1); U. S. Bureau of Public Roads, Highway Statistics (data adapted from Table MV-1); and U. S. Office of Business Economics, Survey of Current Business, Apr., Aug. 1964.

[b]1963 dollars.

[c]Annexations to central cities between 1950-1960 were very substantial: Atlanta, Ga. 171, 467; Tampa, Fla. 140, 331; San Antonio, Dallas and Houston, Texas, 583, 392; Columbus, Ohio, 75, 635; and San Diego, California, 65, 843.

[d]Denotes major influencing factors.

[e]Excludes New York.

[f]Excludes the New Jersey counties in Philadelphia, Standard Metropolitan Statistical Area.

[g]This gain was in New Jersey, but outside a Pennsylvania central city.

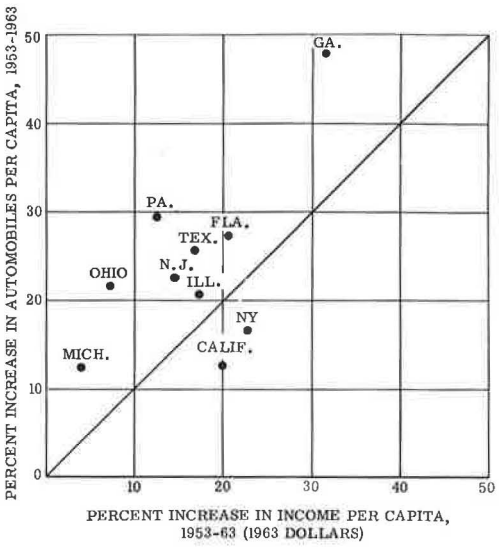

Figure 5. Trend in automobiles per capita and personal income for 10 selected states.

ownership and should be associated with a relatively low rate of recent and future growth in the autos-per-capita ratio. A high percentage of housing units with two or more cars available also indicates extensive automobile ownership that would dampen the growth of the autos-per-capita ratio.

Constraint on automobile availability is largely determined by the rate of growth in personal income per capita, population density in large cities, urban and suburban population shifts. In Table 9 these factors are compared for the two state groups and each of the selected 10 states.

Therefore, by dividing the United States into two groups of states on the basis of the absolute growth in automobile registrations over the past decade, comparisons can be made which give some insight into the factors determining automobile ownership. Better insight into the relative impacts of these variables requires a closer look at the 10 states which lead the country in the number of automobile registration increases but, as a group, lag behind the rest of the country in the growth-rate of automobile ownership.

STATE GROUPS BY RATE OF GROWTH

Factors Influencing Trends in Autos per Capita

Comparisons of the socio-economic variables determining automobile ownership for the 10 states are presented in summary form in Table 9. For each of these states,

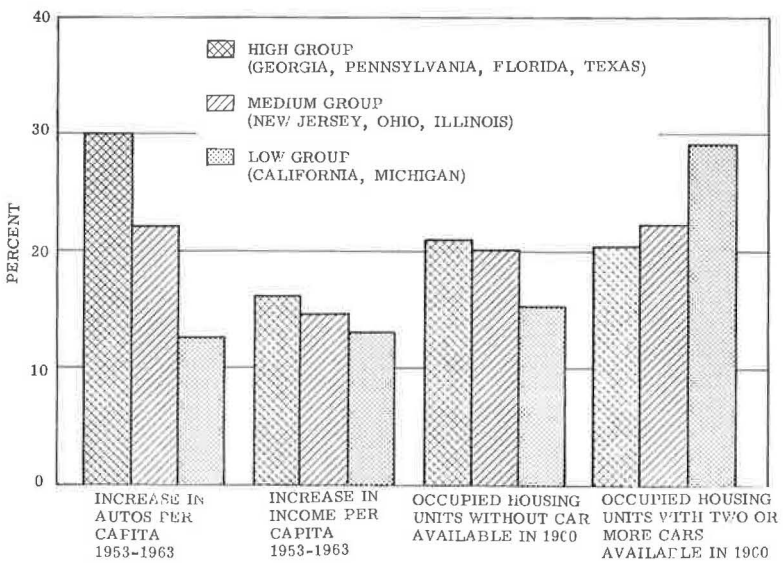

Figure 6. Increase in automobile ownership and major factors in three groups of states.

trends in autos per capita are presented with data on income per capita (Fig. 5), multi-car and no car availability, shifts in central city and suburban populations, changes in population density of large central cities, and use of public transportation. The states are ranked according to percent increase in automobiles per capita over the 10-yr period, 1953 to 1963. They are then grouped as high (25 percent or over); medium (20 to 24 percent); and low (under 20 percent).

In Table 9, trends in automobile ownership are represented by the percent increases in automobiles per capita shown in column 1. In columns 3 and 4, percentages of occupied housing units, in 1960, with no cars available and with two or more cars available, indicate the extent of automobile ownership existing today.

Trends in automobile ownership (column 1 of Table 9) may be compared with trends in constant dollar personal income per capita (column 2) and the existing levels of automobile ownership (columns 3 and 4). Data are compared for the high, medium and low groups of states. (New York is excluded from these groups because its extremely low degree of automobile availability puts it in a class by itself.)

The averages for the three groups show some association between the increases in autos per capita and income per capita. This is especially apparent in the cases of Georgia and Michigan. In California, however, the effect of a relatively high income is offset by the existing high degree of automobile availability.

Figure 6 shows the relationship of these factors in the three groups of states. While the high and medium groups have similar percentages of automobile availability, they differ widely in the growth of autos per capita and income per capita, indicating income as a causative factor. The difference in the growth of automobile ownership in the medium and low groups is related to the existing levels of automobile availability.

TRENDS IN SOME INDIVIDUAL STATES AND LOCAL AREAS

Georgia

Georgia's rapid growth in automobile ownership is associated with a high rate of increase in income per capita (Table 8). Georgia's per capita income was among the lowest in the nation in 1953. From $1,418 (1963 dollars) in 1953, it rose 32 percent

TABLE 10

AUTOMOBILE OWNERSHIP AND FAMILY EXPENDITURES FOR AUTO PURCHASE AND OPERATION, UNITED STATES AND FIFTEEN URBAN AREAS, 1950 AND 1960[a]

Urban Area	Percentage of Families Owning Autos, End of Year		Percent Change 1950 to 1960	Auto Expenditures as a Percent of Total Family Expenditures		Percent Change 1950 to 1960
	1960	1950		1960	1950	
United States[b]	72	59	22.0	13.0	11.8	-
Los Angeles	85	72	18.1	16.3	15.1	8.0
Cleveland	81	65	24.3	11.7	12.2	-4.0
Northern New Jersey	80	58	38.0	13.2	9.1	45.1
Detroit	77	n.a.	-	15.5	n.a.	-
St. Louis	77	57	35.1	13.1	12.8	2.3
Seattle	76	65	16.9	11.1	13.4	-16.4
Washington, D. C.	72	n.a.	-	11.3	n.a.	-
San Francisco	71	63	12.7	12.9	12.4	4.0
Chicago	70	54	30.0	12.8	10.1	26.7
Atlanta	68	55	24.4	14.8	11.9	24.3
Baltimore	68	48	41.7	12.4	10.3	20.4
Boston	67	42	60.0	12.1	8.2	47.6
Philadelphia	67	41	63.4	12.4	8.1	53.1
Pittsburgh	67	51	31.4	13.6	11.0	23.6
New York	50	39	30.6	8.3	5.5	50.9

[a]Data derived from U. S. Bureau of Labor Statistics, Monthly Labor Review, Vol. 87, No. 3, p. 279, Mar. 1964.
[b]Includes all U. S. urban areas.

to $1,864 in 1963. This factor along with a high (25.8) percent of households without cars in 1960, low density urban population and slightly used public transportation greatly stimulated automobile ownership in Georgia.

The continued development of Atlanta as a major manufacturing and distribution center was a major factor behind the sharp rise in the state's per capita income figure. The percent of total family expenditures in Atlanta for automobile purposes increased from 12 percent in 1950 to 15 percent in 1960, slightly above the 13 percent national average (Table 10). Auto expenditures have increased faster than income as indicated by the high 46 percent increase in autos per capita relative to the 32 percent increase in real income per capita. The automobiles per capita ratio in Georgia has increased at varying rates. The rate of increase from 1950 to 1956 was almost twice that between 1956 and 1961. Since 1961, however, it has increased sharply. This growth curve closely parallels that of personal income per capita (Fig. 7).

Michigan

Michigan's low increase of 11.4 percent in autos per capita over the past ten years coincides with a very low 4.0 percent increase in income per capita (Table 8).

Another depressant to rising automobile ownership is the high degree of automobile availability existing in 1960 as shown in the low percentage of households without cars and the high percentage of multicar households. Adverse economic conditions of 1954, 1958 and 1961 had strong impact on Michigan's manufacturing industries, especially automobile and allied industries. Increased automation in these industries made a large number of lay-offs permanent. Michigan was also adversely affected by shifts in the country's military production. The change in defense purchases from conventional weapons to missiles resulted in a decline in Michigan's share of prime military contracts from 9.5 percent of the United States total in the 1951 to 1953 period to 2.7 percent of the total in 1962 (8, 9).

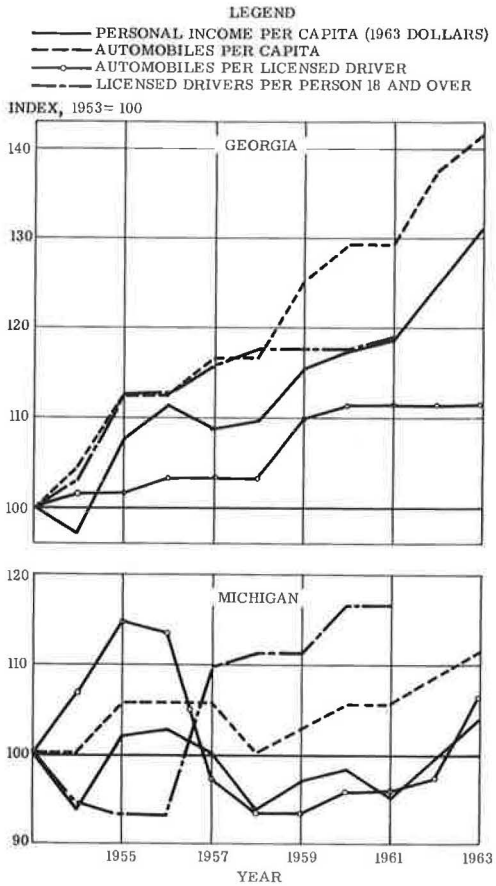

Figure 7. Indexes of automobiles, licensed drivers, and personal income per capita in 1963 dollars (1953 = 100) for Georgia and Michigan.

Heavy lay-offs are reflected in the movement of the index of annual per capita income (Fig. 7).

Michigan's per capita income did not recover to its 1956 high until 1963. Autos-per-capita did not exceed the 1955 level until 1962, although the autos-per-licensed-driver ratio of 0.79 in 1963 was still significantly lower than the high of 0.85 in 1955, yet considerably higher than the low of 0.69 in 1958 and 1959 (see Tables 11 - 18).

Movement of the population from the central city of Detroit to the suburbs was largely responsible for maintaining the higher rate of increase in per capita autos over per capita income. Comparison of these factors is given in Table 9. The 80 percent increase in population outside the central city and the 10 percent decrease in the central city indicate a strong movement to the suburbs.

TABLE 11

TRENDS IN AUTOMOBILE PER CAPITA AND PER LICENSED DRIVERS IN THE UNITED STATES, 1950-1963[a]

Year	Resident Population (thousands)	Automobile Registrations[b] (thousands)	Automobile Registrations[b] Per Capita	Persons Age 18 and Over (thousands)	Licensed Drivers (thousands)	Licensed Drivers Per Person Age 18 and Over	Automobile per Licensed Driver
1950	151,868	40,185	0.26	104,190	62,193	0.60	0.65
1951	153,982	42,525	0.28	104,748	64,444	0.62	0.66
1952	156,393	43,653	0.28	105,417	66,826	0.63	0.65
1953	158,956	46,251	0.29	106,286	69,870	0.66	0.66
1954	161,884	48,286	0.30	107,400	72,183	0.67	0.67
1955	165,069	51,951	0.31	108,669	74,686	0.69	0.70
1956	168,088	54,003	0.32	109,768	77,659	0.71	0.70
1957	171,187	55,693	0.33	110,916	79,616	0.72	0.70
1958	174,149	56,645	0.33	111,980	81,537	0.73	0.69
1959	177,135	59,322	0.33	113,637	84,498	0.74	0.70
1960	179,992	61,307	0.34	115,430	87,361	0.76	0.70
1961	183,057	63,012	0.34	117,103	88,852	0.76	0.71
1962	185,890	65,649	0.35	118,444	90,705	0.77	0.72
1963	188,616	68,683	0.36	119,824	93,811	0.78	0.73

[a]Data derived from U. S. Bureau of Public Roads, Highway Statistics, Tables MV-1 and MV-12; and U. S. Bureau of the Census, P-25 Series, Nos. 146, 193, and 265.
[b]Private and commercial.

TABLE 12

TRENDS IN AUTOMOBILES PER CAPITA FOR TEN SELECTED STATES, 1950-1963[a]

Year	California	Texas	New York	Florida	Ohio	Pennsylvania	Illinois	New Jersey	Michigan	Georgia
1950	0.37	0.30	0.22	0.28	0.30	0.24	0.26	0.28	0.33	0.20
1951	0.38	0.30	0.23	0.30	0.32	0.26	0.27	0.29	0.34	0.21
1952	0.38	0.29	0.23	0.31	0.32	0.26	0.28	0.30	0.33	0.22
1953	0.39	0.31	0.24	0.33	0.32	0.27	0.29	0.31	0.35	0.24
1954	0.38	0.33	0.25	0.34	0.33	0.28	0.29	0.31	0.35	0.25
1955	0.40	0.35	0.26	0.36	0.34	0.29	0.30	0.33	0.37	0.27
1956	0.40	0.35	0.26	0.37	0.35	0.30	0.31	0.33	0.37	0.27
1957	0.40	0.36	0.26	0.38	0.35	0.31	0.32	0.33	0.37	0.28
1958	0.40	0.35	0.26	0.38	0.35	0.32	0.32	0.33	0.35	0.28
1959	0.40	0.36	0.27	0.40	0.36	0.32	0.32	0.34	0.36	0.30
1960	0.42	0.36	0.27	0.41	0.37	0.33	0.33	0.35	0.37	0.31
1961	0.42	0.36	0.27	0.40	0.37	0.33	0.33	0.36	0.37	0.31
1962	0.42	0.38	0.27	0.41	0.38	0.34	0.34	0.36	0.38	0.33
1963	0.44	0.39	0.28	0.42	0.39	0.35	0.35	0.38	0.39	0.34

[a]Data derived from population and automobile registration information published by: U. S. Bureau of the Census, U. S. Census of Population 1960, PC (1) 1A; and U. S. Bureau of Public Roads, Highway Statistics, Table MV-1.

TABLE 13

PERSONAL INCOME PER CAPITA (CONSTANT 1963 DOLLARS)[a]

Year	California	Texas	New York	Florida	Ohio	Pennsylvania	Illinois	New Jersey	Michigan	Georgia
1950	2,343	1,706	2,398	1,640	2,054	1,995	2,326	2,280	2,143	1,296
1951	2,402	1,713	2,360	1,621	2,201	2,044	2,399	2,358	2,199	1,345
1952	2,455	1,756	2,397	1,680	2,253	2,070	2,416	2,437	2,244	1,385
1953	2,479	1,774	2,458	1,758	2,311	2,178	2,516	2,537	2,443	1,419
1954	2,456	1,807	2,464	1,749	2,193	2,069	2,478	2,524	2,289	1,378
1955	2,628	1,882	2,597	1,898	2,358	2,191	2,599	2,636	2,492	1,524
1956	2,729	1,950	2,725	1,994	2,458	2,325	2,747	2,735	2,510	1,579
1957	2,723	1,977	2,768	1,992	2,454	2,340	2,728	2,761	2,445	1,544
1958	2,675	1,952	2,715	1,954	2,286	2,259	2,596	2,642	2,291	1,556
1959	2,810	2,018	2,861	2,061	2,405	2,319	2,710	2,736	2,370	1,639
1960	2,820	1,984	2,875	2,036	2,413	2,335	2,728	2,756	2,398	1,665
1961	2,858	2,020	2,897	2,016	2,387	2,338	2,789	2,817	2,320	1,681
1962	2,916	2,043	2,964	2,090	2,440	2,401	2,895	2,877	2,428	1,771
1963	2,974	2,068	3,013	2,111	2,474	2,452	2,948	2,915	2,541	1,864

[a]Data adapted from Survey of Current Business, p. 16, Aug. 1964.

TABLE 14

TRENDS IN AUTOMOBILES PER LICENSED DRIVER[a]

Year	California	Texas	New York	Florida	Ohio	Pennsylvania	Illinois	New Jersey	Michigan	Georgia
1950	0.75	0.83	0.61	0.61	0.72	0.63	0.57	0.71	0.73	0.58
1951	0.77	0.79	0.61	0.63	0.72	0.67	0.63	0.73	0.74	0.58
1952	0.76	0.73	0.62	0.63	0.69	0.66	0.62	0.72	0.70	0.59
1953	0.77	0.74	0.63	0.67	0.71	0.67	0.61	0.73	0.79	0.61
1954	0.76	0.74	0.63	0.69	0.71	0.63	0.64	0.74	0.79	0.62
1955	0.80	0.81	0.67	0.73	0.73	0.69	0.67	0.76	0.85	0.62
1956	0.80	0.78	0.67	0.71	0.74	0.70	0.66	0.75	0.84	0.63
1957	0.79	0.79	0.64	0.71	0.76	0.69	0.67	0.78	0.72	0.63
1958	0.78	0.79	0.65	0.73	0.74	0.66	0.69	0.80	0.69	0.63
1959	0.77	0.80	0.65	0.76	0.76	0.66	0.71	0.78	0.69	0.67
1960	0.76	0.81	0.64	0.79	0.77	0.64	0.72	0.77	0.71	0.68
1961	0.75	0.77	0.65	0.77	0.75	0.73	0.74	0.75	0.71	0.68
1962	0.85	0.78	0.66	0.77	0.75	0.67	0.75	0.76	0.72	0.68
1963	0.85	0.78	0.64	0.77	0.78	0.69	0.69	0.77	0.79	0.68

[a]Data derived from Highway Statistics, Tables MV-1 and MV-12, U. S. Bureau of Public Roads.

TABLE 15

RATIO OF LICENSED DRIVERS PER PERSON 18 YEARS OF AGE AND OVER FROM 1950 TO 1961[a]

Year	California	Texas	New York	Florida	Ohio	Pennsylvania	Illinois	New Jersey	Michigan	Georgia
1950	0.71	0.53	0.48	0.67	0.60	0.54	0.63	0.53	0.66	0.54
1951	0.69	0.59	0.51	0.70	0.64	0.54	0.60	0.55	0.68	0.59
1952	0.71	0.63	0.52	0.72	0.67	0.57	0.63	0.57	0.71	0.60
1953	0.73	0.65	0.53	0.75	0.68	0.59	0.67	0.59	0.72	0.63
1954	0.74	0.69	0.54	0.77	0.70	0.63	0.65	0.61	0.68	0.65
1955	0.75	0.69	0.54	0.77	0.71	0.62	0.67	0.64	0.67	0.71
1956	0.77	0.71	0.58	0.82	0.73	0.64	0.70	0.65	0.67	0.71
1957	0.80	0.72	0.59	0.85	0.74	0.67	0.70	0.63	0.79	0.73
1958	0.82	0.72	0.60	0.83	0.74	0.70	0.68	0.63	0.80	0.74
1959	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1960[b]	0.85	0.73	0.67	0.81	0.76	0.77	0.69	0.68	0.84	0.74
1961	0.86	0.77	0.61	0.80	0.78	0.69	0.69	0.72	0.84	0.75
1962	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1963	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

[a]Data derived from U. S. Bureau of the Census, Series P-25, Nos. 130, 151, 172, 194, 258, 267 for Civilian Population combined with total military population for each state; and U. S. Bureau of Public Roads, Highway Statistics, Table MV-12.

[b]Census data used for 1960 was for April 1. Annual data by age, and by state was not published by Census for years, 1959, 1962 and 1963.

TABLE 16

PRIVATE AND COMMERCIAL AUTOMOBILE REGISTRATIONS, 1950-1963, IN THOUSANDS[a]

Year	California	Texas	New York	Florida	Ohio	Pennsylvania	Illinois	New Jersey	Michigan	Georgia
1950	3,937	2,311	3,240	798	2,427	2,529	2,282	1,347	2,115	692
1951	4,203	2,453	3,425	895	2,555	2,686	2,401	1,450	2,218	753
1952	4,397	2,447	3,481	971	2,631	2,753	2,459	1,509	2,224	799
1953	4,693	2,619	3,673	1,083	2,761	2,897	2,575	1,594	2,419	847
1954	4,857	2,739	3,880	1,181	2,884	3,011	2,688	1,678	2,479	893
1955	5,275	3,043	4,116	1,368	3,090	3,198	2,852	1,801	2,726	986
1956	5,562	3,114	4,263	1,513	3,236	3,337	2,977	1,838	2,740	1,015
1957	5,783	3,250	4,253	1,684	3,341	3,421	3,068	1,882	2,814	1,054
1958	5,947	3,278	4,347	1,777	3,361	3,491	3,119	1,960	2,717	1,077
1959	6,256	3,435	4,472	1,934	3,478	3,587	3,213	2,020	2,787	1,152
1960	6,625	3,524	4,492	2,041	3,625	3,713½	3,302	2,115	2,883	1,219
1961	6,859	3,601	4,608	2,116	3,697	3,791	3,377	2,241	2,938	1,258
1962	7,226	3,823	4,761	2,249	3,821	3,901	3,483	2,305	3,015	1,351
1963	7,712	4,000	4,918	2,372	3,970	4,020	3,594	2,431	3,149	1,439

[a]Data derived from Highway Statistics, Table MV-1.

TABLE 17

NUMBER OF LICENSED DRIVERS IN FORCE, 1950-1963 IN THOUSANDS[a]

Year	California	Texas	New York	Florida	Ohio	Pennsylvania	Illinois	New Jersey	Michigan	Georgia
1950	5,183	2,797	5,290	1,303	3,377	4,037	3,995	1,891	2,886	1,187
1951	5,471	3,117	5,572	1,420	3,553	4,022	3,792	1,985	3,003	1,304
1952	5,804	3,358	5,634	1,531	3,802	4,171	3,970	2,082	3,162	1,354
1953	6,127	3,556	5,859	1,619	3,889	4,350	4,219	2,190	3,265	1,390
1954	6,351	3,733	6,061	1,709	4,085	4,754	4,171	2,279	3,146	1,446
1955	6,631	3,875	6,144	1,882	4,219	4,640	4,254	2,386	3,196	1,597
1956	6,965	4,009	6,400	2,138	4,386	4,792	4,489	2,461	3,272	1,623
1957	7,622	4,168	6,628	2,385	4,404	4,944	4,586	2,420	3,885	1,623
1958	7,622	4,168	6,688	2,432	4,537	5,251	4,534	2,462	3,959	1,717
1959	8,154	4,282	6,885	2,553	4,606	5,416	4,538	2,574	4,040	1,729
1960	8,694	4,352	7,062	2,659	4,694	5,770	4,565	2,757	4,078	1,791
1961	9,173	4,691	7,090	2,756	4,919	5,221	4,586	2,969	4,114	1,846
1962	8,542	4,881	7,267	2,919	5,066	5,816	4,647	3,044	4,160	1,975
1963	9,053	5,101	7,664	3,073	5,100	5,852	5,229	3,169	3,977	2,102

[a]Data derived from Highway Statistics, Table MV-12.

TABLE 18

RESIDENT POPULATION 18 YEARS OF AGE AND OVER, 1950-1963 IN THOUSANDS[a]

Year	California	Texas	New York	Florida	Ohio	Pennsylvania	Illinois	New Jersey	Michigan	Georgia
1950	7,285	5,229	10,960	1,958	5,611	7,460	6,325	3,549	4,401	2,185
1951	7,889	5,325	10,905	2,030	5,587	7,300	6,302	3,588	4,416	2,228
1952	8,164	5,341	10,918	2,138	5,664	7,347	6,345	3,669	4,460	2,241
1953	8,435	5,434	11,109	2,167	5,743	7,325	6,315	3,683	4,500	2,213
1954	8,553	5,421	11,277	2,223	5,872	7,563	6,380	3,748	4,607	2,233
1955	8,872	5,589	11,314	2,447	5,978	7,427	6,396	3,731	4,781	2,249
1956	9,088	5,626	10,986	2,623	5,978	7,434	6,451	3,812	4,878	2,276
1957	9,200	5,712	11,218	2,794	5,990	7,424	6,526	3,834	4,890	2,303
1958	9,254	5,769	11,188	2,924	6,149	7,519	6,683	3,924	4,921	2,309
1959	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1960	10,268	5,941	10,474	3,271	6,198	7,504	6,642	4,056	4,864	2,410
1961	10,635	6,127	11,658	3,450	6,312	7,518	6,607	4,100	4,918	2,459
1962	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1963	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

[a]Data derived from U. S. Bureau of the Census, Census data for 1950 and 1960, current population survey bulletin (P-25 series) estimates for 1951 through 1959.

California

California leads all the states by far in the number of automobile registrations. The automobile is ubiquitous. A low percentage of households do not own a car while a high percentage of households own two or more. These factors explain why California had a low rate of increase in automobile ownership, as measured by the indicators, autos per capita and autos per licensed driver.

Unlike Michigan, where the low increase in per capita income was a major deterrent to increased automobile ownership, California's personal income per capita increased at the national rate (Table 8).

Existing multiple car ownership in California appears to be the major influence which prevented the increase in autos per capita from being much more than Michigan's. Opposing trends in central city population growth was another influencing factor. While population is increasing in the central city of Los Angeles, it is decreasing in Detroit. The effects of these developments are demonstrated in the data in Table 9.

Evidence of saturation levels in automobile ownership is seen in the recent flattening of the autos-per-capita curve for Los Angeles and San Francisco. Wayne County's (Detroit plus suburbs) curve has not yet begun to flatten. Further indications of saturation may be seen in Table 10 which shows San Francisco and Los Angeles among the lowest of the 15 large urban areas in the growth from 1950 to 1960 in the percent of families owning automobiles.

The increasing proportion of Southern California's population residing in large central cities opposed to the declining proportion in the central city of Detroit, coupled with California's greater percentage of households with two or more cars, caused autos per capita to increase at approximately the same rates in both California and Michigan and thereby offset the probable effect of the much higher rate of increase in California's per capita income. Part of California's higher income may be attributed to the sharp rise in the state's percentage of total military prime contract awards. It rose from 13.6 percent in the 1951 to 1953 period to 23.9 percent of the total in 1962 (8, 9).

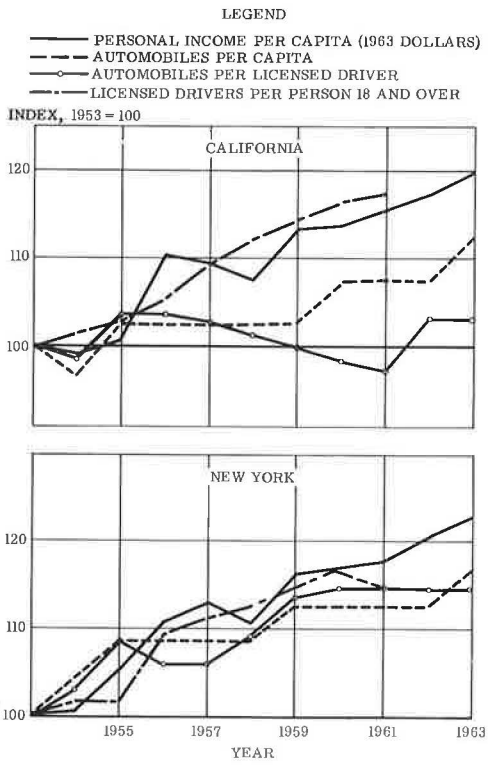

Figure 8. Indexes of automobiles, licensed drivers, and personal income per capita in 1963 dollars (1953 = 100) for California and New York.

Automobiles per capita increased 10 percent from 1953 to 1959. Autos-per-licensed driver leveled off between 1955 and 1961 and thereby regaining about the previous level. Since 1953, licensed drivers per persons 18 years of age and over increased considerably (See Fig. 8). As in Michigan, an increasing proportion of California's total population, as well as persons 18 and over, are acquiring operators licenses, although there is little increase in the proportion of licensed drivers owning cars.

New York

Trends in automobile ownership in New York are quite similar to California's though for different reasons. Percent increases in autos per capita and income per capita were slightly greater than California's. New York's 22.6 percent increase in per capita income was a little above the national rate of 20.0 percent.

The state's increase of 16.7 percent in autos per capita was considerably below the 24.1 percent increase for the country as a whole.

The dominant influence in the state is New York City where almost half the state's population resides. Very high population density and extensive public transportation facilities are the two major factors which operate against high rates of automobile ownership.

New York state's increase in autos per capita, which exceeded Michigan's and California's, is due, in no small part, to the slight decline in the population of New York City and the accompanying large increase in its suburban population. This is an old city which took form in the pre-automobile era when people walked, rode bicycles, or used public transit for transportation for business or pleasure. Under these conditions travel distance was a very important factor. After automobile ownership became significant and good roads were provided, distance became less important and people moved increasingly to areas of lower density.

Local Areas

In Los Angeles, which had its greatest increase in population during the automobile age, heavy population densities are only now beginning to develop. A city's central business district serves important functions which require large numbers of people to travel to and from the center, thereby increasing the daytime population density. This process, which is now taking place in Los Angeles, gives newer cities a tendency to grow more like the old cities. Some indication of the effect of the population movement on automobile ownership may be seen in the relative growth between 1950 and 1960 in the percentage of families owning autos (See Table 10). New York's 30.6 percent increase is considerably higher than the 18.1 percent increase for Los Angeles.

The population movement out of New York's central city to areas of lower density on the city's outskirts (fringe areas in Bronx and Queens counties) and the larger movement to the suburbs outside the city, Nassau and Suffolk counties, for example, have increased the autos-per-capita ratio for the entire New York City. In Nassau County, this ratio has been stable for the past ten years and it shows very little increase in Los Angeles—two areas of similarly low population densities (Table 19). Currently implied saturation levels in Nassau County and Los Angeles appear to be the result of similar social and economic conditions. Relatively low population

TABLE 19

TREND IN AUTOMOBILES PER CAPITA FOR SELECTED COUNTIES, 1953-1963[a]

State, County and Principal City	Automobiles per Capita										
	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Pennsylvania											
Philadelphia Co. (Philadelphia)	0.19	0.19	0.20	0.20	0.20	n.a.	0.20	0.24	0.24	0.25	0.25
Allegheny Co. (Pittsburgh)	0.23	0.24	0.26	0.26	0.26	n.a.	0.28	0.29	0.29	0.29	0.29
Texas											
Harris Co. (Houston)	0.28	0.29	0.31	0.29	0.32	n.a.	0.36	0.34	0.34	0.34	0.34
Ohio											
Cuyahoga Co. (Cleveland)	0.30	0.31	0.32	0.33	0.33	n.a.	0.33	0.34	0.34	0.34	0.36
Illinois											
Cook Co. (Chicago)	0.24	0.26	0.27	0.20	0.29	n.a.	0.29	0.29	0.29	0.29	0.30
New York											
Nassau Co. (New York)	0.37	0.37	0.37	0.36	0.34	n.a.	0.36	0.37	0.38	0.37	0.36
5 Boroughs New York	0.15	0.15	0.16	0.16	0.16	n.a.	0.16	0.17	n.a	0.18	0.18
Erie Co. (Buffalo)	0.28	0.29	0.30	0.29	0.29	n.a.	0.28	0.31	0.31	0.32	0.33
California											
Los Angeles Co. (Los Angeles)	0.40	0.38	0.40	0.40	0.40	n.a.	0.42	0.42	0.43	0.42	0.43
San Francisco Co. (San Francisco)	0.28	0.27	0.29	0.29	0.29	n.a.	0.30	0.34	0.34	0.34	0.34
Michigan											
Wayne Co. (Detroit)	0.31	0.31	0.33		0.32	n.a.	0.32	0.36	n.a.	0.36	0.38

[a]Data adapted from Automobile Facts and Figures, Automobile Manufacturers Association, Annual Eds. 1954-64, R. L. Polk and Co.

densities with mostly single dwelling units (despite increasing multiple dwelling units) are common characteristics, important in explaining the high degree of automobile availability.

The two areas involve somewhat differing levels of saturation: Los Angeles at approximately 0.43 autos per person and Nassau at about 0.37 autos per person. No increase in Nassau, and only slight increase in Los Angeles, since 1953 in autos per capita are indicated. Close examination of relevant 1960 census data reveals some interesting variations in the basic factors responsible for the differences in the automobile ownership saturation levels.

The higher median family income in Nassau is associated with a higher degree of automobile availability: only 7.7 percent of its households with no cars available compared with 16.7 percent in Los Angeles in 1960. Age composition appears to be the main factor underlying this difference. Both areas have similar percentages of their populations in the age group 21 to 64 years, which encompasses the great majority of automobile owners, but Nassau has a much larger percentage of youngsters and Los Angeles a 50 percent greater proportion of oldsters (See Table 20). Older citizens probably constitute many of the Los Angeles households without cars.

Use of public transportation for the trip to work is much more significant in Nassau County. Almost one-fourth of the Nassau population use it compared with only 8 percent in Los Angeles. Yet, Nassau has more extensive automobile availability. Many workers in Nassau County commute to work in New York City via Long Island Railroad, using an automobile to travel to the nearest railroad station. In a great many cases the housewife chauffeurs her husband to the station, so that she may have the car available during the day. Others travel by car to the outlying subway station in Queens County. The automobile is usually a necessary adjunct of the trip to work.

Los Angeles, on the other hand, places scant reliance on public transportation for work travel. Nevertheless, households without automobiles in Los Angeles are twice as large, proportionately, as in Nassau County. Perhaps public facilities in Los

TABLE 20

SOCIAL AND ECONOMIC CHARACTERISTICS RELATED TO AUTOMOBILE OWNERSHIP IN SELECTED COUNTIES[a]

Counties	Median Family Income 1959 ($)	Population by Selected Age Groups (1960)			Occupied Housing Units in 1960 with		Workers Using Public Transportation in 1960 (%)
		5 to 20 Years (%)	21 to 64 Years (%)	65 Years and Over (%)	No Car Available (%)	Two or More Cars Available (%)	
Pennsylvania							
Philadelphia County[b]	5,783	24.5	55.1	10.4	44.0	7.9	41.2
Allegheny	6,173	26.1	53.7	9.6	25.9	14.7	23.6
Texas							
Harris County	6,040	28.9	52.8	5.4	16.7	30.0	10.4
Ohio							
Cuyahoga County	6,943	26.0	53.8	9.2	21.3	21.8	23.2
Illinois							
Cook County	7,287	25.1	54.8	8.9	31.6	13.1	33.5
New York							
Nassau County	8,515	30.0	52.7	6.2	7.7	30.8	24.6
Erie County	6,395	26.5	52.7	9.3	22.1	14.6	18.0
California							
Los Angeles County	7,046	25.9	54.2	9.2	16.7	31.5	8.3
San Francisco County[b]	6,717	20.3	59.2	12.6	42.1	11.1	36.8
Michigan							
Wayne County	6,597	27.1	53.3	8.0	21.5	21.4	16.2

[a]Data derived from U. S. Department of Commerce, County and City Data Book, 1962, Items 10, 11, 12, 49, 71, and 72.
[b]City and county are coterminous; others include substantial suburban areas.

Angeles are more extensively used for nonwork trips. The larger percentage of persons 65 years and over in Los Angeles, many of whom are retired, live close to the central business district and use public transportation for nonwork trips such as for personal business, social, and recreational purposes, which may explain much of the variation between the two counties in the use of public transit.

Youths 5 to 20 years of age comprise a larger proportion of Nassau's population. Included in this group are the teenagers who do not yet own automobiles themselves but belong to households owning automobiles. This age distribution is a depressing factor on the present ratio of automobiles per capita.

The basic characteristics in Table 20 provide some insight into the reasons behind the variations. Differences in level of automobile ownership and in apparent saturation levels (Table 19) are explained, at least in part, by various socio-economic factors such as income, the age distribution of the population, and use of public transportation (which, in turn, reflects density of population and city age) as shown in Table 20. With the understanding of these underlying factors, reasonable estimates may be made of the future growth and saturation of automobile ownership at the county level. If a time series on these underlying factors were available on a continuing basis, correlation analyses would provide knowledge of the relative effects of these factors on the rate of growth in autos per capita, indication would be obtained with respect to the point at which likely saturation levels might be attained, under varying conditions of residential density and population composition.

SUMMARY

Automobile ownership, a prime determinant of highway needs, has been growing nationally at a decelerated rate in recent years. This growth pattern implies future saturation-stability in one or more indicators; automobiles per capita, autos-per-licensed drivers, and percent of households owning automobiles.

