U.S. Department of Transportation
Federal Transit Administration

Public Transportation in the United States: Performance and Condition

Report to Congress

June 1992

Public Transportation in the United States:

Performance and Condition

The Secretary of Transportation's Report to the United States Congress

June 1992

Pursuant to 49 USC 308

United States Department of Transportation
Federal Transit Administration

THE SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

June 5, 1992

The Honorable Dan Quayle
President of the Senate
Washington, D. C. 20510

Dear Mr. President:

I am pleased to transmit the enclosed biennial report on the performance and condition of public mass transportation systems in the United States. It has been prepared in accordance with the requirements of 49 U.S.C. 308.

Sincerely,

Andrew H. Card, Jr.

Enclosure

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INTRODUCTION AND EXECUTIVE SUMMARY

> **(e)(1) The Secretary shall submit a report to Congress in January of each even-numbered year of estimates by the Secretary on the current performance and condition of public mass transportation systems with recommendations for necessary administrative or legislative changes.**
> **(2) In reporting to Congress under this subsection, the Secretary shall prepare a complete assessment of public transportation facilities in the United States. The Secretary shall also assess future needs for those facilities and estimate future capital requirements for 1-year, 5-year, and 10-year periods at specified levels of service.**
> (49 USC 308)

This report has been prepared to fulfill the statutory requirement cited above. It is the fifth biennial submission by the U.S. Department of Transportation and incorporates a number of changes in style and format from previous reports.

It consists of three chapters. Chapter One, entitled "A Profile of Public Transportation in the United States," provides a general overview largely from the perspective of the transit rider, or customer. Using the results of recently completed research, fresh efforts have been made in this chapter to identify and characterize current markets for public mass transportation. Chapter One draws the conclusion that, while mass transit patronage can now be described as reasonably stable in terms of the number of trips taken each year because the length of the average transit trip continues to increase year after year, the total amount of transit service consumed is increasing, thus permitting the conclusion that transit itself is growing.

"Transit Performance and Condition" is the title of the report's second chapter. It provides data and information to document how the cost of mass transportation has changed since the last Section 308 report was issued. New research has been used to explain why certain kinds of mass transportation services perform differently from other kinds; summary assessments of the physical condition of transit infrastructure are also provided.

The third and final chapter in the report addresses an issue that is called out in the legislative mandate of the Section 308 report, cited above: future capital investment needs for mass transportation seen in terms of different projected levels of mass transportation service.

Two hypothetical levels of service are proposed, and capital needs to sustain such services are presented. The first level assumes that public mass transportation in the United States continues its recent rate of growth. This increase in use translates into a modest expansion of mass transportation service. It is called "Maintain Condition and Performance." The annual capital investment, over a ten-year period, needed to sustain this level of service is $3.9 billion.

The second level assumes an increase in market share and a reduction in the backlog of transit investments. It is called "Improve Condition and Performance." Interestingly, while this hypothetical level of service does not represent a forecast in any technical sense, neither is it arbitrary. It is grounded in travel demand forecasts prepared by the Federal Highway Administration (FHWA), and used by that agency in the submission of its own biennial report to Congress on the condition and performance of the Nation's highway (and bridge) infrastructure, essentially a parallel document to this Section 308 report.

It is because of these FHWA forecasts that an expanded level of mass transportation in the United States begins to assume more than a purely hypothetical dimension. More transit may be necessary since FHWA has concluded that, for a variety of reasons ranging from the economic to the environmental, it will not be possible to build sufficient highways, particularly in urban and suburban areas, to meet projected travel needs over the next two decades.

Specifically, FHWA has concluded that it will be necessary to forego the construction of 34,000 lane miles of new highways over the next ten years. The mobility demands that made these lane miles necessary will have to be accommodated by such means as better traffic control strategies, some effort at staggering work hours, demand management techniques, and more use of mass transit.

This Section 308 report uses these foregone highway miles as a point of departure for the level of mass transit service it calls "Improve Condition and Performance." Before it is possible to move from maintaining condition and performance to improving it, a "backlog" of deferred capital investment must be addressed; to do so will require an annual capital investment over ten years of $1.8 billion. Following this, if 10 percent of the urban, suburban and rural travel needs for which the 34,000 foregone lane miles were thought to be needed are accommodated on new and expanded systems of mass transit, this will require an additional $1.8 billion in capital investment a year for ten years.

Summary of Annual Mass Transit Capital Investment Needs

1) maintain condition & performance.............$3.9 billion
   a. maintain current physical condition...(3.1 billion)
   b. maintain current growth trends........(0.8 billion)

2) improve condition & performance..............$3.6 billion
   a) eliminate backlog........................(1.8 billion)
   b) accommodate 10 percent of travel from foregone highway construction......(1.8 billion)

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3) total annual investment needs................$7.5 billion

Perhaps it is merely coincidental, but this relationship between Federal highway and Federal mass transit investment needs comes at a time when a major new reauthorization act has been passed for both Federal programs, highway and mass transit. This legislation opens the way for unparalleled flexibility, at the state and local level, to use highway and mass transit assistance in cross-modal ways.

In the spirit of this new legislation, both the Federal Transit Administration (FTA) and the FHWA have begun work to determine if, in future years, this report and the parallel highway report prepared by FHWA can be combined into a single surface transportation document. If this proves practical, and necessary legislative adjustments can be made, future editions of the Section 308 report may be as different from this one as this one is different from its predecessors.

CHAPTER 1: A PROFILE OF PUBLIC TRANSPORTATION IN THE UNITED STATES

This chapter provides information about the customers of mass transportation, the agencies providing mass transportation, the market for mass transportation, and the financial underpinnings of the overall mass transit enterprise.

FINDINGS

- The use of mass transit in the United States increased by 8 percent between 1980 and 1990.
- While there are almost 500 mass transit providers in U.S. urbanized areas, the ten most intensive transit systems, i.e., those which offer rapid rail as well as bus services, carry 71 percent of total U.S. transit patronage.
- The principal markets of mass transit service are:
  - General mobility for central city residents in all income strata.
  - Journeys to work in the central city; and
  - General mobility in all areas for people with little or no access to automobiles, often for reasons of low income.
- Mass transit in the United States is today a $20 billion per year enterprise.

THE MASS TRANSIT CUSTOMER

Between 1980 and 1990, passenger miles traveled on U.S. mass transit systems increased 8 percent. In aggregate terms, the average transit customer traveled a longer distance in 1990 than in 1980. The average trip length in 1980 was 4.4 miles and in 1990 it was 4.8 miles.

Urban transit patronage in 1990 amounted to approximately 8.0 billion individual transit trip segments ("unlinked trips"), or about 38 billion passenger miles. Based on survey data concerning transfers between transit vehicles (Chapter 2, Figure 2.12), it is estimated that the 8 billion unlinked transit trips translate into approximately 5.9 billion linked trips. In other words, about 47 percent of transit trips involve at least one vehicle change within the transit system. The proportion of "linked" to "unlinked" trips may have changed over time in systems that have become more complex. For example, to adjust to new rapid rail services, transit managers transform many bus routes into feeder services for rail stations, thus adding a transfer to a formerly one vehicle trip. However, because of market shifts and the general aversion of customers to transfers, it is not evident that in the aggregate there were more transfers in 1990 than in 1980.

Urban transit service was provided in at least 293 of the 373 urbanized areas in the Nation (as defined by the 1980 U.S. Census). As shown in Table 1.1, 90 percent of transit passenger miles occurred in the thirty urbanized areas that had a 1980 population over 1,000,000. By comparison, these thirty urbanized areas constituted 58 percent of the total U.S. urbanized area population. Rural and specialized service provided by a variety of agencies, most of them private, nonprofit organizations, amounted to another 0.2 billion annual rides.

Transit patronage in the United States has been relatively stable since 1980. It rose to 8.0 billion trips in 1980, but

Table 1.1

Transit Patronage by Urbanized Area Size, 1980, 1985, 1990

UNLINKED TRIPS

Urbanized Area Size	RAIL 1980	RAIL 1985	RAIL 1990	COMMUTER RAIL 1980	COMMUTER RAIL 1985	COMMUTER RAIL 1990	BUS 1980	BUS 1985	BUS 1990
New York	1,499	1,483	1,564	n/a	170	206	1,110	1,082	1,037
Other Areas Over 1m	650	860	1,009	n/a	105	122	3,552	3,263	3,072
500,000 to 1 million	3	5	7	n/a	0	0	438	418	389
200,000 to 500,000	3	5	1	n/a	0	0	319	309	319
50,000 to 200,000	1	4	1	n/a	0	0	192	229	236
TOTAL	2,156	2,355	2,582	n/a	275	328	5,611	5,301	5,053
TOTAL NOT INCLUDING COMMUTER RAIL							7,767	7,656	7,635
TOTAL INCLUDING COMMUTER RAIL							n/a	7,931	7,963

PASSENGER MILES

Urbanized Area Size	RAIL 1980	RAIL 1985	RAIL 1990	COMMUTER RAIL 1980	COMMUTER RAIL 1985	COMMUTER RAIL 1990	BUS 1980	BUS 1985	BUS 1990
New York	5,894	6,865	7,048	n/a	4,514	4,670	3,408	4,587	3,763
Other Areas Over 1m	3,457	4,226	5,241	n/a	2,019	2,412	12,611	11,526	11,026
500,000 to 1 million	9	27	31	n/a	0	0	2,051	1,741	1,720
200,000 to 500,000	14	27	1	n/a	0	0	1,028	1,137	1,198
50,000 to 200,000	6	26	2	n/a	0	0	638	810	859
TOTAL	9,381	11,171	12,323	n/a	6,534	7,081	19,738	19,802	18,564
TOTAL NOT INCLUDING COMMUTER RAIL							29,119	30,973	30,887
TOTAL INCLUDING COMMUTER RAIL								37,507	37,968

Source: FTA Staff Analysis of Section 15 Data economic recession resulted in a decline by 1982 to about 7.6 billion rides. Total patronage then rose to 7.9 billion in 1985 and 8.0 billion in 1990. Figure 1.1 displays this trend.

Even viewed over a longer term, the best way to characterize transit patronage today is by its stability. In the mid-1970's, spurred on by energy shocks and the influx of Federal, State and local capital and operating assistance, transit patronage ended a steady decline of 50 years' duration, a decline that was interrupted only when patronage increased as a result of restrictions on automobile production and use during the Second World War. Patronage throughout the 1980s was slightly elevated from the low levels of the mid-1970s in terms of the number of passengers carried. However, as noted earlier, since the length of the average transit trip has increased 8 percent over the decade, the actual utilization of mass transit is increasing.

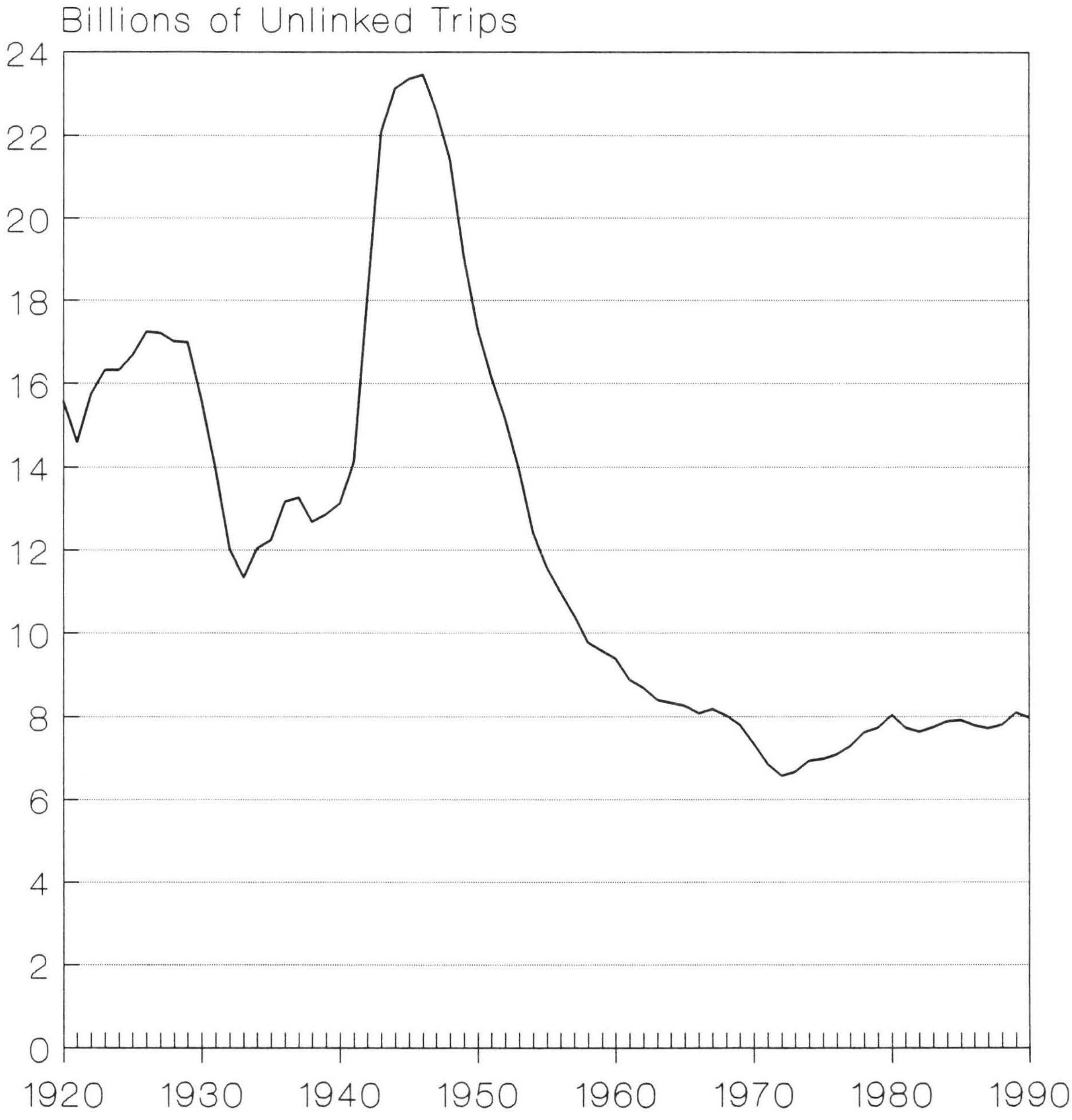
A PROFILE OF TRANSIT USE

Most of the information in this profile of transit utilization was provided by data from the Nationwide Personal Transportation Study (NPTS). The NPTS survey has been conducted every seven years since 1969 by the Department of Transportation. The latest NPTS, a computer-assisted telephone interview survey of 20,000 households and about 40,000 individuals, was conducted from March 1990 to March 1991.

According to the latest NPTS, 2.5 percent of all trips taken in the United States in 1990 were on public transit vehicles; 2.3 percent of all the miles people travelled in the

Figure 1.1

U.S. TRANSIT PATRONAGE
1920 TO 1990



SOURCE: ATA/APTA, TRANSIT FACT BOOKS
(1920-1979 DATA)
SECTION 15 (1980-1990 DATA)

United States in 1990 were aboard transit vehicles. To appreciate the transit share of "trips," it is useful to note that a "trip" is defined as any discrete link in an otherwise continuous journey. Driving home from work and stopping at the grocery store enroute constitutes two "trips;" running an errand from home involves as many "trips" as the errand requires stops, plus one more for the "trip" home.

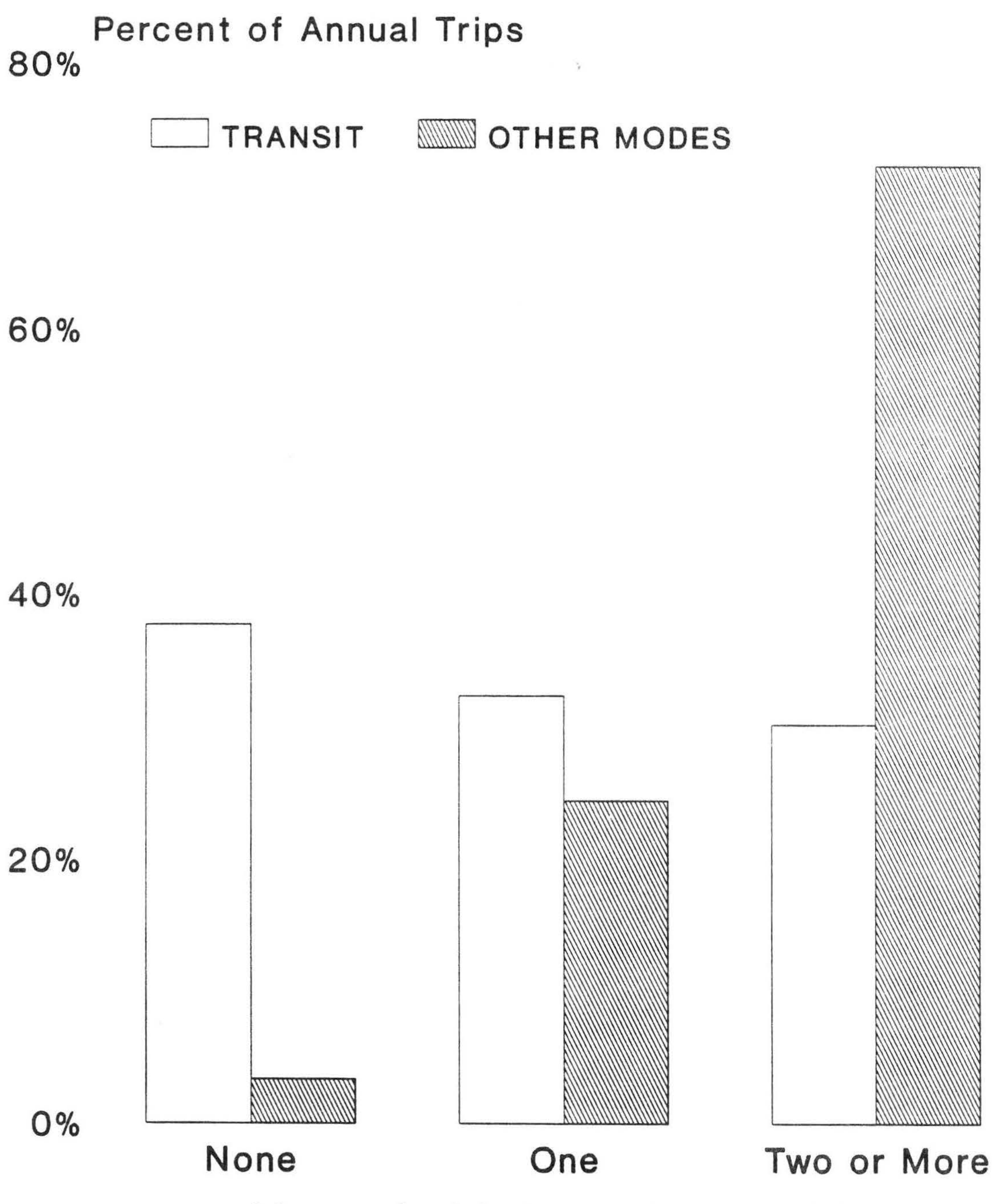
Figure 1.2 displays the relationship between automobile ownership, by household, and the use of mass transit. First, the chart clearly establishes that households that do not own automobiles rely on mass transit more heavily for trip making than those that do. Secondly, the overall utilization of mass transit is split rather evenly among the three categories of households cited, those that own no automobiles, those that own one auto, and those that own two or more autos. This suggests a base of support for mass transit that spread across a rather broad demographic spectrum.

Three Categories of Transit Customers

Most transit riders tend to fall into one of three basic groups. Two of the three groups reflect market conditions in which mass transit is a chosen mode: (1) residents of central cities served by transit systems intensive enough to compete with autos for general purpose mobility; (2) residents of central cities and suburbs for whom transit is the mode of choice for journeys to work, usually in the central city. The third group are those individuals who do not have access to automobiles, often for reasons of low income.

Figure 1.2

AUTO OWNERSHIP AND TRANSIT USE



SOURCE: NATIONWIDE PERSONAL TRANSPORTATION STUDY, 1990

As shown in Figure 1.3, 71 percent of transit trips in 1991 occurred in "transit intensive" areas (defined for this purpose as areas served in part by rapid rail systems). Of the transit trips in intensive areas, 41 percent are for nonwork trips by people with household incomes above the poverty level. Work trips account for 49 percent of transit use in transit intensive areas and 70 percent of transit use in other areas. Finally, 11.9 percent of all transit trips are nonwork trips made by persons from households with income near or below the poverty level. Thus, transit intensity, work trips, and limited access to automobiles, often for reasons of low income are the keys to who rides transit.

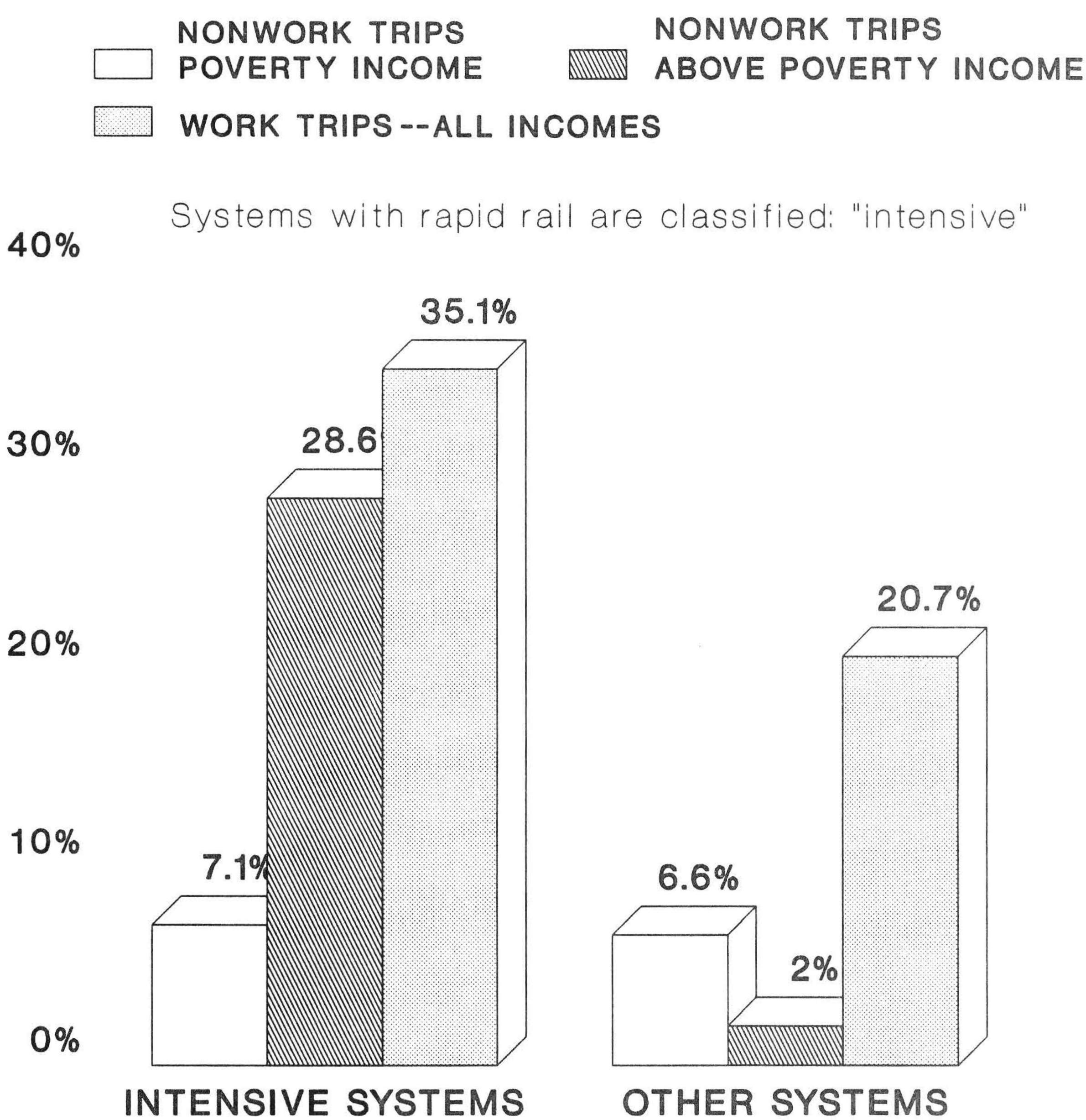
The patterns in Figure 1.4, "Income and Trip Purpose," reflect the above factors. The household income profile of people who commute to work on transit is similar to the income profile of all travelers. However, the household income profile of people who use transit for nonwork trips, i.e., for general mobility, is considerably lower than the public at large. This suggests that moderate to high income people tend to choose transit only under favorable conditions. For example, Figure 1.5 shows that perceived waiting time for transit service is inversely related to household income.

