TRANSIT COOPERATIVE RESEARCH PROGRAM

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TCRP Report 28

Transit Markets of the Future

The Challenge of Change

Transportation Research Board
National Research Council

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Report 28

Transit Markets of the Future

The Challenge of Change

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with assistance from

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TRANSIT COOPERATIVE RESEARCH PROGRAM

The nation's growth and the need to meet mobility, environmental, and energy objectives place demands on public transit systems. Current systems, some of which are old and in need of upgrading, must expand service area, increase service frequency, and improve efficiency to serve these demands. Research is necessary to solve operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the transit industry. The Transit Cooperative Research Program (TCRP) serves as one of the principal means by which the transit industry can develop innovative near-term solutions to meet demands placed on it.

The need for TCRP was originally identified in *TRB Special Report 213—Research for Public Transit: New Directions*, published in 1987 and based on a study sponsored by the Urban Mass Transportation Administration—now the Federal Transit Administration (FTA). A report by the American Public Transit Association (APTA), *Transportation 2000*, also recognized the need for local, problem-solving research. TCRP, modeled after the longstanding and successful National Cooperative Highway Research Program, undertakes research and other technical activities in response to the needs of transit service providers. The scope of TCRP includes a variety of transit research fields including planning, service configuration, equipment, facilities, operations, human resources, maintenance, policy, and administrative practices.

TCRP was established under FTA sponsorship in July 1992. Proposed by the U.S. Department of Transportation, TCRP was authorized as part of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). On May 13, 1992, a memorandum agreement outlining TCRP operating procedures was executed by the three cooperating organizations: FTA; the National Academy of Sciences, acting through the Transportation Research Board (TRB); and the Transit Development Corporation, Inc. (TDC), a nonprofit educational and research organization established by APTA. TDC is responsible for forming the independent governing board, designated as the TCRP Oversight and Project Selection (TOPS) Committee.

Research problem statements for TCRP are solicited periodically but may be submitted to TRB by anyone at any time It is the responsibility of the TOPS Committee to formulate the research program by identifying the highest priority projects. As part of the evaluation, the TOPS Committee defines funding levels and expected products.

Once selected, each project is assigned to an expert panel, appointed by the Transportation Research Board. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, TCRP project panels serve voluntarily without compensation.

Because research cannot have the desired impact if products fail to reach the intended audience, special emphasis is placed on disseminating TCRP results to the intended end users of the research: transit agencies, service providers, and suppliers. TRB provides a series of research reports, syntheses of transit practice, and other supporting material developed by TCRP research. APTA will arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by urban and rural transit industry practitioners.

The TCRP provides a forum where transit agencies can cooperatively address common operational problems. The TCRP results support and complement other ongoing transit research and training programs.

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FOREWORD

By Staff
Transportation Research Board

This report will be of interest to transit policymakers, managers, planners, marketing professionals, and others interested in the effects of current trends (e.g., demographic, economic, social, land use, and transport policy) and trends expected over the next 15 years on current and future transit markets. Although many of these trends are not favorable to public transit, a number are identified that provide opportunities for maintaining current transit markets and creating new, expanded, or different transit markets. The report identifies 40 transit service concepts that appear to offer the most effective means of adjusting to these societal trends.

During the past 30 to 40 years, the portion of urban trips carried by public transportation has declined. This decline has resulted largely from such factors as increasing suburbanization, increases in real income and vehicle ownership, changes in family life styles and household composition, and demands for increasing mobility. Will the decline in transit ridership continue or do these factors create a potential for new transit riders? How must transit adjust its services to meet the demands of an ever-changing marketplace? Answers to such questions will be crucial to the future of transit.

Demographic forces could produce dynamic new demands on transit. Conversely, there are some demographic changes that could result in relative stability in transit ridership. Other forces could alter the effectiveness of existing traditional fixed-route transit services. Some trends may be supportive; others may indicate the need to develop new concepts of service delivery and positioning strategies. For transit to be successful, the opportunities and threats generated by the marketplace must be understood.

Public transit must develop a vision of its role in serving existing and potential markets and ensure that transit benefits the entire population. Most transit operators believe that the greatest benefit is the mobility provided to those who ride transit today — workers traveling to congested urban centers; transit-dependent groups (e.g., senior citizens, students, individuals with disabilities, and the economically disadvantaged); and discretionary travelers who choose transit as the best mode of travel. Traditional transit services, however, will be challenged increasingly by demographic changes, geographic trends, economic influences, technological advancements, and societal concerns and expectations. The variability and direction of change in these factors require a careful assessment of their effects on existing and potential transit users and their influences on the future of transit services.