Most of the increase in automobile registrations over the past decade has come as the result of households acquiring second and third cars. Multicar ownership reflects major characteristics of the contemporary American economy—rising real personal income, suburban residence, and larger families.

Population in the United States is becoming more concentrated in large metropolitan complexes. The 10 states having the largest increases in automobile registrations over the past 10 years are the states in which most of the largest urban agglomerations are located. Growth of automobile ownership in this group of states is slower than in the remaining group of states. In each of these two groups of states, however, the growth in automobiles is closely associated with the rate of growth in income.

State-by-state comparisons reveal the relative importance of other social and economic characteristics, as well as income, in determining the growth of automobile ownership. Per capita income was shown to be the prime determinant behind Georgia's rapid growth in automobiles. In California extensive automobile availability appears to be the major factor causing autos per capita to rise at a slow rate. Michigan's slow rate of growth in autos is attributable to a combination of a low increase in income and existing widespread automobile availability. In New York the relatively slow growth in autos per capita is fundamentally due to New York City's population density and its excellent public transport.

County data on automobiles per capita have reached plateaus in such counties as Allegheny (Pittsburgh), Nassau and San Francisco. Age composition is the strong factor in Nassau, while population density and availability of public transportation are key factors in San Francisco. Relatively low income, resulting from unstable employment and availability of public transit, are major influences in Pittsburgh.

RECOMMENDATIONS FOR FURTHER STUDY

The analysis of automobile ownership and of related data presented in this paper is intended to demonstrate methods of using published data from the U. S. Bureau of Public Roads, the Census Bureau, and other sources which would make possible more accurate interpretation of the indicators of ownership and identify evidence of approaching saturation.

Lack of historical data on some of the underlying data now prevent more refined correlation analyses, and the tasks which await the researcher in this field are considerable. Areas which should be canvassed include:

1. Inclusion of additional factors, especially attitudes toward ownership under various conditions of congestion, high operating costs, and improved public transportation.
2. More extensive application of the socio-economic factors suggested in this paper to other statistical metropolitan areas.
3. Analysis of factors affecting various levels of consumer expenditures for transportation, area differentials in these expenditures, and the trend in them. Data from the U. S. Bureau of Labor Statistics would furnish an appropriate source.
4. Review and evaluation of the ownership assumptions in area transportation studies and of the basic assumptions made in projecting ownership.
5. More extensive search for the evidence of, and conditions making for, saturation levels of ownership.

This paper has demonstrated the application of a normal growth curve to national registration data. Similar investigation might be rewarding on a state and area basis. Changes in urban structure, and in the relation between downtown and suburbia are clearly in the making. Public attitudes toward ownership are certain to be modified with these and other changes. Recognition of these changes, and of the effect on ownership rates must be made a part of the forecasting technique.

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Use of Metropolitan Area Census Data for Transportation Planning

EDMOND L. KANWIT and DAVID M. GLANCY, U. S. Bureau of Public Roads

The 1960 Census of Population, made available for the first time data on availability of automobiles, workers' modes of travel to work, and on general commuting patterns. From the hundreds of other statistical items in the 1960 and earlier Censuses, six characteristics relating to population, employment, and income were selected because they are the major factors generating traffic. This paper illustrates the implications which can be drawn from these data and how they can be utilized in the forecasts upon which sound comprehensive urban and transportation planning must be based. As a means of illustrating these implications, the 212 Standard Metropolitan Statistical Areas (SMSA's), defined by the Bureau of Census, were grouped in nine population size groups.

•THE NEED for effective use of available statistical material has been intensified by the imminent requirement for comprehensive urban planning. The U. S. Bureau of Census collects and tabulates a wealth of statistical materials on metropolitan areas. The 1960 Census of Population makes available for the first time data on the availability of automobiles, workers' modes of travel to work, and general commuting patterns. From the hundreds of statistical items in the 1960 and earlier censuses, six characteristics relating to population, employment, and income were selected. These elements were chosen because they are the major traffic-generating factors (1). This paper discusses the implications of these data and the ways the data can be used in the forecasts on which sound comprehensive urban and transportation planning must be based. To illustrate these implications, 212 Standard Metropolitan Statistical Areas (SMSA's), defined by the U. S. Bureau of Census, were grouped in nine population size groups based on their 1960 populations. The number of SMSA's in each population size group and the population range of each size group are given in Table 1. In addition to presenting general implications based on size group averages and ranges, this report discusses some detailed implications of a study of the Washington SMSA census tracts (2).

SELECTED CHARACTERISTICS

Where people live, where they work, and what they do constitute the basic elements of the land-use pattern. Population trends must be understood because people must travel, produce goods and services, and participate in social activities. Basically, social and economic activity and the land-use pattern are different aspects of the same thing. Available statistical data representing this totality can be used to predict future land-use patterns which could not otherwise be known. Current data on land use are difficult to obtain and are seldom up-to-date.

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ERRATA

Highway Research Record No. 106

On page 22:

EDMOND L. KANWIT and DAVID M. GLANCY, U. S. Bureau of Public Roads

should read:

EDMOND L. KANWIT, U. S. Bureau of Public Roads, and
DAVID M. GLANCY, D. C. Department of Highways and Traffic

In Figure 1, page 55, the family income group reading "$5,000-5,999," should read "$5,000-9,999."

TABLE 1

POPULATION SIZE GROUPS OF 212 SMSA's, 1960[a]

Size Groups	No. of SMSA's
≥1,000,000	24
500,000 - 1,000,000	29
300,000 - 500,000	28
250,000 - 300,000	20
200,000 - 250,000	21
150,000 - 200,000	26
125,000 - 150,000	23
100,000 - 125,000	19
50,000 - 100,000	22
Total	212

[a]Data derived from Ref. 3.

Population Growth

The 212 SMSA's, which contain over three-fifths of the nation's population and employment, accounted for 85 percent of the population increase in the last decade. Although growth was concentrated in the large areas, all size groups showed a substantial rate of increase, and only eight SMSA's lost population. (These areas were Altoona, Jersey City, Johnstown, St. Joseph, Scranton, Texarkana, and Wilkes Barre-Hazelton. With the exception of St. Joseph and Texarkana, they are all in the Northeast, and they also lost population in the previous decade due to the decline in coal mining and the lack of alternate job opportunities.) The most rapid growth took place in a tier of states rimming the country all through the West from the Southwest, Gulf, and South Atlantic borders and in areas of the Great Lakes. (A close examination of industrial trends and location of military installations would explain, in large measure, the geographic variations of growth.) The fast growing segments were the suburbs of the largest areas, some of which were in the Northeast. More recently the U. S. Bureau of Census has indicated some slackening in the suburban growth rate.

Table 2 indicates the rate of population change in the SMSA's between 1950 and 1960. The relation between growth rates of central cities and suburbs was closely associated with the size of the SMSA. As size declined, the rate of growth of central cities in-

TABLE 2

POPULATION CHANGE OF 212 SMSA's, 1950-1960[a]

Size Group	Percent Population Change								
	Central City			Suburbs[b]			Entire SMSA		
	Avg.	Highest	Lowest	Avg.	Highest	Lowest	Avg.	Highest	Lowest
≥1,000,000	2.8	71.4	-13.0	55.6	115.7	17.2	24.0	85.5	7.4
500,000 - 1,000,000	21.4	311.1	-12.6	57.2	124.4	- 4.0	36.1	121.1	- 5.7
300,000 - 500,000	13.7	112.0	-14.9	46.1	546.7	-42.0	28.1	297.9	-11.5
250,000 - 300,000	21.4	368.4	-14.7	20.6	63.5	-44.9	21.0	88.1	- 3.6
200,000 - 250,000	30.6	319.9	-11.2	28.8	140.3	-79.8	29.7	98.9	- 8.9
150,000 - 200,000	19.3	79.4	- 9.3	28.6	106.7	-13.6	23.2	72.0	- 3.0
125,000 - 150,000	21.9	161.6	-10.7	35.4	164.6	-25.1	26.9	163.0	- 1.6
100,000 - 125,000	26.0	340.3	- 6.5	14.6	56.8	-24.9	21.5	61.0	0.6
50,000 - 100,000	28.9	188.4	1.4	12.1	87.9	-40.2	24.6	162.6	- 6.4
Total	10.7	368.4	-14.9	48.6	546.7	-79.8	26.4	297.9	-11.5

[a]Data derived from Ref. 3.
[b]Area of SMSA surrounding Central City, which U. S. Bureau of Census terms SMSA ring.

TABLE 3

POPULATION CHANGE OF CENTRAL CITIES OF 212 SMSA's, 1950-1960[a]

Region	Population Change (%)		
	Within 1950 Area	From Annex-ation	Entire Central City
Northeast	-3.3	0.1	3.2
North Central	-1.6	5.9	4.3
South	5.2	23.3	28.5
West	14.5	16.9	31.4
Total	1.4	9.3	10.7

[a]Data derived from Ref. 4.

creased progressively in relation to that of the suburbs, so that in SMSA's of less that 100,000 the rate for the central city exceeded that in the suburbs.

In the 212 metropolitan areas, the central cities (as a group) gained almost entirely through annexation. Of the 5.6 million added, only 767,000 lived in the cities as defined in 1950 and 4.9 million were in annexed territory. Thus the decentralizing trend is obscured by annexations to the central city. Only 84 of the areas had increases in the central city of greater than 20 percent including annexation. Although annexation resulted in a gain of more than one million in all SMSA's with more than one million inhabitants, the 1950 area of the central cities actually lost almost 200,000 inhabitants.

The greatest numerical increases to central cities from annexation occurred in the South and West; in the South this amounted to four-fifths of the increase in the central cities between 1950 and 1960, and in the West over one-half. Table 3 indicates the role of annexation in central city growth by region between 1950 and 1960.

The growth of suburbs by size group varied directly with the size of the central city. The central cities of 56 of the areas lost population, but this was compensated by sufficient suburban growth to leave only eight SMSA's with overall decline in population. The suburban areas of 122 of the SMSA's increased in population during the decade from 20 to 80 percent. The Fort Lauderdale-Hollywood suburbs gained 547 percent, Tucson 368 percent, and Las Vegas 165 percent. In eleven additional areas, the gain in population was over 100 percent in the suburban portion of the areas. Some cities, like Phoenix, annexed their most rapidly growing suburbs.

The detail that can be obtained on an individual metropolitan area can be seen in Figure 1 which shows that although Washington, D. C. lost population, one tract gained between 60 and 100 percent and seven tracts gained between 40 and 60 percent. This figure also shows that 20 suburban tracts lost more than five percent of their 1950 population during the past decade.

Generalizations grossly misrepresent the varying populations in small component areas, a matter of considerable importance to transportation planners. Recent estimates of the U. S. Bureau of Census indicate not only a reversal of population growth for the central city of the Washington SMSA, but also that the SMSA is now the fastest growing metropolitan area in the nation.

Population Density

In 1960 the average population per square mile of land area for all of the 212 metropolitan areas was 364, or slightly more than seven times the average density of the country as a whole. For example, the Jersey City SMSA had an average of 13,572 inhabitants/sq mi, whereas the Reno SMSA had only 14 inhabitants/sq mi. Thirteen SMSA's had average population densities of less than 50 inhabitants/sq mi. (This extreme variation in density among SMSA's is an indication, of course, of the limitations of whole counties as a basis for defining such areas. The area of San Bernardino in California, for example, is larger than any of the New England States except Maine and nearly ten times the size of the New York SMSA. In short, in those parts of the country where counties are large, counties include large rural areas, and are much larger than the urbanized areas.)

Table 4 indicates the average 1960 population density for the central city, suburbs, and entire SMSA for each size group and the highest and lowest value within each size

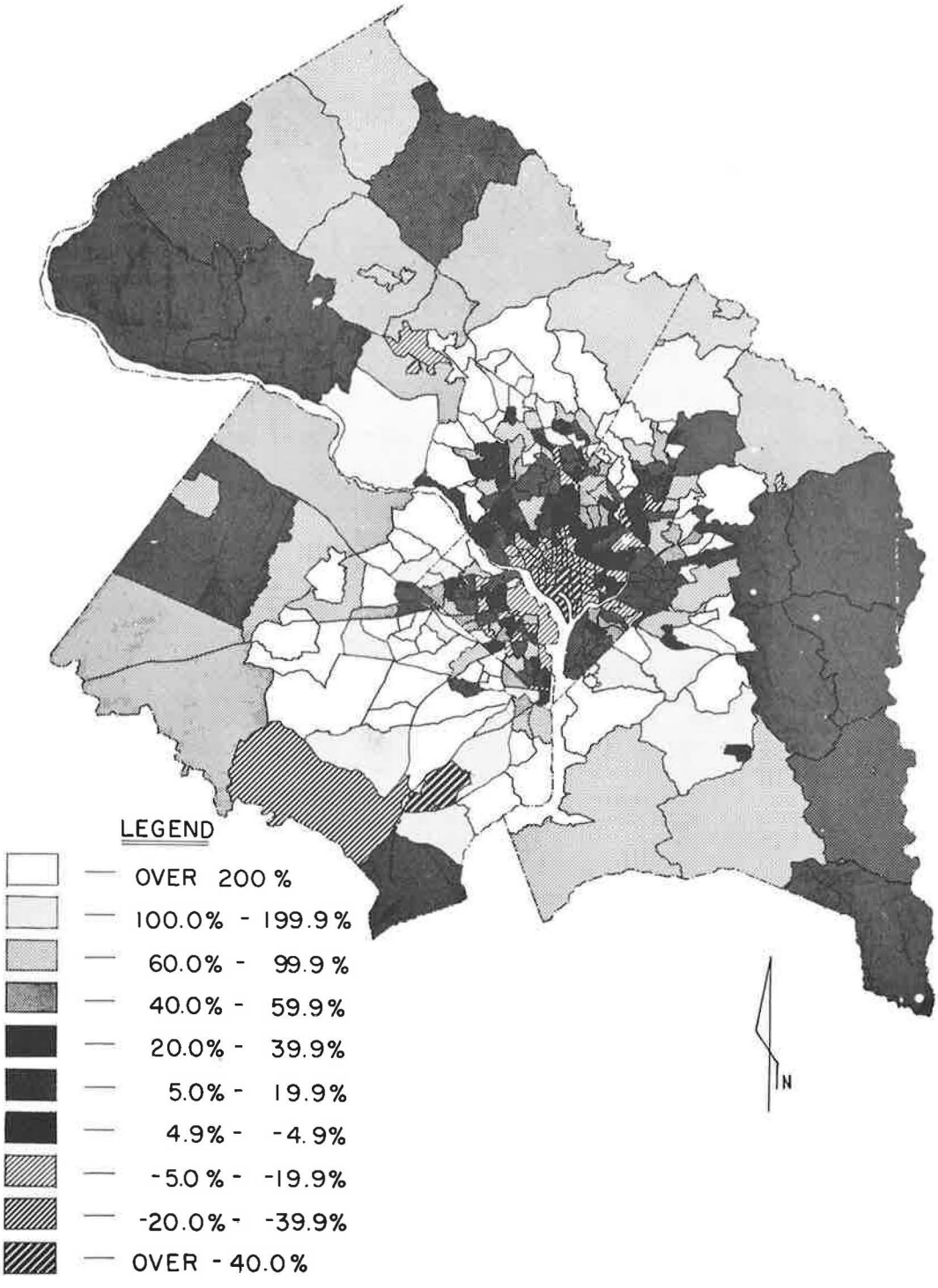

Figure 1. Percent change in population, Washington, D. C. SMSA, 1950-1960.

TABLE 4

AVERAGE DENSITY OF 212 SMSA's, 1960[a]

Size Group	Inhabitants (per sq mi)								
	Central City			Suburbs			Entire SMSA		
	Avg.	Highest	Lowest	Avg.	Highest	Lowest	Avg.	Highest	Lowest
≥1,000,000	9,247	24,697	2,428	609	2,245	113	1,134	4,977	243
500,000 - 1,000,000	4,150	21,239	1,009	133	12,871	22	272	13,572	30
300,000 - 500,000	3,970	10,486	1,326	159	1,218	39	301	2,040	61
250,000 - 300,000	3,751	15,428	1,406	65	689	6	124	1,168	29
200,000 - 250,000	3,518	12,926	1,537	125	287	26	252	880	115
150,000 - 200,000	3,302	7,031	1,716	95	1,714	25	209	2,005	36
125,000 - 150,000	3,091	7,959	768	55	665	7	136	1,535	16
100,000 - 125,000	2,795	6,723	1,427	46	659	12	119	1,270	38
50,000 - 100,000	2,350	5,683	680	16	617	—	69	2,206	14
Total	5,336	24,697	680	183	12,871	—	364	13,572	14

[a]Data derived from Ref. 3.

group. Considerable variability in density occurs among central cities and among suburban areas. New York City had an average density of 24,697, whereas Lewiston-Auburn had only 680 persons/sq mi in its central city. The range of density for suburban areas went from a high of 12,871 for the suburbs of Jersey City to a low of less than 1 inhabitant/sq mi for the San Angelo suburbs in Texas.

The density pattern is related to the period when the major development of the area occurred; older cities have multi-family structures and vertical expansion to accommodate close-in industry and mass transportation. The automobile made possible the development of land at lower densities than in the older central cities and also some suburban development of the Northeast. New cities and suburban areas which developed after the advent of the automobile have grown and continue to grow at lower densities.

Figure 2 shows the pattern of densities of the Washington SMSA. Six central city tracts had average densities of over 50,000 persons/sq mi, but a majority of the tracts in the area had densities of less than 1,000 inhabitants/sq mi. Enclaves of high density in the suburban areas are discernible.

Differences in density not only reflect regional differences, administrative boundaries, and historic periods of growth, but also have significant influence on the urban transportation planner's choice of the most effective mode of transportation. Thus, public transportation can be supported only in areas of high density.

Participation in the Labor Force

The mature noninstitutional population, i.e., 14 years and over, is divided into those at work or seeking work (the labor force) and those not in the labor force. The latter are composed of housewives, students, retired persons, and others who do not work for pay or profit. The labor force, in turn, is divided into the employed and the unemployed; members of the armed forces are, of course, excluded from the civilian labor force. The U. S. Bureau of Census has rigorous definitions of employed, unemployed, and labor force, which all students in the field should understand.

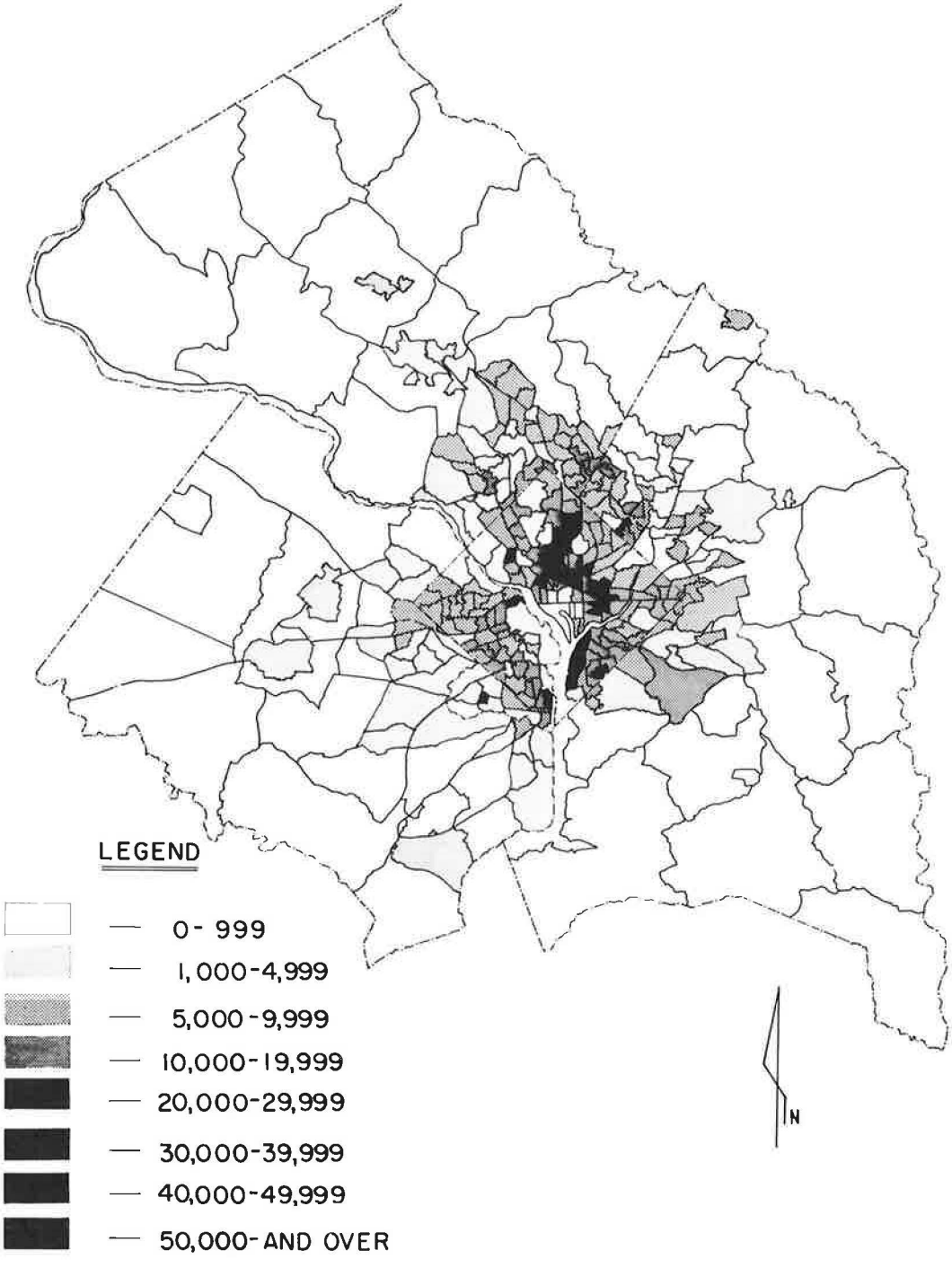

Figure 2. Population density, Washington, D. C. SMSA, 1960.

TABLE 5

U. S. LABOR FORCE PARTICIPATION RATES[a]

Year	Labor Force (%)		
	Male	Female	Total
1920	85.9	24.1	55.8
1930	83.4	25.1	54.6
1940	80.9	27.4	54.1
1950	82.4	31.9	56.8
1960	77.4	34.5	55.3

[a]Percent of noninstitutional population, ≥ 14 yr, working or seeking work.

The size of the labor force reflects the size of the population 14 years old and over from which it is drawn and the extent to which the component age-sex groups seek work. The propensity of these groups to enter the labor market, in turn, is primarily affected by employment opportunity, varying social customs in rural and urban areas, and to a lesser extent by income, education, and racial and national origin characteristics.

Labor force participation rates since 1920 show an increasing tendency of women to work and a decline in male rates. These rates, given in Table 5, are based on the noninstitutional population 14 years of age and over. They reflect increased utilization, earlier retirement, prolonged education, and greater job opportunities for women. As might be expected, significant differences in labor force participation exist among areas, in suburbs and central cities, and these differences affect the transportation planners work by yielding differing travel peak-loads in the journey to work.

The extent of participation in the labor force does not change rapidly, but it can be influenced by both cyclical and secular economic factors. With the maturation of the vast crop of post-war babies, coincident with growing automation, past trends which have brought rapid increase in female labor participation may not continue indefinitely.

TABLE 6

DISTRIBUTION OF LABOR FORCE, 1960[a]

Size Group	Labor Force (%)				
	Manufacturing	Wholesale & Retail Trade	Government	Other Ind. Groups & Armed Forces	Unemployed
≥1,000,000	28.1	17.3	10.7	37.3	6.6
500,000 - 1,000,000	24.2	17.8	12.3	37.9	7.8
300,000 - 500,000	27.1	17.6	12.3	53.3	7.7
250,000 - 300,000	30.0	19.8	14.0	28.3	7.9
200,000 - 250,000	25.9	16.8	11.9	36.0	9.4
150,000 - 200,000	26.3	17.3	12.2	36.9	7.3
125,000 - 150,000	24.7	16.9	11.5	36.6	10.3
100,000 - 125,000	26.2	18.6	12.5	36.5	6.2
50,000 - 100,000	22.1	18.3	9.6	39.4	10.6
Total	27.1	17.5	11.4	36.7	7.3

[a]Data derived from Ref. 3.

TABLE 7

REGIONAL CHARACTERISTICS OF EMPLOYMENT, 1960[a]

Region	No. of SMSA's	SMSA's with More than Avg. U. S. Employment (%)		
		Manufacturing	Wholesale & Retail Trade	Government
Northeast	47	87.2	17.0	12.8
North central	58	69.0	60.3	22.4
South	77	29.9	80.5	48.1
West	30	16.7	80.0	73.3
Total	212	51.4	60.8	36.8

[a]Data derived from Ref. 3.

Table 6 indicates employment by major industry groups for the three largest components of each of the population size groups. It indicates the relative importance of the three largest industry groups in employment: manufacturing, wholesale and retail trade, and government.

Table 7 gives departures from national norms, indicating the proportion of SMSA's exceeding the United States average employment in three key industrial groups. The dominance of manufacturing continues in the Northeast, the originating region of American industrialization. The influence of Federal government policy in developing areas in the South and West appears clearly since the rate at which western areas exceed the national norm in government employment is six times that at which the Northeast exceeds the national norm. Trade probably represents more of a residual effect than an intrinsically significant factor, although many southern and western areas have not developed beyond the essential function of being distribution centers.

Median Family Income

Median family income was selected as the best single measure of income with regard to transportation demand, as most travel is determined by family needs and desires. The income data are for the year preceding the Census and are based on a 25 percent sample. The reported income excludes nonrecurrent income such as inher-

TABLE 8

MEDIAN FAMILY INCOME, 1959[a]

Size Group	Income ($)					
	Central City			Entire SMSA		
	Avg.	Highest	Lowest	Avg.	Highest	Lowest
≥ 500,000 - 1,000,000	5,921	6,942	5,029	6,618	7,577	5,758
300,000 - 500,000	5,982	7,024	4,450	6,151	7,417	4,490
250,000 - 300,000	5,834	6,340	3,816	6,065	6,776	4,908
200,000 - 250,000	5,782	6,621	4,438	5,805	6,707	4,540
150,000 - 200,000	5,441	6,865	3,603	5,407	6,702	4,292
125,000 - 150,000	5,632	7,728	3,807	5,674	8,745	3,216
100,000 - 125,000	5,832	7,662	3,995	5,820	7,010	4,419
50,000 - 100,000	5,667	7,035	3,958	5,539	6,916	4,274
Total	5,850	7,433	2,935	5,255	8,002	2,952
	5,945	7,728	2,935	6,324	8,745	2,952

[a]Data derived from Ref. 3.

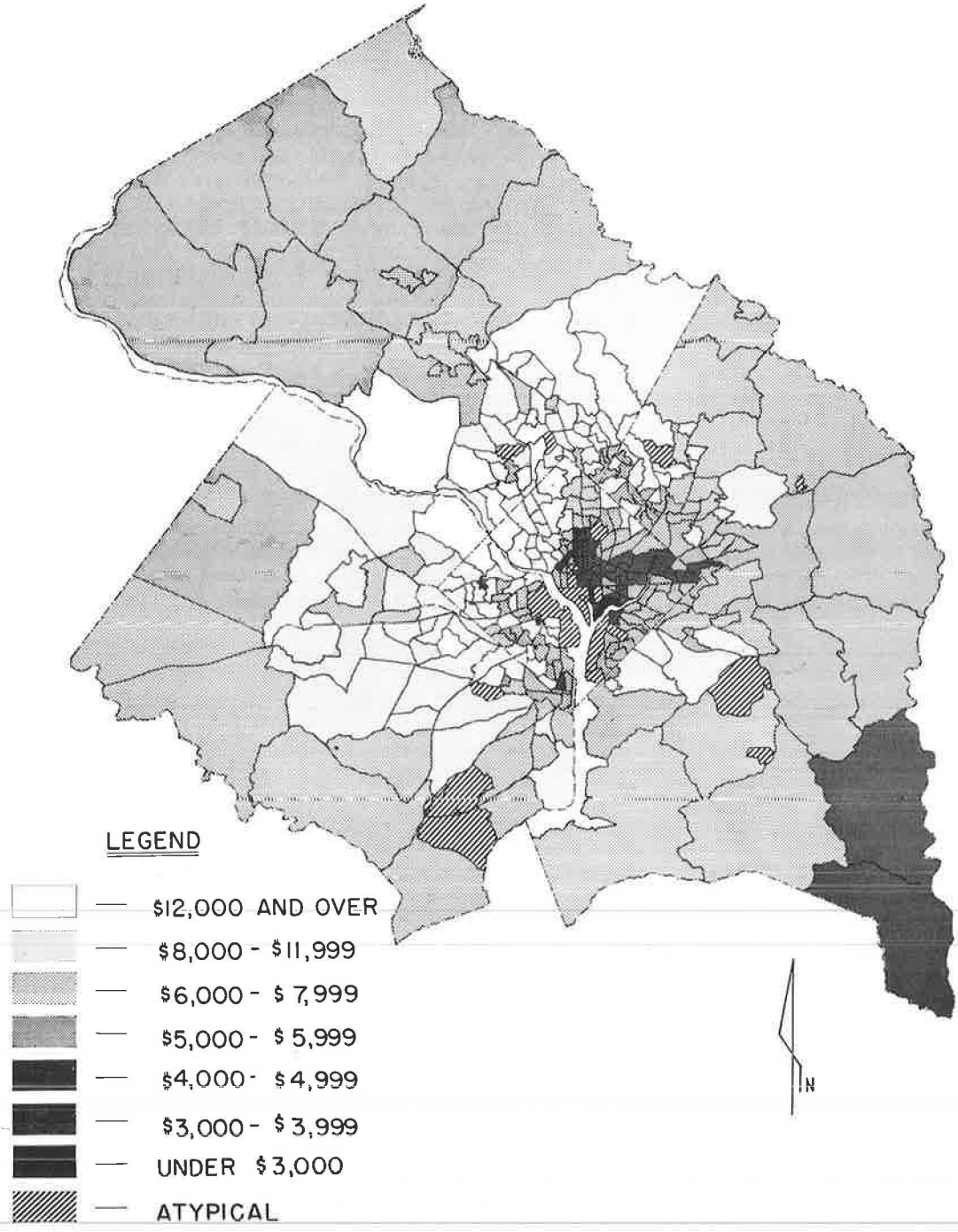

Figure 3. Median family income of individual tracts, Washington, D. C. SMSA, 1959.

itance, gifts, income from sale of property, and insurance payments. It includes wages and salaries, income from self-employment, and from rents, dividends, interest, pensions, social security and annuities.

The attraction toward urban areas becomes clear when the 1959 median family monetary income for the nation as a whole is compared with that of the urban and rural areas. The U. S. median income was $5,660, the urban area median was $6,166, and that of rural areas only $3,228.

Table 8 indicates that, generally, the central city median family income is lower than that for the entire SMSA. (In two areas in Tennessee it was significantly lower, reflecting the low income typical of Appalachia.) Higher income families have been moving to the suburbs to take advantage of more space and privacy. Migration to the central cities of low-income families from rural areas and the entrapment of low-income families in the central cities by land development patterns and customs contribute to the income differentials. These patterns are apparent in Figure 3, which shows the median family income of the individual tracts in the Washington SMSA.

Data on more than present income, however, are needed. The change in income in real terms and the change in distribution of income must be examined to gain a clearer picture of the effects of income on transportation. Figure 4 shows these for the period 1949 to 1959 for the District of Columbia and for its suburbs. (The Washington Consumer Price Index was used to convert 1949 dollars into 1959 dollars. The national consumer price index is only a rough measure for such a conversion for the 212 SMSA's and individual area indices are available only for a limited number.) The changes for the suburbs are more distinct than those for the District itself, but the outward moving pattern of income is discernible.

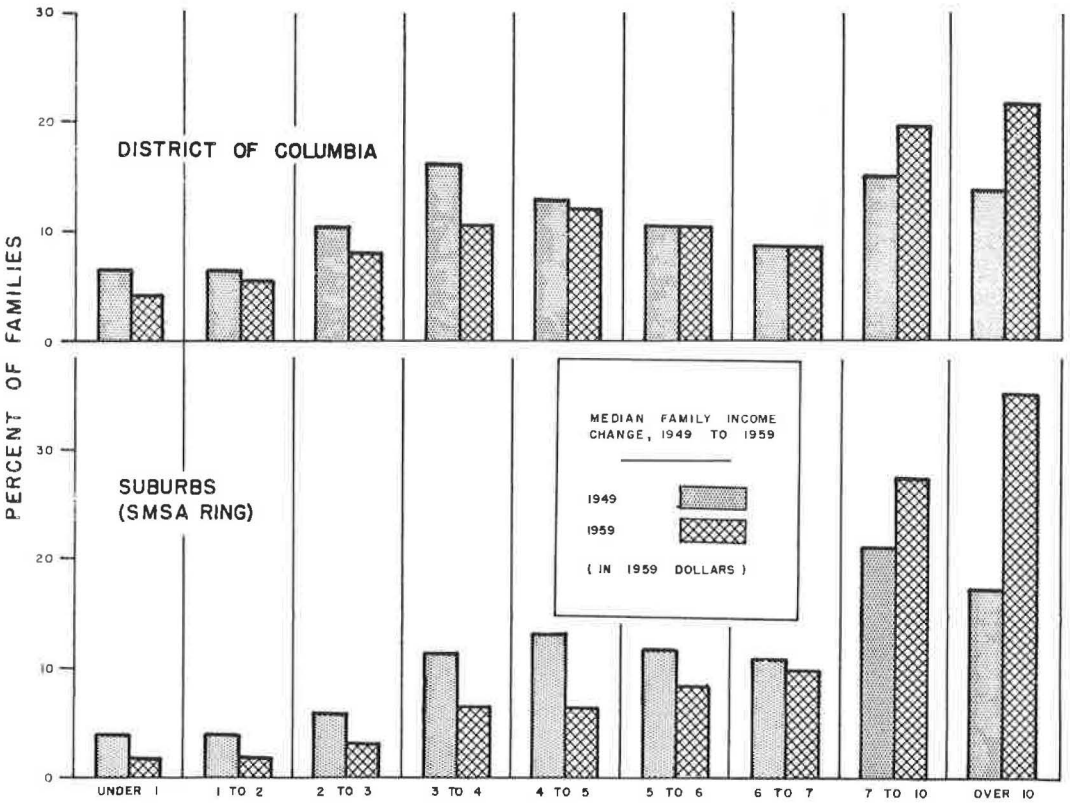

Figure 4. Median family income groups, 1000's 1959 dollars, Washington, D. C.

Automobile Availability

More than half of the 62 million automobiles reported as available in the 1960 census were in metropolitan areas. The count of automobiles available represents the number of passenger automobiles, including station wagons, owned or regularly used by any of the occupants of the housing unit. Passenger cars were counted if they were owned by a member of the household or if they were regularly used and ordinarily kept at home, such as some company cars. Taxis, pickups or larger trucks, and dismantled or dilapidated cars in an early stage of being junked were not counted. It was only in the size group of one million or more inhabitants that any differential by population size group of automobile densities was noted. Otherwise, significant differences in automobile densities characterized individual areas, but the differences were intra- rather inter-group as indicated in Table 9.

Among all size groups, automobiles were more numerous in relation to both population and housing units in the suburbs than in the central cities. The differential was greatest between central cities and suburbs in largest metropolitan areas and tended to narrow rapidly to areas of about 200,000 in population. Thereafter, the differential rose slightly but remained at a stable level for smaller population size groups.

An interesting study of the use of public transportation by Professor Leo Schnore in Traffic Quarterly, October 1962, shows that three factors—size of city, population density, and age—account for most variation in the use of public transportation. Within a particular area, the availability of various means of transportation, the distance from the central business district, and income are also determinants. The interrelationships of all these factors are the key to forecasting transportation demand.

The net effect of population shifts in the United States on automobile density is complex. While the census reports greater automobile density in rural areas than in urban areas, it would not be correct to conclude that urbanization, per se, is tending to reduce automobile densities. The reason is that almost the entire increase in population in recent years has either taken place in the suburbs where automobile densities are even greater than in rural areas or in the annexed portions of central cities, which are generally suburban in character and in automobile density.

The automobile density pattern of the tracts in the Washington SMSA is shown in Figure 5. When Figure 5 is compared with Figure 4, a strong positive relationship appears between automobile availability and income. In Figure 6 the central city and suburban tracts are plotted using these two elements as coordinates. Least-square zones of central tendency for both the central city and the suburbs were computed and plotted. Analysis of the tracts in the District outside the zone revealed that the majority of the tracts below the zone were locations in which walking was a major mode of travel to work and tracts above the zone were locations where public transit service was limited. (Many believe that race is a factor in automobile ownership. This, however, is not apparent in the Washington SMSA statistics. Analyzed on a basis of income, no difference in automobile availability appears according to the racial composition of the various Census tracts once income is taken into account.)