<u>Residence and Trip Purpose</u>

Central city residents make up the largest proportion of transit riders, 74 percent as compared to 26 percent suburban residents (see Figure 1.6). For central city residents who ride on transit, 45 percent of all trips are for journeys to work.

Figure 1.3

THREE TRANSIT MARKETS
INCOME, TRIP PURPOSE AND TRANSIT INTENSITY



FTA staff analysis of 1991 NPTS data.

Figure 1.4

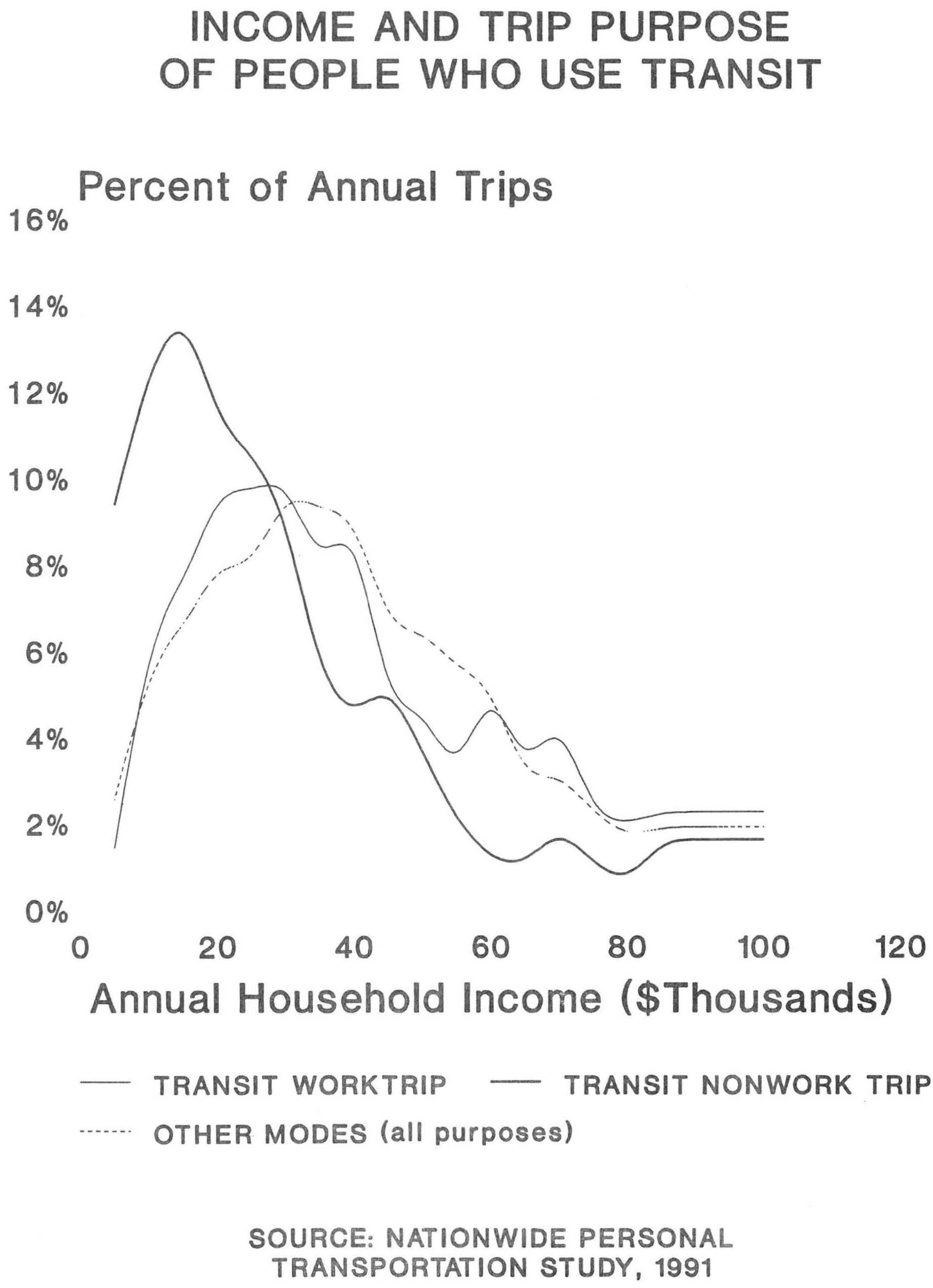
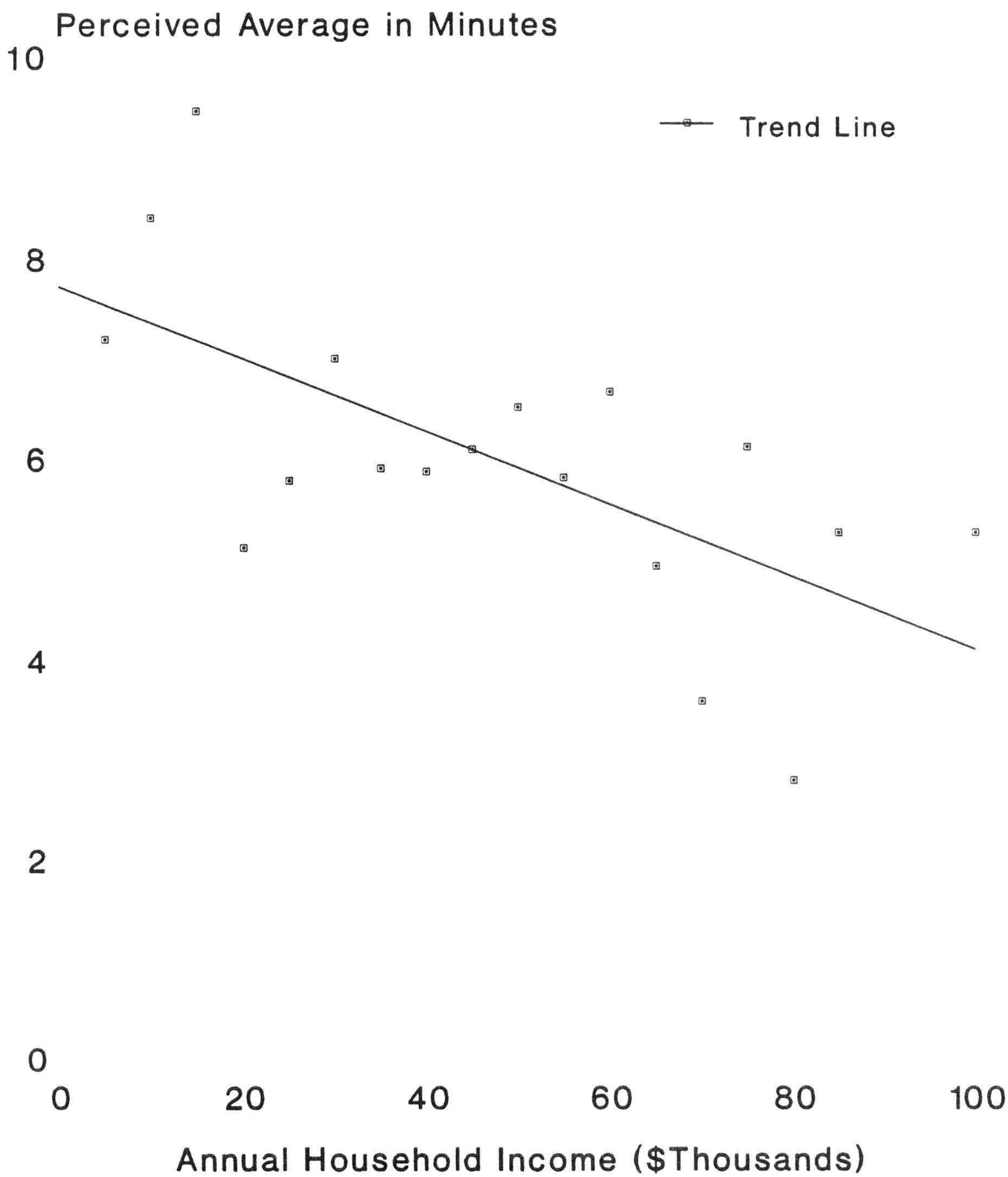

INCOME AND TRIP PURPOSE
OF PEOPLE WHO USE TRANSIT
Percent of Annual Trips
16%
14%
12%
10%
8%
6%
4%
2%
0%
0
20
40
60
80
100
120
Annual Household Income ($Thousands)
TRANSIT WORKTRIP
TRANSIT NONWORK TRIP
OTHER MODES (all purposes)
SOURCE: NATIONWIDE PERSONAL
TRANSPORTATION STUDY, 1991

Figure 1.5

INCOME AND WAITING FOR TRANSIT



SOURCE: NATIONWIDE PERSONAL TRANSPORTATION STUDY, 1990

TRANSIT TRIP PURPOSES:
SHARE OF TRANSIT TRIPS, 1990
Urbanized Area Residents

74 Percent — CENTRAL CITY

26 Percent — SUBURBAN

SOURCE: 1990 NATIONWIDE PERSONAL TRANSPORTATION STUDY

Figure 1.6

For suburban residents who ride on transit, 57 percent of annual trips are for journeys to work.

Gender, Age, and Race

In 1991, 53 percent of transit users were female and 47 percent male. Figure 1.7 shows the age profile of transit patronage in contrast to the age profile for users of other modes.

As illustrated in Figure 1.8, among transit users, people who identify themselves as "white" represent 44 percent of transit trips while they account for 78 percent of the population. "Black" survey respondents account for 33 percent of transit riders although they are 11.4 percent of the population; and Hispanic people account for 16 percent of transit patronage although they account for 7.5 percent of the population.

Time of Day

The importance of journey-to-work travel is reflected in the distribution of transit trips by time of day. As shown in Figure 1.9, the peak commuting hours of 6:00 to 9:00 a.m and 3:00 to 7:00 p.m. account for over 50 percent of daily transit trips. Such "peaking" of transit demand is a major influence on transit operating costs, as special work rules often exist that pay premium labor rates to provide drivers for the peak periods at either end of the workday.

Future submissions of the Section 308 report will expand this discussion and present further data and information about the transit customer. This will involve more detailed analysis of the 1991 NPTS data and other studies.

Figure 1.7

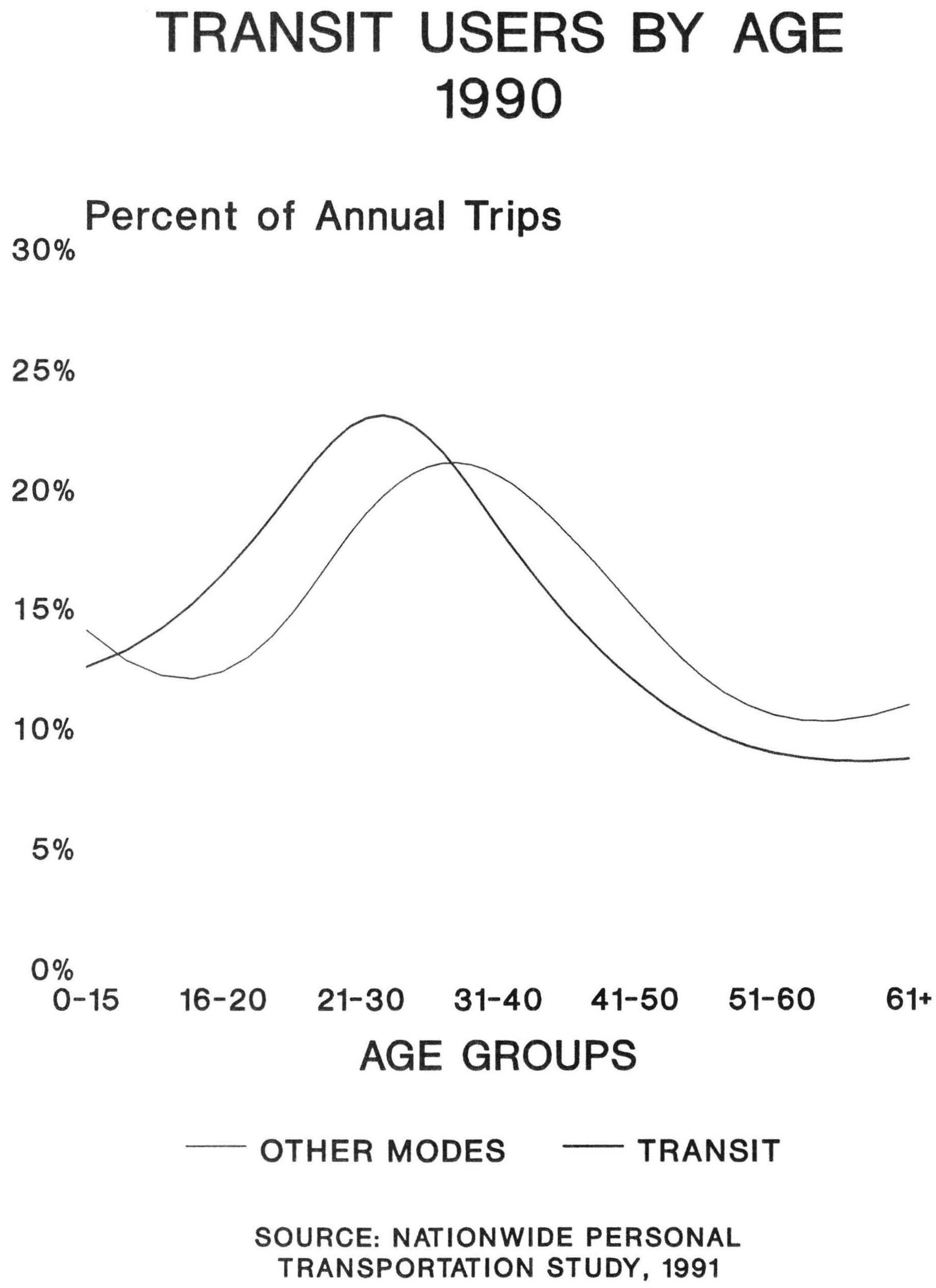
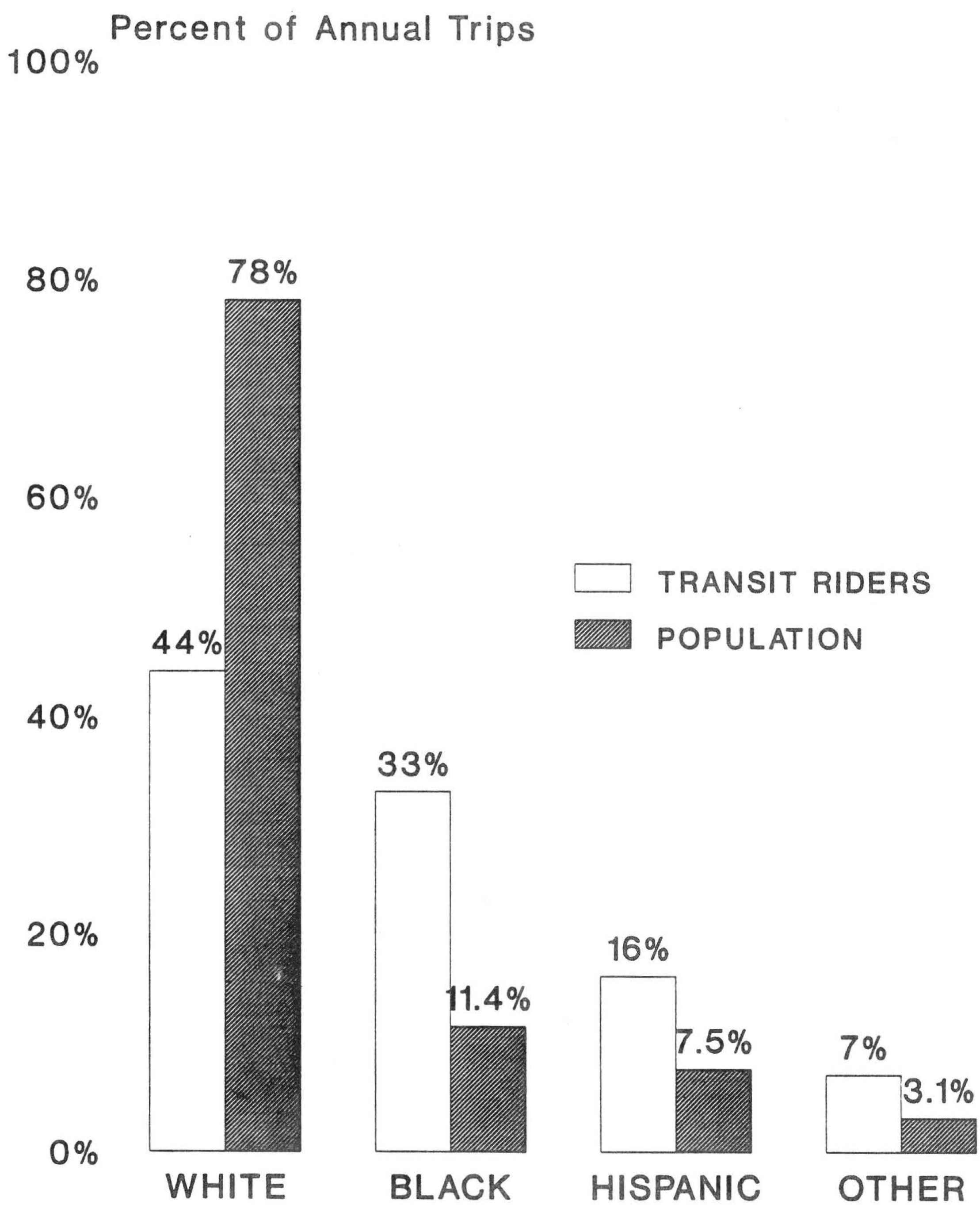

TRANSIT USERS BY AGE
1990
Percent of Annual Trips
30%
25%
20%
15%
10%
5%
0%
0-15
16-20
21-30
31-40
41-50
51-60
61+
AGE GROUPS
OTHER MODES
TRANSIT
SOURCE: NATIONWIDE PERSONAL
TRANSPORTATION STUDY, 1991

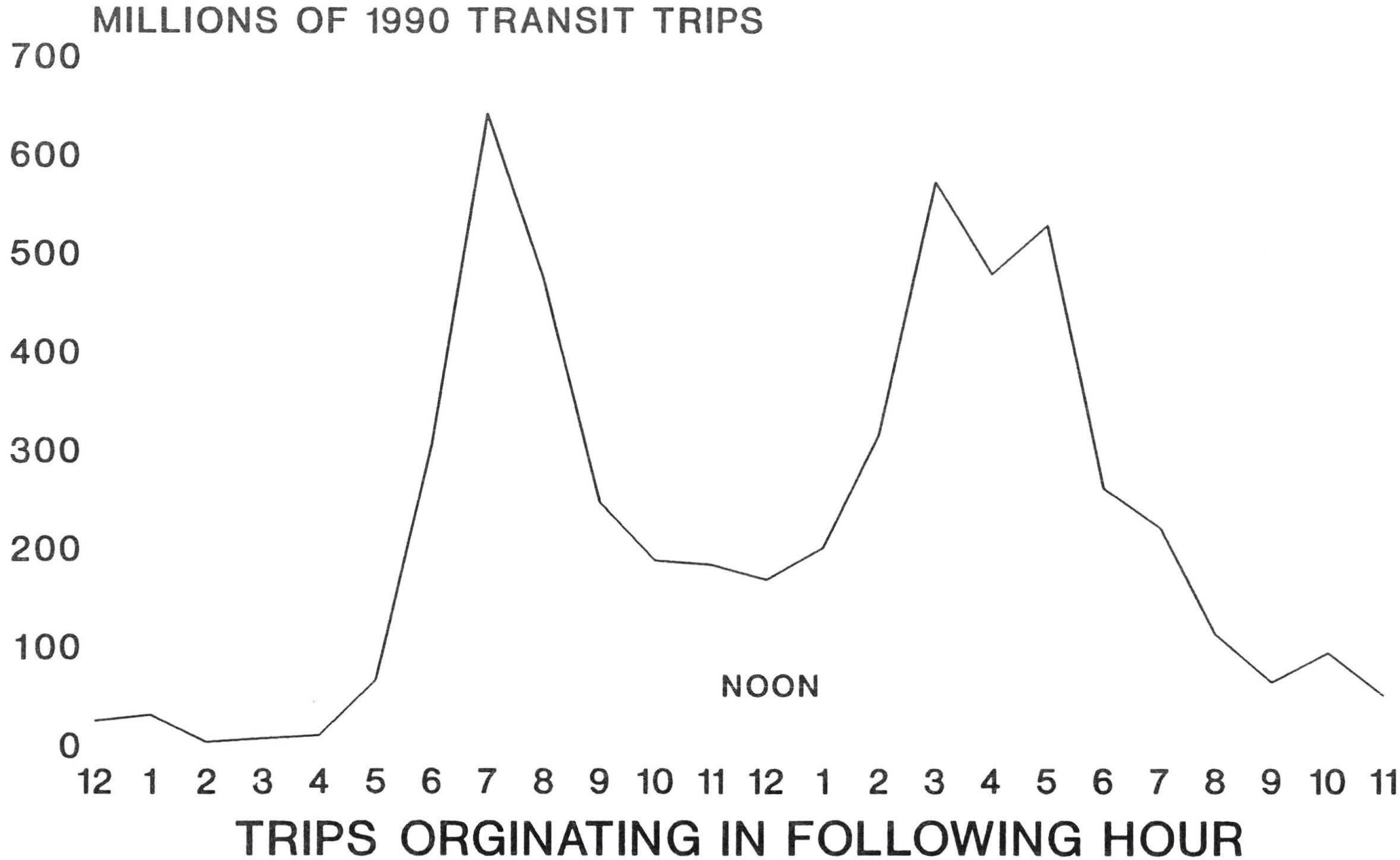
Figure 1.8

TRANSIT AND ETHNIC DIVERSITY



SOURCE: NATIONWIDE PERSONAL TRANSPORTATION STUDY, 1990

TRANSIT TRIPS BY TIME OF DAY 1990



SOURCE: NATIONWIDE PERSONAL TRANSPORTATION STUDY, 1990

MASS TRANSIT PROVIDERS

In areas with populations of 50,000 or more, FTA's annual statistical report on the mass transit industry based on submittals by recipients of Federal transit assistance ("the Section 15 report") identifies 498 providers of mass transit service. This figure can be misleading, however, since the greater proportion of mass transit customers ride aboard the vehicles of a relatively few transit systems, namely large ones that operate in and around larger cities.

For instance, 35 percent of transit passengers and 41 percent of passengers miles in 1990 were in the New York City area. As was mentioned earlier, 71 percent of transit trips in 1991 were in the ten cities which had rapid rail services (New York City, Boston, Philadelphia, San Francisco, Chicago, Washington, D.C., Cleveland, Atlanta, Baltimore, and Miami).

Transit Infrastructure

Table 1.2 displays the active transit fleet in 1990 according to FTA's Section 15 report as well as an inventory of rural and specialized operators developed by the Community Transportation Association of America (CTAA). In addition, Table 1.2 displays other major elements of the existing transit infrastructure.

SPECIALIZED AND RURAL MASS TRANSIT PROVIDERS

CTAA a nonprofit organization representing rural and specialized transit operators, has developed data on

Table 1.2

Mass Transit Active Vehicle Fleet and Infrastructure

VEHICLES

Buses	52,945
Subway Cars	10,325
Streetcars and Cablecars	940
Commuter Rail Cars	4,646
Commuter Rail Locomotives	472
Vans	2,412
Other (including ferryboats)	372
Rural Service Vehicles (primarily vans--public)	10,101
Vans for service to senior citizens and people with disabilities (not public)	20,970
TOTAL ACTIVE VEHICLES	103,183

INFRASTRUCTURE

Miles of rapid rail transit track	1,744
Rapid rail transit stations	911
Rapid rail transit maintenance facilities	43
Miles of light rail track	687
Light rail light maintenance facilities	18
Miles of commuter rail track	4,830
Commuter rail stations	958
Commuter rail light maintenance facilities	35
Ferryboat light maintenance facilities	4
Bus light maintenance facilities	523
Demand response service maintenance facilities	86

Sources: 1990 Section 15 data
Community Transportation Association of America

approximately 1,600 agencies receiving Federal funds under Section 18 of the Federal Transit Act. CTAA has used its inventory to make the following estimates [CTAA, 1989]:

- About 39 percent of the agencies providing rural transportation are private, nonprofit organizations; 56 percent are public agencies, and the remaining 5 percent are private, for-profit.
- The average rural program provider (under Section 18) has a fleet of 9 vehicles and provides 100,000 one-way trips annually.
- At least some rural transit service is provided in those nonmetropolitan counties which contain 64 percent of the nonmetropolitan population.
- The total cost of operation is approximately $270 million per year. Of this amount, 15 percent comes from riders, 25 percent from FTA, 38 percent from State and local subsidies, and the remainder (7 percent) from all other sources.
- Rural transit services provide a total of 110 million one-way trips per year.