Under TCRP Project H-4B, research was undertaken by the Drachman Institute for Land and Regional Developmental Studies, The University of Arizona, to (1) identify the potential effects of anticipated demographic, geographic, economic, technological, and societal trends on today's transit ridership and services and (2) identify future transit ma rkets resulting from these trends and the most appropriate services to address those marks.

To achieve the project objectives, the researchers first identified current transit markets using various sources, including the 1990 U.S. Census, 1991 American Housing Survey, and 1990 Nationwide Personal Transportation Study. The researchers then identified projected trends potentially influencing travel. Trends discussed include industrial restructuring; a flexible labor force; work at home and telecommuting; women's labor force participation; growth of the aging population, single-parent and single-adult households; suburbanization; migration and immigration; decreasing population and employment densities; increasing downtown employment density; increasing density in older suburbs; family support relationships; perception of crime; division of household responsibilities; transit funding; relaxation of transportation control mandates; and flexibility of the use of federal transportation funding. An assessment of how these societal trends will probably influence current transit markets was then performed. In addition, potential markets being created by these trends are identified, along with potential service options to meet these emerging needs. Finally, a brief analysis of the equity and efficiency implications of implementing these service options is presented.

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TRANSIT MARKETS OF THE FUTURE—THE CHALLENGE OF CHANGE

PREFACE

Major societal changes have produced travelers with myriad variations in transportation patterns and needs, but transit systems have not been quick to understand the need to provide different travelers with targeted or specific services. Brad Edmondson, the editor of *American Demographics* commented in 1994,

> [T]ransportation planners must learn the basics of niche marketing. The consumers of transportation come in many shapes and sizes, and each segment has different needs. Like skilled marketers, planners must craft strategies rooted in consumer information that encourages people to chose mass transit ... over private vehicles.[1]

Despite this real need, the Surface Transportation Policy Project recently noted,

> In transportation planning ... we still seem to follow Henry Ford's dictum about Model T colors: "Give 'em any color they want, so long as it's black." ... Planning transportation ... solely around the work place or around median or average behavior obscures the real needs of real Americans.[2]

Public transit must assess the markets where its current strengths lie, consider what new markets exist or are evolving, evaluate how these new markets can best be served, and evaluate the areas where it is possible to strengthen the role of public transit. The striking and complex sociodemographic and industrial changes that are occurring worldwide create not just problems but new opportunities for transit operators to play a crucial role in urban mobility and accessibility.

TCRP Project H4-B, "Transit Markets of the Future—The Challenge of Change," was designed to objectively identify what potential or actual transit markets are created, strengthened, or threatened by these complicated societal changes. The study had four specific objectives as follows:

- To synthesize what has happened to transit use and ridership in various circumstances in response to the range of socioeconomic, demographic, and technical trends affecting U.S. society;
- To evaluate the direction and magnitude of future societal changes which might affect transit use, indicating new markets created by, as well as markets diminished by, these trends;

1. Brad Edmondson, "Alone in the Car," *American Demographics,* June 1994, p. 57.
2. "Putting People First," *Progress,* vol. IV, no. 7, Surface Transportation Policy Project, September 1994, p. 1.

- To analyze the kinds of transit services which could be fashioned to respond to emerging markets and niches while maintaining cost-effective services to existing markets; and
- To suggest to the transit community the political, financial, and institutional context needed for the successful development and implementation of appropriate services.

Tasks included the following:

- Identify current and emerging transit markets;
- Identify a range of projected societal trends—sociodemographic, economic, social, and policy—and then evaluate how these trends would affect the current transit markets identified in the first task;
- Identify societal trends which might maintain current markets or create new, expanded, or different transit markets;
- Identify transit options which might be appropriate for new and changing transit markets;
- Evaluate the effect of implementing the effective service options;
- Consider how sensitive projected effects were to policy and funding positions; and
- Recommend the best way to disseminate the study findings to the transit industry.

The results and analyses undertaken in these tasks are presented in this report in five chapters (described in the Summary). The eight appendixes contain a glossary, a list of areas included in each service environment, a description of the Section 15 analyses leading to the selection of the case sites, complete case studies of those sites, a comprehensive description of operational experiences with promising and effective service options, an evaluation of the attributes of promising options likely to lead to greater transit use in different service environments, and a full evaluation of the major societal trends affecting transit use.