Other analyses must be made of automobile availability to determine effects on transportation planning. In Figure 7 the percent of households with none, one, two, and three or more autos available is shown by income groups for the District of Columbia and its suburbs. Here the relationship between auto availability and income is more pronounced. In planning for mass transit, the captive ridership, i.e., households with no autos available, is important, but multi-car households are also important.

The influence of income on auto availability varies among metropolitan areas. Figure 8 shows the striking differences between areas, using the central cities of the five largest SMSA's as examples. At the $3,000 annual family income level, only

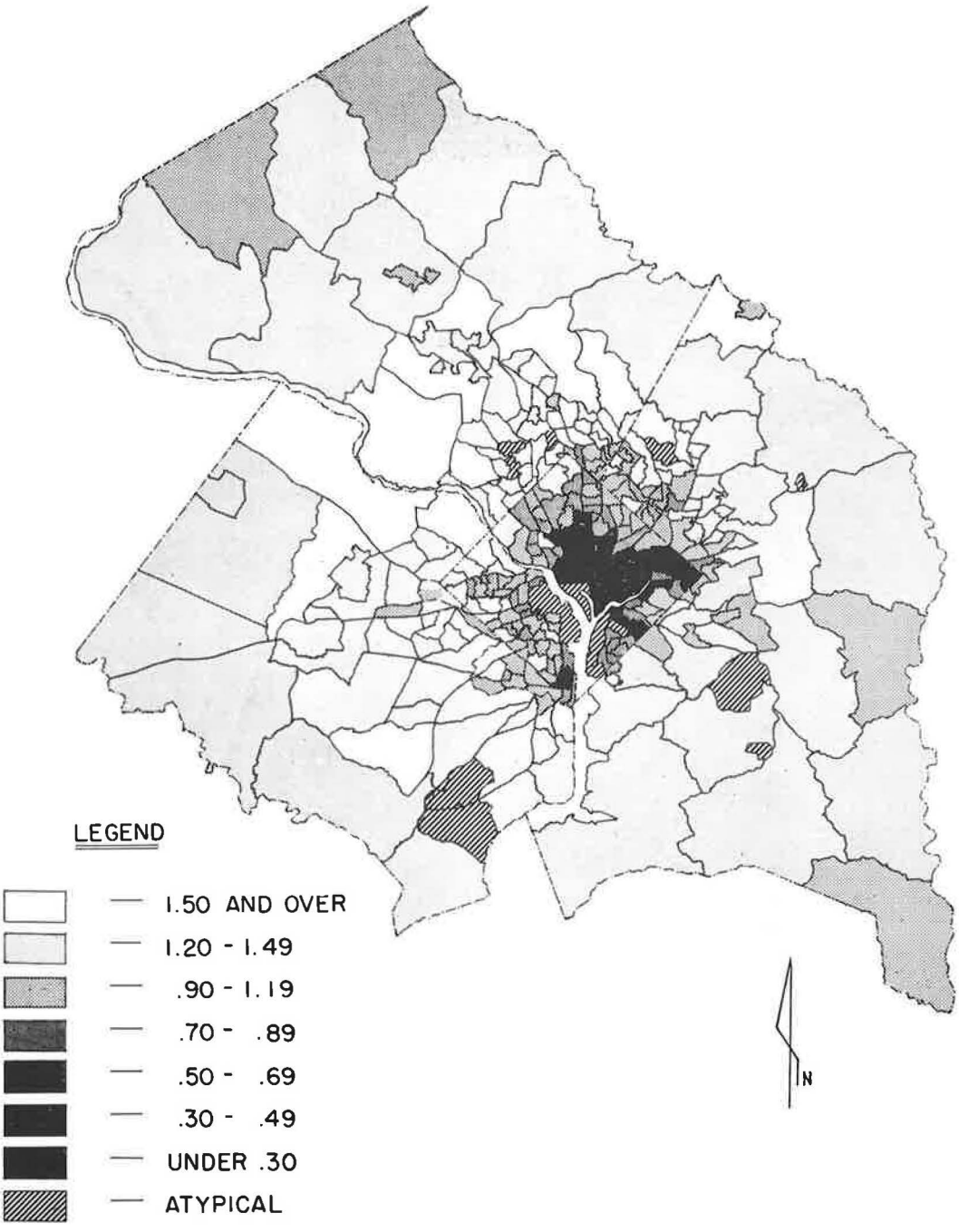

Figure 5. Average auto availability per household, Washington, D. C., 1960.

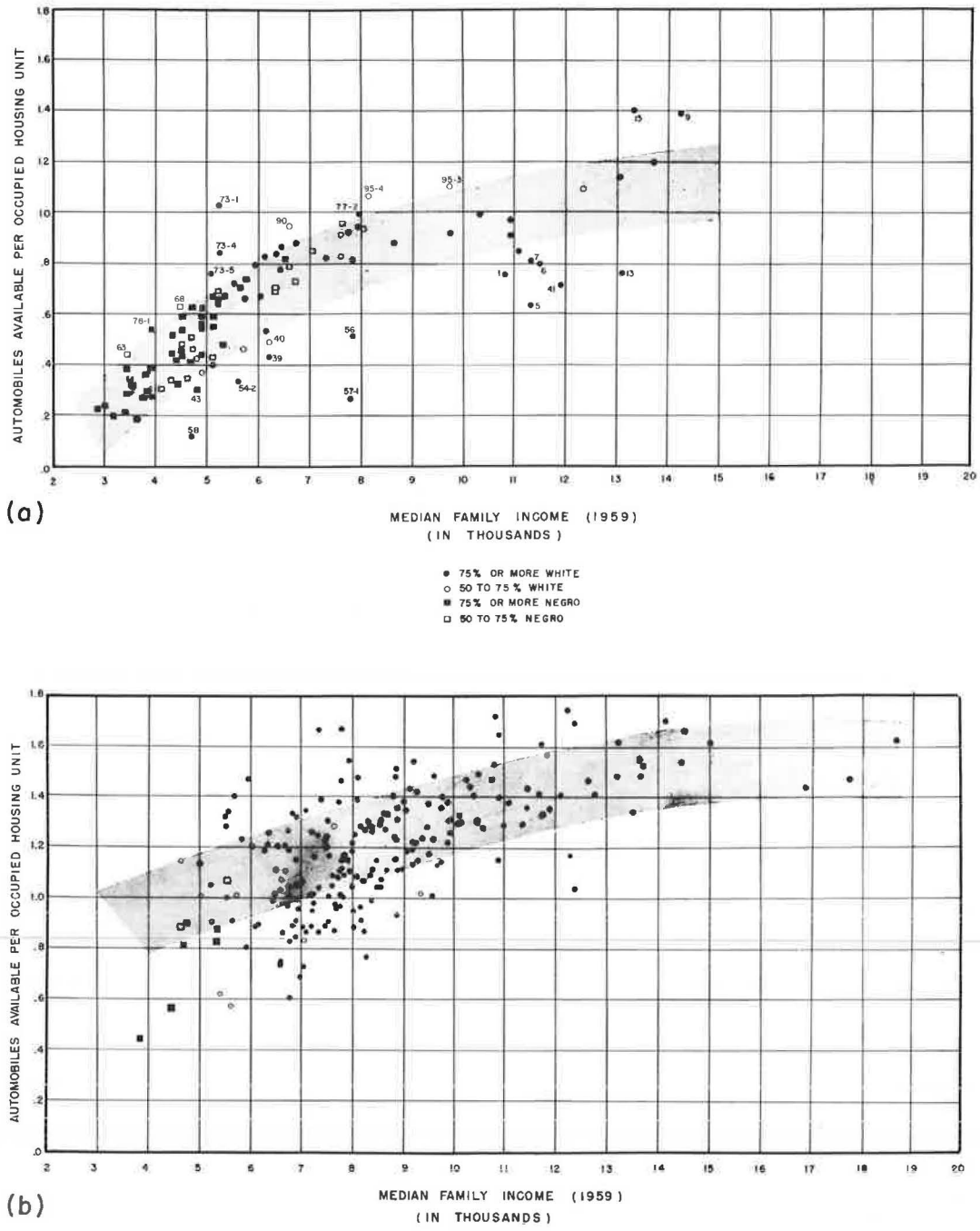

Figure 6. Automobiles available per occupied housing unit (1960) by median family income (1959); (a) District of Columbia, (b) Washington SMSA ring.

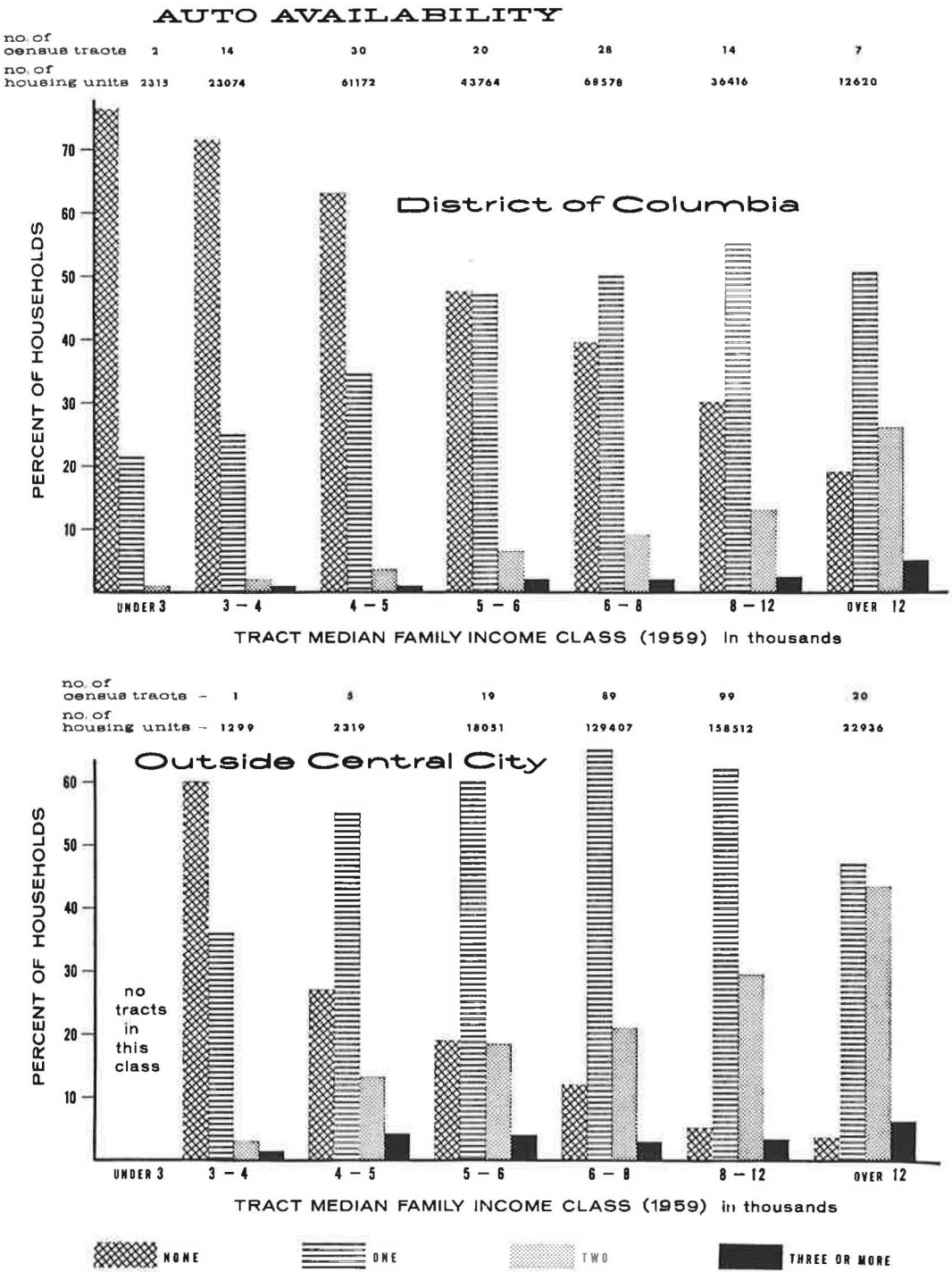

Figure 7. Percent of households with none, one, two, and three or more autos available by income groups for District of Columbia and its suburbs, 1959.

TABLE 9

AVERAGE AUTOMOBILE AVAILABILITY PER OCCUPIED HOUSING UNIT, 1960[a]

Size Group	No. Cars per Unit								
	Central City			Suburbs			Entire SMSA		
	Avg.	Highest	Lowest	Avg.	Highest	Lowest	Avg.	Highest	Lowest
≥1,000,000	0.75	1.15	0.47	1.20	1.32	1.01	0.96	1.21	0.64
500,000 - 1,000,000	0.95	1.24	0.64	1.22	1.43	0.75	1.07	1.33	0.70
300,000 - 500,000	0.96	1.17	0.72	1.20	1.40	0.96	1.08	1.23	0.93
250,000 - 300,000	1.00	1.27	0.74	1.16	1.35	0.94	1.08	1.25	0.91
200,000 - 250,000	1.01	1.16	0.62	1.15	1.35	0.97	1.07	1.19	0.90
150,000 - 200,000	0.98	1.29	0.46	1.19	1.50	0.88	1.07	1.34	0.84
125,000 - 150,000	1.01	1.26	0.77	1.21	1.35	1.02	1.08	1.27	0.85
100,000 - 125,000	1.04	1.32	0.80	1.20	1.38	1.00	1.10	1.29	0.92
50,000 - 100,000	1.05	1.35	0.76	1.21	1.55	0.99	1.09	1.37	0.78
Total	0.85	1.35	0.46	1.20	1.55	0.75	1.01	1.37	0.64

[a]Data derived from Ref. 5.

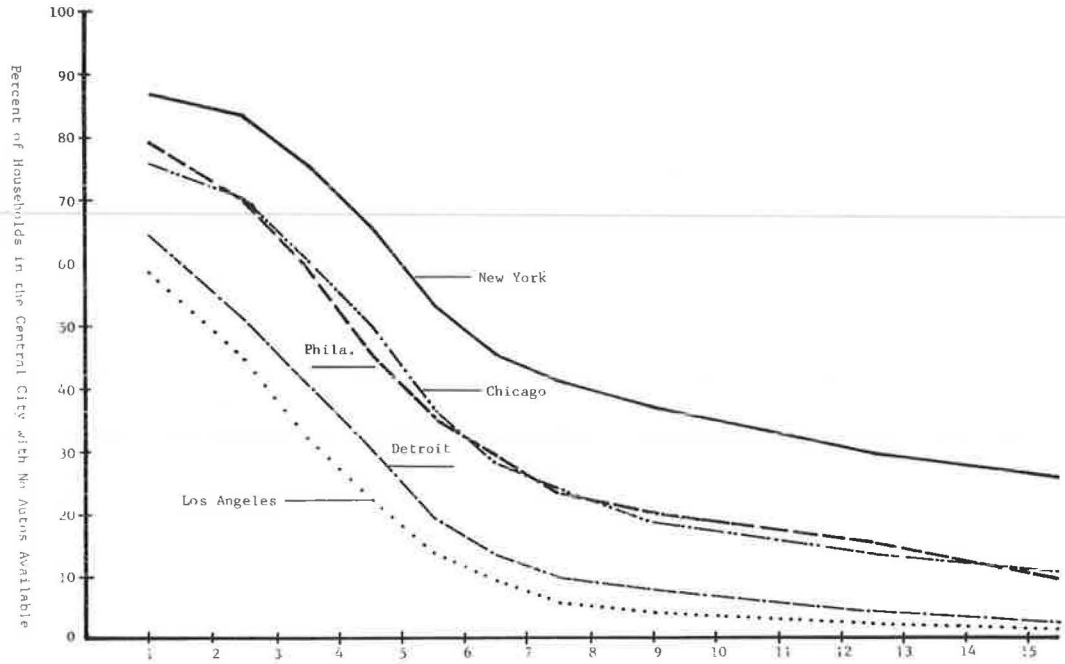

Figure 8. Income for families and unrelated individuals by households (thousands of dollars), 1959.

three-eighths of the households in the Los Angeles central city are without a car, whereas in New York City four-fifths are without. At the $10,000 level, both percentages decrease: only 3 percent in Los Angeles but still more than one-third in New York City. Thus, it is apparent that income is a determinant of auto availability only in conjunction with other factors, such as population density, availability of public transit, and vehicle operating cost, including garaging and insurance. Although there is an apparent general relationship between income and auto availability, other factors determine where in the family of curves the curve for a specific area will fall.

Work Trip Modes of Travel

As might be expected, the pattern of private automobile or carpool use was similar to that of automobile availability. Except in the over one million population size group, the differences due to size were slight. But unlike auto availability, and again except for the largest size group, there were only slight differences between the central cities and the suburbs. There were, however, considerable intra-group differences, with high percentage use in the newer southern and western metropolitan areas and lower use in the older eastern areas. The interrelationship of density of development and auto usage is thus apparent.

The average percentage use of automobiles on the work trip is given for the nine size groups in Table 10. The average percentage of use of private cars by central city workers on the work trip ranged from a high of 87.7 percent in Lawton, Oklahoma, to a low of 20.2 in New York City. In the suburban areas it ranged from 88.8 percent for the Muskegon-Muskegon Heights suburbs in Michigan to 23.0 percent for the Lawton suburbs. (Lawton, the site of Fort Sill is atypical and includes a very large proportion of work at home. Public transportation is insignificant.) The range narrowed somewhat, but is still wide, when entire SMSA's are compared with the high at 86.8 for the Odessa SMSA in Texas and a low for the New York SMSA of 30.9 percent.

The pattern of car usage within a metropolitan area is shown in Figure 9. Only three suburban Washington tracts reported having car usage in the 40 to 50 percent range with the remainder all over 50 percent. A majority of tracts were reported to have over 80 percent usage. The District of Columbia, on the other hand, had no tract with

TABLE 10

AVERAGE PERCENTAGE USE OF PRIVATE AUTOMOBILES OR CARPOOL BY WORKERS ON WORK TRIP, 1960[a]

Size Group	Central City			Suburbs			Entire SMSA		
	Avg.	Highest	Lowest	Avg.	Highest	Lowest	Avg.	Highest	Lowest
≥1,000,000	47.8	77.2	20.2	75.5	87.8	63.2	61.3	81.5	30.9
500,000 - 1,000,000	68.0	85.9	39.0	78.4	88.3	40.7	72.8	83.8	41.2
300,000 - 500,000	70.0	83.8	54.2	80.0	88.8	39.3	74.9	84.7	66.2
250,000 - 300,000	71.7	85.0	44.9	76.0	86.1	63.0	73.9	83.9	65.0
200,000 - 250,000	72.3	82.4	41.6	75.2	83.9	50.7	73.6	79.4	62.1
150,000 - 200,000	70.4	84.9	32.0	77.7	87.2	57.4	73.4	81.3	60.1
125,000 - 150,000	73.8	85.3	61.3	77.9	88.8	57.3	75.3	83.4	64.0
100,000 - 125,000	74.7	84.7	58.7	76.4	87.4	45.6	75.3	84.8	62.9
50,000 - 100,000	75.6	87.7	61.5	63.7	85.7	23.0	73.0	86.8	58.4
Total	58.3	87.7	20.2	63.7	88.8	23.0	66.8	86.8	30.9

[a]Data derived from Ref. 6.

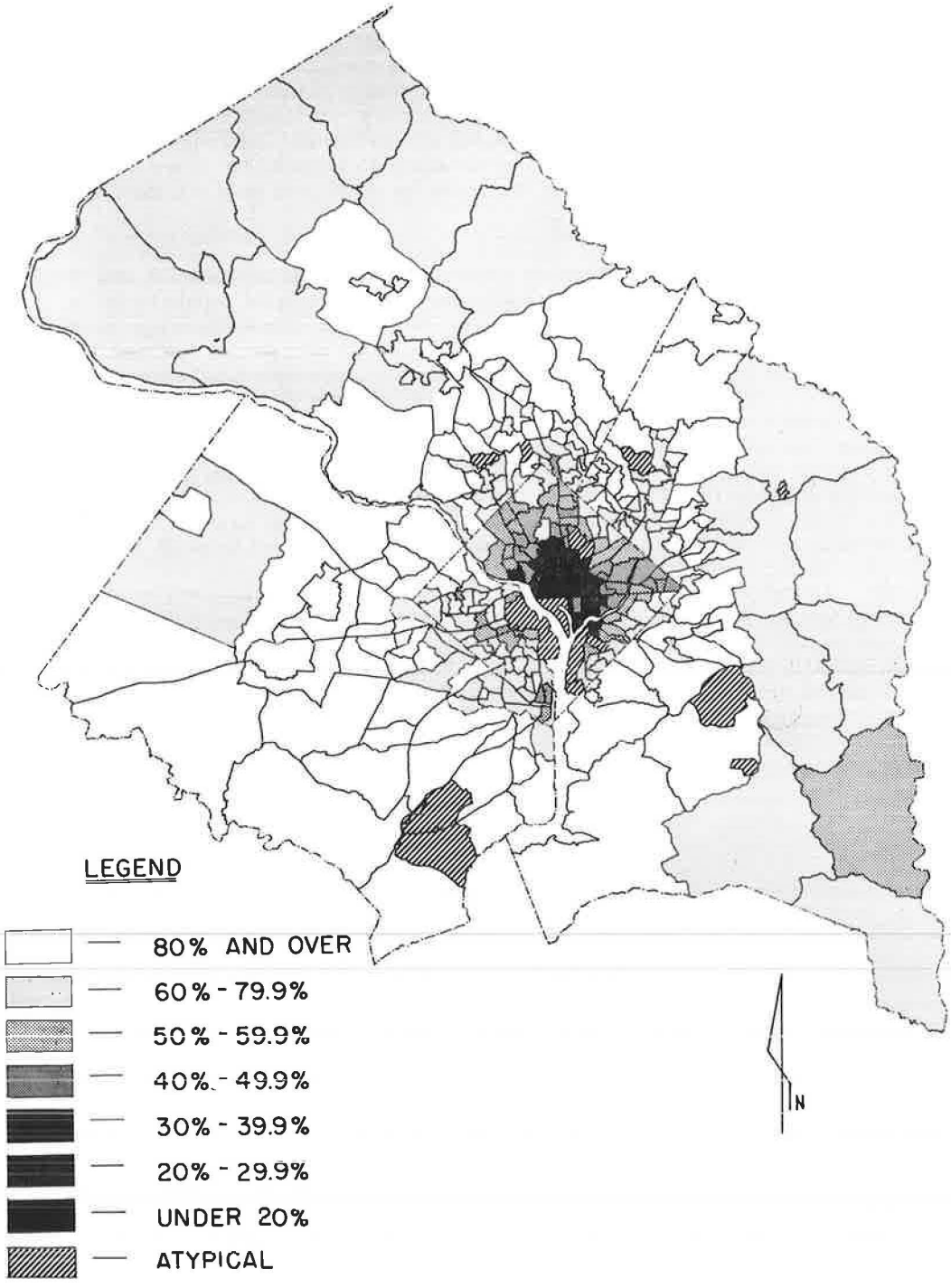

Figure 9. Pattern of car usage within Washington, D. C. SMSA, 1960.

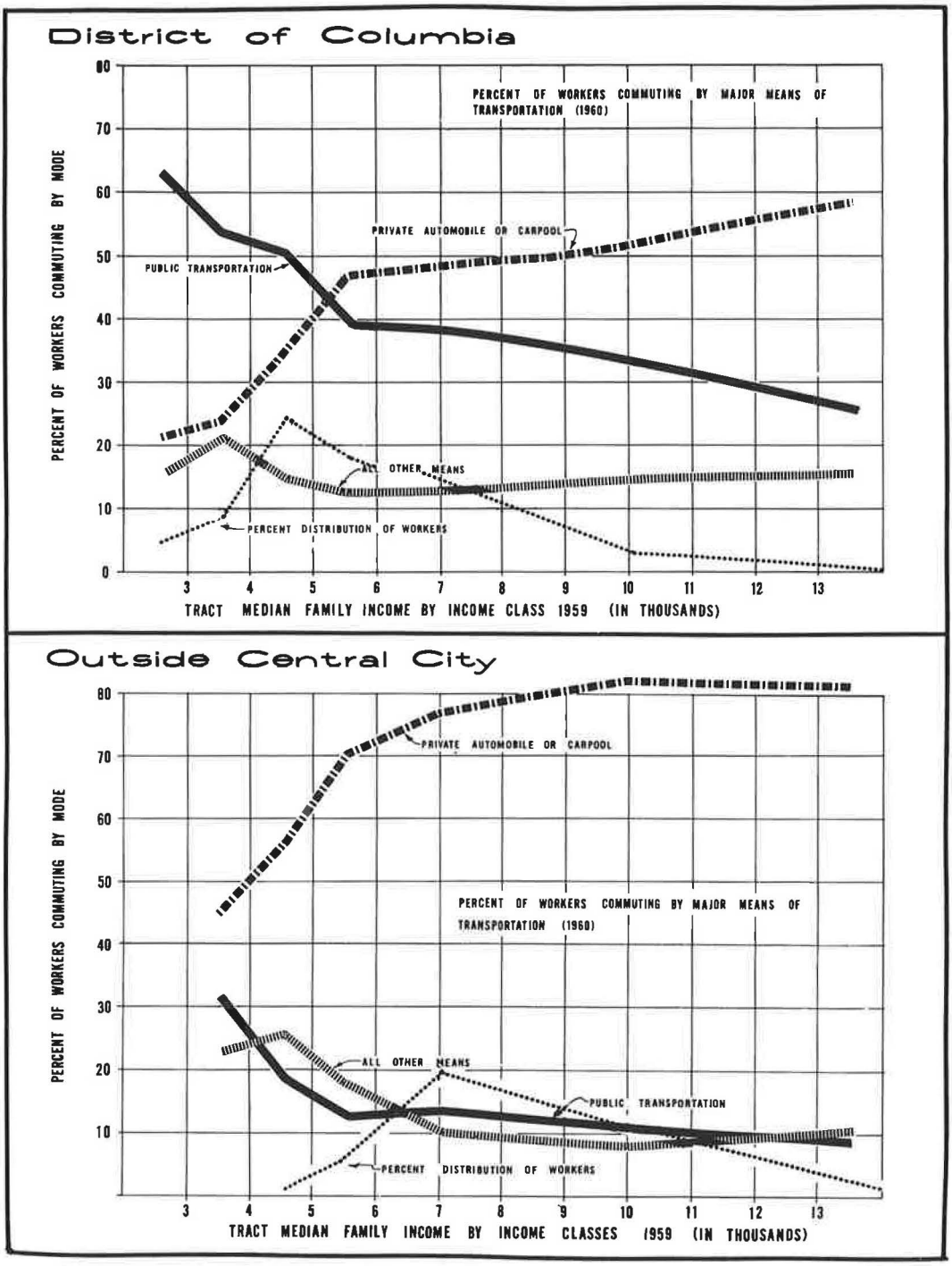

Figure 10. Relationship of auto usage to income, central city and suburbs of Washington SMSA, 1959.

usage of car on the work trip over 80 percent, but it had 15 tracts with less than 20 percent auto usage.

Auto usage, like auto availability, is interrelated with income. Figure 10 shows this interrelationship for both the central city and the suburbs of the Washington SMSA. (This type of analysis was first presented in a paper at the 1962 Annual Meeting of the Highway Research Board. In that paper, the Scissors phenomenon in central cities was illustrated with graphs showing transportation usage of central city workers in the Norfolk and Richmond SMSA's in Virginia.) The direct relationship between auto usage and income and the inverse relationship between public transit usage and income are even more pronounced in the suburbs than in the central city. The differential between the central city and suburbs can be partially explained by the availability of public transportation.

Commuting Patterns

The data collected for the first time in the 1960 Census make possible the study of general commuting patterns in metropolitan areas. The residence of workers is reported on a tract basis. The place of work was collected and reported on the basis of central city and suburban cities and counties. (It is hoped that the 1970 Census will collect and report place of work by Census Tracts. If this is done, a great deal more can be learned.) From these data the number and percent of workers commuting into the central city, out from the central city, and from outside the SMSA can be tabulated. Table 11 indicates the average percent of workers commuting by size groups and the range of percentages. Here again the differences are mostly intra-group rather than inter-group.

The apparent inverse relationship of commuting out from the central city with population size can be understood more fully when the relationship of jobs to resident workers is examined. Table 12 gives these ratios and their ranges for each of the size groups. Although the relationship between jobs to resident workers ratios and size is not as pronounced, there is a definite decrease in the central city ratios as size decreases. In other words, the location of employment centers is a major determinant in worker commuting. Thus, to predict future commuting patterns, the

TABLE 11

AVERAGE PERCENT OF WORKERS WHO COMMUTE TO WORK, 1960[a]

Size Group	To Central City			From Central City			From Outside SMSA		
	Avg.	Highest	Lowest	Avg.	Highest	Lowest	Avg.	Highest	Lowest
≥1,000,000	15.5	27.4	7.5	5.6	14.4	3.1	2.4	27.1	0.4
500,000 - 1,000,000	17.2	34.1	2.6	7.3	19.2	3.0	3.1	18.9	0.1
300,000 - 500,000	19.3	29.8	2.3	7.5	19.0	4.5	3.4	10.1	0.8
250,000 - 300,000	15.2	30.0	3.4	7.8	17.6	2.4	2.7	7.2	0.4
200,000 - 250,000	17.0	31.9	4.5	8.2	25.6	4.5	2.9	11.0	0.4
150,000 - 200,000	14.5	30.7	2.9	9.1	20.1	3.4	4.6	18.7	0.4
125,000 - 150,000	17.4	32.0	5.8	10.1	17.9	4.0	4.5	20.5	0.2
100,000 - 125,000	14.2	21.3	2.4	11.0	27.1	3.5	2.5	8.5	0.5
50,000 - 100,000	6.9	13.9	1.7	10.9	21.6	5.3	2.9	11.8	0.4
Total	16.1	34.1	1.7	6.6	27.6	2.4	2.8	27.1	0.1

[a]Data derived from Ref. 6.

transportation planner must first be able to forecast the changes in the locations of employment centers as well as the changes in residential locations of workers; i.e., forecasts must consider both ends of the work trip.

Commuting into the central city is generally more critical than reverse commuting, or commuting out from the central city. The reason, of course, is obvious. As workers commute into the central city their paths converge, adding to the peak-period congestion. Figure 11 shows the pattern of commuting from the Washington suburbs into the District of Columbia. The pattern of commuting into each of the suburban counties and cities can be determined in the same manner.

The highest auto use in commuting is in the distant suburbs. However, when Figure 11 is compared with Figure 10 it becomes apparent that close-in tracts in the Washington SMSA having a high percentage of workers commuting into the central city also generally have high auto use for the work trip. Transportation planners in forecasting future travel demands must relate the patterns of travel with the modes of travel. The Census data are useful in improving the planners' gravity model by pointing up factors which influence trends in travel.

CONCLUSIONS

From available statistical data, past trends can be determined. If the influence of factors on these trends can be understood, rational forecasts of present and future needs for transportation facilities can be made with greater reliability than those made previously.

When analyzing metropolitan area statistics, the environment of the area must be considered. By environment is meant not only the physical and political situation but also the social values of the area and the time period in which its major development occurred. Environment can and does change, however, as the far-reaching effects of government policies on aid to Appalachia, military production, and the war on poverty are now demonstrating.

An area whose major development occurred after the advent of the automobile, which had a seemingly unlimited supply of reasonably level land, a mild and pleasant climate, and many institutions of higher learning will have a pattern of growth far different from

TABLE 12

RATIOS OF JOBS TO RESIDENT WORKERS, 1960[a]

Size Group	Central City			Suburbs			Entire SMSA		
	Avg.	Highest	Lowest	Avg.	Highest	Lowest	Avg.	Highest	Lowest
≥1,000,000	1.19	1.55	0.96	0.73	0.85	0.53	0.97	0.99	0.70
500,000 - 1,000,000	1.19	1.56	0.66	0.68	1.46	0.26	0.95	1.00	0.69
300,000 - 500,000	1.24	1.70	0.86	0.66	1.38	0.39	0.95	0.98	0.87
250,000 - 300,000	1.15	2.17	0.87	0.76	1.37	0.49	0.96	0.98	0.89
200,000 - 250,000	1.17	1.60	0.90	0.71	1.14	0.40	0.95	0.98	0.85
150,000 - 200,000	1.09	1.48	0.86	0.68	1.27	0.29	0.92	0.98	0.68
125,000 - 150,000	1.12	1.67	0.81	0.61	1.33	0.33	0.92	0.98	0.66
100,000 - 125,000	1.05	1.24	0.81	0.76	1.83	0.30	0.95	0.98	0.81
50,000 - 100,000	0.95	1.12	0.75	0.78	1.68	0.32	0.91	0.97	0.69
Total	1.18	2.17	0.66	0.71	1.83	0.26	0.96	1.00	0.66

[a]Data derived from Ref. 6.

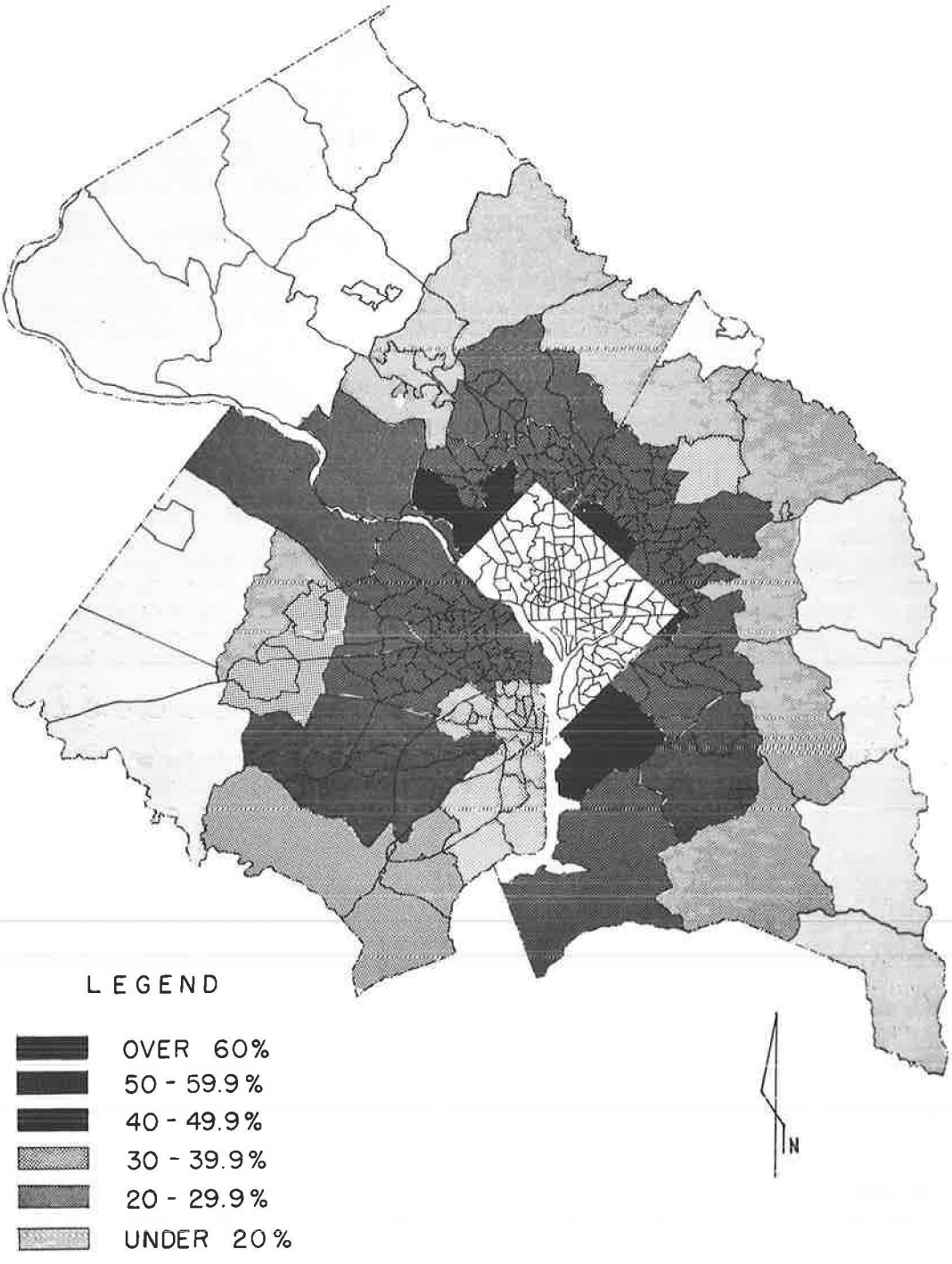

Figure 11. Pattern of commuting from Washington suburbs into District of Columbia, 1960.

that of an area developed before the advent of the automobile and whose principal resources oriented it toward a single industry.

The former area would likely have been developed at low density. Such development, oriented to private auto travel, would probably not have much public transit available and employment centers would probably be decentralized. With its high educational base and advantageous physical environment, it would likely have attracted the development of a diversified industrial base, including some of the exotic electronic, space- and missile-oriented industries. It would have a high participation of women in the labor force and thus high family income and a high percentage of multi-car ownership and use. The commuting pattern would be highly diffuse with a great deal of cross-commuting. Its population would likely be younger and growing more rapidly. Its future growth in all ways, however, would depend greatly on public policy with regard to defense spending and other factors.