CTAA has also developed an inventory of the 3,495 agencies which receive assistance under Section 16(b)(2) of the FT Act. These are private, nonprofit agencies which provide service to senior citizens and persons with disabilities:

- Thirty-seven percent of these agencies serve people with disabilities as their principal purpose. Thirty-five percent primarily serve senior citizens. The remainder include multipurpose agencies, nonprofit transportation providers and other social service providers.
- The agencies operate an average of six vehicles, 3.2 of which were purchased using Section 16(b)(2) funds.
- These private, nonprofit social service agencies provide over 100 million one-way trips per year.

THE MARKET FOR MASS TRANSIT IN THE United States

The Conditions For Effective Transit

The suburbanization and dispersal of both residential areas and work locations has been the dominant demographic theme in the United States for many decades. The growth in automobile ownership and use, driven as much by increasing household income as by the need for flexible, efficient and convenient regionwide personal mobility, has transformed urban America in the last half century and, in the process, "created" suburban America.

In the face of these developments, mass transit has witnessed declines in its share of most kinds of urban travel--despite success over the last 15 years in maintaining patronage in absolute numbers and experiencing increases in average trip length. Transit patronage has remained at approximately 8 billion per year for more than a decade after Federal, State and local intervention in the 1970's halted a patronage decline that began in the 1920's and had previously only been interrupted by the rationing of fuel and tires during World War II.

Conventional mass transit works most effectively in situations where densities are high. But while dense travel corridors show transit at its best, transit services generally perform poorly when deployed in low density areas. As will be discussed later in Chapter 2, routes designed for dense travel patterns in and near the central city tend to operate at much lower cost per passenger than routes that serve less dense travel patterns.

In the last four decades, the geographic profiles of cities have changed with the growth of a more automobile-centered lifestyle. The exodus of people out of central cities to the suburbs, on the one hand, and the regional shift to the South and Southwestern United States, on the other, have shifted the ground out from under many transit systems. This shift is reflected in decennial census data showing that job and population growth in central cities in the last 30 years have not kept up with overall population growth. But jobs and population in suburban areas have grown well in excess of overall population growth. The 1990 census is expected to show that a majority of metropolitan area jobs are now in the suburbs rather than in the central cities.

As these demographic changes have swept through urban areas since the 1920's, the transit industry has been transformed from a highly regulated semiprivate industry into a predominantly public service. An important result of this transition was transit's ability to meet the challenge posed by the changing profile of the markets it served. A key to the transition was to build an institutional structure and financial foundation to operate services which by nature are regionwide, serving not only passengers from different local jurisdictions, but serving the public interest and the governments of different, often competing, jurisdictions.

The shift of transit services involves not only new customers but also a new constituency. The new constituency is largely suburban residents who are not regular transit users but who, through their elected local and State representatives, recognize the indirect benefits they receive from transit services.

Expressed in constant 1990 dollars, State and local subsidies for transit operations over and above the transit fares paid by passengers increased from $29 million in 1965, to $567 million in 1970, to $2 billion in 1975, to $3.3 billion in 1980, to nearly $5 billion in 1984, to approximately $8 billion in 1990. This increase in financial support over many years is a reasonable measure of a perception that transit provides benefits to the community-at-large.

The interplay of transit markets and interjurisdictional finances plays itself out differently in specific U.S. cities. For example, in Manhattan, the hub of transit's largest commuter market, approximately 500,000 manufacturing jobs "disappeared" during the 1970's. Many of these jobs had been filled by people residing within the five boroughs of New York City, whose normal method of commuting was aboard city subway trains. During the same period, and continuing into the 1980's, growth in the white collar sector in Manhattan increased substantially. However, these new jobs were filled in large proportion by people residing in suburban locations whose principal mass transit link to Manhattan is commuter railroad service. Thus, subway patronage has been in decline in New York, but commuter rail (and express bus) travel into Manhattan from the suburbs has grown steadily.

Parallels between New York and other American cities on mass transit matters are often difficult to draw, but in this case the

New York experience represents a pattern that has been repeated, in one fashion or another, in many other places, although usually with bus service rather than rail: less transit riding on closer in routes, more riding on longer distance services.

Three Dominant Mass Transit Markets

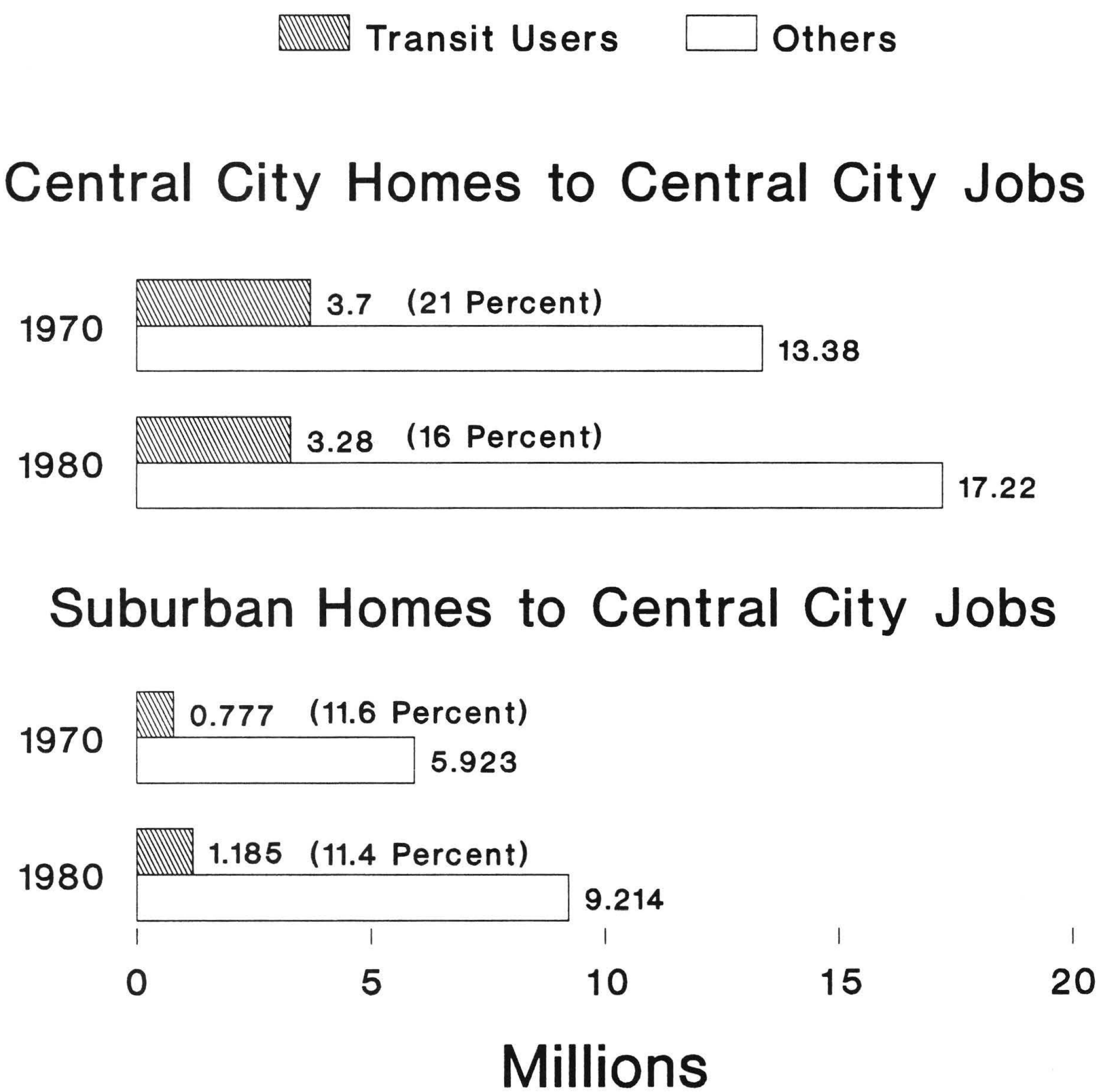
The three principal categories of transit riders identified above in discussing the transit customer can also be used to define three principal market for transit services:

- General mobility for residents of central cities with intensive transit systems;
- Journeys to work in the central city from both residential areas within central cities and the surrounding suburbs; and
- General mobility by people with limited or no access to automobiles, often for reasons of low income.

As depicted in Figure 1.10, from 1970 to 1980 (1990 census journey-to-work data will be available in mid-1992), the number of people commuting between suburban homes and central city jobs increased by approximately 53 percent while transit patronage increased by 50 percent in this market. This is the largest and most significant growth area in all of mass transit. Patronage growth in this suburb-to-central city market reflects increasing transit services in this market. This large growth in suburban transit services, which tend to require higher subsidies per passenger than local services (see Figure 2.10) expresses a willingness on the part of taxpayers to support expanded suburban mass transit service through their local and State governments. In some cases, e.g., Boston and Chicago, expanded suburban mass

Figure 1.10

TRANSIT USE FOR URBAN WORK TRIPS BY MARKET SEGMENT, 1970 AND 1980
(Daily Urbanized Area Commuters)



SOURCE: FTA Staff Analysis of Joint Cntr. for Pol. Studies, Demographic Change and Worktrip Travel, 1985.

transit service, while important and well patronized in and of itself, also has to be seen as part of an overall policy to secure new suburban tax support for central city transit services as well, services that can no longer be funded with central city resources alone.

Most major new transit investments involve downtown-oriented services largely for suburban markets. Not only commuter rail systems, which are being initiated or expanded in several major cities, but the new generation of "subways," (e.g., BART in San Francisco, METRO in Washington, D.C., and MARTA in Atlanta) serve the work travel of suburban residents. These are, in fact, regional rail systems that extend far into suburban areas. They more resemble commuter rail service than older central city subway operations in Boston, New York, Philadelphia, or Chicago.

As depicted in Figure 1.10, the other core of transit's traditional commuter market, general mobility for residents of central cities with intensive transit systems, declined from 21 percent of total worktrips in 1970 to 16 percent in 1980. This resulted from a combination of reduced central city services and receding demand due to increased auto ownership in central cities. As Figure 1.10 shows, journeys to work by modes other than transit increased by 28.7 percent from 1970 to 1980 in the central city to central city segment. The extension of new service to the suburbs in the 1970's may even have shifted resources from central city services, leading to some patronage loss on central city services.

THE FINANCIAL STRUCTURE OF MASS TRANSIT IN THE United States

Transit Costs and Revenues

In 1990, the cost to operate mass transit service in the United States was approximately $14.7 billion, compared to $13.8 billion the previous year. Capital expenditures by Federal, State and local governments in 1990 were reported as $4.3 billion; they were $3.6 billion in 1989. Adding capital and operating expenses in 1990 produces an overall mass transit expenditure of $19.0 billion. This means that mass transit represents approximately four tenths of one percent of the U.S. Gross National Product or 1.5 percent of the 1990 U.S. Budget.

Table 1.3 displays the sources of transit capital and operating revenue by urbanized area size. In total, fares and other revenue collected from direct transit customers amounting to $6.3 billion covered about 43 percent of operating costs in 1990, with State and local subsidies of $7.6 billion covering 52 percent and a Federal subsidy of $823 million covering 6 percent. These shares have shifted over time; Federal operating assistance began in 1975 and peaked in both dollar and percentage terms in 1980 ($1.1 billion, 17 percent). Since then the Federal share has declined at the rate of inflation, since the Federal amount has remained fixed at approximately $800 million.

Figure 1.11 illustrates the shifting mix among fares, state and local subsidies and Federal operating assistance since 1970. As is clear from this chart, the farebox contribution to total

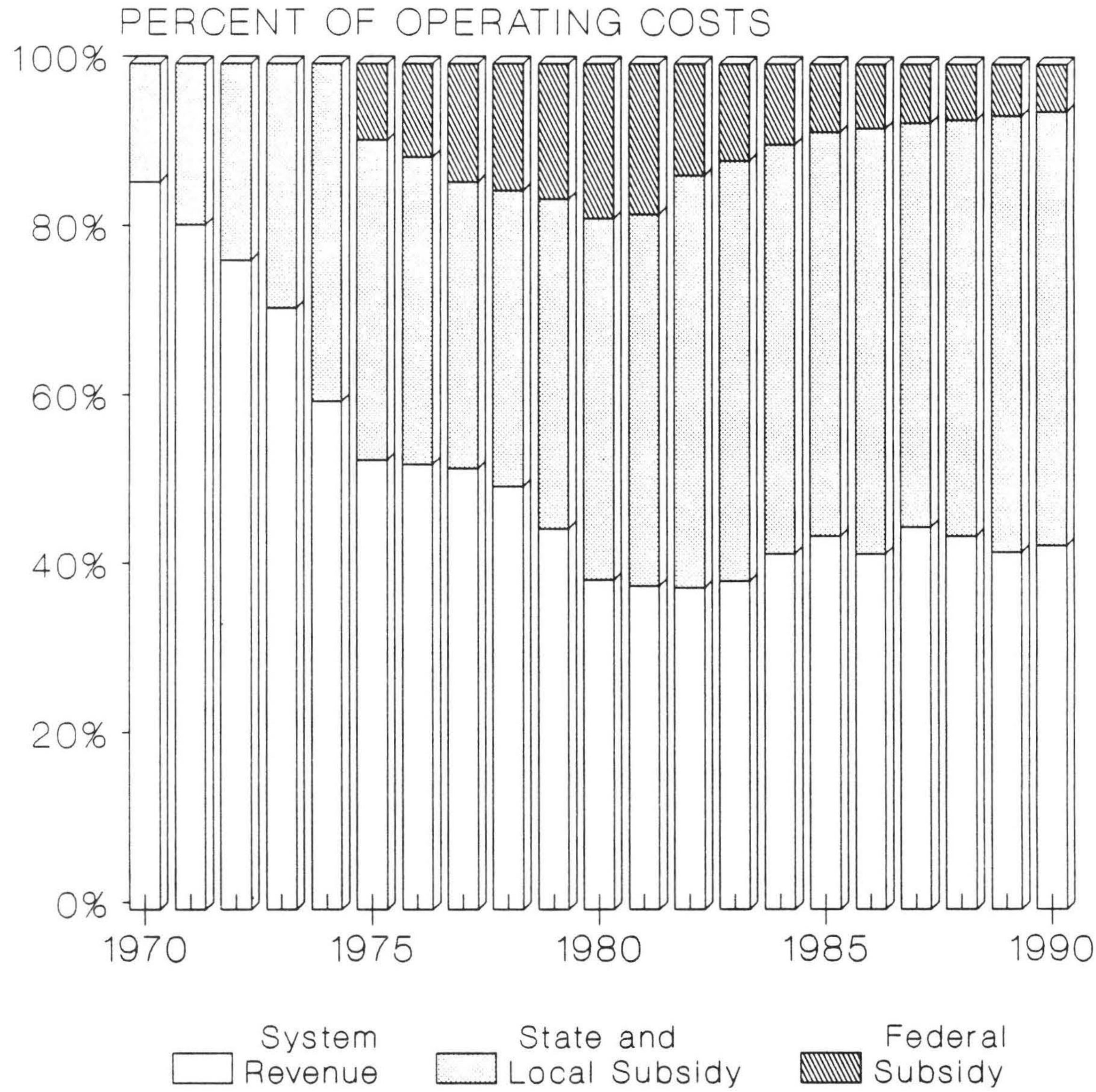
Table 1.3
TRANSIT OPERATING AND CAPITAL REVENUES BY SOURCE AND
URBANIZED AREA SIZE, 1990
(millions of dollars)

	Fares and Other System Revenues	Other Internal Revenues	Federal	State General	State Dedicated	Local General	Local Dedicated	TOTAL
OPERATING REVENUES								
New York	$2,967	$133	$149	$964	$182	$1,180	$151	$5,725
Other > 1 m	2,921	31	428	796	655	700	2,430	7,962
500,000 to 1m	209	0	82	68	19	135	163	675
200,000-500,000	120	1	77	49	34	70	104	454
50,000-200,000	103	2	89	58	33	46	86	418
TOTAL	$6,319	$166	$824	$1,935	$924	$2,132	$2,933	$15,234
CAPITAL REVENUES								
New York	$0	$0	$875	$114	$124	$198	$191	$1,502
Other > 1 m	0	0	1,533	85	286	124	512	2,540
500,000 to 1m	0	0	86	7	3	6	7	108
200,000-500,000	0	0	80	7	2	11	15	115
50,000-200,000	0	0	63	7	6	7	9	92
TOTAL	$0	$0	$2,637	$220	$421	$347	$733	$4,358
TOTAL REVENUES								
New York	$2,967	$133	$1,024	$1,078	$306	$1,378	$342	$7,226
Other > 1 m	2,921	31	1,961	880	941	825	2,942	10,502
500,000 to 1m	209	0	167	75	22	141	169	784
200,000-500,000	120	1	157	56	36	81	118	569
50,000-200,000	103	2	151	66	39	54	95	510
TOTAL	$6,319	$166	$3,461	$2,155	$1,345	$2,479	$3,666	$19,591

Source: FTA Staff Analysis of 1990 Section 15 Data

Figure 1.11

SOURCES OF TRANSIT OPERATING REVENUES 1970 TO 1990



SOURCE: APTA, TRANSIT FACT BOOK AND FTA SECTION 15 DATA operating revenues stabilized from 1980 to 1983 and has increased since then, reflecting fare increases during the 1980s. Nationally, aggregate real fare revenue per passenger mile increased by 38 percent between 1980 and 1990, from 11.8 cents to 16.2 cents.

State and local governments employ a wide variety of measures to fund transit capital costs. As displayed in Table 1.3, the total capital spending in 1990 of $4.36 billion was made up of $2.64 billion (60.5 percent) from the Federal government, $641 million from State governments (14.7 percent) and $1.08 billion from local sources (24.8 percent). The table also shows the split in State and local funding from general funds versus dedicated funds, by urbanized area size.

The Federal percent of total reported capital activity has been declining for some time, from a reported 78 percent in 1980 to the 60.5 percent reported in 1990. In fact, the total capital spending reported represents approximately $1.0 billion more than would be needed solely to match the Federal funding made available. This "overmatch" is the result of significant State and local commitments to restoring and expanding transit capital assets in a number of urbanized areas. Table 1.4 displays the sources of capital assistance at the 12 transit operators reporting the most capital funding in excess of the minimum amount needed to match Federal assistance. The first column shows the amount of Federal funds used by each operator in 1990. The second column shows the minimum amount of State and local funds required by the FT Act to match the Federal funds used.

Table 1.4

TRANSIT CAPITAL INVESTMENTS BY SOURCE
AT SELECTED TRANSIT OPERATORS, 1990
(millions of dollars)

	Federal	Minimum Req'd Match	State	Local	"Overmatch"
New York CTA	$590.3	$163.3	$ 70.7	$245.7	$153.1
New Jersey Transit	157.2	44.4	123.0	39.2	117.8
So. Calif. RTD	186.8	57.3	32.6	131.1	106.4
Baltimore - MTA	68.5	17.3	92.5	14.9	90.1
Bay Area Rapid Tr	22.5	6.9	18.1	77.8	89.0
Metro Atlanta RTA	40.1	12.8	-0-	80.8	68.0
Chicago RTA	63.3	17.5	13.1	66.1	61.7
Long Island RR	56.3	16.0	22.5	50.9	57.4
Seattle Metro	51.9	13.3	1.0	59.7	47.4
Washington DOT	0.8	0.2	47.5	-0-	47.3
Metro North CRR	44.2	12.7	17.8	40.0	45.1
Chicago CTA	55.8	15.0	7.0	39.2	31.2

Source: FTA Staff Analysis of 1990 Section 15 data.

The third and fourth columns show the amounts of State and local funds actually used for capital purposes in 1990 and the fifth column shows how much of these amounts were in excess of the statutory minimum required to match Federal funds.

State and local governments are using these investment funds both to restore and to expand transit systems. In New York, New Jersey, and Chicago, most of the additional spending is going to address large rail modernization needs. In Los Angeles, Baltimore, and Atlanta, additional State and local funds were used to build new rail transit systems.

Innovative Finance

"Innovative finance," common in other areas of public investment and in the private sector, has not traditionally been used to support transit investment. Such techniques include capital leases, cross-border leases, joint development and other concepts currently being investigated.

Capital Leases. Until recently, leases have not been considered appropriate for financing transit capital needs. The availability of public funds for capital purposes allowed operators to purchase equipment and facilities outright. In addition, operators often did not have reliable streams of revenue available to cover the multiyear payments required under leases. Recently, as grant funds became scarce and agencies obtained dedicated funding sources, leasing has become more popular as a means to acquire transit equipment and facilities.

Rather than having to obtain total funding all at once to replace vehicles, for example, the transit agency acquires the vehicles it needs under a lease and distributes the cost of the purchase over the years when the vehicles are in use.

Certificates of Participation (COP's). This technique capitalizes on a transit agency's status as a municipal entity by the sale of tax-exempt securities to private firms and individuals. COP's represent a hybrid arrangement combining the advantages of leases with the use of tax-exempt financing. Simply put, a public entity (although often not the actual transit operating agency) will issue tax-exempt debt to finance the purchase of transit equipment, which will then be leased to the public transit operator. In this way, the entire transaction is tax exempt and the interest will be at a tax-exempt rate. Lease payments will thus be less than they would be in a conventional arrangement, and lease payments can come from a variety of sources, including Federal grant proceeds.

Cross-Border Leases. These are financial arrangements that take advantage of foreign tax laws. In such transactions, the transit agency purchases rolling stock and immediately resells it to a foreign purchaser who then leases it back to the transit agency. The foreign lessor receives a tax benefit in its own country, and "shares" that benefit with the U.S. transit agency through reduced lease payments. Due to the complexity of such transactions, cross-border leases must exceed $50 million per transaction to be cost effective, making them useful primarily to larger transit agencies. Also, care must be exercised to avoid undue transaction fees.

Joint Development Projects. These involve anything from multiple use of a parking facility to leases to developers who will then build an office or shopping center over or adjacent to a transit facility. The transit agency receives a steady income stream from the increased economic activity that the development makes possible. In addition, the presence of complementary land uses in the proximity of transit stations helps increase transit patronage.

SUMMARY

Public mass transportation in the United States, a $20 billion per year enterprise, carries approximately 8 billion passengers annually. This level of patronage was stabilized by State, local and Federal intervention since the early 1970's. Mass transit serves a diverse public with myriad mobility needs. Although members of low income households and households without automobiles are more likely than other groups to use public transit, the majority of transit riders fit the income profile of the general public. Core transit services are central city-oriented, and thus transit patronage tends to reflect the social and economic characteristics of central cities. Limited public transportation is also provided in small urban and rural areas. Specialized transportation is available for people with unique mobility requirements, such as people with disabilities.

CHAPTER 2: TRANSIT PERFORMANCE AND CONDITION

TRANSIT PERFORMANCE: Mass Transportation costs in the United States appear to have stabilized in terms of year-to-year increases in the unit cost of providing service. Furthermore, new methods are now available to allow analysis of transit in terms of the various kinds of services agencies typically provide their customers.

TRANSIT CONDITION: While capital investments over the last 25 years have greatly improved the physical condition of transit rolling stock, infrastructure, and stations, the need persists to reduce investment backlogs and to lay the foundation for new growth.

FINDINGS

- Since 1984, the inflation adjusted cost to provide a vehicle hour of mass transit service in the United States has stayed about the same.
- Recent research tentatively supports the conclusion that long-distance express service from suburban areas to the central city is more costly to provide--per passenger--than traditional mass transit service.
- The average age of transit vehicles currently in service indicate that, despite considerable capital expenditures over the past 25 years, optimum replacement cycles are not being followed.

TRANSIT PERFORMANCE

The performance of mass transit in the United States will be examined in two principal dimensions, economic performance and service performance. Each of these dimensions will also be explored at both a macro and micro level. The macro level will examine data and information at a national level of aggregation; the micro level will introduce new methods to study and evaluate transit performance in a sample of cities to help understand how various kinds of transit service perform.