The latter area would likely have developed at relatively high density with its development oriented to the terrain, public transit, and employment center location. The participation of women in the labor force would be low. The area's population would probably be older, its family income lower, its percentage of families with no autos available higher. Its future growth would depend on its locational advantage and on the technological developments and implementation of automation in its one major industry.

These two extremes are exemplified by the Los Angeles and Pittsburgh metropolitan areas. There are many gradations between these two, however. Among the 212 SMSA's, areas of rapid, moderate and slow growth can be identified, but further analysis must be made of their socio-economic peculiarities, their economic base, and their potential for future growth. History is not likely to recur precisely.

Effective use of the Selected Statistics by Standard Metropolitan Statistical Areas for Use in Transportation Planning, published by the U. S. Bureau of Public Roads, October 1964, together with other available statistical material, will improve the forecasts needed for transportation planning both on the national and the metropolitan area level.

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The Use of Behavioral Surveys in Forecasting Transportation Requirements

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This paper highlights some of the important results obtained from a nationwide survey of urban households conducted by the Survey Research Center of the University of Michigan, and shows how behavioral surveys of this type can be used to improve forecasting procedures used in urban transportation planning.

The findings are based on 824 home interviews in about 30 standard metropolitan statistical areas. Information was collected and analyzed on recent residential moves, travel habits, socio economic characteristics of households, and attitudes and preferences regarding the choice of residential location and mode of travel on the journey to work.

The critical factors influencing households' decisions on residential location and mode of travel are identified, and several conclusions are drawn about the implications of the findings for future patterns of urban development and transportation systems usage.

The paper reviews currently used methods of forecasting residential land use and trip generation, and shows how, in light of the findings of the University of Michigan study, significant improvements in these methods can be made by taking a more behavioral approach in model building.

•THIS PAPER considers the potential use of behavior surveys in highway planning and attempts to place in the perspective of current practice the findings of a recent study conducted by the Survey Research Center, University of Michigan, for the U. S. Bureau of Public Roads. The major findings of the Michigan report are presented in the first section. The forecasting implications of the behavioral approach are discussed in the second part of the paper, with special reference to residential land use and trip generation.

THE RESIDENTIAL LOCATION AND URBAN MOBILITY STUDY

The Survey Research Center study investigated intensively the attitudes and behavior of urban families, with emphasis on two types of decisions having primary bearing on urban transportation demand. Although covering a broad field of interest to city and highway planners, the study concentrated particularly on two related decision-making processes: (a) choice of location of residence, and (b) choice of mode on the journey to work.

The first report on this study was recently published by the Survey Research Center (1) and distributed to each state highway department and a number of other interested agencies and persons. Findings of the study's first phase are based on 824 personal

Paper sponsored by Committee on Economic Forecasting.

interviews from a representative cross-section of homes in standard metropolitan statistical areas. (The New York metropolitan area was excluded because of budget limitations, the area's complexities, and other considerations.)

This research effort seeks to answer questions faced by each urban area transportation study in developing and testing alternative plans for land use and transportation facilities. How will people behave under changing environmental conditions? What kind of new residential areas will be demanded, and where? How many, and what type of, trips will future residents make?

Despite the fact that the staff of every transportation study must forecast these elements, their time and budget limitations almost always preclude extensive basic research into the character of an area's urban growth and travel demand. Forecasts are necessarily based largely on trend projections of current patterns, described through massive data collection programs and analyses of highly aggregated data. This is the only course open to the transportation studies since so little precise knowledge exists about the nature of the basic factors and interrelationships involved in the decision-making processes. Forecasts based on gross descriptions of current conditions may prove reliable only in the short range.

With the foregoing state of the art in mind, the U. S. Bureau of Public Roads initiated the University of Michigan study to investigate another possible approach that might improve methods of forecasting residential land-use patterns and transportation systems usage. The specific objectives of the study were as follows:

1. To gain a better understanding of the key factors influencing choices of residential location and travel mode;
2. To measure the relative importance of the factors involved in these two areas of decision making; and
3. To gain experience with behavioral survey and research techniques to assist urban transportation studies in conducting such studies as part of their continuing planning processes.

The first report presents the findings gained from simple cross tabulations of the survey data. Additional work, now in progress, will result in a second report to be released early in 1965 covering the results of more thorough statistical analysis.

FINDINGS

The major conclusions[1] of the Residential Location and Urban Mobility study were the following:

1. The existing pattern of residential location, described by density and distance from city center, is strongly influenced by family income and by stage in the family life cycle.
2. A large proportion of potential movers would like to shift to less urbanized locations, farther away from the center of the city, into a more rural setting. Inconvenience and distance to work are unlikely to be major deterrents to outward migration.
3. The number of persons desiring to move from an apartment to a single-family house is much larger than the number interested in the opposite change. The recent boom in apartment demand reflects existing demographic and financial conditions, but not a shift in consumer preferences.
4. A widespread desire for vacation cottages or vacation homes exists and a significant proportion of families, particularly in the upper income brackets, expect to realize this ambition.
5. The number of vehicle trips per family in a 24-hr period is associated with such family characteristics as income, occupation, and age of the family head, size of the residential lot, density of neighborhood, age of the city, and number of automobiles owned. Further analysis is needed to determine the extent of independence of these

[1] This section is taken from "Summary of Findings" from the original report by the Survey Research Center, with minor revisions.

variables and their relative importance when they are taken into account simultaneously.

6. Automobile ownership and the mean annual number of miles the principal family car is driven depend on income and, to a lesser extent, on distance from city center and city age.

7. Choice of mode for the journey to work does not appear to be sensitive to cost. Most people have never even estimated the cost of driving to work; those who have report widely varying costs per mile, indicating that very little care was taken in making the estimate.

8. People would choose overwhelmingly to go to work by car rather than by common carrier if the costs and the time were the same. A frequent complaint about common carriers is that they are crowded; people prefer the freedom of movement and the convenience of travel by automobile.

FORECASTING IMPLICATIONS

General Implications

The merits of the Survey Research Center study, however, lie not so much in these 8 broad statements—for generalizations are plentiful in this field—but in the impressive array of quantified evidence behind these statements. Many ideas that had been mere conjecture before have been critically examined by the University of Michigan team. For example, the suspicion by many that the choice of mode for the journey to work was not primarily an economic decision is strongly confirmed by the report: 73 percent of all persons who drive to work have never bothered to estimate what it costs them. Again, it has long been known that there is a strong existing and potential demand for single-family housing; the present study indicates that 60 percent of families in multiple-family dwellings would prefer to live in single-family housing.

Another contribution of this survey is the fact that it cuts across cities of all types, in all parts of the country. Data collected in one metropolitan area, in an O-D study for example, apply only to that area. Such data leave unanswered the question of whether or not the relationships found are peculiar to the special socio-economic and travel characteristics of that area. With data collected in a nationwide representative sample of urban areas, it is possible to determine to what extent certain measurable characteristics of urban areas may influence deviations from the national average. Generally applicable models of behavior may be formulated and the variations among urban areas estimated.

The greatest asset of this study, however, is its comprehensive scope. Data collected for each household include not only the usual items obtained in an O-D survey, but much pertinent data usually collected by the Census of Population, as well as a wealth of information on attitudes relating to housing and modes of travel.

The move to the suburbs, to lower densities, and to increased dependence on the automobile, is a trend that will not be easily reversed. Every indication points to the assumption that this will continue to be an extremely strong force. Of all persons now living in single-family homes, the number who feel their lots are too small outnumber those who feel their lots too large by more than two to one. Until families occupy lots as large as 0.3 acre or more, those who feel they have too little land will outnumber those who feel they have too much. This implies a demand for land that would create average residential densities of about three dwelling units per net residential acre (a 100- by 130-ft lot is approximately 0.3 acre) for single-family areas.

Given a choice between a house in the suburbs on a paved street with sidewalks and lawns, or a house in the country with woods, or a field between you and the next house, 45 percent of urban residents said they would prefer the country house. The proportion tended to rise with income, with distance from downtown, and with a tendency to engage in various outdoor activities.

Even those families who stated preference for close-in living did not often give reasons which would seem to tie them strongly to the central area. Only 5 percent of these families mentioned closeness to work as a reason; even fewer mentioned social advantages of central city living. The majority, 69 percent, gave closeness to other

activities (stores, schools, etc.) as their reason for wanting to live closer in than they now do. These activities are becoming ubiquitous in modern suburbs.

A majority of respondents (52 percent) go downtown less than once a month for purposes other than work. Shopping trips outnumber other nonwork trips to the central business district by more than three to one. Some 44 percent of all recent movers stated that closeness to place of work made no difference in their choice of residential location. The proportion rises to a majority for those now living more than 10 miles from their place of work (54 percent) and those who are now 30 minutes and more from work (60 percent). Attitudes toward present and preferred housing appear to depend much more on characteristics of the house itself and qualities of the neighborhood than on locational considerations.

The study makes it obvious that most people have a poor image of central-city living. Concern about living with "nice people," social status, and neighborhood amenities undoubtedly are attitudes which are attracting people toward outlying locations.

Residential Land-Use Forecasting

The current practice among urban transportation studies in forecasting land use is to allocate anticipated total regional growth to small areas, dealing with each of perhaps half a dozen or more categories of activity separately, i.e., residential, retail, manufacturing, services, other industrial, public buildings, public open space, transportation, highways, and streets (2-6). With the exception of two or three research efforts now in progress, the allocation of population growth to new residential land is treated as if households were a single homogeneous quantity.

Typically, residential development is forecast by allocating units of growth (population or households) to available land in each small area. Factors considered in distributing growth usually include two or more of the following:

1. Either holding capacity, or the amount of land available and suitable for development;
2. Accessibility to employment sites;
3. Soil and terrain conditions (drainage, slope, soil type, etc.);
4. Level of sewer and water services; and
5. Land value.

Several weaknesses exist in this approach. Residential land deserves and requires finer analysis than this since it accounts for over half of total developed urban land and over half of all trip-ends generated. The procedure handles only the development of new residential land. It assumes implicitly that there is no change in existing built up areas. Frequently the central core area is handled by separate analysis, especially if there are plans for urban renewal or if there are areas of significant population decrease.

The new University of Michigan study demonstrates clearly the danger in treating all households alike. Present methods of forecasting do not take into account the fact that different types of households have different locational characteristics. The more important characteristics distinguishing behavior of families in residential site selection are (a) stage in the family life cycle, (b) age of the head of the household, (c) income, (d) race, and (e) education.

Also, the study shows that several of the more important factors that people consider in choosing new housing are ignored by current techniques. These include:

1. Proximity to similar types of families;
2. Type of housing available (lot size, value, number of rooms);
3. Proximity to stores, schools, etc.; and
4. Amenities of the neighborhood.

Improved methods must take a more behavioral approach to the prediction of residential growth. A significant improvement over most current methods could be made by stratifying all households into a small number of categories by stage in the family life cycle, or by income, or, preferably, by both variables. Using regression

techniques, an estimating equation could be developed for each type of household by relating the increase (or decrease) in the number of households in each small area over a recent time period, to the following variables measuring the attractiveness of each small area for that household group[2]:

1. Accessibility to households of the same stratum;
2. Accessibility to retail activity;
3. Distance to nearest school;
4. Average value of housing;
5. Holding capacity, in number of potential dwelling units, stratified by type and size of lot; and
6. Accessibility to appropriate types of employment sites.

In the forecasting process, soil and terrain conditions, general planning policies, zoning, plans for the provision of sewer and water services, and anticipated areawide demands for housing of each type should all be considered in estimating holding capacities by type of dwelling unit and size of lot.

Land-use models developed along the lines described offer several advantages. They are more reasonable conceptually and, therefore, can be used with more confidence. Since they would conform more closely with our knowledge of human behavior, the values and signs of the regression coefficients can be readily checked against hypotheses. Also, because the relationships involved in the equations are more behavioral in nature, the parameters can be expected to be more stable over time and in different metropolitan areas. Research of this type should lead toward generally applicable models of urban change.

Forecasts made with these regression equations would provide transportation planners with values of income, density, and other household characteristics for small areas, which should be helpful in estimating trip generation and modal split. Most current land-use forecasting methods will not provide these data directly.

Most importantly, these models would be sensitive to a number of key policy variables ignored by many current forecasting methods. This approach would provide another major step toward replacing the undesirable trend-based projection methods with powerful tools for comprehensive metropolitan planning.

The residential land-use forecasting method proposed poses no serious statistical complications beyond what is now typically encountered. In fact, some problems of parameter reliability would probably be simplified. One refinement that may add accuracy to the suggested procedure is worth mentioning, however.

The University of Michigan study suggests that the two variables, family life cycle and income, are most important determinants of where people tend to locate. Stratification of households into a small number of categories according to these two characteristics is definitely warranted. However, other characteristics such as family size, age, education, and occupation might also be considered.

If a large number of variables is to be considered, multivariate statistical techniques could be used to define household categories so that the behavior of each household type would be more nearly homogeneous. Component, factor, or cluster analyses could be used to aggregate categories based on the geographic correlation of household groups. Variance or regression analysis could be used to identify the most important distinguishing household characteristics for stratification of the groups. Latent class analysis has been suggested as another approach (7). This technique would define groups in a manner which would satisfy the criterion that behavior with regard to any manifest variable be independent of behavior with regard to any other manifest variable, for households within the same category. Multiple discriminant analysis might also be used.

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[2]The regression equations for the several household types form a highly interrelated equation system. Significant bias is likely to be introduced if equation parameters are estimated by single equation least squares methods. Modern econometric methods for estimating parameters in a simultaneous equation system should be used.

Trip Generation

Many urban transportation studies base their forecasts of trip production on regression equations relating daily trips per household to one or more of three variables: automobile ownership, residential density, and distance from the central business district. The data used to develop the estimating equations are average values for traffic analysis zones, or districts, for the current year (for example, see 8). An excellent discussion of the problems involved in correlating aggregated data, and an analysis of household trip generation in Detroit and Modesto was written by Oi and Shuldiner (9).

Several problems are inherent in the approach typically used. The first of these problems is what is being measured and explained by the model, i.e., the variance between zones, not the variance between the basic units responsible for travel behavior, the household. The between-zone variance is small in relation to the between-household variance. The household is the basic observation unit for most of the data collected. Much information is lost by areal aggregation, and undoubtedly less data would be needed to develop equations with the same statistical reliability.

Relationships developed from these aggregated data are sensitive to the size of the zones and the degree of internal homogeneity achieved in drawing their boundaries. Undoubtedly this is an important factor explaining why relationships tend to differ significantly from city to city.

Relationships developed from area data will not be reliable for forecasting purposes unless the ratio of within-zone-variance to between zone-variance, with respect to all variables, can be expected to remain constant over time. On the contrary, evidence shows that newer suburban areas are less highly differentiated with respect to household characteristics than older areas in the central city (10).

Areal aggregation can obscure much of the difference in socio-economic characteristics of households and, therefore, obscure correlations that may exist between these variables and travel behavior. Cross tabulations in Residential Location and Urban Mobility show that trips per household vary with income, family size, stage in the family life cycle, occupation, as well as other variables usually considered by transportation studies such as density, automobile ownership, and distance from downtown.

Another weakness of much of the work on trip generation analysis is that too often all relationships are assumed to be linear without justification. An example would be an equation containing a positive linear regression coefficient for distance to downtown. Despite the fact the model probably overstates trip-making in existing suburbs because of the leveling off of the relationship in the outer areas, it is expected to hold valid for future fringe areas considerably further from downtown. Such assumptions become most critical when forecast values are likely to fall outside the range of current observations.

Also, it can be shown that relationships will be invalid if they are derived from aggregated data, and the basic relationships are nonlinear. As a general rule, analysis should precede aggregation rather than the reverse; the invariance of relationships with regard to area size should be verified before the analysis of aggregated data is used for forecasting purposes.

Considerable improvement might be made in trip estimation by using the household as the basic unit of analysis and by taking more care in developing relationships. Rather than assuming linearity for all independent variables, the analyst can stratify each household characteristic into several classes and treat each class as a separate dummy variable in the regression. (One class must be left out of the equation to avoid overdetermination. For a discussion of the dummy variable technique, see 11.) If a plot of the resulting regression coefficients against values of the characteristic approximates a straight line, then that household characteristic may be confidently treated as a linear variable in a subsequent equation. It should be pointed out that a simple plot of the raw data is not sufficient to verify the hypothesis of linearity, since the influence of other significant independent variables is not accounted for. An apparent linear fit in a two variable plot can, and often does, change signs, become substantially nonlinear, or become insignificant when several variables are considered simultaneously.

Preliminary analysis of the data collected in the University of Michigan study shows that transportation studies may not be focusing attention on the right variables. Table 1 gives all variables which have been found to influence trip-making significantly, in the order of their importance (the beta coefficient is a measure of the relative importance of each variable when all variables are considered simultaneously). The table also indicates which variables were approximately linear in earlier regression equations and, therefore, treated as such in the final analysis. The dependent variable is total trips made by the household per day.

Of three variables commonly analyzed in transportation studies, one is insignificant (distance from downtown) and another (density) ranks last among the other six variables. These preliminary results argue strongly for inclusion of family size, income, stage in the family life cycle, and occupation in trip generation analysis.

Trip production equations developed at the household level are easily applied to the forecasting of total zonal trip-ends. If the analyst knows the average value for each independent variable and the number of households in each category of dummy variables, he can estimate directly trip production for the zone.

For example, an estimate for a particular zone might be

$$T = Na + Nb_1\overline{X}_1 + Nb_2\overline{X}_2 + N_3b_3 + N_4b_4$$

where

T = trip-end estimate for the zone;
N = total households in the zone;
a = intercept from household regression analysis;
b_1, b_2 = regression coefficients for linear variables, from household regression analysis;
$\overline{X}_1$, $\overline{X}_2$ = average values for the zone for each of the linear variables (e.g., family size and automobiles owned);
b_3, b_4 = regression coefficients for dummy variables, from household regression analysis;
N_3, N_4 = number of households in each dummy variable category (e.g., income and family cycle classes).

The strongest argument in favor of analysis at the household level is that behavioral relationships are more likely to remain true over time and, therefore, produce more reliable forecasts. Analysis of household data, rather than area data, is needed to develop these behavioral relationships.

Thirty-five percent of the variance in trips per household was explained by the household characteristics in the analysis of the University of Michigan data. (The proportion of variance in household behavior explained by a model is substantially lower than the variance among area averages explained by models developed from area data. This is true because of the inherent daily variability in household travel habits.

TABLE 1

RANKING OF CHARACTERISTICS IN ORDER OF SIGNIFICANCE

Characteristic	Beta Coeff.	Rank
Family size (linear)	0.29	1
Automobiles owned (linear)	0.23	2
Income	0.14	3
Stage in the family life cycle	0.13	4
Occupation	0.11	5
Density of neighborhood	0.10	6
Distance	(insignificant)	7

For the errors to be directly comparable, the household model would have to be used to make estimates for the same areas for which an area model was developed.) An additional 7 percent was due to variance between cities. Further analysis showed that about one-third of the unexplained variance between cities is attributable to a few simple differences among cities, i.e., geographic region, central city population density, and age of the city. Stated another way, only 4.4 percent of the variance in household trip production is due to differences between cities which cannot be explained by the household and city characteristic variables. It does not seem unrealistic to hope that further refinements toward a general model of trip production would produce a model accurate enough to make unexplained differences among cities insignificant and thereby alleviate the need to collect trip generation data for every transportation study.

CONCLUSIONS

1. Much helpful information is to be gained in urban transportation planning by nationwide studies of the behavior of urban residents. General understanding of urban phenomena as well as forecasting methodology benefit from these efforts. Further intensive research building on the results of the University of Michigan study is definitely warranted.
2. The possibility of changing attitudes and tastes must be recognized. What will be the impact of the new towns springing up around the country? Will the image of public transit change with the introduction of modern, clean, and comfortable rapid transit systems now being planned? How much will the urban renewal programs change attitudes toward central city living? Periodic resurveys are needed to answer these and other questions.
3. In-depth behavioral surveys in individual metropolitan areas are recommended as part of the continuing planning process. Information on community attitudes will be most helpful to the planner in identifying problems, and formulating objectives.
4. Behavioral research of the type described in this paper can substantially improve our methods of forecasting and decrease the amount and cost of other large data collection programs.

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Travel Characteristics of Persons Living in Larger Cities

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•THE PURPOSE of this paper is to examine some of the travel characteristics of workers now living in cities (exclusive of the surrounding urban areas) having a population of 100,000 and over. The data considered are the choice of travel modes used by workers related to the nearness to public transportation to work, the distance to work, and the family income of the workers. Also considered is the distribution of trips and travel to the downtown by purpose of trips and for each purpose the proportion of all trips destined for the downtown area.

The principal data on which this paper is based are derived from a nationwide automobile-use survey conducted in Spring 1961 by the Bureau of the Census under contract to the Bureau of Public Roads, supplemented by other information that has become available since that time.

The sample used by the Bureau of the Census for this study was one of approximately 5,000 dwelling units from the Current Population Survey. This survey, conducted monthly by the Bureau of the Census, is based on a statistically selected sample representing the noninstitutional civilian population. Its main purpose is to obtain current information on employment, unemployment, and related data compiled monthly. This paper reports on data obtained in over 1,300 households of the sample located in cities having a population of 100,000 and over. Because these data are based on a probability sample of households, the figures are subject to sampling variability, i.e., the expected differences between results of a sample survey and those that would have been obtained from a complete enumeration of all households. Based on the estimates of sampling variability from this survey in places having a population of 100,000 and over, there are about two chances in three of being right in assuming that the relative difference between the estimate of vehicle-miles by purpose yielded by this sample and the true value is approximately 20 percent of the estimate. The sampling error in the estimate of trips by purpose would be approximately 10 percent.

BACKGROUND

It can be reasonably assumed that the major portion of highway needs of this country will be concentrated in urban areas in the next two or three decades, which is generally as far into the future as one cares or dares to look. It is highly probable that in 1990 about 80 percent of the total population of the 48 contiguous states and the District of Columbia will reside in urban areas.

Projections of future population growth show a range in total predicted population from 262 million to 301 million for the year 1990. A recent projection prepared by the U. S. Bureau of Public Roads resulted in a 1990 estimate of 286 million. If the probability of 80 percent of this number being residents of urban areas holds, this would mean an urban population of 230 million.

The planning and constructing of the urban highway system—or, for that matter, systems including all modes of urban transportation—to meet the travel needs and desires of 230 million persons is a task of unparalleled magnitude in transportation history. With more and more of the population living in urban concentrations, it

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becomes increasingly necessary to plan the development of transportation systems embracing the various modes in a balance that will provide efficient and effective transportation service for states and local communities.

The study of travel habits of workers reported here sheds some light on preferences for certain modes of transportation and how these preferences may suggest the trend of future transportation development.

NEARNESS TO PUBLIC TRANSPORTATION

As indicated in Table 1, 69.3 percent of all workers living in cities having a population of 100,000 or more had some form of public transportation available within two blocks of their homes. At the other extreme, 8 percent had no available public transportation to work.

Of all workers, 87 percent had public transportation available six blocks or less from home. Furthermore, of the working population living 15 miles or more from work, 15.6 percent has no public transportation available nearer than six blocks from their home; for other distance groups less than 5 percent was reported in this category.

COMMUTING BY AUTOMOBILE

Half of all workers who have some form of public transportation to work available to them chose to use automobiles for this purpose, as indicated in Table 2. The percentage is even a little higher than the average in the case of workers living within two blocks of public transportation. Among possible reasons for this might be inadequacy of, or dissatisfaction with, the public transportation system.

The time factor may enter into the choice of the automobile as the means of getting to work. In the 1963 Passenger Transportation Survey by the Bureau of the Census, it was found that 74 percent of the persons commuting to work by automobile required less than 25 min to get there, whereas only 25 percent of the workers commuting by public transportation were able to get to work within this time.[1] These figures may be an indication of the value commuters attach to time savings.

TABLE 1

DISTRIBUTION OF PERSONS ACCORDING TO DISTANCE TO NEAREST PUBLIC TRANSPORTATION TO WORK[a]

Distance to Work One Way (mi)	Distance to Nearest Public Transportation to Work				
	1 to 2 Blocks (%)	3 to 6 Blocks (%)	Over 6 Blocks (%)	None Available (%)	All Dist. (%)
Under 5	71.7	15.5	2.8	10.0	100.0
5.0 - 9.9	69.0	23.0	4.7	3.3	100.0
10.0 - 14.9	71.5	19.5	3.0	6.0	100.0
15.0 and over	56.2	13.9	15.6	14.3	100.0
All distances	69.3	18.0	4.7	8.0	100.0

[a]Nationwide automobile-use survey of locations having populations of 100,000 and over, spring 1961.

[1] Preliminary Progress Report, Home to Work Travel Survey, 1963 Census of Transportation; data shown are for central cities of Standard Metropolitan Statistical Areas.

TABLE 2

PERCENTAGE OF PERSONS USING AUTOMOBILE FOR WORK BY DISTANCE TO NEAREST PUBLIC TRANSPORTATION TO WORK[a]

Distance to Work One Way (mi)	Distance to Nearest Public Transportation to Work[b]			
	1 to 2 Blocks (%)	3 to 6 Blocks (%)	Over 6 Blocks (%)	All Distances (%)
Under 5	44.8	46.1	56.7	45.4
5.0 - 9.9	61.2	41.1	39.7	55.3
10 - 14.9	54.3	60.3	51.4	55.4
15.0 and over	53.6	60.3	31.6	50.7
All distances	51.5	47.3	42.8	50.2

[a]Nationwide automobile-use survey of locations having populations of 100,000 and over, spring 1961.
[b]Excludes persons for whom no public transportation is available.

COMMUTING BY ALL MODES

Of the one-half of all workers who did not elect to go to work by automobile, 38.6 percent used public transportation and 11.5 percent walked to work or used a bicycle, as indicated in Table 3. Where the distance to work was under 1 mi, three-fourths of the workers either walked or rode a bicycle. But even at this relatively short distance from home to work, 14 percent chose to go by automobile as compared with 11.1 percent by public transportation. Moreover, most of those who went by automobile were drivers rather than passengers.

Table 3 indicates the mode of travel to work in 1-mi increments up to 5 mi and then in 5-mi increments. Generally, the greater the distance from work the larger the proportion of workers using automobiles for home-to-work transportation. The table also indicates that mileage to work influences the extent of car pooling. As the distance to work increased above 3 mi, a higher proportion of persons were reported as automobile passengers, the range being from 5.4 percent in the 4.0 to 4.9 mileage group to 12.7 percent in the 20.0 to 24.9 mileage group.

TABLE 3

DISTRIBUTION OF WORKERS CLASSIFIED BY MODE OF TRAVEL, ACCORDING TO ONE-WAY DISTANCE TO WORK[a]

Distance to Work One Way (mi)	Automobile			Public Transportation or Combination[b] (%)	Walk or Bicycle (%)	Total (%)
	Driver (%)	Passenger (%)	Total (%)			
0.1 - 0.9	13.1	0.9	14.0	11.1	74.9	100.0
1.0 - 1.9	40.2	4.8	45.0	30.0	25.0	100.0
2.0 - 2.9	41.3	2.1	43.4	51.8	4.8	100.0
3.0 - 3.9	51.0	8.6	59.6	38.7	1.7	100.0
4.0 - 4.9	55.5	5.4	60.9	39.1	-	100.0
5.0 - 9.9	48.6	8.5	57.1	42.3	0.6	100.0
10.0 - 14.9	50.5	7.2	57.7	42.3	-	100.0
15.0 - 19.9	41.3	8.1	49.4	50.6	-	100.0
20.0 - 24.9	52.8	12.7	65.5	34.5	-	100.0
25.0 and over	55.4	8.6	64.0	36.0	-	100.0
Unknown[c]	19.7	19.7	39.4	57.4	3.2	100.0
Total	43.2	6.7	49.9	38.6	11.5	100.0

[a]Nationwide automobile-use study of locations having a population of 100,000 and over, spring 1961.
[b]Public transportation alone or public transportation with automobile.
[c]Distance not reported (amounted to less than 3 percent of those reporting).

TABLE 4

DISTRIBUTION OF PERSONS CLASSIFIED BY FAMILY INCOME AND BY METHOD OF HOME-TO-WORK-TRANSPORTATION[a]

Family Income	Automobile			Public Transportation or Combination[b] (%)	Walk or Bicycle (%)	All Means (%)
	Driver (%)	Passenger (%)	Total (%)			
Under $1,000	15.9	4.7	20.6	25.1	54.3	100.0
$ 1,000 - $ 1,999	14.1	-	14.1	71.7	14.2	100.0
$ 2,000 - $ 2,999	18.9	3.0	21.9	57.5	20.6	100.0
$ 3,000 - $ 3,999	26.7	8.5	35.2	51.5	13.3	100.0
$ 4,000 - $ 4,999	36.6	12.0	48.6	41.4	9.0	100.0
$ 5,000 - $ 9,999	50.0	9.1	59.1	31.2	9.7	100.0
$10,000 - $14,999	54.3	1.9	56.2	36.6	7.2	100.0
$15,000 and over	63.3	-	63.3	36.7	-	100.0
Unknown[c]	41.7	4.2	45.9	39.8	14.3	100.0
Totals	43.2	6.7	49.9	38.6	11.5	100.0

[a]Nationwide automobile-use study of locations having a population of 100,000 and over, spring 1961.
[b]Public transportation alone or public transportation with automobile.
[c]Income not reported (amounted to 13 percent of sample).

FAMILY INCOME AND MODE OF TRAVEL

The choice of mode of travel to work is undoubtedly influenced by many factors, singly or in combination. It is highly probable that at least two and possibly more of these factors enter into any given situation. Income is an important factor both in the choice of methods for going to work and in the distance between the worker's home and his place of employment. As indicated in Table 4 and Figure 1, where annual family income was under $1,000, more than half of all workers walked or bicycled to work. It is possible that the under $1,000 family income group were domiciled at the job site. The data, however, did not show this. In the next income bracket ($1,000 to $1,999), there was a very substantial shift to public transportation, with almost 72 percent of the workers using this mode. The percentage of workers using public transportation drops rather sharply until family income reaches $10,000 at which point it increases somewhat.

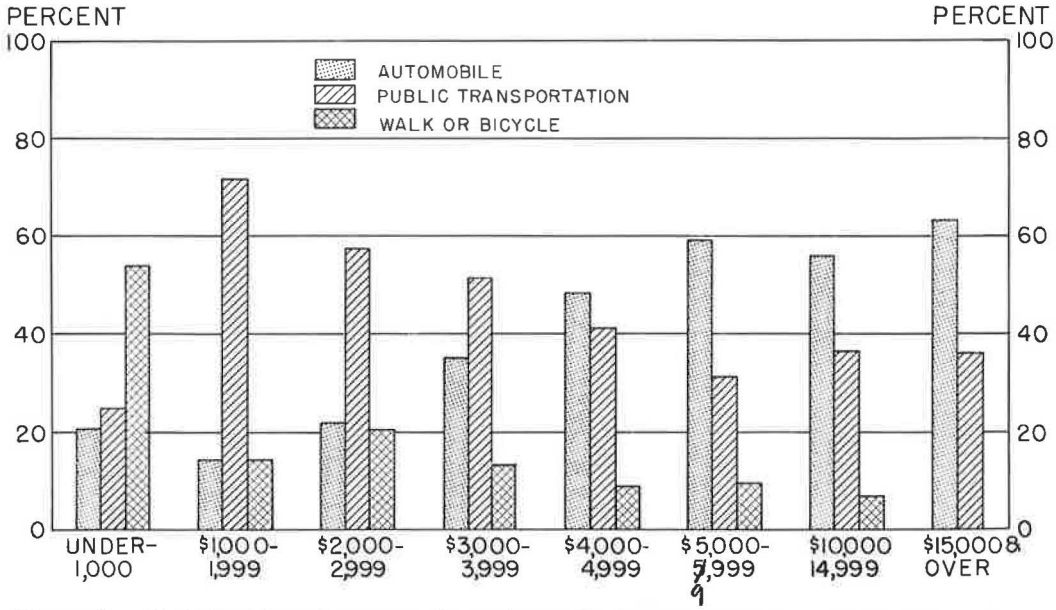

Figure 1. Distribution of persons in each family income group by method of home-to-work transportation.

ERRATA

Highway Research Record No. 106

On page 22:

EDMOND L. KANWIT and DAVID M. GLANCY, U. S. Bureau of Public Roads

should read:

EDMOND L. KANWIT, U. S. Bureau of Public Roads, and
DAVID M. GLANCY, D. C. Department of Highways and Traffic

In Figure 1, page 55, the family income group reading "$5,000-5,999," should read "$5,000-9,999."

As the size of family income increases, the choice of the automobile as a commuting mode increases and 63 percent of the persons having family incomes of $15,000 and over used automobiles for trips to work. Surprisingly, over 20 percent of the lowest income group commuted by automobile with more than three-fourths of that total driving. The higher relative use of automobiles for home-to-work transportation as the family income exceeds $5,000 may be noted in Figure 1, which shows the distribution of persons in each income group according to the mode of home-to-work transportation. Except for the family income group under $1,000, where 54 percent of the workers reported they walked or bicycled to work, the income groups were relatively consistent in the proportion of walkers. One might conclude that income above the $1,000 level is not closely related to walking to work.

PURPOSE OF TRIPS BY INCOME GROUPS

Family income is generally considered an important determinant of the use of automobiles. Table 5 indicates the distribution of automobile trips by purpose for the various income groups.

The proportion of trips related to earning a living rose from 24.7 percent for the family income group under $1,000 to 42.6 percent for the $4,000 to $4,999 income group and then drops off steadily to 33.7 percent for the income group above $15,000. Persons in the family income groups under $2,000 made a higher proportion of the trips for family business purposes than did other income groups. Social and recreational trips accounted for 16.7 percent of all trips with the highest and lowest income groups both reporting 22 percent of the trips for such purposes.

TRIPS AND TRAVEL BY AUTOMOBILE TO DOWNTOWN SHOPPING AREAS

Urban planners are constantly aware of the problems of keeping traffic flowing to and in the central business districts. Although, with the tremendous buildup of suburban shopping and medical areas the relative attraction to a downtown shopping area has decreased, the downtown areas still attract people for a variety of reasons. Table 6 indicates, by purpose of trips, the distribution of trips and travel by automobile to downtown shopping areas by one-way distance groups. Over one-half of all the trips and travel to the downtown shopping areas were made for purposes of earning a living, with an additional one-third for family business purposes. Only 2.1 percent of the

TABLE 5

DISTRIBUTION OF AUTOMOBILE TRIPS BY PURPOSE AND FAMILY INCOME GROUPS[a]

Purpose of Trip	Family Income								
	Under $1,000 (%)	$1,000 1,999 (%)	$2,000 2,999 (%)	$3,000 3,999 (%)	$4,000 4,999 (%)	$5,000 9,999 (%)	$10,000 14,999 (%)	$15,000 and Over (%)	All (%)
Earning a living:									
To and from work	16.2	26.5	30.6	34.9	37.7	36.3	33.8	29.0	34.5
Related business	8.5	1.7	7.2	6.1	4.9	3.5	5.3	4.7	4.4
Total	24.7	28.2	37.8	41.0	42.6	39.8	39.1	33.7	38.9
Family business:									
Medical and dental	3.1	2.1	3.6	1.4	1.2	2.1	1.9	3.4	2.1
Shopping	18.1	23.5	15.2	16.2	13.7	14.1	14.2	17.7	14.9
Other	20.3	18.9	18.5	14.1	14.3	15.0	15.1	12.0	15.1
Total	41.5	44.5	37.3	31.7	29.2	31.2	31.2	33.1	32.1
Educational, civic, and religious	11.6	8.7	11.7	10.4	11.2	12.9	13.1	11.1	12.3
Social and recreational:									
Vacations	-	-	-	-	-	0.1	-	-	-
Pleasure rides	3.2	2.1	1.6	2.8	2.9	1.9	1.6	3.2	2.1
Other	19.0	16.5	11.6	14.1	14.1	14.1	15.0	18.9	14.6
Total	22.2	18.6	13.2	16.9	17.0	16.1	16.6	22.1	16.7
All purposes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a]Nationwide automobile-use study of locations having a population of 100,000 and over.

TABLE 6

DISTRIBUTION OF TRIPS AND TRAVEL BY AUTOMOBILE TO DOWNTOWN SHOPPING AREAS CLASSIFIED BY ONE-WAY DISTANCE AND BY MAJOR PURPOSE OF TRIP[a]

One-way Distance from Residence (mi)	Purpose of Trips and Travel									
	Earning a Living		Family Business		Educational, Civic and Religious		Social and Recreational		All Purposes	
	Trips (%)	Travel (%)	Trips (%)	Travel (%)	Trips (%)	Travel (%)	Trips (%)	Travel (%)	Trips (%)	Travel (%)
0.1 - 1.9	28.6	29.7	62.8	61.7	1.1	0.9	7.5	7.7	100.0	100.0
2.0 - 4.9	58.1	57.2	30.3	30.6	2.5	2.6	9.1	9.6	100.0	100.0
5.0 - 9.9	51.7	54.5	36.3	34.3	1.7	1.8	10.3	9.4	100.0	100.0
10.0 and over	50.9	52.5	35.5	34.3	2.2	1.8	11.4	11.4	100.0	100.0
Total	51.9	53.5	36.3	34.0	2.1	1.9	9.7	10.6	100.0	100.0

[a]Nationwide automobile-use study in locations having populations of 100,000 and over.