The Big Picture (Macro Level)

As noted in Chapter 1, mass transit in the United States is an enterprise with annual expenditures, for all purposes, of approximately $19 billion annually, or four-tenths of one percent of the Nation's Gross National Product. Of this $19 billion, $14.7 billion is required for direct operating expenses, while the remaining $4.3 billion is used for long-term capital investment.

Economic Performance

The economic performance of public transportation is measured in terms of (1) the cost of producing each unit of service; (2) the amount each unit of service is used; and (3) the resulting cost per passenger or per passenger mile.

To understand and interpret the economic performance of mass transit in the United States, previous editions of the Section 308 report relied exclusively on aggregate statistics at the national level. Such data provides important insight, and this edition of the Section 308 report will continue to make use of them.

Such aggregation, however, does not capture the complexity of mass transit, the range of different mobility services it provides, the diverse and competing public purposes mass transit serves and it tends to overlook important transformations in the character of public transportation in the United States. This chapter will begin with a discussion of aggregate industry operating conditions, but follows with case studies on the disparate performance of different types of transit service.

AGGREGATE TRANSIT OPERATING CONDITION

Unit Costs

Based on national data for all transit modes, between 1965 and 1980 operating cost per vehicle-revenue-mile increased at about 3.6 percent per year, adjusted for inflation. Between 1980 and 1985, this increase fell to 2.1 percent per year, for an increase overall of 11 percent between 1980 and 1984. Between 1984 and 1990, real unit operating costs (as expressed in cost per revenue-vehicle-mile) stayed about the same, increasing a total of only 1 percent between these two years. Figure 2.1 displays the operating cost trend after adjustment for inflation and shows the long-term trends from 1975.

Data on operating cost per revenue vehicle hour is also displayed in Figure 2.1. Between 1980 and 1984, this indicator increased 16 percent; however, between 1984 and 1990, unit operating costs stayed about the same, increasing only 0.7 percent. Cost per revenue vehicle mile increased less than cost per revenue vehicle hour before 1984 because of increasing average vehicle speed. As more longer distance express services were instituted, and the relative amount of rail service increased compared with bus service, average system speed increased 5 percent between 1980 and 1984.

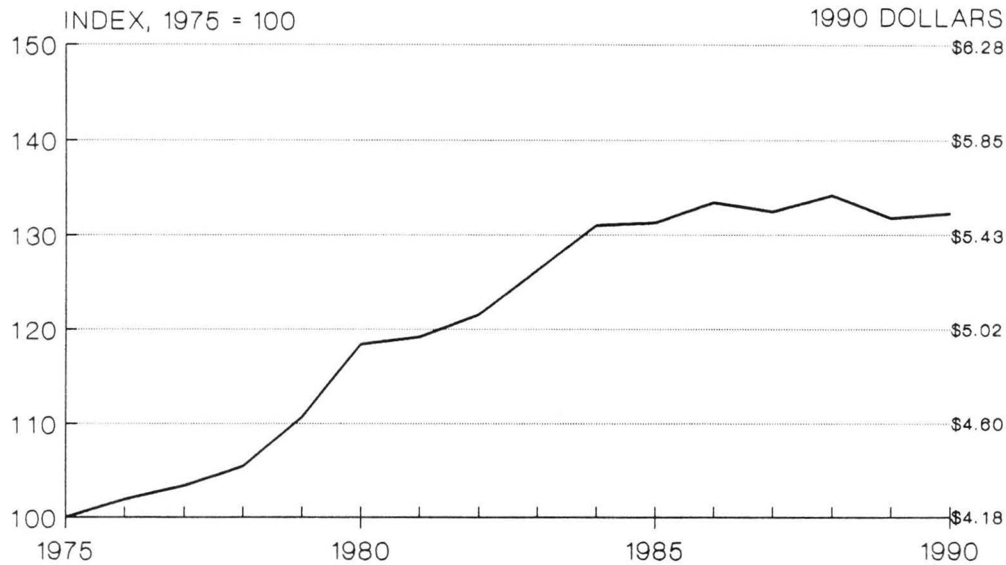
Service Utilization

Figure 2.2 shows passenger miles per revenue vehicle hour (excluding commuter rail), a factor that decreased overall by 14 percent between 1980 and 1990. The decline in this indicator

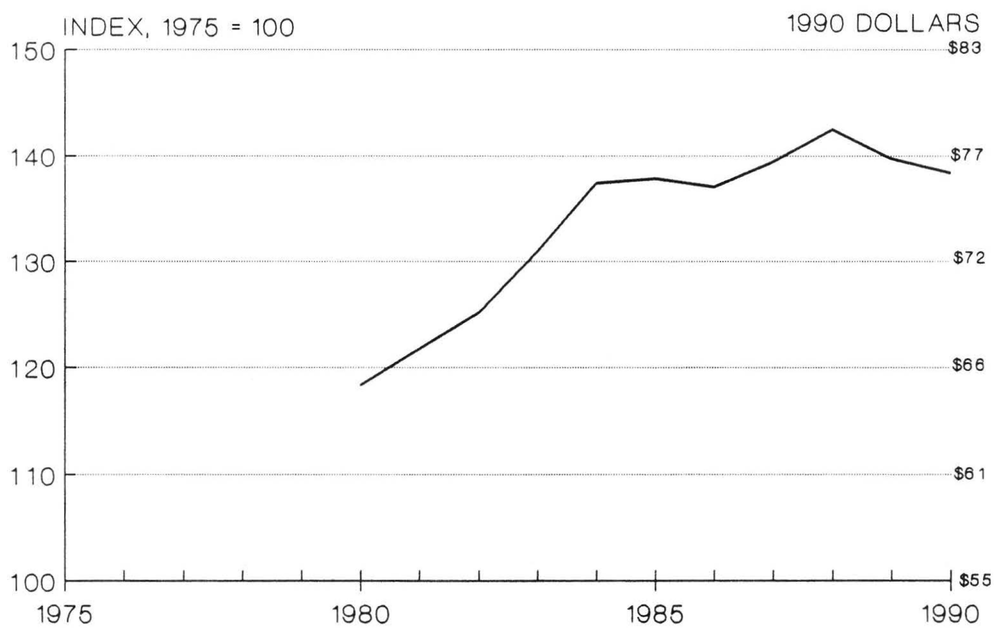
Figure 2.1

COST PER HOUR AND MILE

COST PER REVENUE VEHICLE MILE

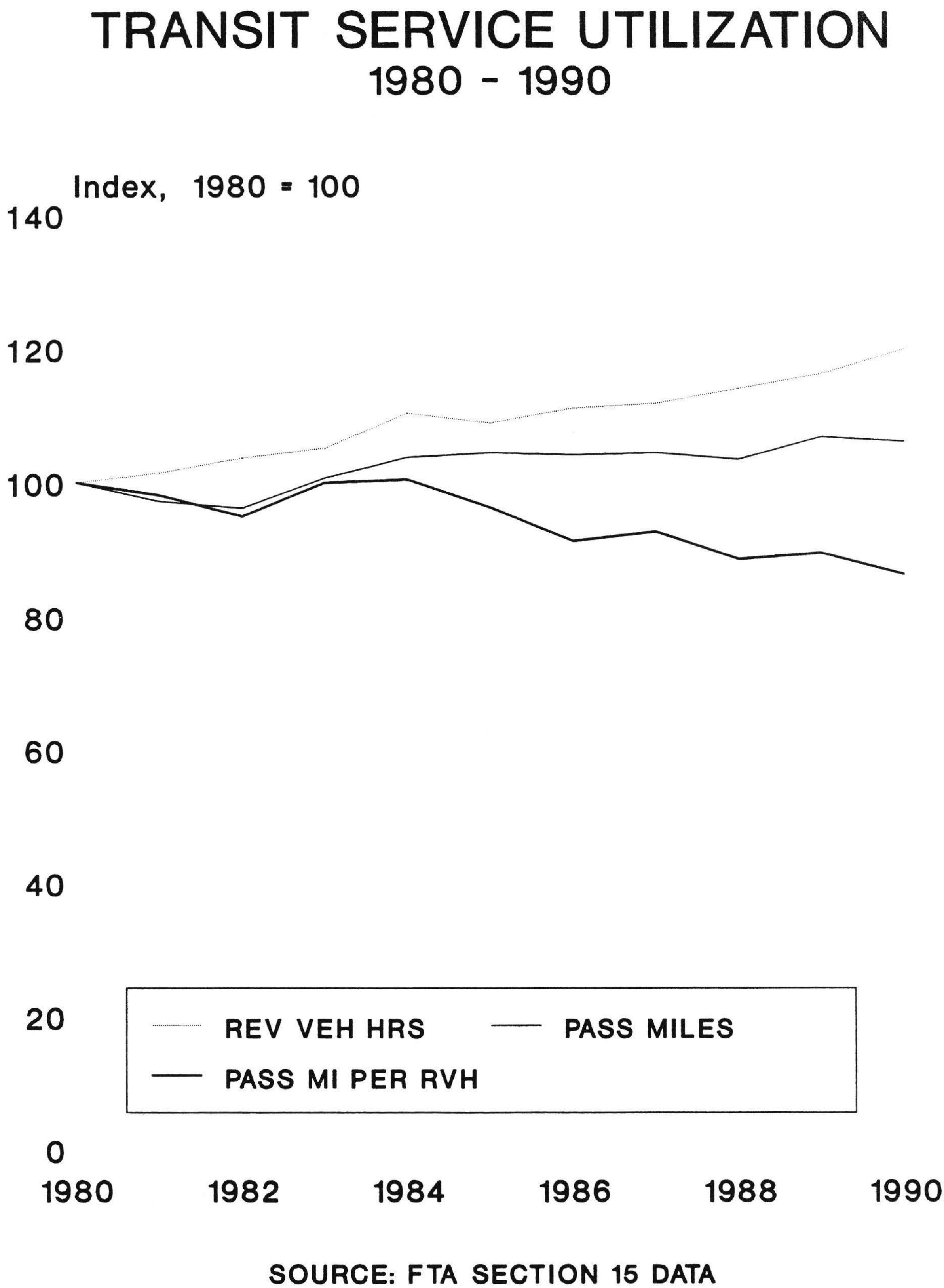


COST PER REVENUE VEHICLE HOUR



SOURCE: APTA, TRANSIT FACT BOOKS;
SURVEY OF CURRENT BUSINESS;
SECTION 15, 1980 AND AFTER

Figure 2.2


TRANSIT SERVICE UTILIZATION
1980 - 1990
Index, 1980 = 100
140
120
100
80
60
40
20
0
1980
1982
1984
1986
1988
1990
REV VEH HRS
PASS MILES
PASS MI PER RVH
SOURCE: FTA SECTION 15 DATA

reflects a greater increase in revenue vehicle hours (20 percent) than in passenger miles (7 percent).

Operating Cost Per Passenger and Per Passenger Mile

The product of operating costs and service utilization is operating cost per passenger, or cost per passenger mile. The long-term trend in operating cost per passenger is shown in Figure 2.3. Before 1980, increases in patronage resulted in a stabilization in operating cost per passenger. Between 1980 and 1984, declines in patronage per vehicle mile and per vehicle hour combined with increases in real operating costs per vehicle mile and vehicle hour to produce faster deterioration in cost effectiveness, as measured in cost per passenger (17 percent) and cost per passenger mile (12 percent). Between 1984 and 1990, unit operating costs per vehicle mile stabilized, but service utilization continued to decrease, resulting in a continued rise in both real operating cost per passenger (25 percent) and operating cost per passenger mile (17 percent). Again, the slower increases in cost per passenger mile compared with cost per passenger reflect the longer trips being taken on average.

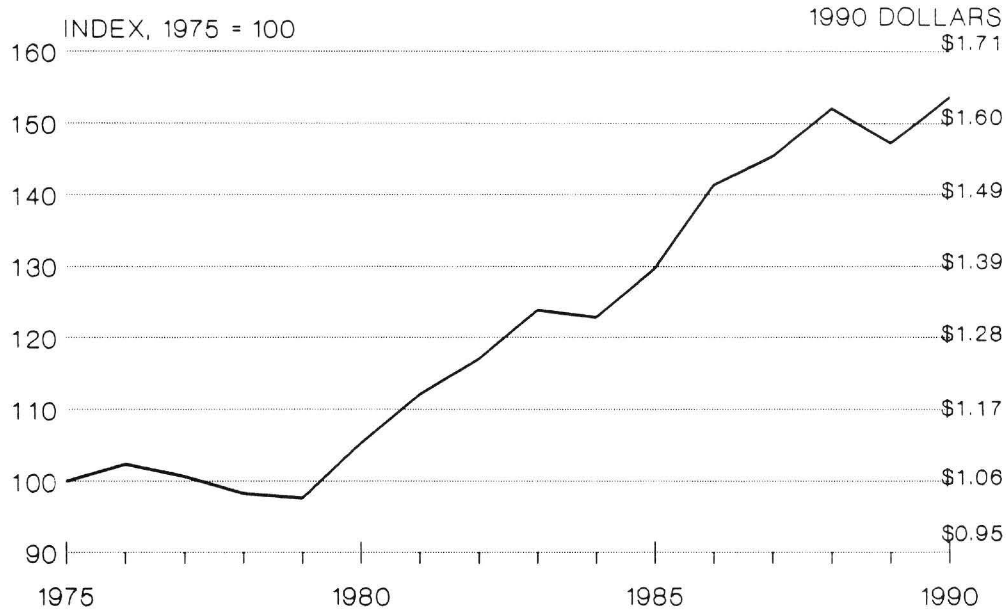
THE TYPES OF TRANSIT SERVICE IN SAMPLE CITIES (MICRO LEVEL)

To explore fully the performance of transit the various categories of services provided by transit agencies should be understood. Data are being generated on the changing mix of transit services, the conditions affecting such different mixes of service types and appropriate performance indicators for different types of services.

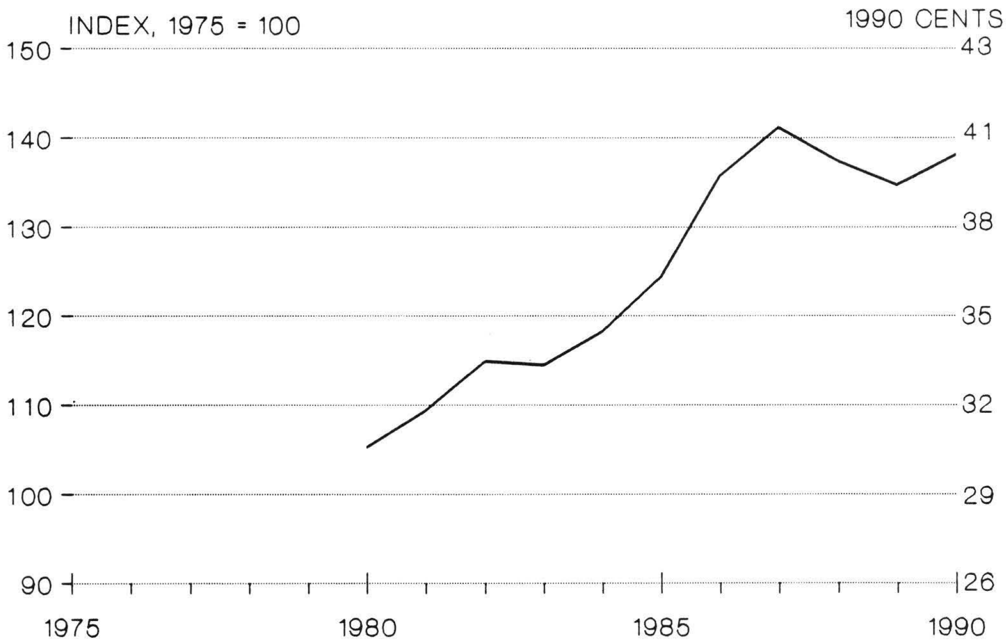
Figure 2.3

COST PER PASSENGER AND PASSENGER MILE

OPERATING COST PER PASSENGER



OPERATING COST PER PASSENGER MILE



SOURCE: APTA, TRANSIT FACT BOOK (1975 - 1980), SECTION 15 DATA (1981-1990), SURVEY OF CURRENT BUSINESS

Preliminary Research

A satisfactory system to report this data in the desired form will take time to develop and implement. Ongoing research, however, has tentatively identified six (6) different types of bus service, and has also provided informed judgement about the different functions, characteristics, and clientele of each. The matrix in Figure 2.4 presents this material in outline.

The next step is to apply this six-fold division to the real world of mass transit and determine how each of the service types performs. To do this, "case studies" have been developed that deal with transit services in nine cities: Houston, Miami, Minneapolis, Los Angeles, St. Louis, San Diego, Albany (New York), San Antonio, and Washington, D.C. These cities were selected because (1) they represented a geographic cross-section of large and medium-sized cities served by complex transit systems, and (2) their own data were in a form readily useful for this analysis. Figure 2.5 displays the mix of transit services in these nine cities in terms of the types noted above, although for purposes of this preliminary exercise, "local" and "radial" services are combined into a single type.

Local and radial services are the largest percent of service in each system, representing transit's classic central city and close-in suburban commuting and mobility functions. Beyond the basic local and radial services, however, systems differ significantly on the mix of crosstown, suburban, and express/limited services they provide. In addition, bus systems which are part of a larger system that includes rail services,

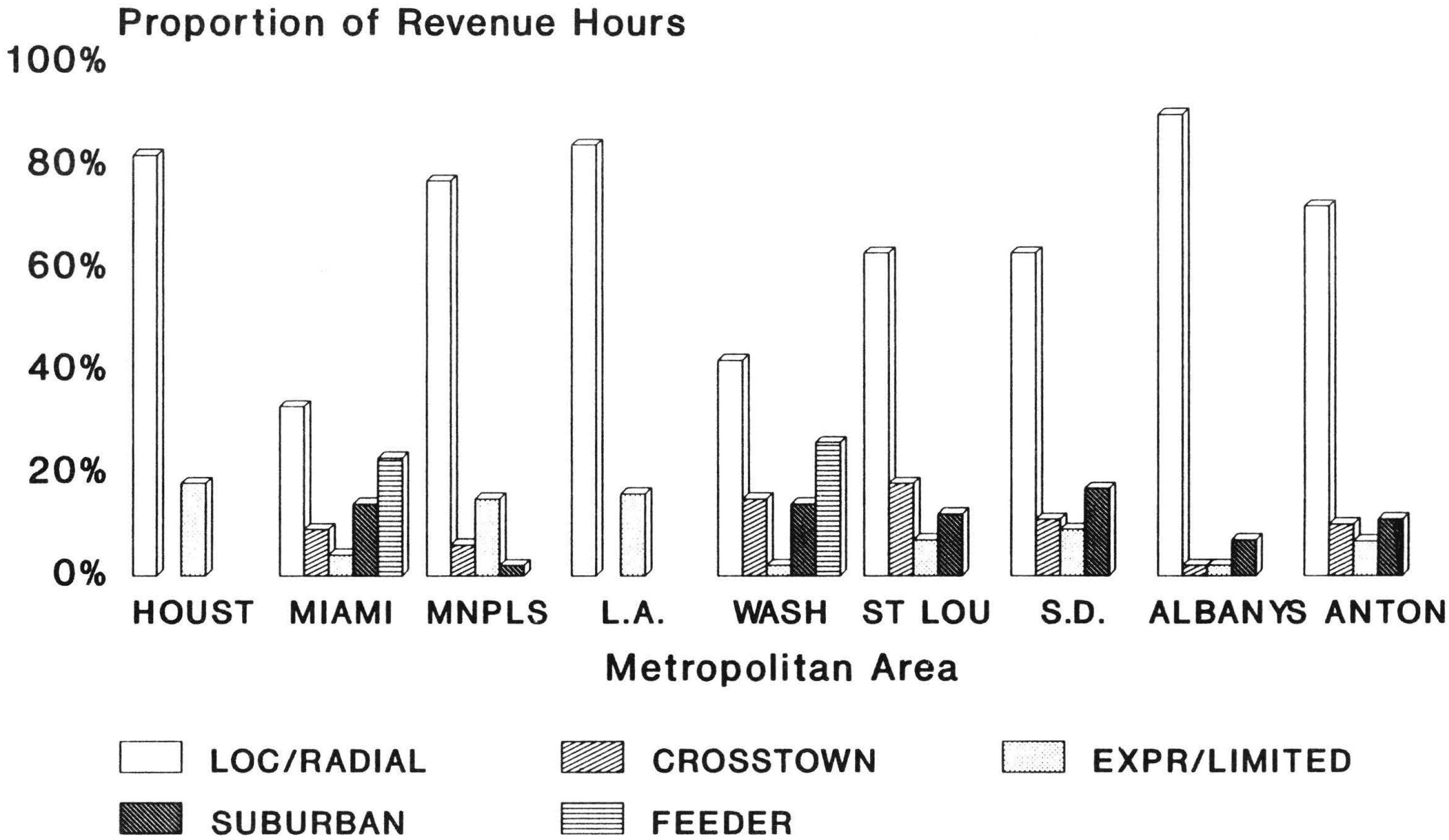
Figure 2.4
TYPOLOGY OF TRANSIT BUS SERVICES

Route Type	Terminal Locations	Boarding/ Alighting	Route Structure	Typical Patronage
LOCAL	In and Outside of Central Business District	Not Restricted	Circulatory Central City and Inner Suburbs	General mobility in dense mkts & low income neighbor-hoods
RADIAL	One inside CBD; Other outside CBD	Not Restricted	Radiating from Central City Hub	General mobility in dense mkts & work commuting
EXPRESS/ LIMITED	One inside CBD; Other Outside CBD	Restricted to Increase Speed	Radiating from Central City Hub	Choice mode for work commuting
CROSSTOWN	Neither inside CBD	Not Restricted	Circumference and cross-radial in Central City and Inner Suburbs	General mobility in dense mkts & low income neighbor-hoods
FEEDER	Rail Stations outside CBD	Sometimes Restricted to increase speed	Radiate from Rail Stations	Choice mode for work commuting
SUBURBAN	Local Service in Suburbs with Terminals at Suburban Centers and Rail Stations	Not Restricted	Circulatory sometimes with focus at Rail Stations	Choice mode for work commuting and general mobility for low income neighbor-hoods

SOURCE: FTA Case Studies on Types of Transit Services, 1992.

Figure 2.5

COMPOSITION OF TRANSIT BUS SERVICE BY TYPE, 1989-90



Houston data reported in Revenue Miles

SOURCE: FTA CASE STUDIES

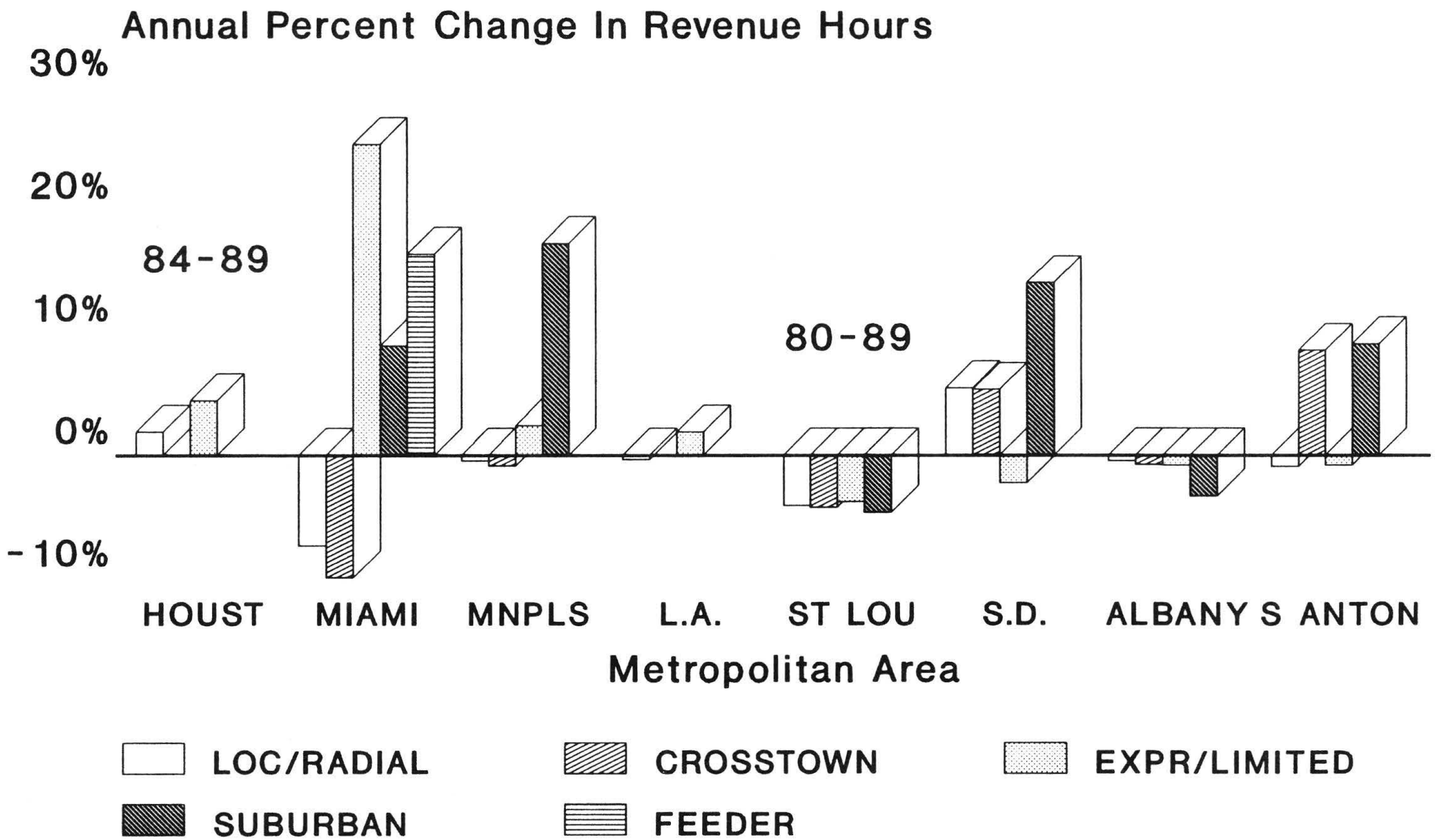
(in Figure 2.5, Miami and Washington, D.C. so qualify) have a significantly different bus service profile than single mode bus systems. Figure 2.6 builds on the one-time snapshot displayed in Figure 2.5 and shows the percentage change, over a five-year period, each city has experienced in the five service types. Values displayed above the zero axis indicate growth in service; values below the axis show decreases in service.

<u>Comparative Unit Costs</u>

Figure 2.7 presents 1989 and 1990 case study data for eight cities on cost per vehicle hour. Five types of services are represented in Figure 2.7: local/radial, crosstown, express/limited, suburban, and feeder. For the case studies, a uniform cost allocation model was used to allocate "joint expenses" such as maintenance and administration across the service types. Using "cost per vehicle hour" as an indicator, Figure 2.7 suggests that within each individual system, the unit cost of service is relatively uniform across the different types of service, with the exception of express services, which will be discussed below. In Albany, for example, the cost per revenue vehicle hour ranges from $41.97 to $45.29; in Miami, from $70.49 to $86.87. The relative uniformity of hourly costs of different service types other than express/limited services suggest a successful effort to maximize the amount of service for the given resources. The uniformity is strongest between crosstown and local/radial services. This is because variable hourly costs are determined by the number of driver pay hours. Local/radial and crosstown services both have relatively little "deadheading,"

Figure 2.6

THE CHANGING COMPOSITION OI TRANSIT BUS SERVICE BY TYPE, 1985 to 1990*

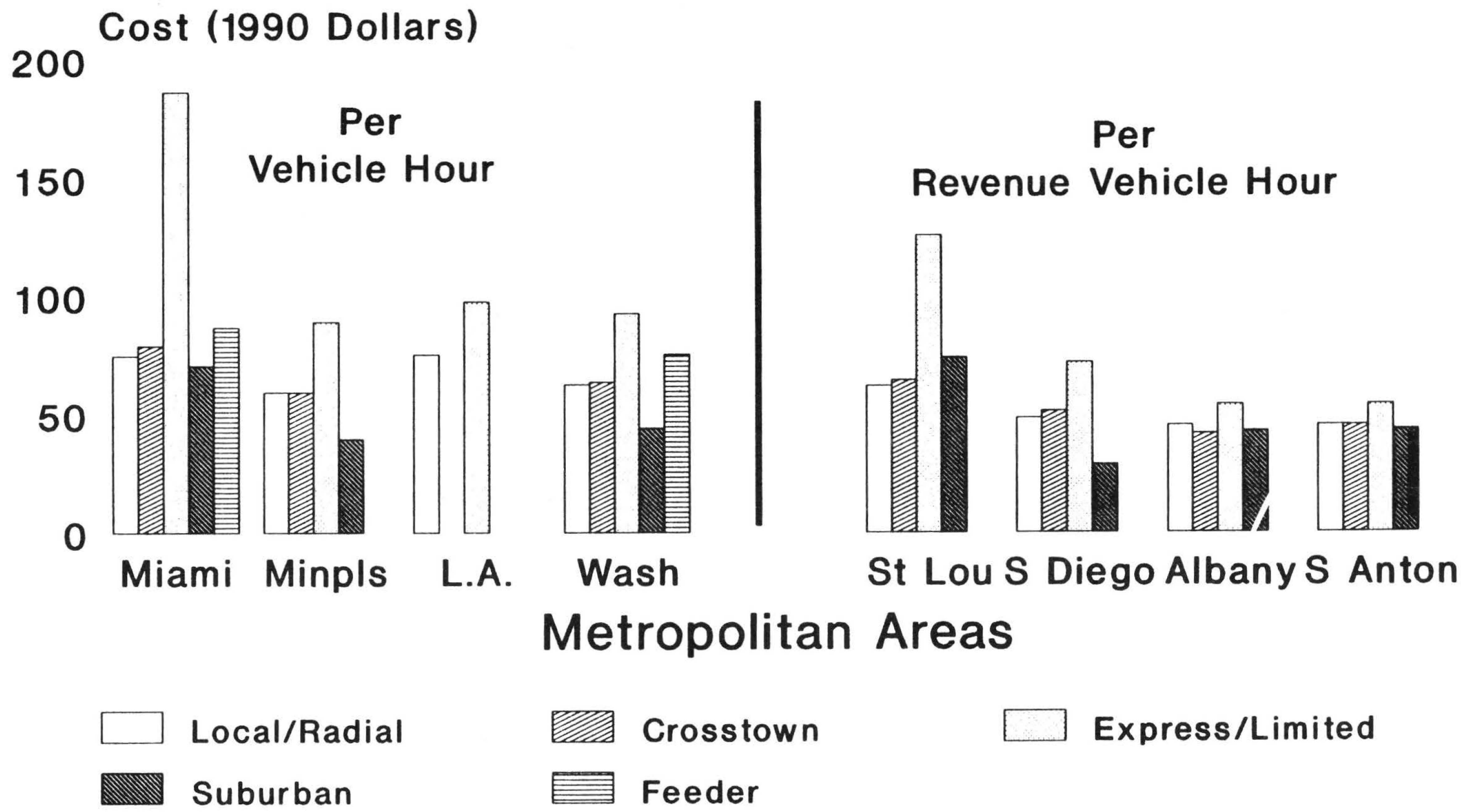


Houston data reported in Revenue Miles

*Other Years Noted in Graph

SOURCE: FTA CASE STUDIES

TYPES OF TRANSIT SERVICES
COMPARATIVE UNIT COSTS
Per Hour / Per Revenue (Service) Hour*



*Whenever available, Revenue Vehicle Hours data are reported

SOURCE: FTA CASE STUDIES

Figure 2.7

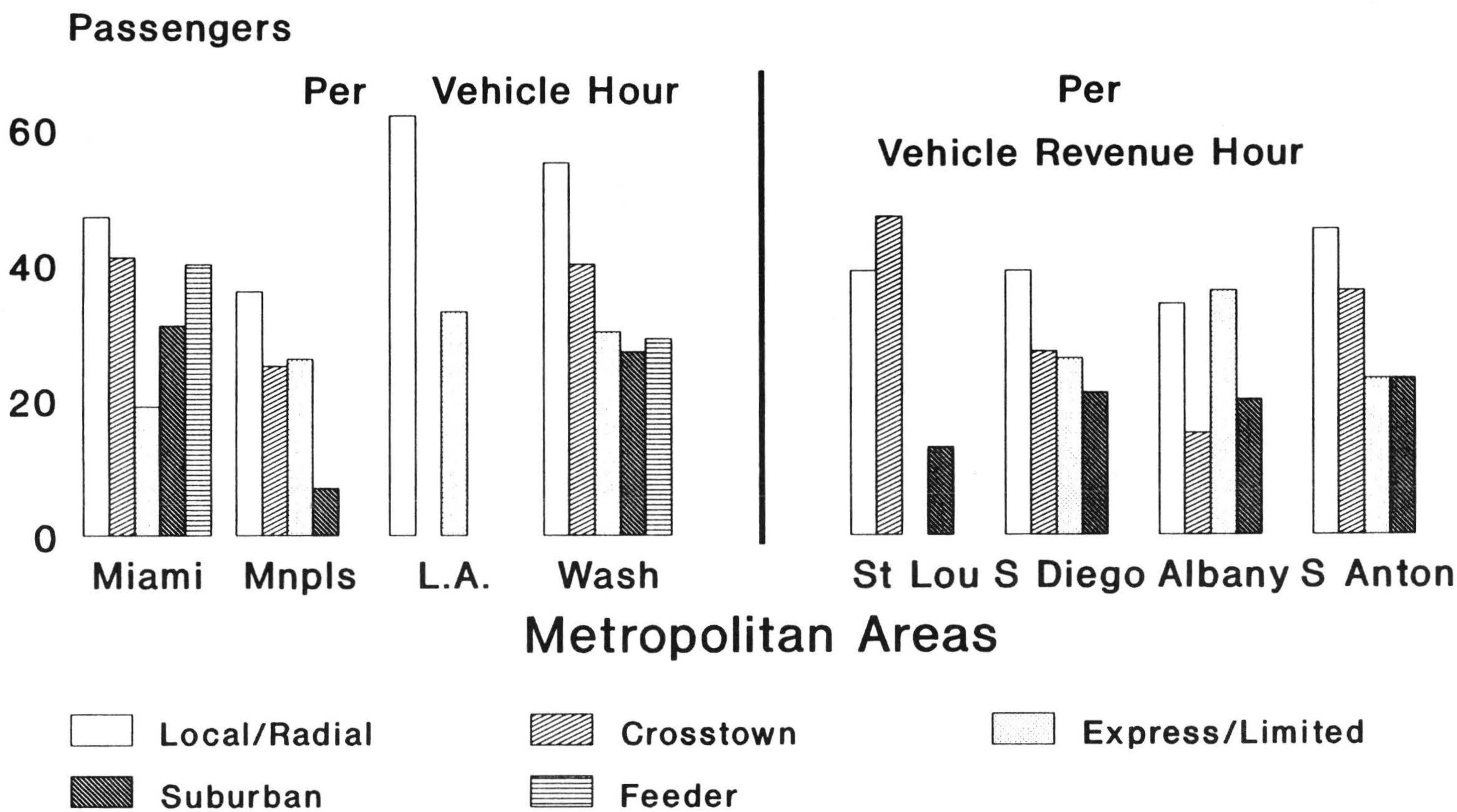
i.e., operating "out of service" while returning to the route origin, because the routes are "two-way" by design. In addition, the design of services is a responsibility in which the professional discretion of transit managers tends to prevail over other considerations--such as work rules and public policy.

In most cases presented in Figure 2.7, express/limited services cost much more per hour than other services. The costs p vehicle hour for express/limited services in St. Louis and Miami are more than twice as high as local radial services in those cities. This disparity is associated with the extreme peaking of most express services and the low ratio of revenue service hours to actual pay hours for drivers because express/limited routes typically involve a great deal of "deadheading." In view of their high cost, it bears repeating that express/limited services tend to be a very small proportion of total services; in Miami only 4 percent of services and in St. Louis 7 percent. In Los Angeles, where express/limited services account for nearly 20 percent of total services, the disparity in efficiency is relatively small and the cost of local service is comparatively high.

Service Utilization

Figure 2.8 presents 1989 and 1990 data on the number of passengers per revenue vehicle hour of types of transit services for eight cities. These data suggest the comparative utilization of different types of services. It is readily apparent that types of services in individual cities are considerably more variable on this indicator than they were on comparative unit cost.

TYPES OF TRANSIT SERVICES
COMPARATIVE SERVICE UTILIZATION
Per Hour / Per Revenue (Service) Hour*



*Whenever available, Revenue Vehicle Hours data are reported

SOURCE: FTA CASE STUDIES

Indeed, different types of service by definition are tailored for different markets; it is no surprise to see different service utilization profiles reflected in passengers per vehicle hour.

Generally, local/radial and crosstown services carry more passengers per hour than other service types. However, this does not always hold true. Feeder service in Miami and express service in Albany carry as many passengers or more than local/radial and crosstown services in those cities.

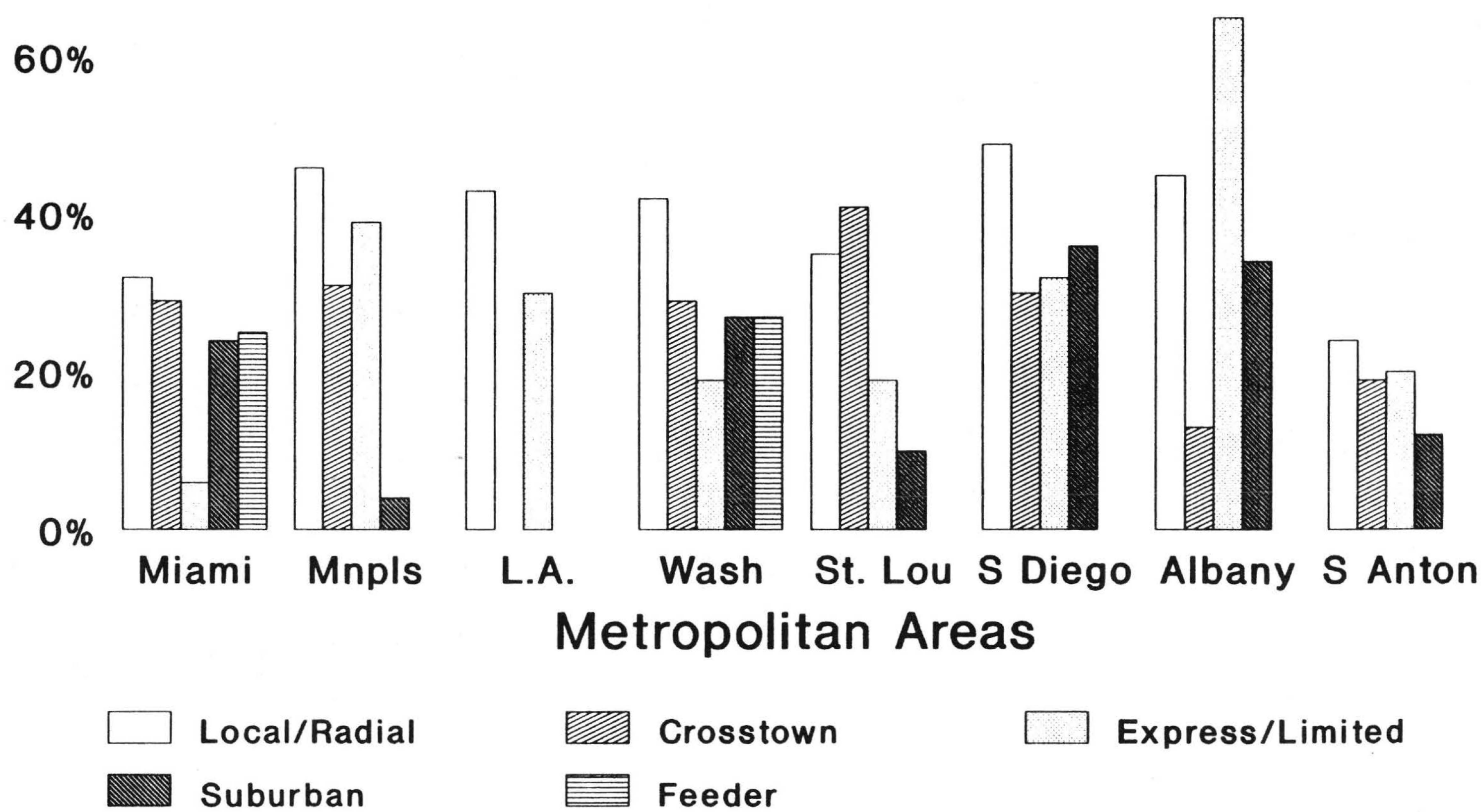
Across the six case studies, there is a lack of uniformity in the service utilization of crosstown, express/limited, and suburban services. It is noteworthy that data on farebox revenues as a percent of operating costs, presented in Figure 2.9, show a similar pattern to the data in Figure 2.8. It is not evident why cities differ so markedly in the patronage strength of their crosstown, express/limited, and suburban markets.

Comparative Cost Per Passenger

Figure 2.10 presents 1989 and 1990 data on the cost per passenger for five types of bus services in the eight cities. Generally, the lowest costs per passenger are in local/radial bus services. Across the six cities the cost per passenger for local/radial services ranges from $1.10 in Long Beach, California, to $1.59 in Miami, Florida. The cost per passenger tends to be highest in express/limited and suburban bus services. Crosstown and feeder bus services appear to rank close to local/radial services in most cases. Data on cost per passenger mile might provide more interesting patterns, but is not readily available.

TYPES OF TRANSIT SERVICES
FAREBOX RETURNS

Farebox Revenues as a Percent of Costs



SOURCE: FTA CASE STUDIES

Figure 2.9

TYPES OF TRANSIT SERVICES
COST PER PASSENGER

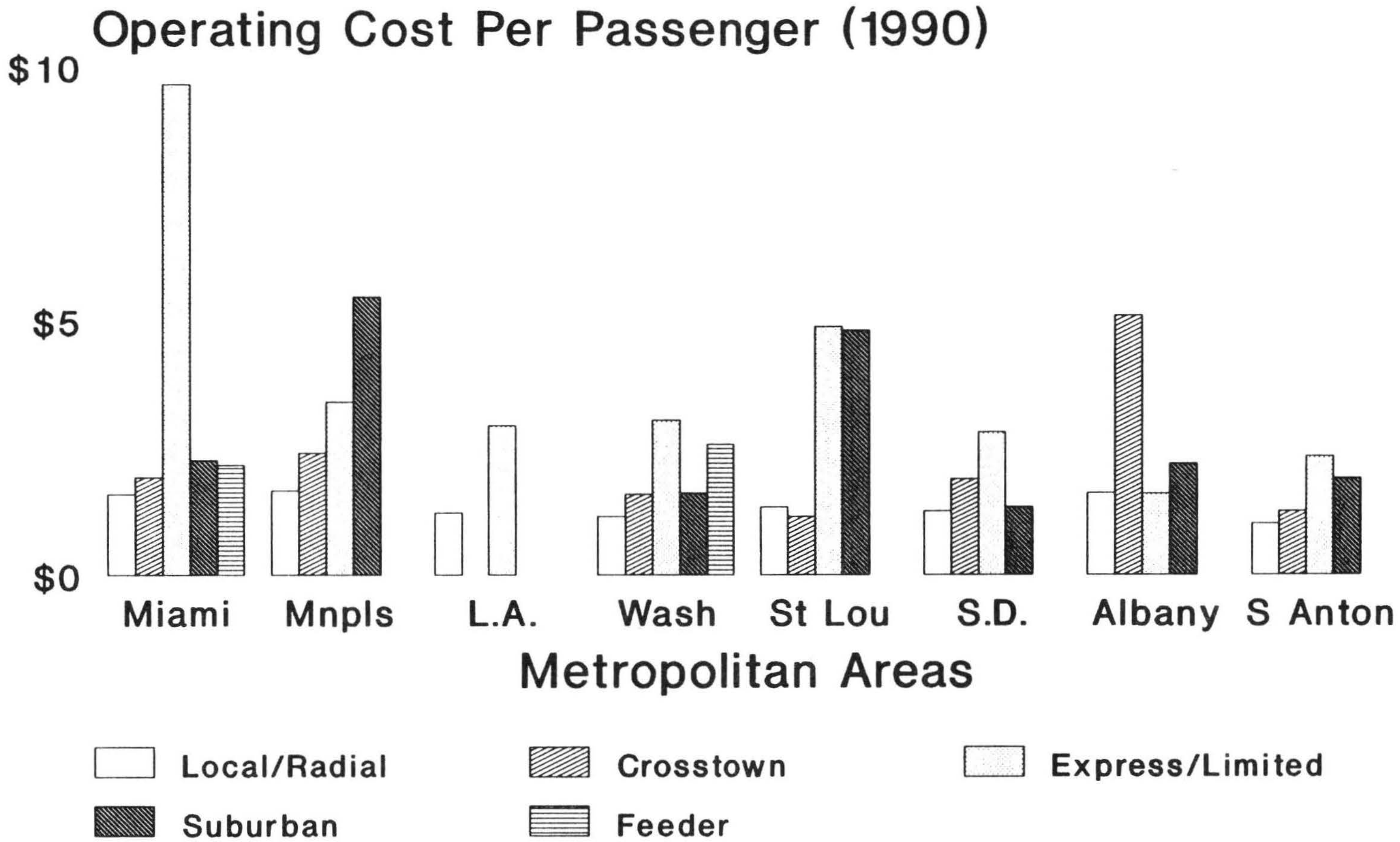


Figure 2.10

SOURCE: FTA CASE STUDIES

COMMUTER SERVICES

The service types discussed above do not generally correlate with the three principal functions of public transportation presented in Chapter 1. Journeys-to-work are significant on all service types, for instance. Radial routes both provide urban mobility for low income people and also increase highway capacity for peak period journeys-to-work. It is possible, by carefully selecting data from a variety of sources, to examine services in isolation that specialize in rush-hour journeys-to-work. While this approach ignores a great deal of other information on multiple function routes, this partial picture demonstrates the value of focusing on services that can be closely tied to the economic function transit serves in moving people between their jobs and homes.

Unit Operating Costs

Data on the efficiency of transit commuter services have seldom been collected in a systematic fashion. However, data are available on a few individual systems. These data shed light on the efficiency of commuter services relative to the general pattern discussed above. As shown in Table 2.1, the cost per vehicle hour for all transit bus services nationwide remained constant at about $65 from 1985 to 1990. The costs per vehicle hour for commuter bus services operating in the New York metropolitan areas increased by 3.0 percent from 1985 to 1989, to $75.76 in 1989.

The cost per train hour of New York area commuter rail services decreased by 6.3 percent from 1985 to 1989, from

Table 2.1

Unit Operating Cost of Commuter Transit Services (Constant 1990 Dollars)

	Base Year	Latest Year	Percent Change
All Bus Systems	$64.60 (1985)	$64.95 (1990)	0%
Bus Systems Under 200,000 Pop.	35.64 (1985)	35.44 (1989)	0%
New York City Commuter Services			
Cost Per Vehicle Hour			
Bus	74.05 (1985)	75.76 (1989)	3%
Rail	346.00 (1985)	324.00 (1989)	-6%
EXPRESS/LIMITED BUS ROUTES--COST PER REVENUE HOUR			
Houston, Texas (Cost Per Revenue Mile)	3.86 (1984)	3.92 (1989)	0%
Miami*	195.29 (1985)	139.38 (1990)	-29%
Minneapolis*	69.13 (1985)	75.36 (1990)	9%
Los Angeles*	76.89 (1985)	77.68 (1989)	1%
St. Louis	109.34 (1984)	110.24 (1989)	1%
San Diego	69.39 (1985)	71.93 (1990)	4%
Albany, N.Y.	67.41 (1985)	67.24 (1990)	-0%
San Antonio	49.76 (1985)	54.00 (1990)	8%
Washington, D.C.	78.90 (1985)	77.65 (1990)	-2%

*Cost Per Vehicle Hour in Los Angeles, Minneapolis, and Miami.

Sources: Section 15 and FTA Case Studies, 1990.

$346.00 to $324.00. In this period, vehicle miles of New York area commuter rail services increased by 14 percent. The cost per hour of express bus services in five case study cities (Houston, Los Angeles, St. Louis, San Diego, Albany and Washington, D.C.) remained fairly steady from 1984 to 1990. In Minneapolis, the cost per hour of express services increased 9 percent; in San Antonio, the cost per revenue hour increased 8 percent. In Miami, the cost of express service decreased 29 percent.

The data in Table 2.1 suggest that in the latter half of the 1980's many transit managers and policymakers focused on the internal efficiencies of services. The case study cities reflect restructured commuter routes and schedules to address demand for services, improved maintenance, and "consolidation" of the previous decade's growth.

Operating Cost Per Passenger

Table 2.2, presenting data on cost per passenger, reflects wide variations in cost per passenger. This suggests that systems which generally recorded fairly stable costs diverged on the costs they were willing to incur to attract commuters on express routes.