TABLE 7

PERCENTAGE OF AUTOMOBILE TRIPS FOR EACH PURPOSE DESTINED TO THE DOWNTOWN AREA[a]

Purpose of Trip	% to Downtown Business Area
Earning a living:	
To and from work	13.7
Related business	20.5
All trips for earning a living	14.5
Family business:	
Medical and dental	13.8
Shopping	13.1
Other	16.6
All trips for family business	14.5
Educational, civic, and religious	2.6
Social and recreational	6.7
All trips	12.0

[a]Nationwide automobile-use study of locations having a population of 100,000 and over, spring 1961.

trips and 1.9 percent of the travel to the downtown shopping areas were made for educational, civic and religious purposes. Trips for social and recreational purposes amounted to 9.7 percent of the trips and 10.6 percent of the travel.

By mileage-distance groups it was found that persons living closer to the downtown shopping areas, that is, under 2 mi, made a smaller proportion of automobile trips for work and a larger proportion of trips for family business purposes than persons living farther from the downtown.

Table 7, although not indicating the distance to downtown shopping areas, does give the percentage of total trips destined for the area by purpose of trip. A fairly substantial share of total trips, 12 percent, were destined to the downtown area.

Of all trips related to earning a living, 14.5 percent are to the downtown area. The same percentage of the trips for family business are to the downtown area. Trips for educational, civic, and religious purposes comprised less than 3 percent of downtown trips; but 6.7 percent of social and recreational trips were made to the downtown area.

CONCLUSIONS

Information related to travel characteristics of residents of large cities obtained from sources valid for nationwide (but not local) comparisons has been presented in this paper. From this information it may be concluded that the automobile is the mode of transportation used by a large proportion of the residents of our large cities, regardless of the availability of other modes. The fact that a worker lives close to public transportation does not necessarily result in his use of it as his regular means of getting to and from work. Neither does closeness of home-to-work by itself cause a worker to forego use of his automobile for work trips. Use of the automobile for work trips tends to increase with income.

Although only one-seventh of all automobile trips made for purposes of earning a living were destined for the downtown area, more than half of all the trips with downtown destinations were for this purpose.

Highway Income, Expenditures, and User-Tax Earnings in Standard Metropolitan Statistical Areas

STANLEY F. BIELAK and JAMES F. McCARTHY, U. S. Bureau of Public Roads

•POPULATION, motor vehicle registrations, and travel continue to grow in urban areas at such a rapid rate that increasing allocations of funds for highways are necessary to keep pace with their growth.

The high cost per mile of urban highway facilities, in view of the uniform rate of state and Federal user charges on rural and urban residents alike, prompted this inquiry into highway finances in population centers. State and local highway finance data which have recently become available are used to make comparisons relating highway income, expenditures, and highway-user earnings for selected areas. This paper provides only a limited view of the total picture, but it focuses on an area of highway finance not extensively explored in the past. No attempt was made to include or evaluate social costs attendant to the cost of urban highway systems.

To determine how highway-user earnings, highway income, and expenditures compare in urban areas, the Standard Metropolitan Statistical Area (SMSA) was adopted as the unit of measurement. This unit, established by the U. S. Bureau of the Budget for convenience of reporting, consists of the counties (or towns in New England) containing the entire urbanized portion of a metropolitan area. The SMSA includes, of necessity, the rural portion, if any, of its constituent counties. Of the 212 SMSA's defined in the 1960 census, exclusive of Puerto Rico, data were obtained on 46 for study. In Table 1, the study sample is compared with the 212 SMSA's in the United States. The sample represents nearly 22 percent of the total national population and a little more than 31 percent of the total SMSA population. As the table indicates, it is somewhat weighted in favor of the more populous areas, having 37 percent of the population of those over 1,000,000 and only 20 percent of the population of those under 250,000. Since the population groups are treated and discussed separately, the effect of this disparity is somewhat minimized.

SELECTION OF SMSA's

All of the states were requested to report the total travel for one SMSA in 1960, subdivided where possible into travel by automobiles and travel by trucks and buses. They were also asked to give an estimated motor-fuel consumption rate for each of the two classes of motor vehicles. To obtain adequate travel data, the states were asked to report on an area in which a transportation study was recently completed or sufficiently advanced to aid in preparing the travel estimates.

The 46 SMSA's included in this analysis represent one in each of 44 states, and 2 in Indiana. New Hampshire did not provide the necessary data and there were no SMSA's in Alaska, Idaho, Vermont, and Wyoming. Although the selection on this basis does not sample the geographic or population areas to the same degree, it provides a more representative cross-section of areas in other respects. By sampling each state it was possible to report on: (a) a greater diversity of state motor-fuel and motor-vehicle tax rates; (b) a variety of construction programs, particularly of the Interstate system which in a given year may be more active in the urban areas of some states than in others; (c) a sample of areas having central cities of an origin and development in different periods of time, such as the older eastern cities and the

Paper sponsored by Committee on Highway Taxation and Finance.

TABLE 1

COMPARISON OF SMSA's SELECTED FOR STUDY WITH ALL SMSA's IN UNITED STATES[a]

Census Region and Population Group	No. of SMSA's and Population				Sample as Percent of Total		Square Miles of Land Area		Sample as Percent of Total	Population/Sq Mi	
	All SMSA's in United States		Study Sample				All SMSA's (sq mi)	Study Sample (sq mi)		All SMSA's	Study Sample
	No.	Population (thousands)	No.	Population (thousands)	No.	Population					
All SMSA's	212	112,885	46	35,246	21.7	31.2	310,233	75,855	24.5	364	465
By Census Regions:											
Northeast	47	35,347	7	6,961	14.9	19.7	35,650	6,746	18.9	991	1,032
North Central	59	30,960	13	10,443	22.0	33.7	87,834	16,678	19.0	352	626
South[b]	77	26,447	16	7,676	20.8	29.0	59,328	15,351	25.9	446	500
West	29	20,131	10	10,166	34.5	50.5	127,421	37,080	29.1	158	274
By Population Groups:											
>1,000,000	24	61,582	7	23,065	29.2	37.5	54,285	19,321	35.6	1,134	1,194
500,000 to 1,000,000	29	19,215	7	5,096	24.1	26.5	70,767	16,896	23.9	272	302
250,000 to 500,000[b]	48	15,829	11	3,901	22.9	24.6	78,460	11,219	14.3	202	348
<250,000	111	16,259	21	3,184	18.9	19.6	106,721	28,419	26.6	152	112

[a]Excludes Puerto Rico.

[b]Population and area of Osage County of the Tulsa, Oklahoma, SMSA are not included in the sample but are included with totals of all SMSA's in the United States.

newer rapidly growing western areas; and (d) cities having urban transportation systems developed around rails and highways, and others where transportation is chiefly highway oriented.

The geographic distribution of the SMSA's covered by this study is illustrated in Figure 1.

Some characteristics of the SMSA's selected are given in Table 2. The areas are listed in alphabetical order within each of four population groups. The population, square miles of land area, vehicle travel, and vehicles registered are given for each SMSA and for each population group to illustrate the diversity in the makeup of each area. The last four columns contain averages of persons per square mile, persons

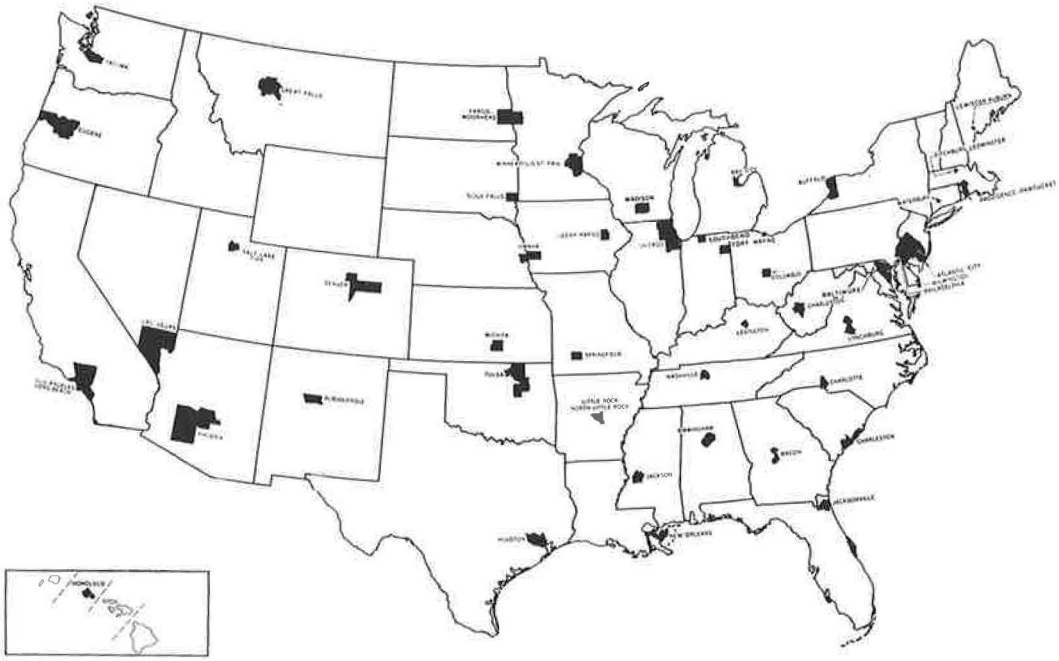

Figure 1. Geographic distribution of the 46 selected SMSA's.

per motor vehicle registered in the SMSA, average daily travel per person, and annual travel in the area per vehicle registered therein.

SOURCES AND DESCRIPTION OF DATA

The data for population, land area, and motor vehicles registered are a matter of record, except in a few cases where motor vehicle registrations were estimated. The data on vehicle-miles of travel are perhaps the most uncertain link but they appear to maintain an acceptable consistency. The extreme value of 20.0 mi of travel per person per day in the Atlantic City, N. J., area is attributable to the very heavy seasonal use by non-residents. This figure, and the corresponding figure of 20,372 mi of annual travel in the Atlantic City area per vehicle registered there, point up the fact that the denominators of these ratios are somewhat defective, in that the travel in an SMSA includes that of visitors as well as residents. On the other hand, the low value of 7.8 mi/person/day in the Philadelphia area compares reasonably with 11.3 mi in Los Angeles, and reflects a greater reliance on transit facilities and a much later development of freeways in the Philadelphia area than in Los Angeles.

TABLE 2

POPULATION, LAND AREA, VEHICLE-MILES, AND VEHICLES REGISTERED IN 46 SELECTED SMSA's, 1960

SMSA's by Population Groups	Population	Land Area (sq mi)	Vehicle-Miles of Travel (thousands)	No. of Registered Vehicles	Persons/Sq Mi	Persons/Veh	Travel/ Person/Day (mi)	Annual Travel in SMSA/Veh Registered Therein (mi)
<250,000:								
Atlantic City, N. J.	160,880	575	1,175,000	57,678	280	2.8	20.0	20,372
Bay City, Mich.	107,042	446	425,000	44,280	240	2.4	10.9	9,598
Cedar Rapids, Iowa	136,899	713	501,680	63,557	192	2.2	10.0	7,893
Charleston, S. C.	216,382	945	715,000	67,786	229	3.2	9.1	10,551
Eugene, Ore.	102,090	1,560	643,400	85,003	36	1.9	10.8	7,569
Fargo, N. D.	106,027	2,799	451,962	51,492	38	2.1	11.7	8,777
Fitchburg-Leominster, Mass.	82,486	99	426,000	28,479	833	2.9	14.1	14,958
Fort Wayne, Ind.	232,196	670	581,960	99,016	347	2.4	6.9	5,877
Great Falls, Mont.	73,418	2,659	273,057	35,904	28	2.0	10.2	7,605
Jackson, Miss.	187,045	877	589,712	70,890	213	3.6	8.6	8,319
Las Vegas, Nev.	127,016	7,927	358,823	75,750	16	1.7	7.7	4,737
Lewiston-Auburn, Me.	70,295	120	174,125	24,167	586	2.9	6.8	7,205
Lexington, Ky.	131,906	280	432,700	53,644	471	2.5	9.0	8,066
Little Rock-N. Little Rock, Ark.	243,980	767	795,700	103,603	317	2.3	9.0	7,680
Lynchburg, Va.	110,701	1,014	423,912	37,168	109	3.0	10.5	11,406
Macon, Ga.	180,403	630	451,870	66,077	286	2.7	6.9	6,839
Madison, Wis.	222,095	1,197	911,610	87,628	186	2.5	11.2	10,403
Sioux Falls, S. D.	86,575	815	340,451	40,403	106	2.1	10.8	8,426
South Bend, Ind.	238,614	467	570,090	98,138	511	2.4	6.5	5,809
Springfield, Mo.	126,276	677	659,096	56,713	187	2.2	14.3	11,622
Waterbury, Conn.	181,638	182	523,263	76,696	998	2.4	7.9	6,823
Subtotal	3,183,764	28,419	11,424,431	1,324,052	112	2.4	9.8	8,628
250,000 to 500,000:								
Albuquerque, N. M.	262,199	1,163	827,424	109,249	225	2.4	8.6	7,574
Charleston, W. Va.	252,925	908	814,431	86,166	279	2.9	8.8	9,452
Charlotte, N. C.	272,111	542	675,129	120,599	502	2.3	6.8	5,598
Jacksonville, Fla.	455,411	777	1,807,115	187,524	586	2.4	10.9	9,637
Nashville, Tenn.	399,743	532	1,208,996	147,128	751	2.7	8.3	8,217
Omaha, Neb.	457,873	1,533	1,842,338	189,698	299	2.4	11.0	9,712
Salt Lake City, Utah	383,035	764	1,155,000	174,021	501	2.2	8.3	6,637
Tacoma, Wash.	321,590	1,676	1,281,000	134,292	192	2.4	10.9	9,539
Tulsa, Okla.[a]	386,533	1,538	1,436,382	187,975	251	2.1	10.2	7,641
Wichita, Kan.	343,231	999	1,381,796	161,042	344	2.1	11.0	8,580
Wilmington, Del.	366,157	787	1,586,247	139,170	465	2.6	11.9	11,398
Subtotal	3,900,808	11,219	14,015,858	1,636,864	348	2.4	9.8	8,563
500,000 to 1,000,000:								
Birmingham, Ala.	634,864	1,118	2,052,312	234,198	568	2.7	8.9	8,766
Columbus, Ohio	682,962	537	2,606,374	282,428	1,272	2.4	10.0	9,547
Denver, Colo.	929,383	3,665	3,500,000	465,125	254	2.0	10.3	7,525
Honolulu, Hawaii	500,409	598	1,123,090	175,676	837	2.8	6.1	6,393
New Orleans, La.	868,400	1,118	1,940,483	280,907	777	3.1	6.1	6,908
Phoenix, Ariz.	663,510	9,226	3,083,304	336,465	72	2.0	12.7	9,164
Providence, R. I.	816,148	634	3,401,100	318,539	1,287	2.6	11.4	10,677
Subtotal	5,095,756	16,896	17,796,663	2,093,338	302	2.4	9.6	8,502
Over 1,000,000:								
Baltimore, Md.	1,727,023	1,807	5,965,707	572,478	956	3.0	9.5	10,421
Buffalo, N. Y.	1,306,957	1,587	3,417,680	448,307	824	2.9	7.2	7,624
Chicago, Ill.	6,220,913	3,714	19,210,133	2,083,209	1,675	3.0	8.5	9,221
Houston, Texas	1,243,158	1,711	4,265,000	572,343	727	2.2	9.5	7,452
Los Angeles, Calif.	6,742,696	4,842	27,808,000	3,415,201	1,393	2.0	11.3	8,142
Minneapolis-St. Paul, Minn.	1,482,030	2,111	5,500,000	642,617	702	2.3	10.2	8,559
Philadelphia, Pa.	4,342,897	3,549	12,313,914	1,536,952	1,224	2.8	7.8	8,012
Subtotal	23,065,674	19,321	78,480,434	9,271,107	1,194	2.5	9.3	8,465
Grand total	35,246,002	75,855	121,717,386	14,325,361	465	2.5	9.5	8,497

[a]Does not include the population and area of Osage County of the Tulsa, Oklahoma SMSA.

Travel

The states were requested to report the total motor-vehicle travel on all roads and streets of the selected SMSA for 1960. It was further asked that the travel be classified into: (a) that on rural roads and that on urban highways and streets of the SMSA, and (b) that of automobiles, and that of trucks and buses combined. The response by the states produced varying degrees of detail ranging from travel classified by vehicle types and by road systems to travel reported only in terms of total vehicle-miles, with percentages indicating distribution of the total travel between automobiles, trucks and buses.

The method of estimating and classifying the travel in the SMSA's varied for the different areas. For those in which some form of area transportation studies were available, the data were fitted to 1960 by travel trends; in others, estimates were prepared from available information on mileage of local streets and arterials and the corresponding current travel volumes on them. Generally, too, where data from area transportation studies were utilized, it was necessary to supplement them with travel in the area beyond that study's external cordon to the county boundaries forming the SMSA. Since these outlying areas are predominantly rural, however, it is believed that sufficient accuracy was obtained because the routes carrying the bulk of the travel are the state highways and primary local roads for which data were available from current traffic-counting programs.

Motor-Vehicle Registrations

Registrations of motor vehicles by counties, compiled by the states, are currently available for approximately 41 states. For the SMSA's in the remaining states, registrations were estimated by use of collateral data of the U. S. Bureau of Census (1), and the annual and special reports of state motor vehicle registrations (2).

Road and Street Income

The income for road and street purposes of the SMSA's comes from various revenue sources. The accounting of the income for each SMSA is obtained by the state highway departments from state and local records and summarized in reports transmitted annually to the U. S. Bureau of Public Roads.

Income and expenditure data of local governments in this analysis are summarized from forms PR-532 and PR-535, Local Road and Street Finance Report. The PR-535 report includes for each SMSA the annual receipts, disbursements, obligations issued, application of proceeds, and a statement of interest and bond redemptions. State road-user income equivalent to state highway expenditures given in form PR-532-B is assigned from state and Federal user revenues as explained later.

In this study, highway income is classified according to: (a) the imposts on highway users collected at Federal, state and local levels and tolls on state and local facilities; and (b) other SMSA revenue income, consisting of property taxes and assessments, general fund appropriations (state and local), and miscellaneous local income derived from a variety of sources including subdivider's payments for road improvements, fines for parking meter violations, rentals, excavation permits, utility taxes, adjustments and repairs, and such sources as traffic fines and other fees not specifically identified.

Investment income and borrowing, indicated under a separate heading in Table 3, includes interest on deposits and earnings on short-term investments as well as proceeds from bonds and notes issued.

The income in Table 3 represents all of the funds reported available for roads and streets in each SMSA.

Road and Street Expenditures

The expenditures on roads and streets for each SMSA are complete insofar as was possible from the available data.

TABLE 3

ROAD AND STREET INCOME OF 46 SELECTED SMSA's, 1960
($ x 1,000)

SMSA's by Population Group	From Imposts on Road Users						Other Revenue Income				Total Revenue Income	Investment Income and Borrowing	Total Income
	Federal Aid	State	Local (includes parking fees)	Tolls, State Facilities	Tolls, Local Facilities	Total	Property Taxes and Assessments	General Fund Appropriations	Miscellaneous	Total			
<250,000:													
Atlantic City, N. J.	550	1,835	273	380	—	3,038	1	3,593	—	3,594	6,632	221	6,853
Bay City, Mich.	1,634	3,524	—	—	—	5,158	48	449	219	716	5,874	555	6,429
Cedar Rapids, Iowa	702	2,131	210	—	—	3,043	2,214	22	122	2,358	5,401	561	5,962
Charleston, S. C.	1,815	2,267	—	—	—	4,082	—	485	—	485	4,567	—	4,567
Eugene, Ore.	6,727	5,780	276	—	—	12,783	1,292	—	39	1,331	14,114	696	14,810
Fargo, N. D.	8,298	4,523	—	—	—	12,821	1,983	573	133	2,689	15,510	2,186	17,696
Fitchburg-Leominster, Mass.	53	253	1,012	—	—	1,318	—	269	198	467	1,785	7	1,792
Fort Wayne, Ind.	1,259	3,337	95	—	—	4,691	1,079	171	68	1,318	6,009	—	6,009
Great Falls, Mont.	2,052	1,465	137	—	—	3,654	1,687			1,687	5,381	161	5,462
Jackson, Miss.	1,858	2,048	137	—	—	4,043	2,761	848	301	3,910	7,953	2,313	10,266
Las Vegas, Nev.	2,355	2,012	197	—	—	4,564	635	424	139	1,198	5,762	460	6,222
Lewiston-Auburn, Me.	58	53	134	272	—	517	—	717	15	732	1,249	20	1,269
Lexington, Ky.	880	726	81	—	—	1,687	—	826	—	826	2,513	188	2,701
Little Rock-N. Little Rock, Ark.	12,349	6,802	188	—	—	19,339	1,084	943	157	2,184	21,523	—	21,523
Lynchburg, Va.	974	1,228	260	—	—	2,462	4	412	2	418	2,880	768	3,668
Macon, Ga.	1,050	774	174	—	—	1,998	502	493	10	1,005	3,003	—	3,003
Madison, Wis.	3,219	6,780	360	—	—	10,359	2,196	2,463	206	4,865	15,224	1,486	16,710
Sioux Falls, S. D.	4,724	3,492	158	—	—	8,374	641	494	144	1,279	9,653	600	10,253
South Bend, Ind.	99	2,667	152	—	—	2,918	1,039	—	516	1,555	4,473	1,000	5,473
Springfield, Mo.	1,408	2,569	770	—	—	4,747	860	155	265	1,280	6,027	265	6,292
Waterbury, Conn.	1,050	3,296	26	—	—	4,372	4	1,960	287	2,251	6,623	25	6,648
Subtotal	53,114	57,562	4,640	652	—	115,968	17,970	15,297	2,821	36,088	152,056	11,552	163,608
250,000 to 500,000:													
Albuquerque, N. M.	6,589	4,472	629	—	—	11,690	2,692	52	276	3,020	14,710	2,809	17,519
Charleston, W. Va.	422	2,220	257	—	—	2,899	363	1,023	—	1,386	4,285	—	4,285
Charlotte, N. C.	970	2,706	144	—	—	3,820	—	1,857	—	1,857	5,677	—	5,677
Jacksonville, Fla.	10,438	10,001	427	3,338	—	24,204	2,234	1,634	1,997	5,865	30,069	1,673	31,742
Nashville, Tenn.	11,288	6,962	1,401	—	—	19,651	1,813	85	198	2,096	21,747	654	22,401
Omaha, Neb.	6,591	9,489	1,987	—	197	18,264	5,003	—	344	5,347	23,611	2,760	26,371
Salt Lake City, Utah	5,798	3,707	257	—	—	9,762	2,391	943	171	3,505	13,267	—	13,267
Tacoma, Wash.	3,341	6,495	—	—	—	9,836	1,451	1,157	259	2,867	12,703	—	12,703
Tulsa, Okla.	1,996	4,380	484	1,598	—	8,458	850	744	426	2,020	10,478	4,481	14,959
Wichita, Kan.	4,149	3,478	418	359	—	8,404	7,842	362	840	9,044	17,448	6,659	24,107
Wilmington, Del.	3,762	1,597	407	4,770	—	10,596	99	4,412	28	4,539	15,135	5,853	20,988
Subtotal	55,344	55,507	6,471	10,065	197	127,584	24,738	12,269	4,539	41,546	169,130	24,889	194,019
500,000 to 1,000,000:													
Birmingham, Ala.	3,088	4,020	2,203	—	—	9,301	4,502	—	969	5,561	14,952	3,300	18,252
Columbus, Ohio	7,076	16,711	446	—	—	25,033	2,337	696	961	3,994	29,027	8,203	37,230
Denver, Colo.	6,677	10,453	—	643	—	17,773	4,441	2,580	752	7,773	25,546	47	25,593
Honolulu, Hawaii	3,806	8,284	4,368	—	—	16,458	3,493	85	474	4,052	20,510	—	20,510
New Orleans, La.	8,314	8,997	539	2,926	1,437	22,213	5,259	5,476	1,796	12,531	34,744	9,074	43,818
Phoenix, Ariz.	7,651	6,850	—	—	—	14,501	1,635	5,144	4,349	11,128	25,629	4,686	30,315
Providence, R. I.	13,686	13,454	1,390	718	—	29,248	12	10,104	222	10,338	39,586	4,368	43,954
Subtotal	51,098	68,769	9,026	4,287	1,437	134,617	21,769	24,085	9,523	55,377	189,994	29,678	219,672
Over 1,000,000:													
Baltimore, Md.	7,820	32,683	4,602	5,558	351	51,023	865	13,016	442	14,323	65,346	4,840	70,186
Buffalo, N. Y.	8,804	13,139	781	4,637	—	27,361	5,069	18,223	1,277	24,569	51,930	12,774	64,704
Chicago, Ill.	88,098	104,595	39,000	10,420	3,308	353,007	30,443	5,928	2,741	39,112	392,119	83,073	375,192
Houston, Tex.	15,146	21,653	687	—	—	37,486	20,674	6,387	3,766	30,827	68,313	19,224	87,537
Los Angeles, Calif.	32,529	121,236	3,686	—	281	157,734	11,202	44,776	15,262	71,240	228,974	10,720	239,694
Minneapolis-St. Paul, Minn.	26,225	27,770	1,072	—	—	55,067	19,945	6,832	3,175	29,952	85,019	11,495	96,514
Philadelphia, Pa.	12,406	40,074	1,999	28,034	1,566	84,079	429	26,987	7,215	34,631	118,710	14,601	133,311
Subtotal	191,637	361,152	51,907	56,655	4,406	665,757	88,827	122,149	33,878	244,654	910,411	156,727	1,067,138
Total, all SMSA's	351,193	542,990	72,044	71,659	6,040	1,043,926	153,104	173,800	50,761	377,665	1,421,591	222,846	1,644,437

The roads and streets of these areas are under several jurisdictions, state, county, and municipal (city). Road and street construction and maintenance are accomplished by one, two, or jointly by all three, levels of government. To the extent that capital outlays are identified by system, they are listed in this report by state and local systems, rural and municipal. Expenditures for maintenance, operation, and administration, being less easily identified, are combined. In the latter classification, local expenditures are complete but state outlays are not, as explained later.

Expenditures of state funds may be through capital outlay, including Federal aid, or state maintenance on state highway extensions in municipalities, on local rural roads or municipal streets, or by grants-in-aid payments to local rural or municipal units which are reflected in construction, maintenance and administration expenditures at the local level. Fund transfers also take place between local rural and municipal units, as well as by direct construction in each other's jurisdiction.

Local rural (county), and municipal (city) highway administration, traffic police, bond service, and other miscellaneous expenditures are believed to be adequately represented in the reported data from the local records.

Data for state and local toll facilities are available from the annual reports to the U. S. Bureau of Public Roads. The income and expenditures for each of the facilities situated entirely within a SMSA were used as recorded in the annual reports. However, the expenditures for facilities beyond the boundary of a SMSA, principally toll roads, for all purposes (construction, maintenance, administration, etc.) were assigned in the proportion that the earnings within the SMSA reported for this analysis were to the earnings of the entire facility.

Highway-User Earnings

User taxes consist of a variety of levies: on the owner or operator of a vehicle, on the vehicle itself, or on vehicle use. Registration fees, vehicle excise and use taxes, transfer and title charges, certain truck and bus franchise or use permits, and driver licenses are paid periodically and are a condition for owning and operating a vehicle on the highways. Gasoline and special fuel taxes, truck and bus mileage taxes, and taxes on tires and tubes are paid intermittently depending on the number of miles a motor vehicle is operated.

At the Federal level, in 1960 excises of the Federal trust fund on gasoline and special fuels at $0.04/gal; tires at $0.08/lb; innertubes at $0.09/lb; tread rubber at $0.03/lb; truck, bus, and trailer excise at 5 percent of manufacturers' wholesale price; and the vehicle use tax at $1.50/1,000 lb, are designated for highway purposes and constitute the group of user taxes for which earnings were evaluated. Other Federal automotive excise taxes, such as the automobile vehicle excise tax, taxes on accessories and lubricating oil, and the remaining truck, bus, and trailer excise at 5 percent of the manufacturers' wholesale price, accrue to the general fund and are not included with the earnings of this analysis.

State user charges consist of gasoline and special fuel taxes, mileage, ton-mile, and franchise taxes, registration fees, operator and chauffeur licenses, and miscellaneous charges for titling or transfer of vehicles.

Local road-user charges are not levied in all states or in all local jurisdictions of a state. These charges, where imposed, may consist of motor fuel, bus and wheel taxes, and licenses for automobiles and trucks. Although traffic fines and allied fees are often not considered to be regularly imposed user levies, when identified and used for highway purposes they are included with user taxes.

Earnings based on use were computed for all travel in a SMSA regardless of where the vehicles were domiciled. The periodic payments, such as registration and other charges, are only those paid by the vehicles domiciled in the SMSA.

METHODS USED TO DEVELOP ROAD-USER EARNINGS

Evaluation of Earnings

Federal, state, and local fuel taxes, where levied, are earned with each mile of travel. Federal excises on tires, tubes and tread rubber are earned in direct proportion to the amount of travel and are paid at the time these items are purchased or replenished. Other tax earnings, such as state and local registration fees, operator and chauffeur licenses, titling taxes, transfer, certain mileage, permit, and other fees, are in the form of annual or periodic charges.

Imposts on highway users at the local level include parking and other miscellaneous fees such as traffic fines and penalties. The latter are not usually considered in a user tax category but because they are attributable to motor vehicles or paid as a consequence of their use, they have been included with user earnings in the amounts reported received by the localities making up the SMSA's of this analysis.

Federal and State Motor Fuel Tax Earnings.—It is estimated that automobiles consume an average of a gallon of gasoline for every 14.3 mi of travel (0.070 gal/mi), representative of all travel (3). To obtain a consumption rate applicable to automobiles operating in SMSA's with the greater incidence of stop-and-go driving and lower average speeds, compared with rural operation at higher average speeds and with less interruption from traffic signals and traffic friction, it was necessary to examine consumption rates obtained from operation under these different conditions.

For instance, in a study examining the financing of road systems in the Philadelphia area (4), a motor fuel consumption rate 50 percent greater for all vehicles, automobiles and commercial vehicles was considered for operation in urban vs rural areas. Recent studies giving some indication of consumption rates for rural, urban, and overall operation support evidence that fewer miles per gallon (more gallons per mile) are obtained in urban operation than in average or rural operation.

TABLE 4

INDEX OF AUTOMOBILE-MOTOR FUEL CONSUMPTION RATES UNDER CONDITIONS OF OVERALL OPERATION COMPARED WITH OPERATION PREDOMINANTLY IN RURAL AND IN URBAN AREAS

Source	Consumption Rates (gal/mi)			Index of Consumption Rates		
	Avg.	Rural	Urban	Avg.	Rural	Urban
Illinois MVU[a]	0.0725	0.0671	0.0813	1.00	0.93	1.12
Lieder[b]	0.0690	0.0625	0.0785	1.00	0.91	1.14
7-State MVU[c]	0.0669	0.0616	0.0724	1.00	0.92	1.08
This study	0.0700[d]	0.0650	0.0756	1.00	0.93	1.08

[a]Data derived from Ref. 11.
[b]Data derived from Ref. 12.
[c]Data derived from Ref. 13.
[d]Data derived from Ref. 3; rate for urban consumption developed for this analysis.

Table 4 lists the automobile motor fuel consumption rates obtained from three studies, as well as the rate adopted for use in this analysis. The consumption rates for rural and urban operation of the first three studies were obtained from respondents to questionnaires. Urban operation in these studies is defined as the mileage operated at speeds below 35 mph which would be indicative of operation in urban areas. The rates given for operation under rural conditions in Table 4 are those obtained by vehicles reported to have been operated 90 percent or more of their travel at speeds above 35 mph, and the rates for urban conditions are for vehicles operated 90 percent or more of the reported mileage at speeds under 35 mph.

The fourth set of rates was obtained in a somewhat different manner. The 0.070 gal/mi (14.3 mi/gal) rate was developed for the Highway Cost Allocation Study (3) as a national average consumption rate applicable to all automobiles. The rural-urban differential applied to this rate was obtained by application of estimated values reflecting operation characteristics of entire SMSA's, some of which contain considerable rural areas.

For this purpose, it was necessary to assume an average operating speed in an urban area, the number of stops per mile, the duration of stops, and the average rural road speeds.

After consultation with persons concerned with traffic analysis, and by reference to other data (5, 6), a decision was made to use 1½ stops per mile as representative of travel in a SMSA.

Using measurements developed by Claffey (7) for fuel consumption at different speeds, consumption of fuel while coming to a stop and accelerating again to average speed, and consumption while idling at a stop, an urban rate 1.08 times the average consumption rate was obtained. This differential was applied to the 0.070 gal/mi national average rate, resulting in an urban automobile consumption rate of 0.076 gal/mi (13.2 mi/gal).

TABLE 5

MOTOR FUEL CONSUMPTION RATES FOR APPLICATION TO SMSA TRAVEL TO DERIVE MOTOR FUEL TAX EARNINGS BY MOTOR VEHICLES

Vehicle Type	Avg. U. S. Motor Fuel Consump. Rate: Gasoline and Diesel Veh[a]		Consump. Rate Differential for Urban Areas When Avg. U. S. Rate is 1.0[b]	Avg. Motor Fuel Consump. Rate for Urban Areas	
	Gal/Mi	Mi/Gal		Gal/Mi	Mi/Gal
Automobile	0.070	14.29	1.08	0.076	13.16
Transit bus	0.237	4.22	1.05	0.249	4.01
Intercity bus	0.167	5.99	1.29	0.215	4.65
School and other bus	0.129	7.75	1.00	0.129	7.75
2-axle, 4-tire truck	0.080	12.50	1.00	0.080	12.50
2-axle, 6-tire truck	0.123	8.13	1.20	0.148	6.76
3-axle truck	0.180	5.56	1.40	0.263	3.97
2-S1, 3-axle tractor-semitrailer combination	0.191	5.24	1.40	0.267	3.75
2-S2, 4-axle tractor-semitrailer combination	0.217	4.61	1.40	0.304	3.29
3-S2, 5-axle tractor-semitrailer combination	0.219	4.57	1.40	0.307	3.26
2-1, 3-axle truck-full trailer combination	0.159	6.29	1.40	0.223	4.48
2-2, 3-1, 4-axle truck-full trailer combination	0.204	4.90	1.40	0.286	3.50
2-3, 3-2, 5-axle truck-full trailer combination	0.218	4.59	1.40	0.305	3.28
3-3, 6-axle truck-full trailer combination	0.229	4.37	1.40	0.321	3.12
3-unit, tractor-semitrailer-full trailer combination	0.233	4.29	1.40	0.326	3.07
All trucks, buses, and combinations[c]	0.129	7.77	1.23	0.159	6.29
All vehicles[c]	0.081	12.35	1.14	0.092	10.87

[a]Weighted average consumption rates developed from those used in the Supplementary Report of the Highway Cost Allocation Study (3). Weighted averages reflect relative numbers of gasoline and diesel vehicles in each vehicle type group.
[b]This differential considers total travel in rural and urban areas by each vehicle type as developed for Highway Cost Allocation Study (3), at consumption rates indicated for rural and urban operation from various studies.
[c]Weighted by total travel and fuel consumption of all vehicle types indicated.

TABLE 6

ESTIMATED MOTOR FUEL TAX EARNINGS PER MILE OF TRAVEL IN SMSA's BY VEHICLE GROUPS AT VARIOUS TAX RATES

Tax Rate/ Gal ($)	Automobiles ($)	Trucks, Buses and Combinations ($)
0.03	0.023	0.048
0.04	0.030	0.064
0.05	0.038	0.080
0.06	0.045	0.095
0.07	0.053	0.111

The truck, bus, and combination urban motor fuel consumption rate differential was determined in somewhat the same manner, employing the consumption rates per stop and idling time of Kent (8) and Sawhill and Firey (9), for the range of vehicle sizes and weights given. A 25-mph average speed in urban areas was assumed; 1½ stops per mile and a 15-sec average idling time were estimated, the latter two being the same as those assumed for automobiles. Average rural speeds for trucks were assumed to be 40 mph, and for buses 50 mph, compared with 45 mph for automobiles.

The results obtained for each vehicle type group are given in Table 5 which indicates the average U. S. consumption rates, the differential, the urban rate, and a composite urban rate for the various types of commercial vehicles. Since vehicle travel data in most cases were obtainable only in the broad categories, i.e., automobiles and all other vehicles, only the automobile and the composite truck and bus consumption rates were used.