SPECIALIZED AND RURAL MASS TRANSIT SERVICES

Specialized and rural mass transportation have received new attention in recent years, primarily as a result of passage of the Americans with Disabilities Act (ADA) 1990. This Act requires, as a matter of civil rights, that persons with

Table 2.2

Cost Per Passenger of Commuter Transit Services (Constant 1990 Dollars)

	Base Year	**Latest Year**	**Percent Change**
All Bus Systems	$1.42 (1985)	$1.59 (1990)	12%
Bus Systems Under 200,000 Pop.			
Cost Per Passenger	$0.40 (1980)	$0.50 (1989)	25%
New York City Commuter Services			
Cost Per Passenger-Bus	$4.49 (1985)	$4.32 (1989)	-4%
Cost Per Passenger Mile			
Rail	$0.33 (1989)	$0.29 (1989)	-12%
EXPRESS/LIMITED BUS ROUTES--COST PER PASSENGER			
Houston	$3.84 (1984)	$3.69 (1988)	-4%
Miami	$7.66 (1985)	$9.79 (1990)	28%
Minneapolis	$2.57 (1985)	$2.88 (1990)	12%
Los Angeles	$1.84 (1985)	$2.81 (1989)	53%
St. Louis	$3.77 (1984)	$5.08 (1989)	35%
San Diego	$2.95 (1985)	$2.81 (1990)	-5%
Albany, New York	$2.71 (1985)	$1.89 (1990)	-30%
San Antonio	$2.62 (1985)	$2.33 (1990)	-11%
Washington, D.C.	$2.69 (1985)	$2.56 (1990)	-5%

Sources: Section 15 and FTA Case Studies, 1990.

disabilities be accommodated in public facilities and transportation systems. It also requires that complementary paratransit systems be operated to transport those persons who, by reason of their disability, cannot use an accessible fixed-route service.

The ADA encourages public transit agencies to coordinate their paratransit services with existing human services transportation operations in their areas. This means that "specialized services" will no longer be separate from the main, urban service but rather an integral part of an urban-suburban transportation network.

There are estimated to be approximately 47 million persons in the United States with some form of disability. Not all of these disabilities impede mobility, but a significant number of them do, including visual impairments, partial and total loss of personal mobility, and cognitive impairments. Of the population of persons with disabilities, approximately 5 million are estimated to be "ADA Eligible." That is, they will be eligible to use the paratransit systems that will complement fixed-route transit services.

At present, persons with disabilities must rely on human services organizations such as State agencies on aging or on their friends and families for a significant portion of their mobility needs.

It is estimated that nearly 100 million trips are taken each year on services funded, in part, with through FTA's rural transportation assistance (Section 18). Cost per vehicle mile on

FTA-supported rural services in 1989 was $1.34. With less than five passengers for every ten vehicle miles on rural services, this results in an average cost of $2.84 per passenger.

SERVICE QUALITY

This edition of the Section 308 report will begin to examine issues related to the quality of mass transit service. While in some dimensions subjective, the perception of quality among customers and would-be customers is an important determinant of transit use, often more important than the fares level.

Transfers and Waiting Times

According to NPTS data, the majority of transit users spend very little time waiting for service. Well over half of all riders (58 percent) reported wait times of five minutes or less, indicating that the service they receive is frequent enough that no schedule is required. More than 80 percent of riders wait no longer than ten minutes (see Figure 2.11).

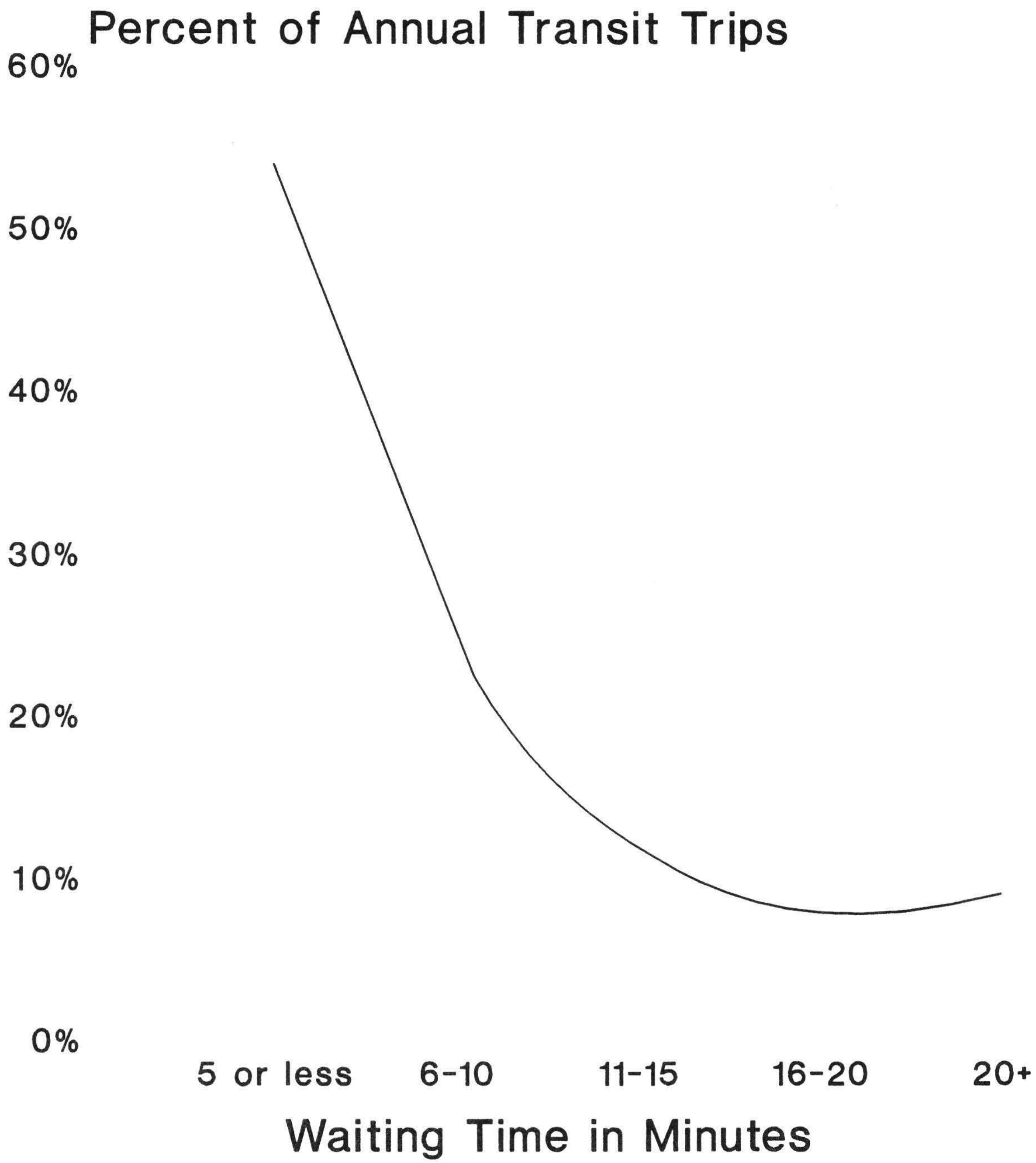
In addition to waiting times, the need to transfer between transit vehicles enroute to one's travel destination influences transit patronage. According to the data in Figure 2.12, approximately 47 percent of transit trips involve one or more transfers. In addition, approximately 17 percent of transit trips involve a transfer from a private vehicle, e.g., park and ride situations.

Available Seats

Service quality is greatly affected by the perception of crowding within the system, which in turn can be measured by the presence of standees aboard transit vehicles.

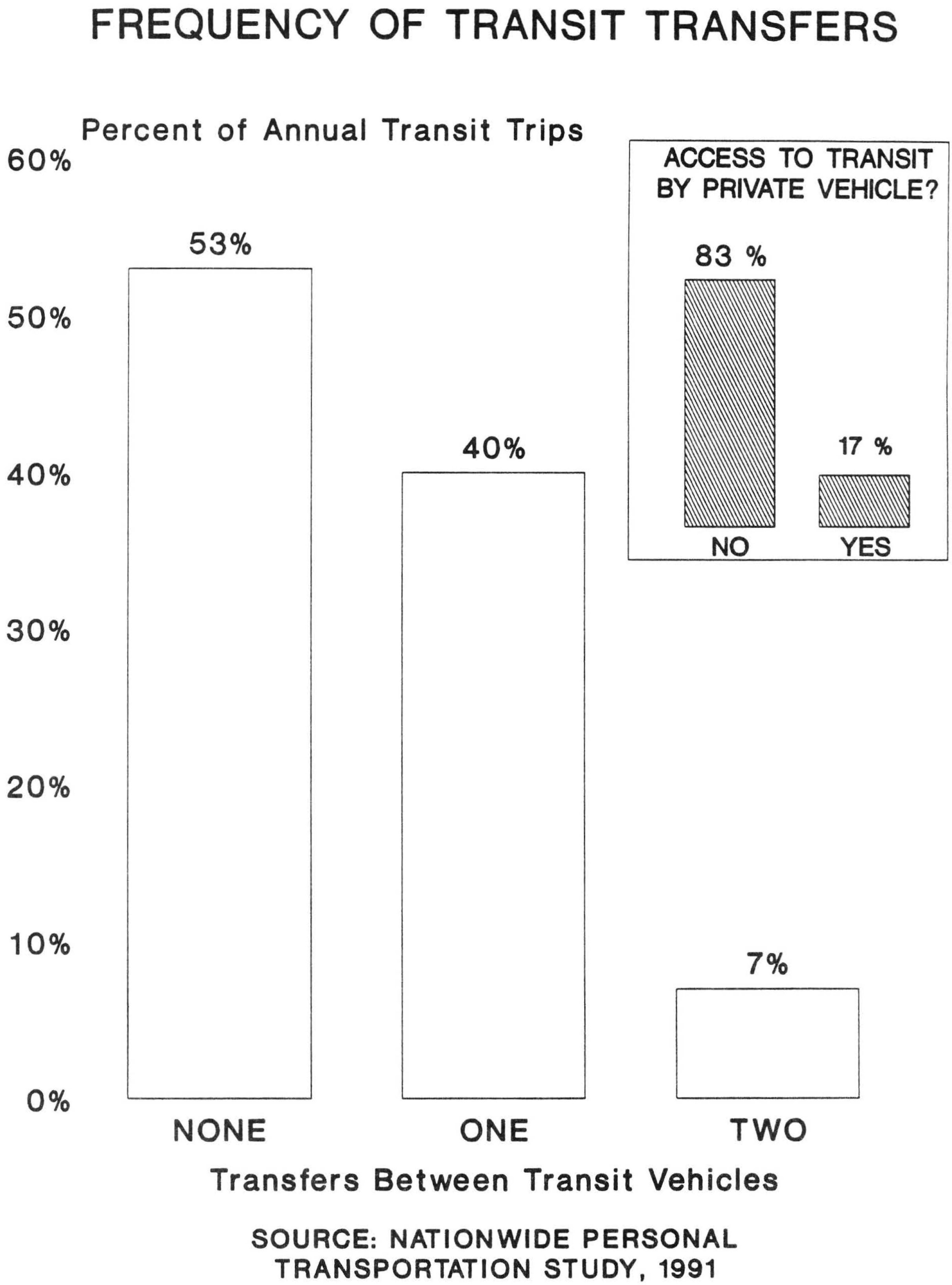
Figure 2.11

TRANSIT WAITING TIME



SOURCE: NATIONWIDE PERSONAL TRANSPORTATION STUDY, 1991

Figure 2.12


FREQUENCY OF TRANSIT TRANSFERS
Percent of Annual Transit Trips
60%
50%
40%
30%
20%
10%
0%
53%
40%
7%
NONE
ONE
TWO
Transfers Between Transit Vehicles
ACCESS TO TRANSIT BY PRIVATE VEHICLE?
83 %
17 %
NO
YES
SOURCE: NATIONWIDE PERSONAL TRANSPORTATION STUDY, 1991

The capacity of a transit vehicle is generally measured in three ways: seated capacity, full capacity, and peak capacity. Seated capacity is defined by the number of seats on a particular vehicle. Full capacity includes seated capacity plus one standee for every 5.5 square feet of open floor space. Peak capacity is the absolute maximum passenger load that a vehicle can accommodate, seated and standing. Industry definitions do not necessarily correspond to passenger perceptions, however. The presence of standees, even one or two, tends to convey a sense of crowding. This is especially true from the perspective of those who must stand. Passengers often consider a vehicle to be crowded when it is operating with a load factor above seated capacity but still significantly below full capacity. As shown in Figure 2.13, 29 percent of transit trips involve standing for at least part of the trip.

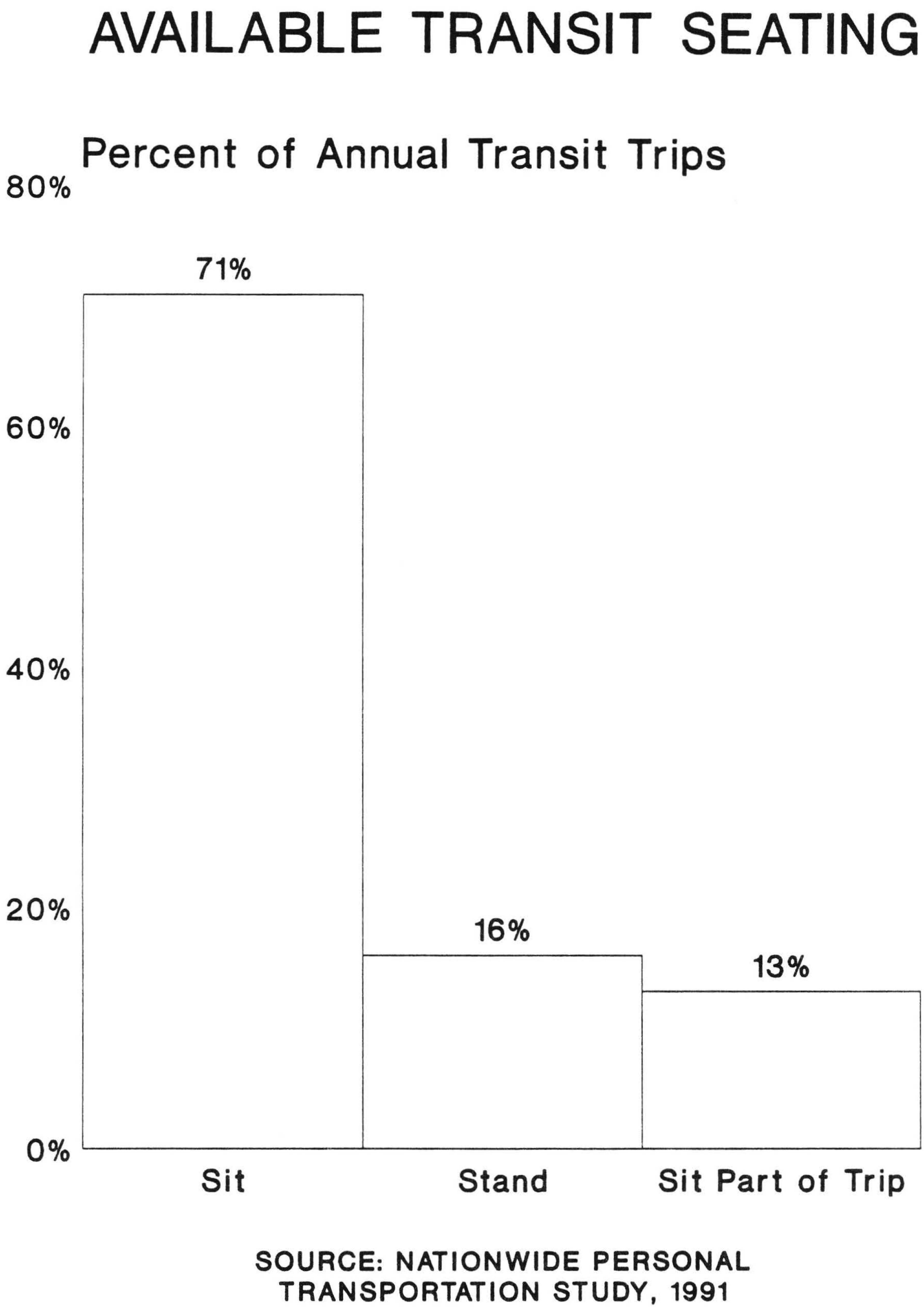
Travel Times

Travel time and speed are somewhat difficult to measure and quantify. Many individuals do not know how far they actually travel (especially transit users) much less their average speed, and their sense of time spent en route is likely to be distorted.

According to data from the 1990 NPTS, over 40 percent of all transit commuters reported trip times of ten minutes or less, and nearly 87 percent of transit riders arrive at work in less than half an hour.

As the U.S. Department of Transportation begins to explore concepts like unified intermodal urban transportation

Figure 2.13


AVAILABLE TRANSIT SEATING
Percent of Annual Transit Trips
80%
60%
40%
20%
0%
71%
16%
13%
Sit
Stand
Sit Part of Trip
SOURCE: NATIONWIDE PERSONAL
TRANSPORTATION STUDY, 1991

performance, better information will emerge on the general subject of service quality.

CONDITION OF TRANSIT CAPITAL ASSETS

Before moving to Chapter 3 and a discussion of the long-term capital investment needs of mass transit in the United States, basic information is required on the current condition of the capital assets used by transit providers.

Bus and Paratransit Condition

The most accurate way of gauging the condition of the bus fleet would be to have information on the results of inspections, using standardized definitions of condition, of all (or a sample of all) of the vehicles. However, such information is not available. Good data are available, however, on the actual age of the entire bus and paratransit fleet. Since the actual condition of a vehicle of a given age would be affected by such factors as usage, maintenance practices, and climate, the age of a vehicle is not necessarily directly correlated to condition. However, on an overall basis, vehicle age is a good surrogate for condition and thus will be used as the basis for evaluating bus and paratransit fleet conditions.

For the purposes of managing the Federal investment in transit, FTA has established minimum requirements for the period of time an asset must remain in mass transit service before it will be considered eligible for replacement. These guidelines are based on such factors as industry practices, manufacturer recommendations, and studies of the trade-off between capital investments and operating costs. On this basis, the following are the minimum useful life guidelines for vehicles used in bus and paratransit service:

Standard Full Size Transit Bus	12 years
Medium Duty Transit Bus	10 years
Small Transit Bus	7 years
Urban Paratransit Van	4 years

It should be noted, however, that there is no recent information on whether or not these guidelines represent optimal vehicle replacement ages in terms of the point at which reduced maintenance costs justify increased replacement costs. If it were possible for transit agencies to replace vehicles on this schedule, the average age of type of vehicle would be one-half the useful life guideline (i.e., full size buses would have an average age of 6 years). The following table displays the actual average age for the major categories of bus and paratransit vehicles using 1990 Section 15 data:

Type of Vehicle	Average Age	Guideline
Standard Full Size Transit Bus	8.2	6.0
Medium Duty Transit Bus	6.7	5.0
Small Transit Bus	3.9	3.5
Urban Paratransit Van	2.8	2.0

The table shows that the average fleet age for all classes of bus and paratransit vehicle is in excess of the minimum useful life guideline. As a result, there is a backlog of overage vehicles of each type in need of replacement. The following table displays the total number of active vehicles of each type and the number of active vehicles in excess of the useful life guidelines in 1990.

Type of Vehicle	Total Fleet	Overage Veh
Standard Full Size Transit Bus	48,325	9,011
Medium Duty Transit Bus	3,223	553
Small Transit Bus	2,658	303
Urban Paratransit Van	3,768	827

Since 1990, the total fleet size has not noticeably changed, and the number of vehicles replaced has fallen below that required to maintain the average fleet age at the current average age. The number of overage vehicles and the average fleet age are thus likely higher than the values shown.

Similar condition data are not currently available for the age or condition of bus and paratransit maintenance garages and other fixed facilities, such as terminals, stations, waiting areas, park-and-ride lots, etc. Chapter 3 will thus have to rely on estimation techniques when it discusses capital needs in these areas.

<u>Rail Conditions</u>

Detailed information is available on the condition of the Nation's rail system from the Rail Modernization Study published in 1987. This congressionally-mandated study assessed the physical condition of the rail systems on the basis of systematic, on-site inspections using consistent definitions and assessment procedures. The inspections were conducted during the period November 1983 through May 1984. Each system element was evaluated to determine its condition at that time (as well as to establish the improvements needed and the associated capital costs). Specific definitions were developed for each of five condition levels ("excellent," "good," "fair," "poor," and "bad"). The key condition level in this analysis was "good" which was defined as "good working order, requiring only nominal or infrequent minor repairs." It was the goal of the analysis to assess the cost of bringing all of the Nation's rail systems to this condition by the end of the 10-year analysis period assumed in the study. Table 2.3 displays the results of Rail Modernization Study assessment of the physical condition of the Nation's rail systems in 1984.

Maintenance yards and facilities were in the most need of improvement, since only 17 percent of the yards and 28 percent of the facilities were in good or better condition. Also in need of substantial improvement were elevated rapid rail structures (with only 19 percent in good or better condition), stations (29 percent) and bridges (32 percent). Substations were in the best overall shape with 66 percent in good or better condition, while commuter rail vehicles were also in general well off with 49 percent of locomotives and 55 percent of unpowered cars in good or better condition.

Although these inspections were conducted in 1984, the overall picture they paint of the condition of the Nation's rail systems is in general still valid (see Chapter 4). This is because total capital spending on rail modernization since that time has been at approximately the level which FTA believes is adequate to maintain conditions.

Table 2.3

Physical Condition of U.S. Transit Rail Systems

		Percent by Condition				
Element	**Quantity**	**Bad**	**Poor**	**Fair**	**Good**	**Excellent**
Track	5,102 mi	0	7	49	31	12
Vehicles						
Rail Cars						
Self-Propelled	12,963	23	24	18	28	7
Unpowered	1,671	3	13	35	49	0
Locomotives	416	3	10	32	43	12
Power Systems						
Substations	673	6	23	5	43	23
Overhead	1,351 mi	20	12	27	36	5
Third Rail	1,895 mi	13	26	19	36	6
Stations	27.7 msqf*	0	15	56	23	6
Structures						
Bridges	11.4 msqf	1	16	51	28	4
Elevated	1.2 mlft**	0	1	80	3	16
Tunnels	1.6 mlft	0	5	49	35	11
Maintenance						
Facilities	8.6 msqf	4	54	14	24	4
Yards	62.9 msqf	4	53	26	16	1

*msgf=Million Square Feet
**mlft=Million Linear Feet

Source: U.S. Department of Transportation, Rail Modernization Study, 1987.

CONCLUSION

In the national aggregate, the condition of mass transit in terms of operating costs and patronage has been stable since the mid-1980s, although overall use of mass transit increased as a result of longer average trip lengths. The demands for transit services are diverse, leading to significant disparities in the economic performance of different types of services. If transit's urban mobility role is to grow in years to come, as discussed in Chapter 3, it would be useful to know what types of services are on the leading edge of transit's growth and how their performance may differ from typical current services. DOT is supporting research to provide more detailed information in this area.

The quality of transit services, as reflected in waiting times, crowding and available seats, and the physical condition of equipment and facilities, affect the attractiveness of transit services. Improvements in the quality of service are closely related to investment needs and strategies. This will be discussed next in Chapter 3.

CHAPTER 3: TRANSIT NEEDS

The need for capital investment in mass transit in the United States is driven by expectations of goals for transit's future. If transit is merely to continue to grow at recent rates, one level of investment is called for. If, on the other hand, transit is expected to reach new levels of performance, then additional investment will be required.

FINDINGS

- For mass transit in the United States to maintain its current condition and performance, plus meet new statutory obligations to serve disabled Americans and improve vehicular emissions, will require an annual capital expenditure of $3.9 billion per year. Of this amount, $3.1 billion per year is needed to maintain current conditions and $0.8 billion per year is needed to maintain current performance by increasing transit capacity consistent with recent growth in transit patronage.

- For mass transit in the United States to improve its condition and performance by eliminating the backlog of investment needs and expand its capabilities and increase its market share of urban travel by 25 percent over a 20-year period will require an additional $3.6 billion in capital investments per year. Of this amount, $1.8 billion per year is needed to eliminate the backlog and $1.8 billion per year to increase market share.

A FRAMEWORK FOR INVESTMENT

At the root of any discussion of transit capital needs is the transit customer, current and potential. To articulate the needs and expectations of that customer for transit service with any kind of precision assumes an ability to answer a long list of questions:

- Will current land use patterns continue into the indefinite future?

- Will petroleum prices (and availability) enjoy relative stability?

- Will non-market constraints be placed on the use of private automobiles?
- What will be the impact on urban America of new waves of immigration, now just beginning?
- What kind of new technology developments might drastically alter the demand for transportation?
- Will central business districts play a lesser or greater role in the overall economy in the 21st century?

Obviously, these questions can not be answered in any way that would allow investment needs to be calculated with precision. There are some things about the future, however, that are known, or at least can be assumed with a minimum of risk:

- The population of the United States will continue to grow.
- The population will continue to have travel needs.
- Current concerns over the environment, congestion, land-use patterns and air quality will not suddenly go away.

A useful point to get a quantitative toehold on these otherwise imponderable considerations is a report issued recently by the FHWA, a needs estimate for national highway investment. This report, 1991 Status of the Nation's Highways and Bridges: Conditions, Performance and Capital Investment Requirements ("1991 Highway Needs Report"), is essentially a parallel document to this Section 308 report.

FHWA expects total highway travel to increase by 2.45 percent per year over the period 1989 through 2009, or a total increase in travel of 65 percent over 20 years. This forecast is below actual historic travel growth levels, which have exceeded 3.0 percent per year for most 5-year periods since 1945.

To estimate the investments required to maintain highway performance at current levels, or improve that performance to a defined standard in the 1991 Highway Needs Report, FHWA introduced constraints on new highway capacity in large urbanized areas, and simulated how a number of travel demand and system management measures and changes in current trip making characteristics would impact the level of new highway investment. The FHWA report assumes these changes are likely to take place over the next 20 years as urban highway capacity is constrained, while urban travel demand continues to grow. The changes simulated effectively reduced increases in travel for which new capacity was estimated from the overall average of 2.45 percent to 1.45 percent in urbanized areas. Even this smaller annual increase would lead to a total increase in urbanized area travel of 33 percent over a 20-year period.

While urbanized area travel has grown at about 4 percent per year between 1980 and 1990, transit has grown at a lower rate. During the 1980's, as described in Chapter 1, transit patronage, measured in term of passenger miles, grew 8 percent (or about 0.8 percent per year). This slower growth reflects the fact that a variety of economic conditions and public policies which might have resulted in higher levels of transit use are not in place. Such conditions and policies include higher gasoline prices, more expensive parking, reduced employer subsidization of parking, increased employer subsidization of employee transit use, various automobile use pricing measures or other constraints and land use patterns more conducive to transit use.

The more important aspect of the 1991 Highway Needs Report as it relates to mass transit is its working hypothesis that a variety of transportation system management and demand management measures will be implemented to accommodate the estimated 1.45 percent annual increase in travel with limited highway investment. Essentially, the 1991 Highway Needs Report presumes that a variety of improved transportation supply and demand management measures could potentially reduce the need for highway investments by a total of 34,000 lane miles and reduce highway travel (i.e., vehicle miles) by a total of between 3 and 8 percent by the year 2009. The coordinated supply and demand management strategies would include efficiency enhancements on existing highways through traffic operations, engineering improvements and demand management targeted at increasing vehicle occupancies during daily peak periods of demand. To accomplish the latter, total peak hour vehicle occupancy would have to increase from 1.10 today to about 1.23, a 12 percent improvement. If all this increase were accomplished in work travel, an increase in peak period work trip automobile occupancy from 1.15 to 1.60, or 39 percent, would be required. FHWA notes that the ability to effect this magnitude of vehicle occupancy shift has been, to date, demonstrated only in a few freeway corridors, and usually associated with fuel unavailability, severe traffic congestion, air quality initiatives or high occupancy vehicle lanes. In any case, transit investments are likely to play a large role in achieving this level of overall increase, together with a variety of low-capital transportation management measures designed to increase carpooling and vanpooling.

Definition of Performance/Investment Levels

Section 308 of Title 49, United States Code, requires that this report provide estimates of "future needs . . . and future capital requirements . . . at specified levels of performance." The purpose of this section is to define the levels of performance against which investment requirements will be estimated.

Two levels have been identified, each requiring a different capital investment effort:

- an investment level that would maintain current mass transit conditions and performance; and
- an investment level that would allow mass transit conditions and performance to be improved.

Within each of these two levels are further divisions and distinctions. In essence, however, the two-fold concept for estimating investment needs involves one level that is consistent with "holding the line" and ensuring that the situation does not deteriorate and a second or incremental level that involves moving forward and investing at a rate sufficient to make substantial improvements. These scenarios are consistent with those identified in the 1991 Highway Needs Report.

The most basic level of investment is that needed to "Maintain Current Conditions and Performance." This level of investment has two parts: 1) the cost to maintain facilities and equipment in their current physical condition, and 2) the cost to increase service levels to permit transit capacity to grow at a rate consistent with recent growth in transit use. Such an understanding of "maintaining performance" is new to this edition of the Section 308 report. It reflects the fact that for transit to maintain its current level of performance, it must continue to grow to meet the demand for transit, which over the last 10 years has increased.

The first part of this first level is simply the investment needed to replace existing equipment as it reaches the end of its useful service life. At this level of investment, existing conditions of the physical infrastructure are maintained. However, no improvements are made in these conditions so a current backlog of vehicle replacement needs and inadequate facility conditions would not be measurably improved. This first part of the first level of investment is adequate to ensure that the continued aggregate amount of service (in terms of vehicle hours) can continue to be provided.

This level of investment also includes those additional features required so that transit service can be provided in compliance with certain new statutory requirements. The most important of these are the Americans with Disabilities Act (ADA) and the Clean Air Act Amendments of 1990. This initial level of investment includes the costs of meeting requirements that buses must be equipped with lifts as they are purchased, complementary paratransit service be provided, and rail transit systems be revised so one car per train is accessible within 5 years and "key stations" are accessible within 3 to 30 years, depending upon the complexity of the necessary renovation. Incremental costs of satisfying these requirements are provided.

The costs of meeting the requirements of the Clean Air Act Amendments of 1990 that transit buses meet certain standards for emissions must also be included at this investment level. If diesel technology cannot be improved sufficiently, this will involve obtaining alternative fuel vehicles and retrofitting existing maintenance facilities to serve these vehicles.

Without additional investments beyond this, performance deteriorates. The amount of urban travel carried by transit would stay constant as the total market grows. As transit patronage stays constant, increasing pressure will be put on the highway system, increasing congestion.

To maintain both conditions and performance, it is necessary to make the additional investment needed to extend coverage and improve service levels to maintain transit's recent patronage growth rate. Thus, <u>the total estimates to maintain current conditions and performance assume that current overall growth continues.</u> As noted earlier, transit is more effective in high density markets (such as Central Business District and central city-oriented travel) and less effective in less dense markets (such as in suburb-to-suburb travel). While overall growth would continue at this level of investment, <u>there would be larger increases in some areas and smaller increases</u> (or even declines) <u>in others</u>.

The first level of capital investment would increase overall transit passenger miles at a rate of increase consistent with recent trends in transit growth. While total urban passenger miles are expected to increase at about 1.45 percent per year, consistent with forecasts by FHWA, this report considers current transit performance to be the slower recent growth rate of transit (0.80 percent per year). This reflects the fact that the economic conditions and public policies which would be needed to see transit grow at the overall rate of urban travel growth are not now in place. This is consistent with the experience of the last 10 years during which transit growth was also slower than overall urban travel growth. To achieve continued growth at current rates, then, capital resources will be needed to increase services and make investments in selected new capital projects. In addition, certain other low capital demand management measures would be implemented to assure that the share levels are achieved.

It must be noted that in providing capital investment estimates for this first level of expenditure, it is being assumed that any increases in transit's carrying capacity will require prior increases in fleet size, facilities and so forth. As a practical matter, a given transit system may be able to absorb such increases with no additional expenditures. In discussing these needs at a national level, however, the only safe procedure is to assume that new levels of service require marginal increases in equipment and facilities. Furthermore, the increase in transit patronage experienced in the past 15 years has only come as a result of significant new investment in transit capacity. It is also known that in most of the principal transit markets where peak hour work trips constitute a primary mission of the transit agency, there is not only no peak hour capacity today, there is often overcrowding that represents a serious threat to service quality standards.

The second level of investment is that needed to "Improve Conditions and Performance." The first part of this level of investment involves those improvements necessary to restore and replace long-deferred deteriorated vehicles, facilities and general conditions, the transit backlog. These improvements will bring the transit infrastructure to a good state of repair, based on modern engineering standards.

This level of investment also includes the additional spending to increase transit capacity and contribute to the overall urban vehicle occupancy increase which the 1991 Highway Needs Report indicates will be necessary to maintain highway performance in the face of increased urban travel demand and constraints on increases in urban highway capacity. As described above, the 1991 Highway Needs Report indicates that about 34,000 lane miles of highway capacity can be replaced by aggressive system and demand management, <u>including transit</u>. Much of this will have to be accommodated by increases in overall vehicle occupancy, some of which will be transit vehicles. These investments can be expected to play a role in improving urban transportation productivity and relieving congestion. In addition, these investments can also be expected to have an effect on urban land use and environmental quality. In essence, this level of investment would result in an increase in transit passenger miles to replace a portion of the passenger miles not accommodated by the lane-miles foregone in the 1991 Highway Needs Report analysis. The transit market share of urban travel would grow by about 25 percent over a 20-year timeframe under this scenario.

COST TO MAINTAIN CURRENT CONDITIONS AND PERFORMANCE

Bus and Paratransit Services

To maintain present bus and paratransit service levels, buses and paratransit vehicles must be replaced in accordance with reasonable replacement schedules, and facilities invested in at normal levels. In addition, additional costs imposed by the Americans with Disabilities Act and Clean Air Act must be addressed.

The total number of vehicles required to operate maximum scheduled fixed route bus service in urbanized areas nationally is 42,870. Using FTA's spare ratio guideline of 20 percent additional vehicles as spares gives a total fleet requirement of 51,444. This is slightly less than the number of buses in the active transit fleet (52,945), which reflects the fact that some operators have more spares in their fleet than FTA's guideline. Section 15 data for 1990 indicates that 92 percent of vehicles used in motor bus service are standard size, double deck or articulated buses, 6 percent are midsize buses and 2 percent are small transit buses. As noted in Chapter 2, FTA has minimum useful life guidelines for replacement of transit vehicles based on these size classes. However, these represent minimum replacement schedules. In fact, buses are being replaced more slowly. For example, as noted in Chapter 2, the average age of the standard size buses is 8.2 years, implying a replacement schedule of 16 years. However, this total includes all buses, including excess spares. The average age of the required fleet of standard size buses is about 7.8 years, implying a replacement schedule of 15 years. The situation is similar for midsize and small buses. Consequently, to maintain current conditions in the total fleet required using FTA's spare ratio guidelines, full size transit buses would be replaced every 15 years (rather than 12 years), midsize buses every 12 years (rather than 10 years) and small buses every 9 years (rather than every 7 years). Using the percentage distribution of the fleet and this replacement schedule indicates a need each year for 3,155 full size buses, 257 midsize buses and 114 small buses for motor bus service. The average capital cost is $228,000 for large buses, $165,000 for midsize transit buses and $90,000 for small transit buses. Using these figures results in estimated annual needs for bus replacements to maintain current conditions of $719.3 million for large buses, $42.4 million for midsize buses and $10.2 million for small buses, or a total of $771.9 million. This is a weighted average cost per replacement bus of $219,000.

There is also a need to ensure that paratransit (i.e., demand response) vehicles provided by urban transit operators are also replaced on a reasonable schedule. Section 15 data indicates that a total of 8,042 such vehicles are required to provide demand response service. This includes those vehicles owned by transit operators (3,234 vans and 1,783 small buses) as well as those owned by private operators providing demand response service under contract to transit operators. Of these vehicles, about 33 percent are small buses and 67 percent are vans. Using the same spare ratio guidelines for buses and assuming that small buses are to be replaced every 9 years (rather than the 7-year minimum useful life called for in FTA guidelines) and vans are to be replaced every 5 years (rather than the 4-year minimum useful life guideline) indicates that annual demand responsive bus replacements should be 354 and van replacements should be 1,293 to maintain current conditions and services. The average cost of a small bus is $90,000 and of a van for demand response transit service is $30,000. Therefore, the annual capital need for demand response service to maintain current conditions is $70.6 million.

Bus and demand response services require a variety of support facilities such as light maintenance facilities as well as other capital stock such as terminals, park and ride lots, waiting facilities, shelters, and transfer facilities. As noted in Chapter 2, data are not readily available on the current condition of these facilities or on the current plans which operators have for their replacement and/or recapitalization. A detailed review of the recapitalization needs of bus maintenance facilities is currently being conducted and should be finished by late 1992. For the purposes of this analysis, the best source of information is recent capital spending for these purposes. Over the last 5 years, FTA has made grants for bus maintenance facilities equal to about one-third of the amount granted for vehicles. In addition, FTA has made grants for other bus facilities (such as terminals, shelters, etc.) equal to about two-thirds of the amount granted for vehicles. Using these factors, it is estimated that the cost to recapitalize present maintenance facilities is about one-third of the cost to maintain the bus and demand response fleet, or about $280.8 million per year. In addition, the cost to recapitalize other bus related facilities is estimated at about $561.7 million per year.

As described in Chapter 1, the total number of vehicles in the rural transit fleet is approximately 10,000. Data from the Community Transportation Association of America (CTAA) indicates that 6,185 of these vehicles are under 16-passenger capacity (i.e., vans), 1,830 are 16- to 25-passenger capacity and 2,092 are over 25-passenger capacity. Using an average useful life standard of 5 years for the vans and midsize vehicles and 9 years for the largest rural vehicles (which are likely to be small buses) gives annual replacement requirements of 1,237 vans, 366 midsize rural vehicles and 232 small buses. The average capital cost of the vans is $30,000, of midsize rural vehicles is $45,000 and small buses $90,000. The total cost to replace rural vehicles on the basis of current replacement schedules (which as for urban buses are longer than FTA minimum useful life guidelines) is $74.5 million annually.

As with urban bus facilities, no data is available on the condition of rural transit facilities. As noted earlier, FTA grants for all urban facilities have totaled about the same amount as grants for vehicles over the last 5 years. Rural area facility needs are likely to be proportionally less than urban needs since, because of the nature of rural service, there is less of a requirement for ancillary facilities such as terminals, stations, transfer facilities, and park-and-ride lots. Accordingly, for the purposes of this analysis, it is reasonable to assume that rural facility needs are likely to be about one-half of rural vehicle needs, or about $37.2 million annually to maintain present services.

As described in Chapter 1, the total number of vehicles serving elderly and disabled persons in agencies which have received FTA assistance under the Section 16(b)(2) program is about 21,000. Of these, about 11,000 were obtained with FTA assistance. The rest were purchased with funds from the Department of Health and Human Services (HHS) and other State and local social service agency funds. Of these vehicles, according to data from CTAA, 86 percent have a capacity of less than 16 passengers, 11 percent have a capacity of 16 to 25 passengers and 3 percent have a capacity of greater than 25 passengers. Using the same replacement schedules and average cost as noted above for rural transit vehicles indicates that 1,892 vans ($56.8 million), 242 midsize special service vehicles ($10.9 million) and 37 large special service vehicles ($3.3 million) need to be replaced each year to maintain current conditions in the FTA supported fleet. This represents a total cost of $71.0 million. Again, similar to the rural services, it is estimated that facilities for services to elderly persons and persons with disabilities are likely to be needed at about one-half this level, or $35.5 million per year.

Operators of urban and rural bus services will be required under the Americans with Disabilities Act to equip all new fixed route vehicles with lifts so that they are accessible to wheelchair users. In addition, operators of fixed route bus service will be required to provide complementary paratransit service for those who by reason of disability cannot use accessible fixed route service. The capital cost to achieve these ends has been estimated by the Department in its Regulatory Impact Assessment (RIA) for the final rule implementing the ADA. This rule was issued on September 6, 1991. The RIA estimated the capital cost of equipping buses with lifts at $33 million per year for urban buses and $9 million per year for rural fixed route buses. In addition, the RIA estimated the capital cost of acquiring the vehicles and other equipment and facilities needed to operate the supplemental paratransit service at $90 million annually.

Implementing the Clean Air Act Amendments of 1990 will require transit operators, primarily in nonattainment areas, to acquire "clean buses." Nonattainment areas are those metropolitan areas in which measured air quality violates the National Ambient Air Quality Standards for one or more pollutants. Depending on the success of vehicle manufacturers in developing so-called "clean diesel" engines for buses that will meet the standards, it may be necessary for operators to acquire alternative fuel buses. If the "clean diesel" buses meet the standards then there will be only a very small incremental cost to operators in connection with this aspect of the Clean Air Act. On the other hand, if alternative fuel buses are required, then a significant additional investment will be needed. This will include a cost to retrofit their maintenance facilities to accommodate the fueling and storage requirements connected with these new vehicles. If alternative fuel buses are needed, approximately 3,000 of the buses acquired each year (those in non-attainment areas) will have to be alternative fuel vehicles, at an incremental cost of $50,000 per vehicle. This is a total cost of $150 million per year. A recent analysis conducted by Battelle-Columbus indicates that the one-time cost to retrofit an average maintenance facility to accommodate alternative fuel vehicles is about $2 million. It is estimated that 300 of the total 523 bus facilities nationally are in nonattainment areas and would therefore have to be retrofitted. If one-sixth of the total were retrofitted each year, the annual cost for this period would be $100 million.

The total annual cost to maintain current conditions for bus and paratransit services is shown in Table 3.1.

To complete the picture of the cost of maintaining current conditions and performance, it is necessary to estimate the additional dollars needed to maintain bus performance levels in terms of meeting continuing transit growth. Clearly, there are a number of factors beyond the amount of transit service provided which affect its actual utilization. These include the fares charged for the trip, the relative travel time for a transit trip compared with an auto trip, the quality of the transit service provided, the level of auto parking costs and other auto user costs, and the degree to which land use patterns support transit

Table 3.1

Total Annual Cost to Maintain Current Conditions and Performance
Bus and Paratransit Services
(millions of dollars)

COST TO MAINTAIN CURRENT CONDITIONS	
Urban	
Vehicle Replacements	$842.5
(3,526 buses per year x $219,000 each)	
(1,647 demand resp veh x $42,887 each)	
Maintenance Facilities	280.8
(one-third of vehicle costs)	
Other Facilities	561.7
(two-thirds of vehicle costs)	
Rural	
Vehicle Replacements	74.5
(1,835 veh per year x $40,600 each)	
Facilities	37.2
(one-half of vehicle costs)	
Services to Elderly and Disabled Persons	
Vehicle Replacements	71.0
(2,171 veh per year x $32,700 each)	
Facilities	35.5
(one-half of vehicle costs)	
Americans With Disabilities Act	
Accessible Fixed Route Vehicles	42.0
Capital Costs of Complementary Paratransit Services	90.0
Clean Air Act Amendments (If No "Clean Diesel")	
Alternative Fuel Buses	(150.0)
(3,000 buses x $50,000 incremental cost)	
Maintenance Facility Retrofit	(100.0)
(50 facilities per year x $2.0 million)	
TOTAL COST TO MAINTAIN CONDITIONS	$2,035.2
COST TO MAINTAIN PERFORMANCE	
Additional Vehicles	90.0
(411 buses per year x $219,000 each)	
Accessibility Requirements on Vehicles	4.9
Clean Air Act Requirements on Additional Vehicles (If No "Clean Diesel")	(20.5)
(411 buses x $50,000 incremental cost)	
Facilities	45.0
(one half of vehicle cost)	
TOTAL COST TO MAINTAIN PERFORMANCE	139.9
TOTAL COST TO MAINTAIN CONDITIONS AND PERFORMANCE	$2,175.1

use. For the purpose of assessing the costs needed to maintain current growth rates, this analysis bases the estimate on the amount of additional service which would have to be provided to accommodate this increased travel. It does not represent a forecast that this increased transit use would occur, given the complexity of the other factors involved. Nevertheless, the estimate made, which assumes that bus service would expand at a rate equal to current growth rates in overall transit use, represents a reasonable basis for estimating the amount of transit investment needed to maintain performance. Based on the rate of growth in overall transit passenger miles during the 1980's, the amount of bus service (measured in vehicle hours) would have to be expanded by 0.80 percent per year to accommodate the trips needed to assure that this rate of growth in passenger miles continued.

Since the number of bus revenue vehicle hours per peak vehicle tended to stay fairly constant through the 1980's, it is likely that any increase in revenue vehicle hours will have to be matched by an equivalent increase in the number of transit vehicles. It is likely that since the additional service would be provided at the margin, it is more likely that a higher rate of increase in bus service would be needed to match the recent rate of increase in transit passenger miles. As a conservative estimate, a 0.80 percent per year increase in the bus fleet is assumed to be necessary to match a 0.80 percent growth in transit passenger miles. This means an increase in the bus fleet of 411 buses per year. At a weighted average cost of $219,000 per bus, this translates into a cost of $90.0 million per year for additional buses to maintain current performance levels. In addition, it will be necessary to assure that these buses are accessible in accordance with the requirements of the Americans with Disabilities Act. The additional cost of lifts on these buses is estimated at $4.9 million per year.

Since some of these vehicles and facilities are likely to be in nonattainment areas, the Clean Air Act Amendments of 1990 could also have an impact on the costs involved in maintaining current bus performance. If "clean diesel" technology does not provide a vehicle meeting Clean Air Act standards, then many of these additional vehicles would have to be alternative fuel buses, subject to the cost variations discussed earlier. If this is the case, using the estimates made above on the incremental cost of alternative fuel vehicles of $50,000, and applying this amount to the additional 411 buses purchased per year results in an estimated additional $20.5 million to assure that these new buses meet the requirements of the Clean Air Act Amendments.

The capital cost to maintain current bus performance levels must also include the cost of providing maintenance and other facilities related to the estimated increase in service required to do so. An amount equivalent to one-half of the cost of the buses themselves ($45.0 million per year) will need to be invested in such facilities. The total cost to provide the additional capacity necessary to maintain current overall transit growth rates in bus systems is thus $139.9 million per year, not including the cost of meeting the requirements of the Clean Air Act Amendments. The total cost to maintain current condition and performance in bus systems is therefore $2,175.1 million per year.

Rail Systems

The cost to maintain current conditions and performance on rail systems includes: 1) the cost of maintaining conditions on the older rail transit systems, 2) the costs associated with meeting requirements such as the Americans with Disabilities Act and 3) the cost of making improvements in existing systems and building new rail transit systems in order to maintain transit's recent rate of growth. These costs are shown in Table 3.2.

As noted in Chapter 2, the Rail Modernization Study provides the best source of information on current conditions in the Nation's rail systems. The Rail Modernization Study primarily focused on estimating the cost needed to bring rail systems to a good state of repair over a 10-year period. This cost, $17.9 billion in 1983 dollars, includes elements which relate to both of the investment levels being discussed in this report: 1) maintain current conditions and performance and 2) improve conditions and performance. Analysis of the improvements programmed over the 10-year period assessed in the Rail Modernization Study indicates that the average annual expenditure of $1,790 million in 1983 dollars is made up of $732 million in ongoing costs needed to maintain current conditions and $1,055 million in costs needed to improve conditions and retire the backlog of deferred investment needs. Inflating the ongoing costs needed to maintain current conditions to 1991 dollars gives a total recurring need to maintain conditions of $950 million.

Table 3.2

Total Annual Cost to Maintain Current Conditions and Performance
Rail Systems (millions of dollars)

• The annualized cost to repair and rehabilitate older rail transit systems solely to maintain current conditions and performance	$950.0
• Costs necessary to meet the requirements imposed by the Americans with Disabilities Act	$123.0
COST TO MAINTAIN CURRENT CONDITIONS	$1,073.0
• Rail fleet increases needed to maintain current market share of a growing urban travel market	$ 82.5
• Construction of new rail transit systems necessary to maintain current market share of a growing urban travel market	$560.0
COST TO MAINTAIN CURRENT PERFORMANCE	$642.5
TOTAL ANNUAL INVESTMENT NEEDED TO MAINTAIN CURRENT CONDITIONS AND PERFORMANCE	$1,715.5

This leaves a total backlog of $13.7 billion over 10 years in costs needed to restore rail systems to good condition.