The gallonage obtained by applying the gallons-per-mile rates to the travel reported for the respective groups of motor vehicles in each SMSA was evaluated at $0.04/gal to obtain the amount of Federal excise tax earned on motor fuel use, and by the appropriate 1960 state motor fuel tax rate (and local fuel tax rate where applicable) to obtain the state and local motor fuel tax earnings.

Table 6 gives the tax contribution per mile of travel at the various rates at which motor fuel is taxed. Only one state, Missouri, had a $0.03 motor fuel tax rate in 1960; none taxed fuel at $0.04 which is the Federal excise tax rate. The weighted average state gasoline tax rate nationally in that year was $0.0592/gal, compared with a weighted average rate of $0.0575 for the gallonage tax of the SMSA's in the study.

TABLE 7

FEDERAL TRUST FUND TAXES PAID BY HIGHWAY USERS, 1960

Vehicle	$ (Million)
Motor fuel	2,269
Other:	
Truck, bus, and trailer excise	127
Motor-vehicle use tax	45
Tires, tubes, and tread rubber	273
Total	2,714

Other Federal Trust Fund Taxes.—The 1960 Federal trust fund taxes paid by highway users (2, pp. 83-84) are accounted for in Table 7.

An additional $5.1 million of truck, bus, and trailer excise, use tax, and rubber taxes paid by the vehicles of the Federal government are not included in the amounts given in Table 7 but were added in the computation to obtain the rates per vehicle-mile of travel.

No differential for rural and urban rates of consumption was assumed for the use taxes other than motor fuel taxes, and a uniform rate per mile of travel was assigned.

The division of vehicle excise, use, and tire, tube, and rubber taxes between those paid for automobile use and commercial vehicle use was accomplished according to the detailed analysis prepared for the Highway Cost Allocation Study (3). The income of the Federal trust fund in 1960 from taxes other than motor fuel,

TABLE 8

HIGHWAY TRUST FUND RECEIPTS FROM TIRE, TUBE, TREAD RUBBER, TRUCK AND BUS VEHICLE EXCISE, AND VEHICLE USE TAXES, 1960

Vehicle Class for Which Paid	Total Amount (million $)	Total 1960 U. S. Travel (billion veh-mi)	Estimated Tax Earning per Mile of Travel ($)
Automobiles	154	588.1	0.00026
Trucks, buses, and combinations	296	130.7	0.00227
Total	450	718.8	0.00

TABLE 9

TEXAS MOTOR VEHICLE REGISTRATION AND OTHER FEES BY AUTOMOBILES AND BY TRUCKS AND BUSES, 1960

Fee	Total ($ × 1,000)	Automobiles ($ × 1,000)	Trucks and Buses ($ × 1,000)
State[a]:			
Auto registration fees	54,576	54,576	—
Bus registration fees	474	—	474
Truck and tractor truck registration fees	36,884	—	36,884
Trailer registration fees	11,516	—	11,516
Motorcycle registration fees	220	220	—
Automobile operator and learners licenses	3,830	3,830	—
Taxi chauffeur licenses	12	12	—
Bus and truck chauffeur licenses	2,964	—	2,964
Other fees:			
Classified[b]	1,683	—	1,683
Unclassified[c]	33,248	26,366	6,882
Total	145,407	85,004	60,403
SMSA registration and other fees[d]	17,269	11,730	5,539

[a]Average fee for registrations is $24.05 for automobiles, $65.47 for trucks and buses. Based on a total of 3,534,351 automobile registrations, and 922,671 truck and bus registrations, totaling 4,457,022.
[b]Oversize and overweight fees, carrier taxes, certificate or permit, and carrier fines and penalties, all of which are attributable to buses and trucks.
[c]Title and titling taxes, transfer, inspection, and other fees paid by automobiles and commercial vehicles, but no identification by whom paid was available. Division between automobiles and trucks and buses made by prorating on the basis of the numbers of vehicles registered in the two categories.
[d]Based on a total of 487,740 automobile registrations, and 84,603 truck and bus registrations, totaling 572,343.

including payments by vehicles of Federal agencies, amounted to $450 million and is divided among automobiles and commercial vehicles as indicated in Table 8.

State Registration Fees and Other State Taxes.—The numbers and types of registered vehicles in the counties of a SMSA are available in varying detail from the registration reports prepared by about 41 states. In addition to the number of vehicles by counties, the reports of several states include payments of registration and other fees on those vehicles, in which case these payments were used as the total of such contribution by road users in the county or counties of the SMSA.

In the states where such payments were not classified by counties, statewide per-vehicle averages for automobiles and for trucks and buses combined were multiplied by the corresponding numbers registered in the SMSA. An example of the division of a state's fees between automobiles and commercial vehicles is indicated for one state in Table 9. As in the example given, each state's fees (or those of a county when data were available) identified by the vehicles for which paid were allocated to automobiles or to trucks and buses. The remaining fees were summarized, and an average per vehicle payment was obtained and allocated to each vehicle group according to numbers of vehicles registered.

For the SMSA's extending beyond state boundaries, separate computations were made for the counties of each state to reflect the state's fee schedules.

The state motor vehicle registration and other fees obtained by these methods produced an earning of $376 million in the 46 SMSA's of the study.

Tolls and Local Taxes and Fees.—Nearly all of the local toll facilities, principally bridges, are located entirely within the study SMSA's. The data from the financial statements of such toll facilities in reports to the U. S. Bureau of Public Roads provided the information for this analysis.

For state-administered toll road facilities extending beyond the boundaries of a SMSA, the total travel and the tolls earned on the travel within the SMSA were reported by the state highway departments.

Local imposts on road users (as well as other highway income and expenditures) for each SMSA were available from the annual reports to the U. S. Bureau of Public Roads (2, pp. 127-140). Motor-vehicle user tax earnings at the local (county or city) level consist of motor fuel taxes, motor vehicle registration and other fees where levied, and parking fees.

COMPARISON OF INCOME, EXPENDITURES AND EARNINGS

Road and Street Income

Table 3 gives the income of each SMSA, by source, Federal, state and local, classified between imposts on road users, other revenue income, and receipts from borrowing. Figure 2 shows by proportions the total income by source. State road-user income, equal to state highway expenditures within each SMSA, is assigned as reported

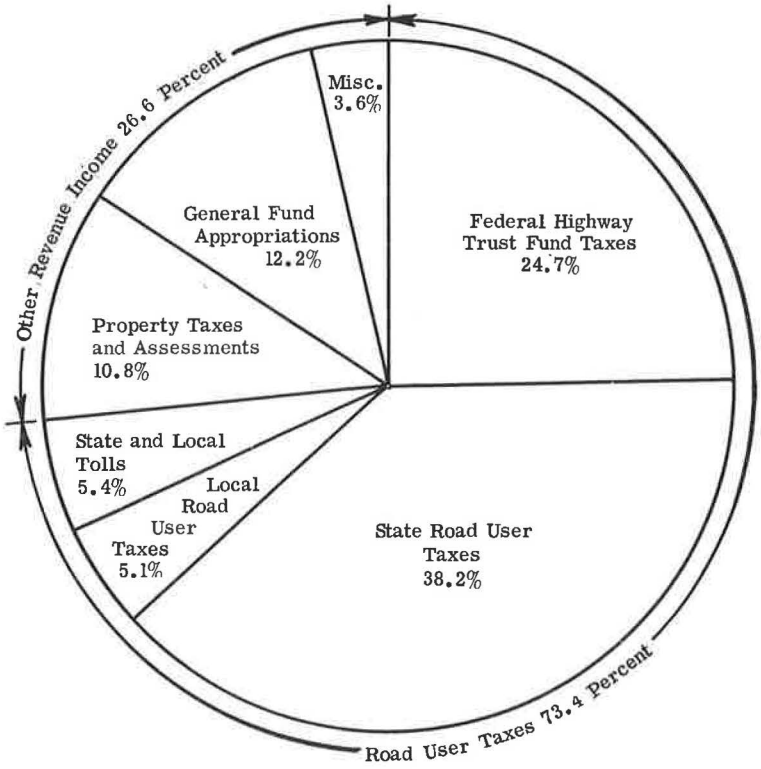

Figure 2. Sources of revenue income for highway purposes in 46 selected SMSA's in 1960.

in annual reports by the states. Since Federal aid is available exclusively for capital improvements, Federal funds were assigned to each SMSA as a pro-rata share of the state's capital outlay in the ratio that Federal-aid reimbursements were to total capital outlay by the state.

Local income, by source, is as reported annually in the road and street finance reports for the SMSA's. Toll facility income, both state and local, is that reported as toll facility earnings in Table 10.

The total revenue income of the 46 SMSA's amounted to $1,422 million of which $1,044 million or 73.4 percent came from imposts on road users and $378 million or 26.6 percent from property taxes and assessments, general fund appropriations, and miscellaneous income. The income of $1,044 million from imposts on road users compares with road-user earnings in these SMSA's of $1,650 million (Table 10), a sharing of 63 percent.

Property taxes and assessments, general fund appropriations, and miscellaneous income of the SMSA's provided 26.6 percent of the road and street income while, nationally, receipts from these sources (10) account for 18 percent of the total receipts for highways, including small amounts of Federal and state general fund appropriations.

Investment income and borrowing of $223 million supplemented the revenue income for highways of the SMSA's. (These items are not relevant to the comparisons made in this paper; borrowings are balanced over time by debt retirements, and are not to be considered as revenue income. Investment income, a very small item, does contribute to the funds available for expenditure, but it is not relevant to comparisons of user and nonuser income.)

The imposts on road users, including tolls, accounted for 71 to 76 percent of the revenue income among the four SMSA groups by population size. The population group 500,000 to 1,000,000 has the lowest percentage of its total income from road-user

TABLE 10

ESTIMATED MOTOR-VEHICLE USER-TAX AND TOLL EARNINGS GENERATED BY TRAVEL AND VEHICLE OWNERSHIP IN 46 SELECTED SMSA's IN 1960, AT 1960 TAX RATES AND TOLLS

SMSA by Population Group	Vehicle-Miles of Travel Within SMSA (millions)	Collecting Agencies: Federal Government	State Agencies[a]			Local Governments[a]			Total User Taxes on Highway Use in SMSA ($ × 1,000)	Ratio of User Earnings to Expenditures
		Excise Taxes of the Federal-Highway Trust Fund[b] ($ × 1,000)	Motor Fuel and Vehicle Taxes and Fees ($ × 1,000)	Tolls ($ × 1,000)	Total State Taxes and Fees ($ × 1,000)	Motor Fuel and Vehicle Taxes and Fees[c] ($ × 1,000)	Tolls ($ × 1,000)	Total Local Taxes and Fees ($ × 1,000)		
<250,000:										
Atlantic City, N. J.	1,175	4,690	7,102	380	7,482	273	—	273	12,445	1.93
Bay City, Mich.	425	1,751	3,354	—	3,354	—	—	—	5,105	0.81
Cedar Rapids, Iowa	502	2,125	4,988	—	4,988	210	—	210	7,323	1.29
Charleston, S. C.	715	3,103	5,332	—	5,332	—	—	—	8,435	1.80
Eugene, Ore.	643	2,597	6,456	—	6,456	276	—	276	9,329	0.67
Fargo, N. D.	153	1,062	1,936	—	1,936	—	—	—	3,797	0.34
Fitchburg-Leominster, Mass.	426	1,492	2,286	—	2,286	1,012	—	1,012	4,790	2.90
Fort Wayne, Ind.	582	2,390	5,072	—	5,072	95	—	95	7,566	1.37
Great Falls, Mont.	273	1,048	2,174	—	2,174	137	—	137	3,359	0.69
Jackson, Miss.	590	2,526	5,112	—	5,112	137	—	137	7,775	1.08
Las Vegas, Nev.	359	1,722	3,658	—	3,658	197	—	197	5,577	0.94
Lewiston-Auburn, Me.	174	622	1,650	272	1,922	134	—	134	2,678	2.20
Lexington, Ky.	433	1,832	3,666	—	3,666	81	—	81	5,579	2.06
Little Rock-N. Little Rock, Ark.	796	3,876	7,330	—	7,330	188	—	188	11,394	0.51
Lynchburg, Va.	424	1,837	3,220	—	3,220	260	—	260	5,317	1.58
Macon, Ga.	452	1,721	3,273	—	3,273	174	—	174	5,168	1.74
Madison, Wis.	911	3,916	7,436	—	7,436	360	—	360	11,712	0.75
Sioux Falls, S. D.	340	1,435	3,027	—	3,027	158	—	158	4,620	0.46
South Bend, Ind.	570	2,301	4,988	—	4,988	152	—	152	7,341	1.88
Springfield, Mo.	659	2,505	2,962	—	2,962	770	—	770	6,237	1.11
Waterbury, Conn.	523	2,146	4,208	—	4,208	26	—	26	6,380	0.94
Subtotal	11,424	47,666	91,029	652	91,681	4,640		4,640	143,927	0.94
250,000 to 500,000:										
Albuquerque, N. M.	828	3,531	7,109	—	7,109	629	—	629	11,269	0.67
Charleston, W. Va.	815	3,504	8,734	—	8,734	257	—	257	12,495	2.95
Charlotte, N. C.	675	2,741	6,462	—	6,462	144	—	144	9,347	1.67
Jacksonville, Fla.	1,807	7,297	15,715	3,338	19,053	427	—	427	26,777	0.70
Nashville, Tenn.	1,209	5,147	10,389	—	10,389	1,401	—	1,401	16,937	0.78
Omaha, Neb.	1,842	7,585	14,988	—	14,988	1,967	197	2,164	24,757	1.00
Salt Lake City, Utah	1,155	4,929	8,908	—	8,908	257	—	257	14,094	1.08
Tacoma, Wash.	1,281	5,087	12,035	—	12,035	—	—	—	17,122	1.28
Tulsa, Okla.[d]	1,436	5,931	15,757	1,598	17,355	484	—	484	23,770	1.67
Wichita, Kan.	1,382	5,514	8,846	359	9,205	418	—	418	15,137	0.85
Wilmington, Del.	1,586	6,554	11,000	4,770	15,770	467	—	467	22,791	1.36
Subtotal	14,016	57,820	119,943	10,065	130,008	6,471	197	6,668	194,496	1.04
500,000 to 1,000,000:										
Birmingham, Ala.	2,052	8,140	14,661	—	14,661	2,283	—	2,283	25,084	1.74
Columbus, Ohio	2,696	10,308	23,291	—	23,291	446	—	446	34,045	1.17
Denver, Colo.	3,500	14,354	26,939	643	27,582	—	—	—	41,936	1.68
Honolulu, Hawaii	1,123	4,544	8,903	—	8,903	4,368	—	4,368	17,815	0.93
New Orleans, La.	1,941	9,138	16,690	2,926	19,616	539	1,437	1,976	30,730	0.82
Phoenix, Ariz.	3,084	13,157	21,430	—	21,430	—	—	—	34,587	1.26
Providence, R. I.	3,401	11,997	27,150	718	27,868	1,390	—	1,390	41,255	0.99
Subtotal	17,797	71,638	139,064	4,287	143,351	9,026	1,437	10,463	225,452	1.16
1,000,000 and over:										
Baltimore, Md.	5,966	24,796	48,698	5,558	54,256	4,602	351	4,953	84,005	1.35
Buffalo, N. Y.	3,417	13,638	31,416	4,637	36,053	781	—	781	50,472	0.89
Chicago, Ill.	19,210	76,656	135,788	18,426	154,214	39,060	2,208	41,268	272,158	0.81
Houston, Tex.	4,265	17,998	30,935	—	30,935	697	—	697	55,500	0.77
Los Angeles, Calif.	27,808	117,625	264,876	—	264,876	3,686	281	3,967	386,468	1.71
Minneapolis-St. Paul, Minn.	5,500	22,557	42,210	—	42,210	1,072	—	1,072	65,839	0.75
Philadelphia, Pa.	12,314	48,908	90,797	28,034	118,831	1,999	1,566	3,565	171,304	1.46
Subtotal	78,480	322,138	650,720	56,655	707,375	51,907	4,406	56,313	1,085,826	1.13
Total all SMSA's	121,717	499,202	1,000,756	71,659	1,072,415	72,044	6,040	78,084	1,649,701	1.11

[a]Includes earnings from state motor-fuel taxes at estimated consumption rates per mile of travel, and registration, operator license, and other fees either recorded collections in each area, or computed on basis of vehicle ownership in that SMSA. Local highway-user imposts include the proceeds from motor fuel, bus and wheel taxes, automobile and truck licenses, and other fees levied on highway users within those jurisdictions.

[b]Includes taxes on motor fuel, truck, bus, and trailer excise, tires, tubes, and tread rubber, and vehicle-use taxes; does not include automobile excise, parts and accessories, and lubricating oil taxes which are general fund revenues.

[c]Includes parking fees.

[d]Excludes Osage County.

imposts, just under 71 percent, and it is also second lowest in state and Federal road-user revenue income, with 63 percent. The proportion of state and Federal road-user tax income, excluding tolls, available to the SMSA's decreases as population increases, accounting for nearly 73 percent in the smallest population group and decreasing to about 61 percent in the largest. Income from local user imposts and state and local tolls, on the other hand, increases with the population size group of areas.

Road and Street Expenditures

Highway expenditures given in Table 11 and shown in Figure 3 are detailed for capital outlays between those expended on state-administered highways and those expended on local roads and streets. Because of the rural areas in the SMSA's, rural-municipal classification is given to the extent the data permitted.

The classification of construction expenditures by systems is frequently incomplete or inexact, or the rural-municipal segregation of expenditures on state-administered highways may not be complete. In the Baltimore, Maryland area, for instance (and this is perhaps the most extreme case), Federal aid of $7.8 million, matched with

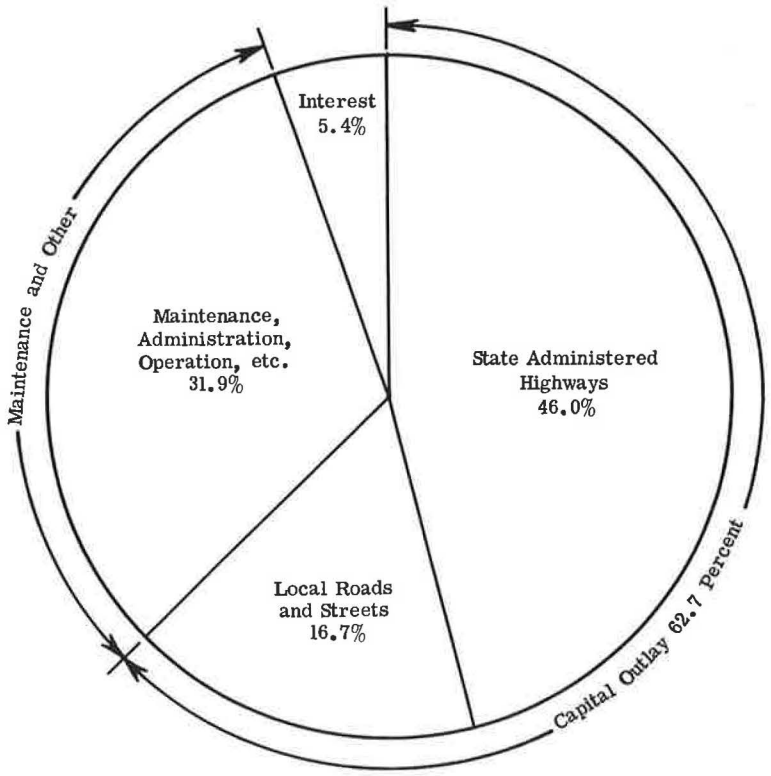

Figure 3. Expenditures for highways by all governmental agencies in 46 selected SMSA's, 1960.

$5.5 million of local city funds, was spent in the city for the construction of Federal-aid route extensions which ordinarily would be extensions of state highways but which were under city jurisdiction because state jurisdiction stops at the Baltimore city limit. The capital expenditure of the entire $13.4 million is given in Table 11 under local municipal streets rather than with those for municipal extensions of state-administered systems, as is the case for the other areas.

The split between rural and municipal expenditures is further complicated by the fact that the states' classification of rural expenditures includes Federal-aid urban outlay to the extent that the Federal-aid urban area extends beyond the corporate limits of cities.

Although such classification difficulties affect the columnar comparisons of individual areas attempted in Table 11, the total outlays are complete.

The total 1960 expenditures for highways were $1,491 million in the 46 SMSA's. Capital outlay, consisting of right-of-way, engineering, and construction costs, amounted to $935 million, 62.7 percent of total expenditures. Maintenance, operation, and administration expenditures were $476 million or 31.9 percent, with interest and financing costs the remainder, $80 million or 5.4 percent.

The broad classification of maintenance, administration, and operation requires some definition. The maintenance, administration and operation expenditures of local units are considered complete and are adequately reported. Local toll facility expenditures for maintenance and administration are equally well reported. At the state level, maintenance of condition and operating maintenance are included but costs of administration, collection, and state highway police and safety expenditures are not. These expenditures are not reported because this would involve an allocation by proration which might be misleading. Nevertheless, earnings from highway use are expended for these functions.

Some indication of the cost to the states of collecting user taxes, administering state highway organizations, and supporting highway police and safety is given in Table 12. Costs of collection, including administrative and enforcement costs, were obtained by relating the total state costs to total state user revenues in each state and applying that relationship to state user tax earnings of the SMSA in that state. State highway administration costs were related to total capital and maintenance expenditures in each state, and this relationship was applied to state expenditures for capital outlay and maintenance of each SMSA. State highway police and safety education expenditures were derived only in total for all SMSA's by relating all travel in the SMSA's to the total nationwide travel. The amounts derived are indicated in Table 12.

Allied Street Functions

As stated earlier, the charges for state administration, collection, and police and safety are not included in Table 11. However, expenditures for indirect municipal street functions, usually termed allied street functions, are included with the maintenance and administration amounts. These functions consist of construction, maintenance and administration for street lighting, street cleaning, sidewalks, storm drainage,

TABLE 11

ROAD AND STREET EXPENDITURES IN 46 SELECTED SMSA's, 1960
($ x 1,000)

SMSA's By Population Groups	Capital Outlay[a]						Total Capital Outlay	Maintenance, Administration, Operation, etc.[b]	Interest	Total Expenditures	Debt Retirement	Total Disbursements
	State Administered Highways			Local Roads and Streets								
	Rural	Municipal	Total	Rural	Municipal	Total						
<250,000:												
Atlantic City, N. J.	1,044	51	1,095	165	293	458	1,553	4,608	298	6,459	406	6,865
Bay City, Mich.	3,773	99	3,872	41	745	786	4,658	1,614	14	6,286	90	6,376
Cedar Rapids, Iowa	907	370	1,277	888	911	1,799	3,076	2,552	56	5,684	279	5,963
Charleston, S. C.	2,817	353	3,170	99	84	183	3,353	1,334	—	4,687	—	4,687
Eugene, Ore.	7,849	—	7,849	1,763	1,135	2,898	10,747	3,084	54	13,885	246	14,131
Fargo, N. D.	10,265	985	11,250	1,572	1,552	3,124	14,374	2,361	273	17,008	536	17,544
Fitchburg-Leominster, Mass.	99	—	99	46	206	252	351	1,289	12	1,652	140	1,792
Fort Wayne, Ind.	1,952	205	2,157	809	599	1,408	3,565	1,875	97	5,537	307	5,844
Great Falls, Mont.	2,834	70	2,904	42	241	283	3,187	1,443	241	4,871	475	5,346
Jackson, Miss.	2,287	478	2,765	505	1,033	1,538	4,303	2,598	295	7,196	2,485	9,681
Las Vegas, Nev.	3,011	24	3,035	180	853	1,033	4,068	1,830	41	5,939	834	6,173
Lewiston-Auburn, Me.	4	110	114	—	110	110	224	795	199	1,218	42	1,260
Lexington, Ky.	1,492	73	1,565	—	—	—[c]	1,565	1,136	—	2,703	—	2,703
Little Rock-N. Little Rock, Ark.	4,739	12,698	17,437	99	1,530	1,629	19,066	2,964	141	22,171	345	22,516
Lynchburg, Va.	1,243	168	1,411	—	604	604	2,015	1,229	120	3,364	304	3,668
Macon, Ga.	1,559		1,559	345	135	480	2,039	915	24	2,978	45	3,023
Madison, Wisc.	6,127	166	6,293	2,006	3,129	5,135	11,428	3,914	227	15,569	1,069	16,638
Sioux Falls, S. D.	4,428	2,782	7,210	1,004	241	1,245	8,455	1,539	14	10,008	20	10,028
South Bend, Ind.	153	16	169	477	436	913	1,082	2,800	25	3,907	575	4,482
Springfield, Mo.	2,911	642	3,553	67	307	374	3,927	1,656	29	5,612	330	5,942
Waterbury, Conn.	3,216	—	3,216	104	245	349	3,565	3,089	103	6,757	192	6,949
Subtotal	62,710	19,290	82,000	10,212	14,393	24,601	106,601	44,627	2,263	153,491	8,120	161,611
250,000 to 500,000:												
Albuquerque, N. M.	1,031	9,157	10,188	101	2,268	2,369	12,557	3,726	469	16,752	1,492	18,244
Charleston, W. Va.	655	—	655	—	37	37	692	3,426	116	4,234	176	4,410
Charlotte, N. C.	1,436	396	1,832	—	428	428	2,260	3,140	181	5,581	298	5,879
Jacksonville, Fla.	17,862	6,338	24,200	143	1,058	1,201	25,401	7,898	5,011	38,310	6,963	45,273
Nashville, Tenn.	7,465	8,694	16,159	626	1,126	1,752	17,911	3,454	276	21,641	866	22,507
Omaha, Neb.	8,205	2,740	10,945	3,156	3,708	6,864	17,809	6,510	402	24,721	2,875	27,596
Salt Lake City, Utah	7,931	174	8,105	778	685	1,463	9,568	3,477	—	13,045	—	13,045
Tacoma, Wash.	2,044	4,629	6,673	—	2,795	2,795	9,468	3,736	179	13,383	346	13,729
Tulsa, Okla.	3,347	419	3,766	1,739	1,856	3,595	7,361	5,151	1,757	14,269	1,547	15,816
Wichita, Kan.	3,658	2,894	6,552	1,152	4,228	5,380	11,932	4,637	1,330	17,899	7,116	25,015
Wilmington, Del.	6,342	1,958	8,300	48	943	991	9,291	5,336	1,145	15,772	3,540	20,312
Subtotal	59,976	37,399	97,375	7,743	19,132	26,875	124,250	51,491	10,866	186,607	24,925	211,532
500,000 to 1,000,000												
Birmingham, Ala.	4,988	103	5,091	2,718	2,251	4,969	10,060	4,144	217	14,421	846	15,267
Columbus, Ohio	7,697	9,822	17,519	1,543	1,892	3,435	20,954	7,196	829	28,979	8,774	37,753
Denver, Colo.	5,920	5,033	10,953	1,625	1,677	3,302	14,255	10,438	325	25,018	455	25,473
Honolulu, Hawaii	2,877	4,584	7,461	—	3,334	3,334	10,795	7,801	475	19,071	446	19,517
New Orleans, La.	4,051	12,478	16,529	1,693	3,594	5,287	21,816	9,892	5,627	37,335	5,038	42,373
Phoenix, Ariz.	2,917	6,046	8,963	8,153	3,117	11,270	20,233	6,767	440	27,440	1,408	28,848
Providence, R. I.	3,197	20,518	23,715	459	4,372	4,831	28,546	12,793	459	41,798	2,038	43,836
Subtotal	31,647	58,584	90,231	16,191	20,237	36,428	126,659	59,031	8,372	194,062	19,605	213,667
1,000,000 and over:												
Baltimore, Md.	10,812	37	10,849	4,146	15,761	19,907	30,756	27,208	4,245	62,209	8,322	70,531
Buffalo, N. Y.	10,100	9,193	19,293	4,346	6,806	11,152	30,445	22,304	3,719	56,468	10,455	66,923
Chicago, Ill.	46,414	120,089	166,503	8,573	26,159	34,732	201,235	101,616	31,450	334,301	32,764	367,065
Houston, Tex.	—	35,954	35,954	2,548	12,087	14,635	50,589	16,949	4,403	71,941	10,190	82,131
Los Angeles, Calif.	38,885	59,884	98,769	15,494	31,647	47,141	145,910	78,583	1,692	226,185	4,546	230,733
Minneapolis-St. Paul, Minn.	7,923	33,772	41,695	6,046	11,761	17,807	59,502	27,096	1,511	88,109	5,729	93,838
Philadelphia, Pa.	23,110	20,642	43,752	3,512	12,195	15,707	59,459	46,787	11,259	117,505	16,506	134,011
Subtotal	137,244	279,571	416,815	44,665	116,416	161,081	577,896	320,543	58,279	956,718	88,514	1,045,232
Total all SMSA's	291,577	394,844	686,421	78,811	170,174	248,985	935,406	475,692	79,780	1,490,878	141,164	1,632,042

[a] In some instances, the classification of expenditures by system is not exact. In the Baltimore area for instance, the state and Federal-aid expenditures for municipal extensions of state highways are included with local municipal street expenditures because state highways stop at the Baltimore municipal limits. In other cases where the expenditures for rural and municipal state highways were not segregated the amounts are given under rural.

[b] Includes parking, policing, and allied street functions.

[c] No local capital outlay given in the report of expenditures for 1960.

TABLE 12

COMPARISON OF NATIONAL AND SMSA EXPENDITURES, 1960

Item	Expenditures ($ million)	
	Total All States and D. C.	Pro Rata Allocation to 46 SMSA's
State Highway administration	290	35
Cost of user-tax revenue collection	212	36
State highway police and safety	234	39

and maintenance and operation of parking meters and lots. Since the division of the expenditures for construction or maintenance was not given in many cases, the entire expenditure is included with maintenance and administration.

With the exception of parking facilities, expenditures for these purposes are of greater service to abutting property and in the protection of public health, safety, and security than they are to highways and motor vehicles. For example, storm sewers drain adjacent property as well as the streets, and street lighting provides safety and security to pedestrians and abutting occupants. Their inclusion may, therefore, be regarded as an expenditure offset against the omission of the allocated expenditures for state highway administration, user-tax revenue collection, and state highway police.

The funds for allied street functions are mainly derived from property taxes and assessments and from local general revenue funds. Road-user revenues, state and local, are used to some extent, chiefly when outlays for those purposes are incidental to highway construction or maintenance operations. The amounts in Table 3 include income from these various sources for indirect municipal street functions, and the expenditures, amounting to $134 million, are included with the amounts in Table 11. Table 13 gives a summary of the nationwide expenditures for allied street functions in 1960 and the corresponding expenditures in the 46 SMSA's.

Road-User Earnings

Table 10 gives the motor-vehicle user tax and toll earnings for each SMSA, and Figure 4 shows the proportion of the total earnings, by Federal, state, and local sources.

TABLE 13

NATIONAL DISBURSEMENT TOTALS FOR PARKING FACILITIES AND ALLIED STREET FUNCTIONS AND CORRESPONDING OUTLAYS IN 46 SMSA's, 1960[a]
($ × 1,000)

Item	Parking Facilities	Allied Street Functions					Total Including Parking
		Street Lighting	Street Cleaning	Side-walks	Storm Sewers	Total	
Capital outlay	55,757	33,615	2,853	19,277	87,393	143,138	198,895
Maintenance and operation	37,093	176,559	67,290	4,425	14,651	262,925	300,018
Interest on debt	13,694	—	—	—	—	11,648[b]	25,342
Total expenditures	106,544	—	—	—	—	417,711	524,255
Debt retirement	18,658	—	—	—	—	31,499[b]	50,157
Fund transfers:							
To municipal street funds	73,974	—	—	—	—	—	73,974
To allied street functions	2,310	—	—	—	—	—	2,310
To county road funds	523	—	—	—	—	—	523
To other purposes	5,142	—	—	—	—	6,977	12,119
Total	81,949	—	—	—	—	6,977	88,926
Total disbursements	207,151	—	—	—	—	456,187	663,338
Amounts included in expenditures of 46 SMSA's	16,370	59,111	19,449	2,876	36,647	118,083	134,553

[a]Data derived from Ref. 14.
[b]Debt service for these functions grouped.

The proportions of earnings from Federal, state and local levies are as follows: state motor fuel taxes, and motor vehicle registration and other fees were 60.7 percent of total earnings, double those realized from the Federal excise group; local levies on road users amounted to 4.4 percent of the total and are equal to the earnings of the state level toll facilities; and tolls from all facilities, state and local were $79 million or 4.7 percent.

By dividing the earnings by the vehicle-miles, the total road-user earnings of $1,650 million are equal to a payment of $0.0136 per vehicle-mile of travel, of which $0.041 is from Federal trust fund excise taxes and $0.088 from state taxes and tolls. Local user levies account for an average per vehicle-mile earning of slightly less than $0.007.

By comparison, the United States total 1960 road-user taxes (10) amounted to $8,211 million, and the corresponding total travel (2, p. 80) was 718,845 million vehicle-miles. These two items compute to an average earning rate of $0.0114/veh-mi of travel. The $0.0136/veh-mi earning rate computed for the SMSA's results in an earning, per vehicle-mile of travel, 19 percent greater than the national average. The motor fuel consumption differential estimated for the SMSA's accounted for approximately 14 of the 19 percent of this greater earning rate (Table 5); the remainder is accounted for by the fact that the annual travel in the SMSA per vehicle registered therein (a synthetic figure since much of the travel is contributed by vehicles from outside the area) runs low, 8,497 mi/yr, in comparison with the national per-vehicle average, which was 9,652 in 1960. When the annual mileage is low, the effect of registration fees and others not varying with mileage is to cause the payment per vehicle-mile to be high.

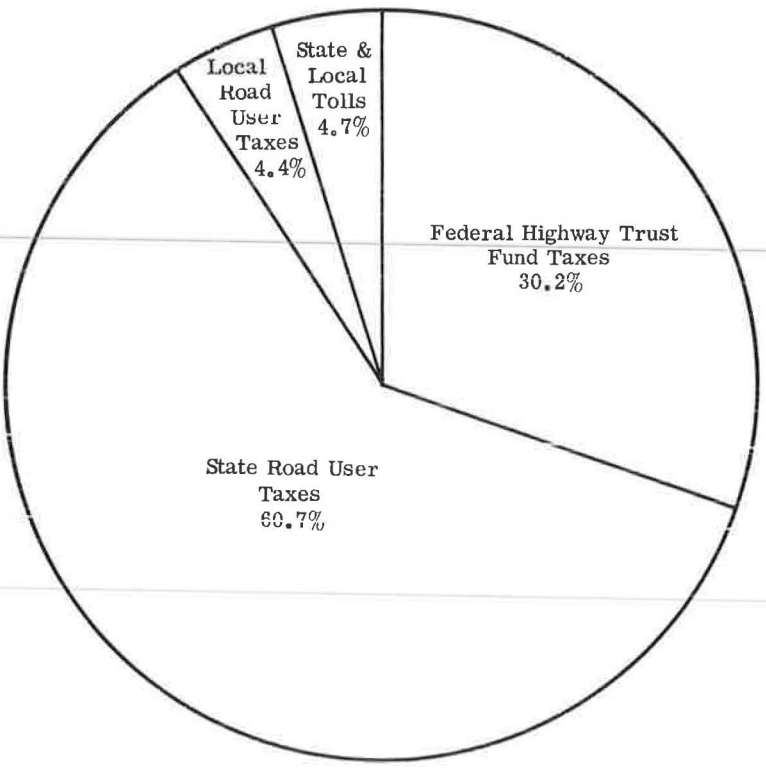

Figure 4. Estimated earnings of Federal highway trust fund taxes, state and local road user levies, and tolls in 46 selected SMSA's, 1960.

TABLE 14

RATIOS OF EARNINGS TO EXPENDITURES MORE OR LESS THAN 1.00

Population	No. Having Ratios >1.00	Group Ratio, Earnings to Expenditures
<250,000	12 out of 21	0.94
250,000 - 500,000	7 out of 11	1.04
500,000 - 1,000,000	4 out of 7	1.16
>1,000,000	3 out of 7	1.13
All SMSA's	26 out of 46	1.11

The last column of Table 10 gives the ratio of motor-vehicle user tax earnings to total current highway expenditures in 1960 as given in Table 11. In 26 of the 46 SMSA's, earnings of user taxes were greater than the total current expenditures for highways, the ratio of totals being 1.11.

The ratios for the several population groups vary generally upward with size of place, but there is no similar consistency in the number of places having ratios of earnings to expenditures more or less than 1.00, as is indicated in the recapitulation in Table 14.

SUMMARY COMPARISONS

The information in Tables 3, 10, and 11 are summarized in Table 15, which provides a ready comparison of the road and street income, expenditures, and user earnings of the 46 SMSA's. In the 46 SMSA's studied, road-user income sources provided 73.4 percent of the revenue income and property taxes and assessments and other sources provided 26.6 percent. Although the earnings accruing from travel in these SMSA's amounted to $1,650 million, the amount of road-user taxes, fees, and tolls applied to these SMSA's was only $1,044 million, or 63.2 percent of the amount earned.

The road-user earnings from the travel in these SMSA's is of the same order, at $1.6 billion, as the total receipts for highways, including $378 million from nonuser sources and $223 million of borrowing, and the total expenditures which include more than $141 million of debt retirement.

TABLE 15

SUMMARY COMPARISONS OF HIGHWAY INCOME, EXPENDITURES, AND ROAD-USER EARNINGS OF 46 SELECTED SMSA's, 1960

Item	SMSA Population Group									
	<250,000		250,000 to 500,000		500,000 to 1,000,000		1,000,000 and more		Totals, 46 SMSA's	
	Amount ($ x 1,000)	Percent	Amount ($ x 1,000)	Percent	Amount ($ x 1,000)	Percent	Amount ($ x 1,000)	Percent	Amount ($ x 1,000)	Percent
Road and street income:										
Imposts on highway users:										
State and Federal taxes	110,676	72.78	110,851	65.54	119,867	63.09	552,789	60.72	894,183	62.90
Local	4,705	3.10	6,471	3.83	9,026	4.75	51,907	5.70	72,109	5.07
Tolls	652	0.43	10,262	6.07	5,724	3.01	61,061	6.71	77,699	5.47
Subtotal	116,033	76.31	127,584	75.44	134,617	70.85	665,757	73.13	1,043,991	73.44
Other revenue income:										
Property taxes and assessments	17,970	11.82	24,738	14.63	21,769	11.46	88,627	9.73	153,104	10.77
General fund appropriations	15,297	10.06	12,269	7.25	24,085	12.68	122,149	13.42	173,800	12.22
Miscellaneous taxes and fees	2,756	1.81	4,539	2.68	9,523	5.01	33,878	3.72	50,696	3.57
Subtotal	36,023	23.69	41,546	24.56	55,377	29.15	244,654	26.87	377,600	26.56
Total revenue income	152,056	100.00	169,130	100.00	189,994	100.00	910,411	100.00	1,421,591	100.00
Investment income and borrowing	11,552		24,889		29,678		156,727		222,846	
Total receipts	163,608		194,019		219,672		1,067,138		1,644,437	
Road and street expenditures:										
Capital outlay:										
On State highways	82,000	53.42	97,375	52.18	90,231	46.50	416,815	43.57	686,421	46.04
On local roads and streets	24,601	16.03	26,875	14.40	36,428	18.77	161,081	16.83	248,985	16.70
Subtotal	106,601	69.45	124,250	66.58	126,659	65.27	577,896	60.40	935,406	62.74
Maintenance, administration, operation, etc.	44,627	29.08	51,491	27.60	59,031	30.42	320,543	33.51	475,692	31.91
Interest on debt	2,263	1.47	10,866	5.82	8,372	4.31	58,279	6.09	79,780	5.35
Subtotal	46,890	30.55	62,357	33.42	67,403	34.73	378,822	39.60	555,472	37.26
Total expenditures	153,491	100.00	186,607	100.00	194,062	100.00	956,718	100.00	1,490,878	100.00
Debt retirement	8,120		24,925		19,605		88,514		141,164	
Total disbursements	161,611		211,532		213,667		1,045,232		1,632,042	
Motor vehicle user tax earnings:										
Federal trust fund taxes	47,606	33.08	57,820	29.73	71,638	31.78	322,138	29.67	499,202	30.26
State motor vehicle user taxes	91,029	63.25	119,943	61.67	139,064	61.68	650,720	59.93	1,000,756	60.66
Local motor vehicle user taxes	4,640	3.22	6,471	3.33	9,026	4.00	51,907	4.78	72,044	4.37
Tolls	652	0.45	10,262	5.27	5,724	2.54	61,061	5.62	77,699	4.71
Total motor vehicle user tax earnings	143,927	100.00	194,496	100.00	225,452	100.00	1,085,826	100.00	1,649,701	100.00

It is not known, of course, whether the total of all metropolitan areas of the country, if organized in this manner, would compare similarly, but it is reasonable to speculate that they would.

During a period of extensive highway construction, of which 1960 is representative, expenditures in any one SMSA may well exceed earnings. If, in a given year a sizeable portion of a state's construction program falls within a SMSA, this occurrence would have a major effect on the earnings-expenditure comparison, and it might not be repeated in the following years. The relationship between earnings and expenditures given here is valid for only one year, but the average for 46 SMSA's may be taken as reasonably indicative of the current trend.

TABLE 16

STATE HIGHWAY DEPARTMENT EXPENDITURES FOR CAPITAL OUTLAY IN 46 SELECTED SMSA's 1960 AND 1961 AND COMPARISON WITH 1960 MOTOR VEHICLE ROAD-USER EARNINGS[a]

SMSA's By Population Groups	Capital Outlay by State Highway Departments on State and Local Administered Highways ($ x 1,000)		1961 Increase or Decrease ($ x 1,000)	Total Expenditures 1960 (Table 11) ($ x 1,000)	Adjusted Expenditures by Substituting 1961 for 1960 State Capital Outlay ($ x 1,000)	1960 Road User Earnings ($ x 1,000)	Ratio of User Earnings to Adjusted Expenditures	Ratio of User Earnings to 1960 Expenditures (Table 10)
	1960	1961						
<250,000:								
Atlantic City, N. J.	1,055	2,363	+ 1,308	6,459	7,767	12,445	1.60	1.93
Bay City, Mich.	3,913	2,375	- 1,538	6,286	4,748	5,105	1.08	0.81
Cedar Rapids, Iowa	1,617	2,377	+ 760	5,684	6,444	7,323	1.14	1.29
Charleston, S. C.	3,170	6,209	+ 3,039	4,687	7,726	8,435	1.09	1.80
Eugene, Ore.	8,102	3,767	- 4,335	13,885	9,550	9,329	0.98	0.67
Fargo, N. D.	11,769	5,389	- 6,380	17,008	10,628	5,797	0.55	0.34
Fitchburg-Leominster, Mass.	106	274	+ 168	1,652	1,820	4,790	2.63	2.90
Fort Wayne, Ind.	2,157	2,181	+ 24	5,537	5,561	7,566	1.36	1.37
Great Falls, Mont.	3,004	1,815	- 1,089	4,871	3,782	3,359	0.89	0.69
Jackson, Miss.	2,765	2,730	- 35	7,196	7,161	7,775	1.09	1.08
Las Vegas, Nev.	3,044	2,850	- 194	5,939	5,745	5,577	0.97	0.94
Lewiston-Auburn, Me.	110	27	- 83	1,218	1,135	2,678	2.36	2.20
Lexington, Ky.	1,557	3,649	+ 2,092	2,703	4,795	5,579	1.16	2.06
Little Rock-N. Little Rock, Ark.	17,536	13,352	- 4,184	22,171	17,987	11,394	0.63	0.51
Lynchburg, Va.	1,411	1,173	- 238	3,364	3,126	5,317	1.70	1.58
Macon, Ga.	1,627	1,482	- 145	2,978	2,833	5,168	1.82	1.74
Madison, Wis.	6,746	15,300	+ 8,552	15,569	24,121	11,712	0.49	0.75
Sioux Falls, S. D.	7,440	10,111	+ 2,671	10,000	12,670	4,620	0.36	0.46
South Bend, Ind.	169	295	+ 126	3,907	4,033	7,341	1.82	1.88
Springfield, Mo.	3,552	7,431	+ 3,879	5,612	9,491	6,237	0.66	1.11
Waterbury, Conn.	833	4,786	+ 3,953	6,757	10,710	6,380	0.60	0.94
Subtotal	81,585	89,936	+ 8,351	153,491	161,842	143,927	0.89	0.94
250,000 to 500,000:								
Alburquerque, N. M.	10,076	8,216	- 1,860	16,752	14,892	11,269	0.76	0.67
Charleston, W. Va.	655	3,708	+ 3,053	4,234	7,287	12,495	1.71	2.95
Charlotte, N. C.	1,832	1,330	- 502	5,581	5,079	9,347	1.84	1.67
Jacksonville, Fla.	11,769	5,761	- 6,008	38,310	32,302	26,777	0.83	0.70
Nashville, Tenn.	16,258	11,558	- 4,700	21,641	16,941	16,937	1.00	0.78
Omaha, Neb.	11,697	12,189	+ 492	24,721	25,213	24,757	0.98	1.00
Salt Lake City, Utah	8,270	13,898	+ 5,628	13,045	18,673	14,094	0.75	1.08
Tacoma, Wash.	6,994	9,531	+ 2,537	13,383	15,920	17,122	1.08	1.28
Tulsa, Okla.	3,771	5,630	+ 1,859	14,269	16,128	23,770	1.47	1.67
Wichita, Kan.	6,914	7,032	+ 118	17,899	18,017	15,137	0.84	0.85
Wilmington, Del.	7,820	6,690	- 1,130	19,772	18,642	22,791	1.46	1.36
Subtotal	86,056	85,543	- 513	186,607	186,094	194,496	1.05	1.04
500,000 to 1,000,000:								
Birmingham, Ala.	5,314	3,964	- 1,350	14,421	13,071	25,084	1.92	1.74
Columbus, Ohio	18,944	14,847	- 3,897	28,979	25,082	34,045	1.36	1.17
Denver, Colo.	11,089	11,335	+ 246	25,018	25,264	41,936	1.66	1.68
Honolulu, Hawaii	7,401	8,015	+ 564	19,071	19,625	17,815	0.91	0.93
New Orleans, La.	8,099	7,037	- 1,062	37,335	36,273	30,730	0.85	0.82
Phoenix, Ariz.	2,940	10,757	+ 7,817	27,440	35,257	34,587	0.98	1.26
Providence, R. I.	24,951	23,175	- 876	41,798	40,922	41,255	1.01	0.99
Subtotal	77,198	78,630	+ 1,432	194,062	195,494	225,452	1.15	1.16
1,000,000 and over:								
Baltimore, Md.	26,034	37,928	+ 11,894	62,209	74,103	84,005	1.15	1.35
Buffalo, N. Y.	17,243	14,390	- 2,853	56,468	53,615	50,472	0.94	0.89
Chicago, Ill.	120,734	60,705	- 60,029	334,301	274,272	272,158	0.99	0.81
Houston, Tex.	35,142	44,338	+ 9,196	71,941	81,137	55,580	0.69	0.77
Los Angeles, Calif.	99,147	182,551	+ 83,404	226,185	309,589	386,460	1.25	1.71
Minneapolis-St. Paul, Minn.	42,470	49,586	+ 7,116	88,109	95,225	65,839	0.69	0.75
Philadelphia, Pa.	41,921	29,203	- 12,718	117,505	104,787	171,304	1.63	1.46
Subtotal	382,691	418,701	+ 36,010	956,718	992,728	1,085,826	1.09	1.13
Total, all SMSA's	627,530	672,810	+ 45,280	1,490,878	1,536,158	1,649,701	1.07	1.11

[a]Although local agencies undertake costly facilities also, the impact of interstate construction under state jurisdiction is most certain to affect large and small population areas.

COMPARISONS WITH 1961 DATA

The first year for which the complete highway finance data for SMSA's were compiled so that it was possible to survey income and expenditures for a 1-yr period was 1960. Since this analysis was undertaken, 1961 data have become available in sufficient detail to permit a comparison of 1960 and 1961 state highway department expenditures, excluding toll facility expenditures, for the 46 SMSA's, with a view to examining any major fluctuations in the two years.

Table 16 indicates how state highway department expenditures may vary from year to year in a SMSA. In this table, the 1960 and 1961 state highway department expenditures for capital improvements on state and local highways are compared, with the increase or decrease given in column 3. The 1960 amount of $628 million is a part of the $686 million capital outlay on state highways of Tables 11 and 15, but excludes local expenditures on state-administered highways and state toll-facility expenditures.

Column 4 of Table 16 duplicates the total road and street expenditures of $1,491 million given in Table 11, then adjusts these amounts for each SMSA by substituting the 1961 state capital outlay for that of 1960. The adjusted expenditure is then compared with the 1960 road user earnings of Table 10, and in column 7 of Table 16 a new ratio of earnings to expenditures is given on this basis.

The result of this examination demonstrates that there is a rather stable relationship between earnings and expenditures for the two successive years. In the last two columns of the table the ratios of the 1960 data and the ratios based on the modified 1961 expenditures are compared.

COMPARISONS OF DATA FOR INDIVIDUAL SMSA's

The ratio of motor-vehicle user earnings to expenditures for the different SMSA's varies over a wide range. The lowest ratio of earnings to expenditures, 0.34, is found in the Fargo, N. D., SMSA, and the highest ratio, 2.95, is in the Charleston, W. Va., area. Attempts to rationalize the differences from the standpoint of population, travel, amount of land area, or population density fail to provide a complete answer. Some effect, of course, is felt through the earnings per vehicle-mile of travel (total earnings divided by total travel) which in the cases cited provides the North Dakota area with an earning of $0.01283/mi and the West Virginia area with an earning rate of $0.01534. This difference can be mainly ascribed to a $0.05 and $0.06 gasoline tax rate in North Dakota (the rate changed from $0.05 to $0.06 in 1960), compared with a $0.07/gal gasoline tax in West Virginia.

The comparison of capital expenditures for 1960 and 1961 given in Table 16, however, shows that in the Fargo area state expenditures for capital outlay on state and local highways amounted to $11.8 million in 1960 and $5.4 million in 1961, while in Charleston $0.7 million was expended by the state for capital improvements on state and local highways in 1960, compared with $3.7 million in 1961.

More striking perhaps is the situation in the SMSA's of Chicago and Los Angeles. In the former, capital expenditures were $121 million in 1960 and $61 million in 1961, a reduction in expenditures which, if applied to the 1960 earnings, would be sufficient to bring the earnings-expenditure ratio to nearly 1.0. In Los Angeles, capital outlays of $99 million in 1960 were followed by an expenditure of $183 million in 1961. In this case, the adjusted expenditures compared with 1960 user earnings would retain a ratio of more than 1.0.

The greatest extremes in the earnings-expenditure comparisons given in Table 10 appear in the under 250,000 population group. Two areas in this group had a ratio under 0.50, and five under 0.70, whereas only one area in the population groups over 250,000, Albuquerque, had an earnings-expenditure ratio under 0.70. At the other extreme, eight areas in the under 250,000 population group had an earnings-expenditure ratio over 1.50, 38 percent of the group, compared with 6 areas in all of the remaining population groups.

The more constant relationship in the areas over 250,000 population may signify that at least for 1960—and to the extent that the substituted 1961 state highway department expenditure comparisons are indicative—there is a greater stability between the

user earnings and expenditures in the larger metropolitan areas, even during this period of extensive highway construction.

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Residential Location and Urban Mobility

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Since the end of World War II rapid changes have taken place both in the locational pattern of urban populations and in urban transportation. The objective of the research reported in this paper is to add to our understanding of the forces affecting urban growth and urban transportation by investigating decisions of private households, which, collectively, are probably the most important source of decisions in the city. The research rests on a total of 824 hour-long personal interviews taken in the fall of 1963 with a nationwide probability sample of families living in standard metropolitan statistical areas exclusive of New York. (Because some questions were unanswered or more than one answer to a question occurred, responses in the tabulated matter may deviate from the 824 total.) Interviews were taken in 33 areas.

•THE CHOICES people make concerning their places of residence within metropolitan areas are the topic of the first main section of this report; the second section considers their choices with regard to transportation, taking the location of their residences as given. The analysis of residential location may proceed either by examining the existing distribution over metropolitan areas of families with different characteristics, or by focusing attention directly on people's attitudes and choices. This study relies mainly on the second, more dynamic approach, with a brief analysis of existing locational patterns serving as an introduction to a discussion of forces which appear to be working for changes.

PRESENT LOCATIONAL DISTRIBUTION

Before discussing the distribution of families among locations within metropolitan areas, it is necessary to decide on what principles locations are to be classified. In this study, several principles of classification are used, with the emphasis on the population density of an area. Density was selected in part because of its known relevance to urban transportation. The success of mass transit systems is related to the population density of the areas they serve. Density also is a useful concept in a study such as this because it can be readily translated into everyday language. People are quite willing to express themselves about living in houses vs living in apartments.

In the measurement of density it is common practice to compute the ratio of population to area for a rather large unit such as a county or a census tract. Investigation has shown, however, that such areas tend to be heterogeneous. Although there are substantial differences from area to area, within areas much variance remains in a variety of characteristics of the population and their residences. For example, Kish (1) showed that suburban places are highly differentiated with respect to many population characteristics. He also showed that if suburbs are grouped into zones by distance, the degree of differentiation is greatest near the center and declines as one proceeds outward. Measures of neighborhood density were therefore developed.

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TABLE 1

DENSITY OF NEIGHBORHOOD BY INCOME AND BY STAGE IN FAMILY LIFE CYCLE IN METROPOLITAN AREAS[a] – PERCENTAGE DISTRIBUTION

Spending Unit	Neighborhood Density (%)			U. S. Population (%)
	High	Medium	Low	
Income:				
Under 3,000	23	39	38	16
3,000 - 4,999	24	30	46	13
5,000 - 7,499	15	29	56	19
7,500 - 9,999	15	20	65	10
10,000 over	13	14	73	11
All	18	28	54	68
Stage in Family Life Cycle:[b]				
Under 45, single	34	35	31	7
Under 45, married, no children	22	48	30	4
Under 45, married, children	11	23	66	24
45 or older, married, children	4	18	78	7
45 or older, married, no children	19	27	54	12
45 or older, single	29	29	42	10
All	18	28	54	68

[a]Data derived from 1962 Survey of Consumer Finances conducted by the Research Center. Family members (primarily adult children living at home) who keep their finances separate from the head and wife were interviewed separately; the latter amounted to only 7 percent of all interviews in the survey. The table includes New York as well as other metropolitan areas.
[b]Based on 1,374 interviews.

The method adopted was to include in the neighborhood six structures, three on either side of the sample dwelling. If an apartment house in included, the neighborhood is considered high density. If there is no apartment house but at least one row house or 2 to 4 family houses, the neighborhood is considered one of medium density. Low-density neighborhoods, therefore, are areas of single-family houses.

The probability that an individual family will live in a neighborhood of a given density depends on the family income and on the stage of the family in the family life cycle, as is indicated in Table 1. About three out of four families with annual incomes over $10,000 live in low-density areas, but only 38 percent of families with incomes below $3,000 live in such areas.

Young unmarried people and widows and widowers often live in high-density neighborhoods. Married couples in the years when they have young children show a strong tendency to live in low-density areas. Only 4 percent of married couples with the husband aged over 45 who have children under 18 in the family live in high-density neighborhoods. There appears to be a flow of families from center to suburbs and back over the life cycle. Families may start their independent existence in apartments near the center, but they move to medium- or low-density neighborhoods to raise their children. They may return to high-density areas after the children have grown. Although such a movement takes place, it is by no means a universal pattern. People at all ages and all stages in their lives are found in the low-density areas.

Within the low-density areas, density can be measured in more detail by taking into account size of lot. As Table 2 indicates, there is a strong tendency for valuable homes to be located on large lots. Most homes worth less than $10,000 are on lots of less than 0.2 acre. Peoples' estimates of home values may be taken as reasonably accurate according to Kish and Lansing (2). Two-thirds of the homes worth $25,000 or more are on lots of 0.3 acre and larger. This relationship suggests that as people gradually find their incomes rising and, therefore, tend to upgrade their housing, they will consume more space.

A second method of classifying locations used in this study, as in many others, is by distance from city center. Measures of the distance in miles from city center can be made for any given city with reasonable precision by locating addresses on a map. When a number of cities are under consideration, however, the distance in miles to the center is subject to different interpretations depending on the size of the city. The size of sample available makes impossible a detailed examination of the relation between distance from city center and family income or stage in the family life cycle for cities of different size classes. Exploratory tabulations, not here reproduced, tend to indicate, as might be expected, that people in the upper income groups in general live farther out than those in the lower income groups.

TABLE 2

SIZE OF LOT FOR SINGLE-FAMILY HOMES

Present Value of House	<0.2 Acre (%)	0.2 to 0.3 Acre (%)	>0.3 Acre (%)	No. of Families
All	47	21	32	553
Under $10,000	58	18	24	54
$10,000 - $14,999	63	15	22	149
$15,000 - $24,999	52	23	25	167
$25,000 and over	11	22	67	84

Consumer Aspirations and Potential Changes in Location

The problem of drawing inferences from present locations about future locational trends is a difficult one. In the first place, present locations often reflect decisions made many years ago rather than current preferences. Future locational patterns will be determined in part by the decisions of newly formed families and, much more importantly, by the choices of the many existing families which may decide to move. The previous section showed that income and demographic factors influence residential location. Much of the variation in residential location between families remains unexplained, however, when only such variables are taken into account because individual tastes also play an important role. Tastes not only differ between families within the same socio-economic group but also may change over time. Ideas as to what constitutes an appropriate and desirable place to live have been transformed in the past by the growing affluence of our society and may continue to undergo change. Hence, past changes in residential location cannot be mechanically projected into the future.

One of the most dynamic factors in the housing market throughout the past 15 years was the shift of population to the suburbs and the consequent growth of shopping centers and outlying community facilities. To many blue collar families suburban living was a new experience and represented a major upward step in their standard of living. Some experts believe that the outward movement from the cities may be reaching a limit now for two reasons: (a) the scarcity of land in reasonably convenient suburban locations, and (b) the time and cost involved in commuting longer distances to work. Both arguments should carry some weight, but without an analysis of consumer preferences they are insufficient.

Some ideas about the kinds of location and housing people would like to have in the future can be obtained from detailed interviews with a representative group of consumers. By discussing with people their plans for future moves, their satisfactions and dissatisfactions with their present place of residence, and the reasons for these attitudes, as well as their wishes and desires, incipient trends in the housing market can be discerned, although they cannot be precisely forecast. Asking people what they need and want differs considerably from a forecasting approach which assumes that the rational consumer is intent on minimizing his commuting time and costs, maximizing the amount of space he obtains per dollar of housing outlay, and the like. However, consumer surveys focus on the demand side of the market. Changes in buying patterns which originate on the supply side, for instance in a major improvement of the product, often may not be anticipated by consumers. The recent boom in apartment demand, for example, was not foreshadowed by a shift in consumer preferences.

The Moving Decision. —The frequency with which urban families move from one house to another is in large part responsible for the fluidity of residential location patterns. The importance of the moving decision is apparent in Table 3, which indicates that over one-half of metropolitan area families think they will or may move during the next 5 years. That these plans are not unrealistic is indicated by the finding that among the group of metropolitan area families studied, 52 percent moved during the past 5 years. The potentially mobile group is about as large now in relation to the total population (according to Survey Research Center measurements) as it has been throughout the past 10 years. Moving plans are particularly frequent among young families and among those renting their present house or apartment. Because of the concentration of renters in higher-density areas, moving plans are much more com-

TABLE 3

PLANS TO MOVE DURING THE NEXT 5 YEARS[a]

Family Characteristic	Distribution of Respondents (%)		No. of Cases
	Plans to Move in Next 5 Yr	No Plans to Move	
All	54	46	824
Age:			
Under 35	77	23	221
35 - 64	50	50	463
65 and over	28	72	129
Owns or pays rent:			
Pays rent	82	18	282
Owns or is buying	40	60	524

[a]The questions were: "Do you think there is any chance you will move in the next twelve months?" "Do you think there is any chance you will move to a new home in the next five years?"

TABLE 4

PRIMARY FACTORS IN THE MOVING DECISION

Factors	Moved in the Past 5 Yr (%)[a]	Plan to Move in the Next 5 Yr (%)[b]
Housing itself	32	31
Cost considerations	14	13
Nearness to place of work (including occupation changes)	13	23
Other locational considerations	18	3
Neighborhood considerations	22	9
Other	14	15
Not ascertained	—[c]	6
Total	—[d]	100

[a]The questions were: "All things considered, how do you feel now about the move—was it a good idea or a poor idea to move here?" "Why do you feel that way?" Figures based on answers given by 429 people.

[b]The question was: "If definitely will move in the next 5 yr, probably will, or may, what might make you move?" Figures based on answers given by 447 people.

[c]Less than 0.5 percent.

[d]More than 100 percent; two mentions were allowed and the results summed.

mon among people in areas of medium or high density than among residents of low-density areas. Moving plans vary little by income, but increase in frequency with education.

The crucial role of the house (or apartment) when it comes to the moving decision is apparent in Table 4 which indicates that, when evaluating the success of their most recent move, about half of all movers evaluated it in terms of the housing they obtained and the money they had to spend for the purpose. Yet suitable housing at the right price often is available at a number of alternative locations. Hence, many other people judged their most recent move by referring to neighborhood and location factors. In a 1950 study, when recent home buyers were asked what kind of a place they were looking for when they first started out to find a house, they mentioned locational preferences more frequently than any other feature of the house (3). The same picture emerges from the responses of people who said they would or might move during the next 5 yr. This group was asked why they were thinking of moving. Again locational and neighborhood reasons (including job changes) were mentioned with about the same frequency as house and cost-related reasons. Major decisions are often motivated by more than one consideration. In the case of housing, the desire for more space, for example, may lead to a moving decision more readily if a wish to live in a different kind of neighborhood is also present. It may be more fruitful, therefore, to visualize housing reasons and locational reasons for moving as mutually reinforcing, rather than to speculate which one, by itself, is the more important motivating force.

That the majority of moves occurring in metropolitan areas are upgrading moves is indicated by the considerable preponderance of recent movers who said they spent more on housing after the move (62 percent) over those who reported that they spent less (19 percent). On the other hand, upgrading need not imply more space. The overall increase in the number of rooms occupied by recent movers before and after the move is small.

Locational Preferences. —Frequent moves on the part of metropolitan area families may lead to a large-scale shift of population out of (or into) the center of the city, or they may imply that families merely "play musical chairs." This problem was approached by first asking people, "If you could do as you please, would you like to live closer to the center of (...metro area...) or farther from the center or just where you are?" Table 5 indicates that about 70 percent of people express satisfaction with their present location; among the remaining 30 percent the answer "farther out" is three times as frequent as the answer "we would like to live closer in." Similar results were obtained in earlier Survey Research Center surveys in 1961 and 1963. Thus, the finding that many people prefer to move farther out is confirmed by repeated measurements.

The contrary wish, to live closer to the downtown area, is most frequent among older people, families with incomes under $3,000, and people who do not engage in outdoor activities (a characteristic associated with advancing age and low income). The desire to live farther out is particularly pronounced among married couples with children; one-fourth of this group would like to live farther out. Significantly, the desire to live farther out does not diminish at all with the distance which people already live from the center of the metropolitan city. The desire to move farther out is not closely related to the population of the metropolitan area in which people now live. Of every size class studied, more people want to move farther out than want to move closer to the center of cities.

TABLE 5

LOCATIONAL PREFERENCE OF RESIDENTS OF METROPOLITAN AREAS

Characteristic	Would Prefer to Live[a]				No. of Cases
	Closer to Center of Metro Area (%)	Same Distance (%)	Farther Out (%)	N. A.	
All	7	71	21	1	824
Income:					
Less than $3,000	10	72	18	—[b]	131
$3,000 - 7,499	6	72	22	—[b]	336
$7,500 and over	7	72	21	—[b]	340
Age of family head:					
Under 35	9	62	29	—[b]	221
35 - 64	5	75	20	—[b]	463
65 and over	11	75	12	2	129
Life cycle:					
Single	9	76	13	2	175
Married without children	6	74	20	—[b]	236
Married with children	7	67	26	—[b]	382
Present distance (mi):					
0 - 3.9	5	72	22	1	254
4.0 - 7.9	5	73	22	—[b]	246
8.0 - 14.9	11	71	18	—[b]	189
15.0 and over	10	70	20	—[b]	135
City size:					
Population of 1,500,000 or more	10	65	25	—[b]	334
Population 350,000 - 1,499,999	6	74	20	—[b]	250
Population 350,000 or less	4	78	17	1	240
Attitude to neighborhood:					
Like very much	5	81	14	—[b]	472
Like moderately well	10	60	29	1	310
Dislike	18	42	40	—[b]	40

[a]The question: "If you could do as you please, would you like to live closer to the center of (...metro area...), or farther from the center, or just where you are?"
[b]Less than half of 1 percent.

Of particular interest is the proportion of the mobile population who would like to move farther out. Among those families who said they would move or might move within the metropolitan area during the next 5 years, about 40 percent reported that they planned to move farther out. This high proportion corresponds to recent experience. Among the group who moved within the metropolitan area during the past 5 years, as many as 42 percent reported that they moved farther out.

The desire to live farther out was usually explained in terms of physical characteristics such as getting away from noise, traffic, dirt, and crowding. As might be imagined, status considerations were hardly ever mentioned explicitly as a reason for wanting to live somewhere else. However, the lowest part of Table 5 indicates that the desire to move farther out or closer in is frequently associated with some dislike

TABLE 6

PREFERENCE FOR SUBURBAN VS COUNTRY LIVING[a]

Characteristic	Prefer			No. of Cases
	House in Suburbs (%)	House in Country (%)	Neither (%)	
All	52	45	3	824
Income:				
Under $3,000	70	26	4	131
$3,000 - 7,499	48	48	4	336
$7,500 and over	49	49	2	340
Age of family head:				
Under 35	42	57	1	221
35 - 64	53	45	2	463
65 and over	65	27	8	129
Family life cycle:				
Single	63	32	5	175
Married without children	47	49	4	236
Married with children	49	50	1	382
Distance from center of city:				
0 - 1.9 mi	54	39	7	119
2.0 - 3.9 mi	55	42	3	135
4.0 - 7.9 mi	52	46	2	246
8.0 - 14.9 mi	53	44	3	189
15.0 mi and over	43	56	1	135
Number of outdoor activities:				
None	51	43	6	51
1 - 3	55	42	3	499
4 - 5	48	49	3	210
6 or more	35	63	2	62

[a]The question was: "Suppose you had to choose between a house in the suburbs on a paved street with sidewalks and lawns, or a house in the country with woods, or a field between you and the next house—which would you choose?" Figures are based on answers given by residents of metropolitan areas.

of one's present neighborhood. The major reason for wanting to live closer to downtown or for expressing satisfaction with one's present location is closeness to stores, schools, and sometimes work.

To determine how strong the attraction of the out-of-doors and of a more rustic life is to residents of metropolitan areas, a more extreme question was put to respondents: "Suppose you had to choose between a house in the suburbs on a paved street with a sidewalk and lawns or a house in the country with woods or a field between you and the next house, which would you choose?" Fully 45 percent of metropolitan area residents expressed a preference for the house in the country. As Table 6 indicates, the proportion of people who prefer living in the country is below 40 percent only for the group with income below $3,000, those over 65 years old, and single people. By contrast, 57 percent of people under 35 and 50 percent of couples with children prefer to live in the country. This is indeed a remarkable finding considering that the question specified a very rural setting for the house in the country, "with woods or a field between you and the next house." Needless to say, these answers reflect wishes or aspirations, rather than concrete plans to be realized in the near future. Yet they seem to be indicative of a widespread liking for outdoor and informal living, and more importantly, of a continued movement toward less urbanized locations among our highly mobile metropolitan population.

The desire for space and pleasing nonurban surroundings also is evident in homeowners' attitudes toward the size of their lot. Generally, the majority of homeowners are satisfied with the size of their lot. Yet among the very large group with lots of less than 0.2 acre, 35 percent would like to have a larger lot; and in the group with 0.2 to 0.3 acre, a larger lot is desired by 20 percent. "We want space for outdoor activities" and "we want more privacy" are the most common explanations given by people who find their lot too small. Only among those with 0.3 acre or more is the group saying "too large" more numerous than the group saying "too small." The feeling that the lot is too large is almost always associated with complaints about maintenance work. The answer that the lot is too small is somewhat more frequent among homeowners with older and cheaper houses than among others, but does not vary systematically by distance from the center of the city.

Attitudes Toward the Neighborhood. —What makes people like or dislike their neighborhoods? This question can be examined in two ways: (a) by asking people directly or indirectly to express their likes and dislikes about the neighborhood in which they live; or (b) by studying the factors associated with favorable and unfavorable attitudes toward the neighborhood.

With the first approach, people were asked, "What are the things you like about this neighborhood?" and "What are the things you dislike about this neighborhood?" Finally, an indirect question was asked in the belief that sensitive matters such as status considerations and attitudes toward minority groups could be elicited more readily by an impersonal approach: "Let's imagine that Mr. and Mrs. Smith were looking for a new home. They found a place they liked but they decided not to take it because they didn't like the neighborhood. What do you think they didn't like about the neighborhood?" The answers to this series of questions show that three considerations play an important role in the evaluation of neighborhoods: the kinds of people who live there; physical characteristics such as cleanliness, noise, traffic, and crowding; and convenience of location, particularly closeness to stores, schools, and work. Nice neighbors were mentioned with considerable frequency as a favorable factor in the present neighborhood. As expected, references to undesirable people appeared primarily in response to the Mr. and Mrs. Smith question.

After the various expressed attitudes toward the neighborhood had been recorded, the discussion was summed up by asking, "All in all, would you say you like this neighborhood very much, like it moderately well, or dislike it?" In reply, 57 percent of people expressed unqualified liking for their neighborhood, 38 percent said they liked it only moderately well, and 5 percent stated flatly that they disliked it. Most commonly in response to survey questions, a majority of people express satisfaction with their standard of living, their possessions, and even their occupational progress. In this perspective, the group who said they like their neighborhood does not appear impressively large. Table 7 compares likes and dislikes about the neighborhood for people who expressed unqualified approval of their present neighborhood and those who liked it only moderately well or disliked it. It appears that feelings about the kind of people living in a neighborhood and the physical characteristics of the neighborhood are more influential in determining overall attitudes toward the neighborhood than is convenience of location.

TABLE 7

FACTORS INFLUENCING LIKES AND DISLIKES OF NEIGHBORHOOD

Comments	Attitude Toward Neighborhood[a]		
	Like Very Much (%)[b]	Like Moderately Well (%)[c]	Dislike (%)[d]
Favorable:			
Kinds of people living there	68	46	8
Physical characteristics (quiet, clean, no traffic, etc.)	61	41	5
Convenience of location	55	61	28
Unfavorable:			
Kinds of people living there	13	30	78
Physical characteristics (noise, dirt, traffic, etc.)	27	44	63
Inconvenience of location	13	16	30

[a]The questions were: "All in all, would you say you like this neighborhood very much, like it moderately well, or dislike it?" "What are the things that you like about this neighborhood?" "What are the things, if any, which you dislike about this neighborhood?" Figures based on answers given by residents of metropolitan areas.
[b]Based on 472 cases.
[c]Based on 310 cases.
[d]Based on 40 cases.

A comparison of the socio-economic and locational characteristics of people with different attitudes toward their neighborhood shows that people who like their

TABLE 8

FREQUENCY OF VISITING DOWNTOWN (FOR PURPOSES OTHER THAN WORK) BY ACTUAL DISTANCE FROM CENTER OF CITY[a]

Characteristic	Frequency Distribution of Visits Downtown(%)[b]				No. of Cases
	Never	Less Often than Once a Month	Once a Month-Several Times a Month	Once a Week or More Often	
All	17	35	29	19	705
Distance from Center					
0 - 1.9 miles	—[c]	—[c]	—[c]	—[c]	119
2.0 - 3.9 miles	9	30	31	30	135
4.0 - 7.9 miles	12	35	36	18	246
8.0 - 14.9 miles	22	37	25	16	189
15.0 miles and over	27	40	20	13	135
City Population					
1,500,000 or more	29	34	24	13	334
350,000 - 1,499,999	7	44	30	19	250
350,000 or less	12	20	31	37	240

[a]Purposes of visits were as follows: shopping, 75 percent; spectator events, 20 percent; eat out, 6 percent; use medical or dental facilities, 13 percent; visit friends and relatives, 6 percent; personal business (pay bills), 23 percent; sightseeing, 5 percent; other, 6 percent; and not ascertained, 11 percent. Total does not add to 100 percent because respondents were allowed more than one mention. These figures were based on 683 cases.
[b]The questions were: "How often do you or your family visit downtown (...metro area...) other than for work?" "For what purposes do you people go downtown?"
[c]These figures for the frequency of visiting downtown were omitted since this group lives virtually in the downtown area.

neighborhood only moderately well or dislike it have a tendency to live in older houses (and therefore in older neighborhoods), in areas of high and medium density, and very close (0 to 1.9 mi) to the center of the metropolitan area; that is, they reside in the older, more urbanized and congested locations. Young people also tend to be critical of their neighborhood, visualizing perhaps a better neighborhood to which they expect to move when they attain their full earning capacity. On the other hand, low and high income people do not differ significantly in satisfaction with their neighborhood.

It appears, therefore, that attitudes toward one's neighborhood depend largely on physical characteristics and on the kinds of people living in the neighborhood. The emphasis on people in some cases means concern about the proximity of minority groups, but often it seems to reflect social status considerations generally, which no doubt have an important bearing on locational preferences. One might go further and ask whether unfavorable comments about physical characteristics of the neighborhood such as noise, crowds, dirt, and traffic are merely an indirect way of expressing an aversion to the kinds of people living in the high-density neighborhoods. The widespread desire for rural surroundings (evident in Table 6), the popularity of outdoor recreation, and some dissatisfaction with small lots argue against this interpretation. Rather, it appears that people, and particularly young people with children, attach a positive value to closeness to the out-of-doors, open spaces, informal living, in addition to status considerations. Conversely, they dislike crowding, noise, and traffic as such. This distinction between status reasons for moving farther out and the desire for less urbanized surroundings is important for city planning. The findings of this study underline the importance of parks, recreation areas, open spaces, and careful segregation of land uses, if a physical environment pleasing to the resident is to be maintained or created closer to urban centers.