Under the Americans with Disabilities Act operators of rail systems are required to provide at least one car per train that is accessible to wheelchair users and other persons with disabilities within 5 years and also ensure that "key stations" on their systems are likewise accessible within 3 to 30 years, depending on complexity. In addition, operators of rail systems will be required to provide complementary paratransit service for those who cannot use accessible fixed rail service. (The cost for this complementary service has been included in the discussion of the costs of bus services.) The total costs of the key station and one car per train within 5 years requirements have been estimated by the Department in its Regulatory Impact Assessment (RIA) for the final rule implementing the ADA. In addition, a separate RIA compiled by the Architectural and Transportation Barriers Compliance Board estimated the total cost of its required specifications. Taken together, and extracting out the operating cost impacts included in the RIA's, these estimates indicate that the total capital cost of ensuring that one car per train (within 5 years) and "key stations" are accessible will be about $123 million per year over the 10-year period of analysis used in this report.

As with bus systems, the cost to improve physical conditions on rail systems represents only the first part of the cost to maintain current conditions and performance. To maintain current rail performance levels in terms of maintaining recent rates of overall transit patronage growth, it is assumed, that like bus patronage, rail patronage increase at a rate equal to the recent growth rate, 0.80 percent per year. As with bus systems, this analysis estimates the cost of accommodating such an increase in patronage by estimating the cost to provide for an increase in capacity commensurate with that needed to handle the additional travel, which amounts to an incremental 155 million passenger miles per year.

In the case of rail systems, it is likely that some of this increase in service would be on existing rail systems and some on new systems. During the 1980's, rail passenger miles grew by approximately 280 million passenger miles per year. Of this annual growth, about 100 million passenger miles per year occurred on the older rail systems (such as New York, Chicago, Philadelphia, and Boston) and about 180 million passenger miles per year occurred on the New Start systems (such as Atlanta, Washington, San Francisco - BART, Baltimore, Miami, and San Diego). This analysis assumes that this split between growth in rail patronage accommodated by increased use of the older systems and by construction and expansion of New Start systems will continue. Therefore, this report will assume that the older systems will accommodate 55 million passenger miles per year of the growth on rail systems and the newer systems will accommodate 100 million passenger miles of this growth each year.

One way for the required increase in passenger miles to be served by existing rail systems is for these systems to acquire additional vehicles and operate a commensurately larger amount of revenue vehicle hours of service. During the 1980's, the number of revenue vehicle hours of service per peak rail vehicle remained essentially constant, so it is reasonable to assume that additional service hours needed to enhance capacity of the old systems would be accompanied by an increase in the vehicle fleet. The old rail systems served approximately 1 million annual passenger miles per vehicle. Thus, to accommodate an additional 55 million passenger miles per year would require an increase in the fleet of 55 rail vehicles per year. At $1.5 million per vehicle, this means $82.5 million per year for additional rail vehicles to maintain current performance levels.

A significant share of the cost of maintaining current conditions and performance with respect to rail service involves the construction of new fixed guideway systems. Since "current performance" has been defined as maintaining recent growth rates, and because forecasts suggest continued growth in urban travel, such new facilities will be needed even at the first level of transit investment.

To assure that New Start expenditures are cost-effective, in 1984, the Department issued a Major Investment Policy which required that projects funded with discretionary capital assistance produced benefits which were commensurate with their costs. To do so, the Department stated that projects must have a total annualized incremental cost of no more than $6.00 per new transit rider attracted compared with the best noncapital-intensive alternative (the "Transportation System Management" alternative). This value was calculated based on the total value of an average foregone automobile trip, including both user and nonuser benefits (such as improved air quality, reduced noise, reduced highway congestion, and reduced automobile accidents).

Recent work for FTA by Charles River Associates has confirmed that the total value of an average new rider is about $7.00, although there is substantial variation from city to city and project to project. Given inflation since 1984, this is consistent with the earlier estimate. On the basis of an average 10-mile work trip, this translates to an average value per passenger mile of $0.70. Recent experience indicates that of the total annualized cost of new rail investments, about 80 percent is made up of annualized capital costs and the remainder of the annual cost of increased transit service. On this basis, a cost-effective rail investment would have an annualized capital cost of no more than $0.56 per incremental passenger mile. Using standard annualization factors, this translates to an up-front capital investment of about $5.60 per incremental annual passenger mile.

As noted earlier, New Start investments would be expected to accommodate about 100 million new passenger miles per year. Using this estimate of the maximum reasonable cost to ensure that these investments are cost-effective suggests that New Start investments to generate this incremental rail patronage should total no more than $560 million.

This analysis assumes that investments in New Start projects at this level will all go toward maintaining performance in terms of maintaining recent transit patronage growth rates. Obviously, new investments such as these will represent some improvement in conditions and therefore could conceivably be included, at least in part, in the improve conditions and performance investment level. On the other hand, some of the improvements included in that investment level to restore the backlog of rail modernization needs could have the effect of enhancing the old rail systems and could thus be counted as maintaining market share. For this reason, it is believed that the overall estimates made for the cost to obtain each level of condition and performance are reasonable, even if the mix of rail investments between New Starts and Rail Modernization and other improvements to older rail systems included at each level could be modified.

Summary

Table 3.3 outlines the major expense categories necessary to maintain current conditions and performance.

COST TO IMPROVE CONDITIONS AND PERFORMANCE

Investment Backlog

One of the most important aspects of improving conditions and performance is the restoration of equipment and facilities to good repair. The investment scenarios discussed above included only the costs of keeping conditions constant, because they addressed only the costs of restoring equipment as it wears out or adding equipment and facilities to keep up with recent growth rates. However, these estimates did not address the fact that the current conditions of the equipment and facilities are not adequate. As noted, there are buses which are older than their minimum useful lives and a substantial amount of rail equipment and facilities in

Table 3.3

Total Annual Cost to Maintain Current Condition and Performance (in millions of dollars):

BUS AND PARATRANSIT SERVICES	
COST TO MAINTAIN CURRENT CONDITIONS	
Urban	
Vehicle Replacements	$842.5
Facilities	842.5
Rural	
Vehicle Replacements	74.5
Facilities	37.2
Services to Elderly and Disabled Persons	
Vehicle Replacements	71.0
Facilities	35.5
Americans With Disabilities Act	132.0
Clean Air Act Amendments	(250.0)
SUBTOTAL	$2,035.2
COST TO MAINTAIN CURRENT PERFORMANCE	
Additional Vehicles	90.0
ADA Requirements on Vehicles	4.9
CAAA Requirements on Additional Vehicles	(20.5)
Facilities	45.0
SUBTOTAL	139.9
TOTAL BUS AND PARATRANSIT	$2,175.1
RAIL SYSTEMS	
COST TO MAINTAIN CURRENT CONDITIONS	
Annualized cost to repair and rehabilitate older rail transit systems to maintain current conditions	$950.0
Costs necessary to meet the requirements imposed by the Americans with Disabilities Act	123.0
SUBTOTAL	$1,073.0
COST TO MAINTAIN CURRENT PERFORMANCE	
Rail fleet increases needed to maintain current transit growth rates	82.5
Construction of new rail transit systems necessary to maintain current transit growth rates	560.0
SUBTOTAL	$642.5
TOTAL RAIL SYSTEMS	$1,715.5
TOTAL COST TO MAINTAIN CURRENT CONDITIONS	$3,108.2
TOTAL COST TO MAINTAIN CURRENT CONDITIONS AND PERFORMANCE	$3,890.6

less-than-good condition. This section estimates the costs of eliminating this backlog, bringing the average fleet age down to the minimum useful life standards and bringing rail equipment and facilities to good condition over a 10-year period.

As noted earlier, there are 9,011 full size urban buses, 553 midsize urban transit buses and 303 small urban transit buses in excess of the minimum useful life guidelines set by FTA. Approximately 1,000 of these vehicles in the active fleet are in excess of the FTA maximum spare ratio guideline, so the actual number of overage vehicles totals about 8,888. These overage small buses include those used in demand responsive services. While the condition of these vehicles is not known, their age indicates that they have exceeded FTA guidelines for minimum useful life and should be retired and replaced with new vehicles. To replace all of these vehicles would cost approximately $1,949 million.

To improve conditions and performance by keeping the bus fleet at an average age consistent with FTA's minimum useful life guidelines will require faster replacements of vehicles than calculated to maintain current conditions and performance. Large bus replacements would have to be increased from 3,155 to 3,944 per year at a cost of an additional $179.9 million, medium bus replacements would have to be increased from 257 to 309 per year at a cost of an additional $8.6 million and small bus replacement would have to be increased from 114 to 147 per year at an additional cost of $3.0 million. The total incremental annual cost of accelerating bus replacements along these lines would be $191.5 million.

If vehicles were replaced at this rate for a 12-year period, at the end of that time, all of the overage vehicles would be replaced and the average fleet age would reach a level consistent with FTA's minimum useful life guidelines. However, 49 USC 308 calls for estimating transit needs over a 10-year period. To eliminate the backlog over that period would require a further increase in large bus replacements from 3,944 to 4,078, at an additional costs of $30.9 million per year.

To improve conditions and performance in demand responsive services by bringing the average age of these vehicles to a level consistent with FTA's minimum useful life guidelines would require additional investment. Section 15 data indicates that about 21 percent of the vans needed for demand responsive service are above the FTA minimum useful life standard. This represents about 1,357 vans. At an average cost of $30,000, replacement of these vehicles would cost about $40.7 million. Under this scenario, vans used in demand responsive service would be replaced at the FTA useful life guideline rate of once every 4 years instead of once every 5 years as assumed in the discussion on the costs to maintain current conditions and performance. This would require that annual replacements increase from 1,293 to 1,616, or an incremental annual cost of $9.7 million.

No information is available on the current age of the rural and specialized service fleets. Thus, it is not possible to calculate a backlog of replacement needs for these vehicles.

However, if these vehicles are to be replaced at the rate called for in the minimum useful life guidelines, then the rate of replacement of rural vans would have to increase from 1,237 per year to 1,546 at an incremental cost of $9.3 million, rural mid-size vehicles would have to have an annual replacement rate increase from 366 to 457 at an incremental cost of $4.1 million and rural large vehicle replacements would have to increase from 232 to 299 per year at a cost of $6.0 million per year. The total incremental annual cost in order that rural vehicles be replaced at the useful life guidelines rate would be $19.4 million.

Likewise, increasing the rate of replacements of specialized service vehicles to meet the minimum useful life guideline standards would require the number of vans replaced to increase from 1,892 to 2,365 per year at a cost of $14.2 million, midsize specialized service vehicle replacements to increase from 242 to 302 per year at a cost of $2.7 million and larger specialized service vehicle replacements from 37 to 48 per year at a cost of $1.0 million. The total incremental annual cost would be $17.9 million.

The estimates used earlier to calculate the cost of keeping transit facilities at their present condition is a reasonable basis for estimating cost to restore them from their present condition to a good state of repair. That is, total expenditures in recent years for maintenance facilities have run at one-third the level of expenditures on vehicles, and total expenditures on other facilities have run at two-thirds of the level of vehicle expenditures. Using these factors involves the assumption that bus facilities are in approximately the same condition as vehicles. This is reasonable, since it can be assumed there is no incentive for localities to have spending patterns which would favor improvements on facilities over vehicle replacements. Therefore, the total backlog of bus facilities needs is estimated to be about $1,949 million. The annual cost to restore these facilities to a good state of repair is estimated at $195 million per year over a 10-year period.

Table 3.4 summarizes the total bus and paratransit investment backlog, the costs to eliminate the backlog over a 10-year period and the cost to increase the pace of vehicle replacements to that permitted under UMTA's minimum useful life standards. Based on this analysis, the total bus and paratransit investment backlog is estimated at $3,939 billion and the 10-year cost to improve bus conditions is estimated at $464.3 million per year.

As noted above, the Rail Modernization Study provides estimates of the cost to restore facilities and equipment to a good state of repair over a 10-year period. The total cost estimated to achieve this goal was estimated at $17.9 billion in 1983 dollars. As noted, some of this cost includes the cost to maintain conditions at good levels once these levels are achieved. Based on the estimate made earlier, the average annual expenditure of $1,790 million in 1983 dollars includes $1,055 million in costs to eliminate the backlog. Inflating the figures in the Rail Modernization Study to 1991 dollars gives a total backlog of $13.7 billion and an average annual cost of $1,371 million over a 10-year period.

As shown in Table 3.4, the total rail investment backlog is $13.7 billion, which together with the bus backlog of $3.9 billion gives a total backlog of transit needs of $17.6 billion. To eliminate the total backlog over a 10-year period would require an annual investment of $1,835.3 million.

New Service

As noted earlier, the Highway Needs Study indicated that a variety of transportation system and demand management measures were simulated to indicate how to meet increased demand for urban travel with constrained new highway capacity. The 1991 Highway Needs Study demonstrated that a substantial savings in highway investments (amounting to $3.4 billion per year) could be achieved if these measures were adopted. The mix of changes in the characteristics of the urban travel market which would achieve the 34,000 lane mile reduction in 20-year highway investment requirements was not specified in the Highway Needs Study. However, some of the travel demand which would have been served by this additional highway capacity would be carried on transit. For the purposes of this analysis, it is assumed that 10 percent of the demand would be on transit, with the remainder being served through increases in vehicle occupancy. Even at this level, a substantial amount of increased transit service would be required.

The foregone increase in highway capacity of 34,000 lane miles represent about 257.4 billion passenger miles, assuming normal urban travel characteristics. Specifically, the 34,000 lane miles was multiplied by the capacity of a lane (2,000

Table 3.4

Transit Investment Backlog and Costs to Meet Minimum Useful Life Standards and Eliminate the Backlog

	Backlog	Per year for 10 years
BUS AND PARATRANSIT		
Urban Buses		
Backlog	$1,949	$ 30.9
Minimum Useful Life		191.5
Urban Demand Responsive Vehicles		
Backlog	41	-0-
Minimum Useful Life		9.7
Rural Transit	n/a	19.4
Specialized Services	n/a	17.9
Urban Transit Facilities	1,949	194.9
TOTAL - BUS AND PARATRANSIT	$3,939	$464.3
RAIL SYSTEMS	$13,710	$1,371.0
TOTAL TRANSIT	$17,649	$1,835.3

vehicles per hour), a peaking factor (10 percent of daily travel occurs in the peak period), an annualization factor (300 average travel days per year) and a typical peak period occupancy factor (1.1 passengers per vehicle) to develop this estimate. If 10 percent of this travel is served by transit, then an additional 25.7 billion passenger miles would be provided by transit over the present 38 billion passenger miles.

Some of this increase would be provided by the facilities and equipment needed to maintain current conditions and performance. Specifically, improvements included in that analysis would provide enough additional transit capacity to increase transit passenger miles by 17.2 percent from 1990 levels, or about 6.5 billion passenger miles by the end of 20 years. Therefore, additional transit capacity necessary to serve the difference (or about 19.2 billion passenger miles) would be required to meet the demand due to the forgone highway investment simulated in the 1991 Highway Needs Report. This is the additional increment of investment needed to improve conditions and performance. Under this scenario, the market share of urban travel provided by transit would increase by about 25 percent between 1990 and 2010.

To provide for this increase in transit use, it is likely that a mix of rail and bus facilities and equipment would be required. It is not possible to specify that mix since it would rely on local conditions and decisions. To calculate the cost of meeting this demand, it is assumed that enough additional transit service would be provided each year over a 20-year period to keep up with the increase in highway travel not being served by the highway system due to the forgone investment simulated in the highway needs study. Thus, sufficient transit investment would be needed each year to serve an additional 960 million passenger miles. If all of this service were provided by bus, and each bus were to serve the same number of passenger miles as is now the case on average (358,683 average annual passenger miles per bus in 1989), then an additional 2,677 buses would be required each year. At a total capital cost of $550,000 per bus (at $225,000 per vehicles and an equivalent amount for all related facilities), this amounts to an annual investment of $1.472 billion.

An estimate of the capital cost required to serve these additional passenger miles can also be made by estimating the maximum reasonable capital cost which is commensurate with the required increase in transit passenger miles (based on the benefits achieved by moving a passenger from a single occupant automobile to a transit vehicle). As noted earlier, on this basis capital costs in excess of about $5.60 per future annual passenger mile are not warranted. Therefore, the maximum capital costs which should be expended to serve the 960 million passenger miles would be $5.38 billion.

It should be noted that the annual capital cost which would have been required to provide the 34,000 highway lane miles which instead are foregone is estimated by FHWA to be about $3.4 billion per year. The 10 percent of this highway capacity which is assumed to be replaced by transit capacity would likely be more expensive than this average. This is because it would be built in places where highway capacity increases would be extremely expensive due to right of way constraints and extremely complex engineering required to fit the capacity into dense urban areas. In addition, as noted above, the benefit of moving travel to transit includes other benefits which go beyond the capital cost of the foregone highway capacity. Based on these additional factors, this analysis will use the $1.472 billion per year cost estimated based on average bus capital costs as the basis for the capital costs involved to provide increased transit service to provide the capacity necessary to serve increased transit use due to foregone increases in highway capacity. The $1.472 billion estimate is simply an average annual amount. The actual demand for transit to replace foregone highway investment is expected to phase in more gradually. In addition, this $1.472 billion estimate represents a potential rather that an existing need to increase transit capacity and is dependent upon certain conditions and policies being in place that make transit more attractive relative to other transportation options.

One area of improvement not included in this analysis concerns the standard of investment in existing rail systems. While the Rail Modernization Study estimated the cost of restoring rail systems to good condition, this was defined as essentially restoring facilities and equipment to like-new condition. It did not account for the fact that standards have changed significantly since these systems were built. Specifically, there are differences in the overall quality of the design of stations in the old rail systems with those in new systems. This includes a variety of factors, such as the presence of escalators, elevators, wider platforms, improved sight distances, and a variety of amenities. While some of these improvements will be made as a part of the effort to make "key stations" accessible under the requirements of the Americans with Disabilities Act, this does not cover all stations, nor do accessibility improvements cover all of the costs of making these stations meet modern standards. It is estimated that it would cost approximately $10 million to bring the average station in one of the older rail systems to modern standards. There are approximately 600 such stations with traffic levels warranting such an investment. Assuming that such investments were made over a 20-year period, this would amount to an annual cost of $300 million.

Based on this analysis, the cost to improve conditions and performance totals $3,607.3 million per year including eliminating the backlog of investment needs over 10 years. This is made up of three elements, as follows:

- The cost to eliminate the backlog of deferred investment in transit over a 10-year period ($1,835.3 million per year);
- The cost to provide the capacity needed to serve increases in transit use due to foregone highway construction ($1,472.0 million per year); and
- The cost to improve conditions in older rail transit systems by bringing stations to current standards ($300 million per year).

SUMMARY OF TRANSIT NEEDS AT SPECIFIED LEVELS OF PERFORMANCE

This chapter estimated the capital costs in terms of two levels of performance: 1) maintain current conditions and performance and 2) improve conditions and performance. The cost to Maintain Current Conditions and Performance is estimated at $3.89 billion per year for 10 years. This is the investment needed to maintain current levels of service and meet such new external requirements such as the Clean Air Act Amendments of 1990 and the Americans with Disabilities Act. At this level of investment, facilities and equipment are maintained in their current state of repair. It also includes the additional investment level needed to extend coverage and improve service levels to maintain current trends in growth in transit patronage. It includes low capital demand management as well as new starts at historical levels.

At this level of investment, the amount of transit service provided would increase at a rate of 0.80 percent per year, consistent with the total rate of increase in transit use of the last 10 years. In 20 years, this would result in an increase in capacity of 17 percent, raising the total amount of transit service from the present 169 million revenue vehicle hours to about 198 million revenue vehicle hours. This increase in capacity could accommodate an increase in passenger miles carried from the present 38 billion to about 44 billion. At this level of investment, transit vehicles would be replaced at about the current rate, which is slightly slower than what is generally regarded as optimal. Existing rail systems would be maintained in about the current conditions, with no major improvements. Investments on existing rail systems would occur at about the rate needed to ensure that equipment and facilities are replaced as they wear out. New rail systems would be constructed at a rate sufficient to accommodate the present rate of transit patronage growth.

The cost to Improve Conditions and Performance is estimated to require an additional $3.61 billion per year for 10 years. This is the additional investment needed to increase market share by 24 percent over a 20-year period in order to contribute to the overall urban vehicle occupancy increase which the 1991 Highway Needs Report indicates will be necessary to maintain highway performance in the face of both increased urban travel demand plus constraints on increases in urban highway capacity. In addition, this performance level includes the cost of eliminating the backlog of deferred capital investment requirements of $18 billion, by spending $1.8 billion per year over a 10-year period.

At this investment level, transit services will increase over a 20-year period, to about 283 million revenue vehicle hours per year, thereby providing capacity to accommodate about 64 billion passenger miles per year, compared with 38 billion passenger miles today. In addition, at this level of investment, the backlog of deferred rail and bus modernization and rehabilitation needs would be eliminated over a 10-year period, restoring those systems to good condition and bringing them up to more modern standards. Accordingly, for the next 10 years, assuming that all investment goals are to be met, mass transit in the United States will require annual capital investment at a level of approximately $7.5 billion per year, expressed in 1991 dollars. In summary, Table 3.5 displays mass transit capital investment needs at both levels of performance discussed in this report and does so, in cumulative fashion at 1-, 5- and 10-year intervals, as specified by law.

DEVELOPMENT OF IMPROVED INFORMATION ON TRANSIT CAPITAL NEEDS

Throughout this report there have been frequent references to the quality and validity of the data used for making estimates of mass transit capital needs. While projections contained in this Section 308 report are unquestionably sounder than those in past reports, it must be recognized that if future reports are to see continued improvement, even better data will be needed. For example, as a working hypothesis this report has assumed that the relative magnitude of unmet rail modernization needs are just about the same as they were when the rail modernization study inspections were conducted 8 years ago, adjusted only to reflect the impact of inflation. Obviously, many things have changed over this interval and transit systems have pursued modernization programs on older rail networks. But the level of investment they have been making is more consistent with holding the line against any continuing growth in the backlog of unmet needs than reducing it, providing plausibility for the hypothesis used in this report. Better information as to the current conditions of these rail systems would be helpful.

Similarly, while the information provided for the age of bus vehicles fleet is quite reliable, there is no equivalent estimate available on the condition and needs related to bus maintenance and other facilities. This report has used historical spending

Table 3.5

Summary of Mass Transit Capital Investment Needs By Level of Performance and Investment Period (billions of 1991 dollars)

	One Year	Five Years	Ten Years
Level 1 - Maintain Current Conditions and Performance	$3.89	$19.4	$38.9
Level 2 - Improve Conditions and Performance	3.61	18.0	36.1
TOTAL	$7.50	$37.5	$75.0

patterns to estimate needs in this area, a valid method but not an ideal one.

A number of efforts are underway to improve the quality of data that will be used in future Section 308 reports. First, the Rail Modernization Study is being updated. This project involves reviewing the actual improvements made since the Rail Modernization Study surveys were conducted and providing an updated estimate of the cost to restore the rail transit infrastructure to good condition. The study is currently underway and is scheduled to be completed in May 1992.

A project has also begun to determine the current conditions and needs of bus maintenance facilities. In this study, information will be collected on the current conditions of facilities at key bus systems as well as pending improvement programs. Case studies will also be conducted of a number of major facilities. The result should be an improved picture of bus facilities needs. This study is scheduled to be completed in October 1992.

The final area for improved information involves a much more extensive program of development. Currently, urban areas are required to develop Long Range Transportation Plans and Transportation Improvement Programs (TIP) identifying investment projects to be conducted in the area in the near-term. These plans and programs are required by Section 8 of the Federal Transit Act, which calls for a planning process which result in these products. Section 8 and the implementing Joint Planning

Regulations provide more detail on how these plans are to be developed and what the TIP must contain.

For the purposes of estimating transit capital investment needs, this process already provides useful information. The TIP have lists of programmed projects which indicate what improvements are likely in the next few years. The Transportation Plans are more expansive efforts and include broad-scale proposals for both major and minor changes in each area's transportation system. Efforts will soon get underway to build on the information base that is implicit in the entire transportation planning process (i.e., Long Range Transportation Plans and Transportation Improvement Programs already being developed in all urbanized areas) and use this to generate better data and information for estimating mass transit capital investment needs as mandated by 49 USC 308(e), the statutory grounding of this report.

SUMMARY

No estimate of capital investment needs can possibly be made without assumptions. To project mass transit investment needs merely as those needed to replace existing plant and equipment in kind, for example, assumes that mass transit's recent growth, in the face of growth in overall travel demand, will not continue.

The preceding sections and chapters have attempted to honor the letter and spirit of the legislative language that mandates the biennial submittal of the Section 308 report. Assumptions have certainly been made in carrying out this legislative mandate.

These assumptions are not unreasonable; more importantly, they are not hidden. How accurate they prove to be as harbingers of the condition of mass transit in the future remains to be seen. Using the assumptions in the report, and the projections that flow from them, provides a range of options and possibilities for policy makers to use as mass transit begins to confront the future.

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