Convenience of Location. —Concern about "nice" people, social status, and physical characteristics of the neighborhood undoubtedly are forces which pull the population toward outlying locations. On the other hand, considerations of convenience should exert a pull in the opposite direction, toward the center of the metropolitan area. Indeed location theorists as well as builders emphasize that the feasible outward movement of population is limited by the time and costs involved in commuting long distances.

TABLE 9

DISTANCE TO WORK BY ACTUAL DISTANCE FROM CENTER OF CITY

Distance to Work	Distances of Home from Center of City (%)[a]						All (%)	No. of Cases
	0 - 1.9 Mi	2.0 - 3.9 Mi	4.0 - 5.9 Mi	6.0 - 9.9 Mi	10.0 - 14.9 Mi	15.0 Mi and Over		
0 - 1.9 mi	6	2	3	3	3	2	19	117
2.0 - 3.9 mi	4	3	4	2	3	3	19	112
4.0 - 5.9 mi	1	3	4	3	2	3	16	93
6.0 - 9.9 mi	2	5	3	5	3	2	20	117
10.0 - 14.9 mi	—[b]	2	3	2	4	2	13	76
15.0 mi and over	1	1	2	2	3	4	13	77
Total	14[c]	16[d]	19[e]	17[f]	18[g]	16[h]	100	592

[a]The question was: "How far is it from your home to (worker's) place of work?"
[b]Less than one-half of 1 percent. [c]Based on 83 cases. [d]Based on 97 cases.
[e]Based on 110 cases. [f]Based on 102 cases. [g]Based on 105 cases.
[h]Based on 95 cases.

An examination of the survey data suggests that the inward pull exerted by considerations of convenience may be weaker than is often supposed. We know that new schools are built to serve outlying areas, so that the wish to be close to schools will hardly deter people from moving farther out. The development of suburban shopping centers enables the suburban consumer to shop close to home. Table 8 indicates that half of all residents of metropolitan areas go downtown less often than once a month, other than for work. The frequency of downtown visits decreases with the distance people live from the center of the city. It also is lower for the very large metropolitan centers than for the smaller ones.

It remains, therefore, to ask how often the burden of a long journey to work will outweigh reasons for moving farther out. To gain some measure of the importance attached to closeness to work, people who moved during the past 5 years and are in the labor force were asked, "When you were looking for a new home, how important to you was it to live close to the place where you (or your husband) works?" Over 40 percent of recent movers answered flatly that this consideration was of no importance at all and another fourth of the movers said that it was only somewhat important. Married couples with children in particular tend to attach relatively little importance to the journey to work, perhaps because the advantages of suburban living for a family with children are foremost in their minds. The distribution of attitudes toward closeness to work by present distance and time to work shows that those to whom closeness to work was important did indeed settle closer to their place of work than other movers. Conversely, those to whom closeness to work made no difference now tend to live in outlying locations.

Yet it does not follow that people in outlying locations always or even predominately have longer journeys to work than those who live close to the downtown area. The decentralization of factories, shopping centers, branch banks, doctors' offices and other service establishments, and even occasionally the administrative offices of large corporations, means that the journey to work need not be a journey downtown and often is shorter than the journey downtown. Table 9 indicates a rather weak relationship between distance to work and distance to the center of the metropolitan area. A similar picture emerges from the experience of recent movers. The survey shows that 41 percent of recent movers located farther out, but only 25 percent had a longer trip to work after the move. In fact, although nearly twice as many families moved farther out as moved closer to the center, at least as many people reported that the time it takes to get to work was shortened by the most recent move as reported that it was lengthened. The time to get to work and the distance to work are by no means identical, as indicated in Table 10. It is possible to move to a location no closer to the place of work but more quickly accessible to it.

The conflicting forces influencing residential location require further study. On the basis of the present data, the centrifugal forces represented by status considerations and the widely prevailing preference for uncongested areas, space, quiet, and closeness to the out-of-doors appear powerful. They appear more powerful than the centripetal forces represented by the attraction of the downtown area for shopping, personal business and leisure time activities or the advantage of a shorter trip to work. If this interpretation of the data is correct, it follows that moving farther out will remain a major aspect of upgrading in the housing market.

TABLE 10

TIME TAKEN TO GET TO WORK BY DISTANCE TO WORK

Distance	Time Distribution (%)							No. of Cases
	<10 Min	10 - 14 Min	15 - 19 Min	20 - 29 Min	30 - 44 Min	45 Min and Over	N. A.[a]	
0 - 1.9 mi	64	23	9	1	1	—[b]	2	80
2.0 - 5.9 mi	12	37	37	11	1	1	1	189
6.0 - 9.9 mi	1	13	22	50	13	—[b]	1	108
10.0 - 14.9 mi	1	—[b]	16	38	37	7	1	71
15.0 mi and over	—[b]	—[b]	5	21	37	37	—[b]	71

[a]Not ascertained. [b]Less than half of 1 percent.

What kind of housing do people want? Associated with the desire to live farther out is a continuing preference for single- over multiple-family housing. Indeed, the study of Residential Location and Urban Mobility as well as other recent Survey Research Center data suggest that a further shift toward single-family housing may be in prospect. The recent upturn in the demand for apartments does not contradict this finding. In part, this increase in demand is occasioned by a more varied and attractive supply. Perhaps even more crucial are two other factors: (a) a change in the age distribution of the population resulting in an increase in the proportion of older people at the expense of the middle-age brackets, and (b) an improvement in the incomes of single-person families (especially widows) as a result of social security and pension funds, which enable them to maintain separate households (1).

About two-thirds of the population in metropolitan areas now live in single-family houses, but 83 percent would prefer to be in a one-family house. The group who would like to shift from a multiple-family unit to a single-family house comprises 20 percent of families residing in metropolitan areas, whereas the group wanting to make the opposite kind of move includes only 3 percent of families. Among the 20 percent of families who want to change to single-family housing, only about one-fifth have very low incomes which might stand in the way of their becoming homeowners. Most of them are in the middle and upper income brackets, are married, and in the lower and middle-age brackets so that home ownership appears to be a realistic aspiration. Undoubtedly, many of them are living in apartments temporarily during the early years of marriage or as a result of having moved into the metropolitan area recently from another city or town.

Table 11 compares the present housing status of potential movers with (a) their preferred housing status and (b) the kind of housing they plan to move into. Again, a shift toward single-family houses is indicated.

The large majority of those who said they prefer single-family houses spoke of privacy or of getting away from the noise and closeness of apartment house living. The major attraction of apartments in the eyes of consumers is that they are more convenient, easier to maintain, and cheaper. The advantage of being close to people was mentioned by one in six of those preferring apartments.

Although in the metropolitan population as a whole only 16 percent of people prefer living in an apartment, this proportion is considerably higher among certain subgroups: 24 percent of people under 25 years of age and 30 percent of those over 65 prefer apartments. Similarly, 40 percent of single people and 36 percent of those with incomes under $3,000 would choose an apartment, "If they could do as they please." Although these proportions are sizable, even among these groups the majority would like to live in a single-family house.

The widely prevailing preference for single-family housing is, of course, partly responsible for the movement to the suburbs. Among those who want to move farther out only about 7 percent said they would like to live in an apartment. The smaller group who want to live closer to the center showed somewhat more liking for apartments: they preferred them in 26 percent of cases. Yet in over 70 percent of cases even those who want to live closer to the center would like to live in a single-family house. This finding points up one of the difficulties of achieving a return movement of population to the central areas of our large cities.

TABLE 11

PRESENT, PREFERRED, AND PLANNED TYPE OF HOUSING[a]

Type	Presently Occupied (%)[b]	Preferred (%)[b]	Planned (%)[b]
Single-family house	54	84	68
Multiple-family dwellings	43	14	24
Other	3	1	3
N. A.	—[c]	1	5

[a]Includes those who plan to move within the metropolitan area during the next 5 yr. The questions were: "If you could do as you please, would you live in a single family house, or an apartment house, or what?" "Would you be more likely to move to a single family house, an apartment, or what?"
[b]Based on 331 cases.
[c]Less than one-half of 1 percent.

Desire for Vacation Home. —The liking for the out-of-doors also manifests itself in aspirations to own a vacation home. At present somewhat over 5 percent of all metropolitan area families have a vacation home or cottage; this proportion is

TABLE 12

PRESENT OWNERSHIP OF AND DESIRE FOR VACATION HOME[a]

Income	Owns 2 Homes (%)	Has Considered — Good or Fair Chance of Achievement (%)	Has Considered — 50 - 50 Chance of Achievement (%)	Not Likely (%)	No. of Cases
All	8	10	4	78	824
Less than $3,000	5	6	1	88	131
$3,000 - $7,499	7	6	4	83	336
$7,500 and over	11	16	5	68	340

[a]Figures in table overstate proportion of people owning or hoping to own two homes, since some people understood question to include rental property. Thirty-four percent of those already owning 2 homes rent one of them all or part of the year. Eleven percent of those hoping to own 2 homes want the second for rental property. The questions were: "Do you own two homes, such as a house and an apartment, a winter home and a vacation home or something like that?" "Have you ever thought you might like two homes?" "What do you think the chances are that you actually will set up an arrangement like that?"

higher among upper income families. In reply to the question "Have you ever thought that you might like two homes?" more than half of all families replied that they would like a vacation home. Most of the families who expressed a desire for a vacation home did not believe that they would be able to realize this wish; about 10 percent of metropolitan families thought there was a good or fair chance that they would be able to buy a vacation cottage or house in the future (Table 12). The growth of two-car ownership was foreshadowed by similar expressions of wishes and aspirations by consumers. If incomes continue to rise, purchases of vacation cottages may well become a significant discretionary expenditure by consumers in the upper and upper-middle income brackets. They may also create new weekend commuting problems.

URBAN MOBILITY

One way of looking at the problems of urban mobility is to think of a three-stage sequence of decisions. People make decisions, first, concerning the location of their residences; second, concerning number of automobiles to own; and third, concerning number of trips to take and whether to make these trips by automobile or by common carrier. This report is organized in that sequence, i.e., following a typical sequence of the thinking of individual families rather than the logical sequences in the minds of those concerned with urban planning, who are well aware that people will not move to areas which are inaccessible.

Automobile Ownership

Table 13 gives the determinants of automobile ownership. How many miles a year the family drives its car is also indicated as a measure of the volume of transportation a family uses. In a sense, the number of miles per year may be regarded as an alternative dependent variable to the number of trips per day.

Density of neighborhood is associated with automobile ownership. Of those who live in high-density neighborhoods, only one-half own a car; of those who live in medium-density neighborhoods, two-thirds own a car; but of those who live in the low-density neighborhoods, 90 percent own a car. Even this finding considered in isolation shows that there is a connection between where people live and their use of transportation.

Previous work has shown differences in automobile ownership within the group of the largest metropolitan areas when these areas are classified into old cities and new

TABLE 13

DETERMINANTS OF AUTOMOBILE OWNERSHIP AND OF MEAN NUMBER OF MILES PER YEAR THE PRINCIPAL FAMILY CAR IS DRIVEN

Family Characteristic[a]	Car Owners (%)	Mean No. of Mi/Yr on First Car[b]	No. of Families Owning Cars	Total No. of Families
All	81	10,900	583	718
Density of neighborhood				
Very low	95	10,800	22	23
Low	90	11,000	391	434
Medium	66	10,400	61	92
High	52	11,300	56	93
Age and size of city[c]				
Central city of one of the 11 largest cities				
Old city	47	8,900	28	59
New city	71	10,500	39	55
Not the central city of one of the 11 largest cities	85	11,100	516	604
Income				
Less than $2,000	27	8,200	18	67
$ 2,000 - 2,999	46	6,000	23	50
$ 3,000 - 3,999	53	8,200	25	47
$ 4,000 - 4,999	84	8,800	43	51
$ 5,000 - 5,999	91	10,000	74	81
$ 6,000 - 7,499	90	10,500	97	108
$ 7,500 - 9,999	96	12,300	117	122
$10,000 - 14,999	96	12,200	111	115
$15,000 and over	100	12,500	66	66
Number of adults in family				
1	48	9,400	74	155
2	91	11,000	422	463
3	86	11,700	67	78
4 or more	91	12,400	20	22

[a] All parts of this table exclude families where a certain characteristic was not ascertained.

[b] Includes mileage for only one car if the family owns several.

[c] Old cities are those where the central city had a population over 500,000 as of 1900, including Baltimore, Boston, Chicago, St. Louis, and Philadelphia. New cities are those where the central city had a population under 500,000 as of 1900. They include Cleveland, Detroit, Los Angeles, Pittsburgh, San Francisco, and Washington, D. C. New York is excluded.

cities. Old cities are taken here as those in which the central city had a population of over 500,000 in 1900, and new cities as those in which that population was reached more recently. Roughly, the distinction is between cities which became large before and after the impact of the automobile on urban areas began to be felt. (In this connection see also the following analysis of Census data concerning the journey to work.) Among the eleven largest cities differences in automobile ownership do appear between the old and new cities, with 47 percent of families in old cities and 71 percent in new

TABLE 14

MEAN NUMBER OF EQUIVALENT VEHICLE-TRIPS IN THE LAST 24 HOURS[a]

Family Characteristic	Mean No. of Equivalent Veh-Trips[b]	No. of Families
All	5.2	822
Auto ownership		
No car	1.7	135
Own 1 car	4.5	384
Own 2	7.2	250
Own 3 or more	9.2	53
Density of neighborhood		
Very low	7.2	30
Low	5.7	495
Medium	4.3	112
High	3.4	101
Frontage of lot (ft)		
<30	3.0	7
30 - 39	5.0	30
40 - 49	5.0	33
50 - 59	5.6	101
60 - 69	5.9	101
70 - 79	5.6	44
80 - 89	5.0	37
90 - 99	6.6	15
100 - 124	6.3	85
125 - 149	7.3	16
150 and over	7.2	36
Size and age of city		
Central city of one of 11 largest cities		
Old cities	2.7	65
New cities	5.0	62
Not central city of one of 11 largest cities	5.4	695
Family income		
<$2,000	1.6	74
$ 2,000 - 2,999	2.8	56
$ 3,000 - 3,999	3.3	50
$ 4,000 - 4,999	4.2	59
$ 5,000 - 5,999	4.6	98
$ 6,000 - 7,499	5.5	129
$ 7,500 - 9,999	5.6	143
$10,000 - 14,999	7.4	125
$15,000 and over	8.3	72
Age of head		
18 - 24	4.7	73
25 - 34	5.4	148
35 - 44	5.9	213
45 - 54	6.9	142
55 - 64	4.9	107
65 - 74	2.6	88
75 and over	2.1	40
Number of adults		
1	2.5	161
2	5.4	543
3	7.0	94
4 or more	9.7	24

[a]Means based on trip report for the family.
[b]For travel by auto, vehicle-trips have the usual meaning. For travel by common carrier, if two or more members of family travel together on same trip, it is considered one equivalent vehicle-trip.

new cities owning automobiles. The level of automobile ownership is highest in the smaller metropolitan areas, where it reaches 85 percent. There also appear to be differences in the number of miles per year cars are driven, which accentuate the differences in ownership.

The effect of income on automobile ownership is confined to people at the lower end of the income distribution. Of families with incomes of $5,000 a year and above, 90 percent or more own a car in the metropolitan areas studied. There are differences in automobile ownership among income groups below that level, however. Only about one family in four owns a car in the income group below $2,000.

The mean number of miles per year which the first car is driven does increase with the income of the family. It is approximately 8,000 mi a year up to the middle of the income distribution, but rises to 12,000 mi for those with incomes in the range beyond about 12,000 mi; presumably, people in the higher income groups drive more miles but buy second and third cars.

Families with two or more adults are about twice as likely to own a car as families with only one adult. This relationship supports the findings reported earlier than single adults tend to live in high-density areas and that those who live in such areas less often own cars.

Trip Generation

Trip generation rates are of basic importance in studies of urban transportation. Although much is known about these rates, additional knowledge about them can be useful. A limited set of calculations of trip generation rates is presented here with the objective of permitting comparison with other bodies of data and of providing an increment of new information.

The dependent variable selected for analysis is a variation on the familiar concept of vehicle-trips. A family's travel by auto is measured by counting vehicle-trips. When some members take a trip by common carrier, however, the vehicle-trip is not a sensible unit to consider. The problem was handled by considering as one equivalent vehicle-trip an excursion by common carrier which included one, two, or more members of the family interviewed. Walking to work is counted as taking a trip, following the conventional usage in urban transportation studies, but no other walking trips are counted. Some other investigators have worked with the count of trips as a dependent variable; we have used vehicle-trips in this simple analysis as closer to what transportation planners need to know.

TABLE 15

CHARACTERISTICS OF THE JOURNEY TO WORK BY CAR

Characteristics[a]	Journeys to Work (%)
Distribution of cars by number of occupants[b]	
One	90
Two	8
Three	1
Four	1
Five	— [c]
Length of time to get to work (min)[d]	
1 - 4	3
5 - 9	11
10 - 14	20
15 - 19	23
20 - 29	24
30 - 44	13
45 - 59	4
60 or more	2
Where workers park at work[e]	
On the street	15
On a lot	77
In a garage	3
Other places	5
Whether have ever estimated cost per day for journey by car[f]	
Have	27
Have not	73
Estimate of cost per day ($)[g]	
0.15 - 0.24	5
0.25 - 0.34	13
0.35 - 0.44	6
0.45 - 0.54	13
0.55 - 0.64	5
0.65 - 0.74	2
0.75 - 0.84	7
0.85 - 0.99	1
1.00 - 1.09	21
1.10 - 1.29	5
1.30 or over	22

[a] All parts of this table exclude those journeys to work where a particular characteristic was not ascertained.
[b] Based on 453 cars.
[c] Less than one half of 1 percent.
[d] Includes only the head's journey to work for his main job. If the head is not working, the journey to work of his wife or other relative is included. Based on 506 journeys to work. Median time = 18 min.
[e] Includes journeys to work by family members other than the head as well as journeys to work on second jobs by the head of the family. Based on 602 journeys to work.
[f] Includes only the head's journey to work for his main job. If the head is not working, the journey to work of his wife or other relative is included. Based on 510 journeys to work.
[g] Includes journeys to work by family members other than the head as well as journeys to work on second jobs by head of the family. Based on 135 journeys to work. Median cost/day = $0.84.

Table 14 indicates the determinants of the number of vehicle-trips per family. The analysis has been carried only to the stage of estimating two-way relationships between values of selected family characteristics and the mean number of equivalent vehicle-trips per day.

Families who own a single automobile take about 2.8 more vehicle-trips a day on the average than families owning no car. Interestingly, the mean number of vehicle-trips by families who own two cars is 2.7 per day higher than that for those who own only a single car. The third car seems to lead to an increment of only 2.0 trips per day. This last estimate, however, must be regarded as tentative in view of the small number of three car families in the sample. An increase in the number of vehicle-trips as the number of vehicles increases was expected.

Since the number of automobiles owned is associated with the number of trips generated per day per family, the variables known to be associated with automobile ownership should also be associated with trip generation. Between the high density neighborhoods (apartment house neighborhoods) and the very low density neighborhoods (single-family houses surrounded by vacant land), the average number of vehicle-trips per family doubles. If attention is restricted to single-family homes, the data also show evidence of a systematic increase in the number of vehicle-trips per family associated with increases in the frontage of the lot. Whether the density effect would persist with other variables held constant is not investigated here. Oi and Shuldiner (5) believe density has no effect after allowing for size of family and vehicle ownership.

The effect of size of city and age of city is also in the expected direction. The average number of vehicle-trips is 2.7 for the old cities but 5.0 for the new.

The overall mean of 5.2 vehicle-trips per family corresponds to the mean for families with incomes in the neighborhood of $6,000. Those with incomes below $2,000 take less than one-third that number of trips; in contrast, those with income over $15,000 average 8.3 vehicle-trips. These large differences among income groups are associated, of course, with differences in automobile ownership and location of place of residence.

Low vehicle-trip rates are characteristic of those aged over 65. The peak years are those when the head of the family is 45 to 54, no doubt because of the activities of adolescent children in the family.

TABLE 16

COST PER MILE OF THE JOURNEY TO WORK BY CAR

$ Per Mile[a]	Percent
Less than 0.05	14
0.05 - 0.099	33
0.10 - 0.149	21
0.15 - 0.199	11
0.20 or more	21

[a]Based on 132 estimates.

TABLE 17

ITEMS INCLUDED IN ESTIMATE OF COST OF JOURNEY TO WORK BY CAR[a]

Item	Percent
Gas, oil, grease only	50
Gas, oil, plus parking, tolls	3
Gas, oil, plus depreciation, repairs, wear and tear	25
Gas, oil, plus depreciation, repairs, wear and tear, plus license, insurance	6
Other items or combinations of items	16

[a]Based on estimates of 126 respondents.

The mean number of vehicle-trips rises in a regular manner with the number of adults. As a first approximation the data fit a pattern of an average of about 2.5 vehicle-trips per adult. Using a somewhat different set of definitions, Oi and Shuldiner also found that the number of persons in the family had a strong effect on the volume of trips.

Journey to Work

The journey to work receives much attention because it accounts for a large volume of travel and the trips to and from work create the rush-hour peaks of traffic. The central problem considered here is the problem of choice of mode. Descriptions of the characteristics of the journeys to work by car and by common carrier, respectively, are followed by a discussion of the statistical effect of different variables on whether a car or a common carrier is used to get to work.

Selected characteristics of the journey to work by car are summarized in Table 15. The large number of cars on the road at rush hour is in part the result of the fact that most cars (90 percent) contain only one occupant. The median length of time for the trip to work by car is 18 min. Two-thirds of the trips take between 10 min and one-half an hour. While at work, most people (77 percent) park in a lot; the next largest group (15 percent) park on the street. Only 8 percent pay to park at work.

The last two parts of Table 15 deal with the cost of going to work by car. Respondents were asked: "Have you people ever estimated how much it costs per day for (the worker in question) to drive (or ride) to work?" To this question, 73 percent of the answers were that they have never calculated this cost. Undoubtedly, some have no choice but to go by car once location has been decided. For others the convenience and flexibility of a car may outweigh any cost considerations by a sufficient margin so that exact estimates do not seem worth the trouble.

The costs quoted by people who do say they have estimated them have been converted into cost in dollars per mile (Table 16). Those who made cost estimates were asked what they included and the results are given in Table 17. Eight percent mentioned a fee or charge for parking. Thus, a majority mentioned only costs which vary dependent on the number of miles driven, but a substantial minority included depreciation and other costs which do not vary in proportion to the number of miles driven.

The main result of the series of questions asked about costs, therefore, is that many people do not seem to know what it costs to drive to work, except in the most general way. Those who do give cost estimates mention figures which vary widely. This wide variation may reflect to some degree differences in people's situations, especially differences in whether the cost of driving to work should include operating costs only or the total cost of owning and operating a vehicle whose principal use is to get someone to work.

TABLE 18

CHARACTERISTICS OF JOURNEY TO WORK BY COMMON CARRIER

Characteristic[a]	Journeys to Work (%)
Distance from worker's home to common carrier stop (mi)[b]	
Less than ¼	78
¼ up to ½	8
½ up to 1	6
1 - 2.9	3
3 - 4.9	—c
5 - 9.9	4
10 or over	1
Distance from common carrier stop to worker's place of work (mi)[d]	
Less than ¼	91
¼ up to ½	6
½ up to 1	2
1 - 2.9	1
Frequency of common carrier service on way to work[e]	
Every 1 - 3 min	2
Every 4 - 5 min	6
Every 6 - 9 min	6
Every 10 - 14 min	13
Every 15 - 19 min	15
Every 20 - 29 min	24
Every 30 min	22
Longer intervals	12
On way home[f]	
Every 1 - 3 min	2
Every 4 - 5 min	3
Every 6 - 9 min	5
Every 10 - 14 min	16
Every 15 - 19 min	15
Every 20 - 29 min	25
Every 30 min	21
Longer intervals	13
Whether journey to work by common carrier is comfortable for worker[g]	
Very comfortable	4
Comfortable	59
Comfortable part of the time; comfortable in some ways, not others	7
Uncomfortable	28
Very uncomfortable	2
Whether journey to work is comfortable by whether worker gets a seat[h]	
Usually gets a seat[i]	
Comfortable	74
Comfortable part of the time; comfortable in some ways	5
Uncomfortable	21
Sometimes stands; usually stands[j]	
Comfortable	24
Comfortable part of the time; comfortable in some ways	20
Uncomfortable	56

NOTES: (a) All parts of this table exclude those journeys to work where a particular characteristic was not ascertained. (b) Based on 224 journeys to work. (c) Less than one-half of one percent. (d) Based on 226 journeys to work. (e) Based on 216 journeys to work. (f) Based on 208 journeys to work. (g) The questions were: "Would you say the trip by (common carrier) is comfortable or uncomfortable for (worker)?" "Why do you say so?" Based on 212 journeys to work. (h) The questions were: "Once (worker) get on (common carrier), is (worker) usually able to gets a seat, or does (worker) have to stand?" (i) Based on 147 journeys to work. (j) Based on 41 journeys to work.

Characteristics of Journey to Work by Common Carrier. —Table 18 gives descriptive material regarding the trip to work by common carrier (rapid transit, bus, or suburban railroad). People who use a common carrier part of the time are included as well as those who always go to work by common carrier.

Most workers who travel to work by common carrier do not have to go far to catch the common carrier. About 78 percent of the workers live within a quarter mile of the stop or station. A few workers (5 percent) live more than 5 mi from the common carrier stop. These probably are people who live in suburbs and commute to work by train. At the other end of the trip to work, 91 percent of the workers can take the common carrier to within a quarter mile of their work place.

Both on the way to work and on the way home, common carrier service does not tend to be frequent. Few common carriers run more often than every 10 to 14 min; one-third run no more often than every 30 min at the time when people are leaving for work.

Although a majority of workers find the trip to work by common carrier comfortable, a substantial group (30 percent) find the trip uncomfortable. As Table 18 indicates, an important factor in determining comfort seems to be the availability of seats. People were asked if the worker usually gets a seat; of those who do, three out of four feel the trip is comfortable. Of those who do not get a seat, only one in four finds the trip comfortable.

Choice of Mode for Journey to Work. —This study was conducted only in metropolitan areas with a population of 50,000 or more. No doubt in most of these areas some sort of public transit system is available to the residents. Yet about 79 percent of all journeys to work in these areas are made by car, with the worker either driving or riding as a passenger. Only 9 percent of the workers use a common carrier exclusively for the trip to work.

The 1960 Census also included a question about the mode used on the journey to work. For all urban areas with a population of 2,500 or more, the distribution (including only those who go to work either by car or common carrier) was as follows:

Mode Used	Percent
Car	80
Railway, subway, elevated	6
Bus, street car	14

TABLE 19

PRINCIPAL MODE USED FOR JOURNEY TO WORK

Family Characteristic	Auto	Common Carrier	Both Auto and Common Carrier[a]	Other[b]	No. of Journeys to Work[c]
Who made the journey					
Head of family	83	7	7	3	557
Wife of head	71	14	11	4	151
Other relatives	68	15	15	2	73
Family income($)					
Under $3,000	50	32	13	5	39
3,000 - 3,999	47	39	7	7	28
4,000 - 4,999	79	7	10	4	53
5,000 - 5,999	78	7	10	5	96
6,000 - 7,499	87	5	6	2	131
7,500 - 9,999	80	8	9	3	166
10,000 - 14,999	84	5	10	1	179
15,000 and over	81	8	11	—[d]	94
Density of neighborhood					
Very low	91	—[d]	6	3	32
Low	86	4	9	1	504
Medium	67	16	12	5	115
High	54	27	13	6	82
Automobile ownership per adult					
No autos	17	56	17	10	71
More adults than autos	78	7	12	3	402
Adults equal to autos	94	1	3	2	295
Less adults than autos	100	—[d]	—[d]	—[d]	33
All	79	9	9	3	801

[a]Includes those who travel to work on some days by auto and some days by common carrier.
[b]Includes those who walk to work as well as those who go by taxi or by truck. Also includes 0.37 percent for whom the principal mode was not ascertained.
[c]Includes journeys to work by family members other than head as well as journeys to work on second jobs by head of family.
[d]Less than one half of 1 percent.

TABLE 20

CHOICE MADE BETWEEN AUTO AND COMMON CARRIER BY THOSE WHO HAVE A CHOICE

Characteristic[a]	Use Common Carrier Although Could Use Car	Use Car Although Could Use Common Carrier	No. of Journeys to Work
All	22	78	221
Frequency of common carrier service			
Every 1 - 10 min or more often	52	48	23
Every 10 - 14 min	60	40	20
Every 15 - 19 min	12	88	25
Every 20 - 29 min	21	79	42
Every 30 min	14	86	43
At longer intervals than every 30 min	18	82	22
Whether car or common carrier is faster[b]			
Car is faster	13	87	159
Common carrier is faster; car and common carrier are equal in speed	55	45	22
Whether car or common carrier is more convenient[c]			
Car is more convenient	12	88	156
Common carrier is more convenient; car and common carrier are equal in convenience	65	35	20
Whether car or common carrier is more expensive[d]			
Car more expensive	21	79	75
Car and common carrier cost same	26	74	49
Common carrier more expensive	4	96	45

[a]All parts of this table exclude those journeys to work where a particular characteristic was not ascertained.
[b]The questions were: "Would it take the same amount of time for (worker) to get to work either way, or is one way faster?" "Which way is faster?" "How much difference in time is there?"
[c]The question was: "How do they compare in convenience?"
[d]The questions were: "How does this trip by (common carrier) compare with going by car in terms of total cost? Do they cost the same or is one more expensive than the other?" "Which is more expensive?"

The estimate of 80 percent by car and 20 percent by common carrier does not refer to the same population of trips as those studied here. The present inquiry is not directed to all urban areas, but to all Standard Metropolitan Statistical Areas, exclusive of New York. The passage of 3½ years from the spring of 1960 to the fall of 1963 also may have made some difference. However, the survey results are reasonably close to the Census. If anything, the survey has too few journeys to work by common carrier.

The point of interest here, however, is not the average proportion who go to work by car, but the determinants of the choice between modes. Two populations of trips have been studied with this question in mind. Table 19 indicates determinants of the principal mode used on the journey to work disregarding whether or not the worker feels he has a choice of modes. Table 20 gives data only for those workers who feel that they do have a choice of transportation to work. More questions could be asked in those interviews where a choice existed in the opinion of the person interviewed.

It would seem that the head of the family rates first priority with regard to using the car (Table 19). Eighty-three percent of the trips to work by family heads are made by car, compared to 71 percent of the trips made by wives and 68 percent of the trips by other relatives. This drop in the use of the car is accompanied by corresponding increases both in the use of common carriers and a combination of car and common carrier.

Income has a strong effect on the choice of mode up to the middle of the range. In the income groups under $4,000, about 40 to 49 percent go to work by car alone whereas about one-third depend on the common carrier for transportation to work. In the income group $10,000 to $14,999, 84 percent of the workers go by car, and only 8 percent rely on the common carrier. People in the lower income groups are less likely to own a car than those in the upper income groups, and less likely to live in the suburbs, so it is not surprising that the former depend more on public transportation.

Age is also related to the mode used. With advancing age the car is used less and the common carrier more, pointing to a reluctance or inability on the part of older people to withstand the strain of rush-hour driving. But even in the age group 65 or over, of those who are working two-thirds depend on the car to get to work.

Density of neighborhood has a strong effect on choice of mode. Of those living in neighborhoods of very low density, 91 percent go to work by car, and not even one-half of one percent by common carrier. In high density neighborhoods only 54 percent rely on the auto exclusively.

As mentioned earlier, car ownership is certain to affect choice of mode for the journey to work. Table 19 indicates the relation between auto ownership and choice of mode. In families with no car, 17 percent ride to work as passengers in other people's cars. In families with at least one car, the percentage of auto users jumps to 78 percent. Finally, in families with more cars than adults, everyone, not surprisingly, uses a car to get to work.

Of the population of journeys to work studied, in 28 percent the worker reported that he had a choice of mode. Where such a choice was reported, questions could be asked about alternatives (Table 20).

If the common carrier runs frequently, a majority of the workers choose it, but when the frequency of service drops to every 15 min or less often, the proportion who use the common carrier drops from 50 to 60 percent to the range of 12 to 21 percent. People on the way to work cannot or will not wait 15 min or more for the bus or train. Headway of more than 15 min may be associated with other deficiencies or disadvantages, of course.

If the common carrier equals or surpasses the car with regard to speed, convenience or price, the worker is more likely to choose the public transportation. Of the three considerations the most important is speed. If the car is thought to be the faster way to get to work, 87 percent choose the car, and only 13 percent the bus or train. But if the car is thought to be no faster or slower, 45 percent choose the car and 55 percent the common carrier. Most people find the automobile faster, and act accordingly.

There are also large differences in choice of mode between those who say the car is more convenient, of whom 88 percent go by car, and those who say the car is no more convenient than the common carrier, of whom only 35 percent go by car. Again, the group giving answers unfavorable to the automobile is small.

TABLE 21

COMPARISON OF WORK TRIPS BY AUTO IN LARGE CITIES, 1960 VS 1900

Largest Cities by Total Population, 1960[a]	Percent Going to Work by Auto, 1960	Largest Cities by Population of Central City, 1900	Percent Going to Work by Auto, 1960
New York	36	New York	36
Los Angeles	91	Chicago	63
Chicago	63	Philadelphia	67
Philadelphia	67	St. Louis	81
Detroit	86	Boston	70
San Francisco	79	Baltimore	77
Boston	70	Pittsburgh	76
Pittsburgh	76	Cleveland	75
St. Louis	81	San Francisco	79
Washington, D. C.	73	Detroit	86
Cleveland	75	Washington, D. C.	73
Baltimore	77	Los Angeles	91

[a]Largest Standard Metropolitan Statistical Areas as defined by Census of Population.

The effect of relative cost is less striking. People who say that the automobile is more expensive, still drive to work in the ratio of four to one.

More thorough analysis of the data would require simultaneous consideration in a single statistical calculation of all factors relevant to choice of mode. It is unlikely, however, that such a calculation would change the finding that choice of mode depends more on how long it takes to get to work by each mode than on which is more expensive.

The choice of means to get to work as it is presented to the individual worker depends on the characteristics of the city in which he lives. It has been shown previously that the effect of the age of the city can be traced in this survey in tabulations giving automobile ownership and vehicle-trips per family. The relation between age of the city and choice of mode for the journey to work is most easily shown by the use of the 1960 Census of Population. Tabulations are available on a city or metropolitan area basis.

In the first column of Table 21 cities are ranked by their total population in 1960. The percent who went to work by auto in 1960 is given in the second column. The rank order correlation is poor. New York is largest in population and has the lowest proportion of automobile users, but Los Angeles, the second largest city, has the highest proportion going to work by auto.

In the second part of Table 21 the same cities are ranked by population of the central city in 1900, before the advent of the automobile. The rank order correlation with the percent going to work by auto in 1960 is much better. Los Angeles, for example, drops to the end of the list. The percent going to work by auto does rise, with occasional exceptions, as one reads down the column.

These relationships may emphasize the general proposition that people's preferences as they exist at present are not the only determinants of their behavior. Their choices must be made in urban environments created by past decisions whose consequences will continue to be felt in the future.

PRINCIPAL FINDINGS

1. Residential locations may be described by density and distance from city center. The existing pattern of location is influenced, but by no means fully determined, by family income and by stage in the family like cycle.

2. About one-half of metropolitan area families moved during the past 5 years, and a similar proportion plan to move during the coming 5 years. A large proportion of potential movers would like to move to less urbanized locations, farther away from the center of the city into a more rural setting.

3. The number of people wanting to move from an apartment to a single-family house is much larger than the number interested in the opposite change. The recent boom in apartment demand reflects demographic and financial changes, but not a shift in consumer preferences.

4. There is a widespread desire for vacation cottages or vacation homes, and a significant proportion of families, particularly in the upper income brackets, believe that they will be able to realize this wish.

5. The number of vehicle-trips per family in a 24-hr period is associated with family income, occupation of the head, age of the head of the family, the size of the lot, the density of the neighborhood, and the age of the city.

6. Automobile ownership and the mean number of miles the principal family car is driven per annum depend on income and to some degree on distance from city center and the age of the city.

7. Choice of mode for the journey to work does not appear to be sensitive to cost. Most people never have estimated the cost of driving to work; those who have made estimates report widely varying costs per mile.

8. People overwhelmingly say they would prefer to go to work by car rather than by common carrier if the cost were the same and the time were also the same. A frequent complaint about common carriers is that they are crowded; however, people like the freedom of movement and the convenience of travel by car.

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