SUMMARY

Many metropolitan areas face declining transit ridership. Many societal trends accelerate this problem. Although a few trends, such as increased immigration, have led to temporary increases in ridership in some communities, the complex industrial, demographic, and land use changes affecting U.S. society continue to erode ridership, even among the most dedicated groups of transit users. Soon, the losses will outweigh the gains. Some transit operators, however, have accepted the reality of these trends as a challenge to identify innovative opportunities, to better serve existing riders, and to find ways to provide different or improved transit services that attract new markets. These transit operators have maintained or even increased ridership through innovative planning and services.

This study focuses on communities that have expanded their markets or found new ones by providing different transit services that focus more on user needs and patterns. The study results are presented in five chapters, which are summarized in the following subsections.

CHAPTER 1: CURRENT TRANSIT MARKETS

Eleven groups of users, or markets, were identified as being more likely than average to use transit as their principal mode for commuting to work, relatively independent of their income or the size or density of the metropolitan areas in which they lived:

- Workers with low incomes,
- Workers with no household cars,
- Workers with college education,
- Blacks,
- Hispanics,
- Workers with graduate school,
- Workers age 17 to 29,
- Women,
- Asians,
- Immigrants (under 10 years in the United States), and
- Workers with mobility or work limitations.

The data show that there are distinctly different markets among those riding transit—it is unlikely that they all could or would be well served by the same services, routes, schedules, and marketing approaches.

CHAPTER 2: SOCIETAL TRENDS: THEIR EFFECTS ON CURRENT AND EMERGING MARKETS

To evaluate the effect of societal trends, research team personnel examined five aggregate categories of trends likely to affect the demand for transit in the future. These categories were as follows:

- Economic,
- Demographic,
- Social,
- Land use, and
- Transport policy.

Research team members found that most trends act to the detriment of public transit. Traditional transit services are best at serving large groups of travelers going to one or a few destinations along concentrated corridors of demand in concentrated peaks. Unfortunately, most of the societal trends analyzed reduce the net number of such travelers. For example, economic trends are creating a major class of workers who do not work in the same place each day or whose schedule changes frequently or who work late at night, early in the morning, or on weekends. Land use trends are resulting in longer trips which are more difficult to serve by transit.

In the short term, transit ridership may increase in absolute terms among some markets, simply because the population within that market is growing. For example, immigrants, who tend to rely heavily on transit, are increasing in number. However the absolute growth in these markets may not translate into greater total system ridership in either the short or long run because (1) the group's relative contribution to total transit ridership is so small or (2) the share of each group riding transit may be decreasing even as it increases in size (as a result of the same trends that negatively affect ridership among other groups).

CHAPTER 3: PROMISING SERVICE CONCEPTS: THEIR EFFECTS ON CURRENT AND EMERGING MARKETS

The research team found communities that had implemented new or different services or that had changed the ways in which they organized and targeted their tradi-

tional services and thus increased transit ridership by doing so. The research team found ridership data indicating that 13 service concepts were effective in increasing transit ridership—most in various metropolitan environments. These concepts are as follows:

- Feeder services,
- Express buses,
- Services to large employers,
- Reverse-commute services,
- Vanpool incentives,
- Park-and-ride services,
- Fare incentives,
- Travel training and transit familiarization,
- Light rail,
- Commuter rail,
- Route restructuring,
- Community buses/service routes, and
- Special event services.

Not every community that implemented one or more of these concepts was successful in maintaining or increasing ridership; however, the study findings suggest there are clear opportunities, despite immense barriers, to increase ridership by carefully targeting services to user needs and preferences.

The ridership increases occurred in the following 10 transit niches and markets (although not all services increased all the markets listed):

- People with disabilities,
- People age 17 to 25 (particularly university students),
- Children age 5 to 12,
- Blacks (particularly inner-city residents),
- Hispanics,
- Immigrants,
- People age 65 and over,
- People with high incomes,
- People age 50 and over, and
- Men.

Many of these riders are not those traditionally seen to depend on transit.

CHAPTER 4: SOCIETAL EFFECTS OF IMPLEMENTING PROMISING SERVICE CONCEPTS

The research team evaluated the societal benefits which might arise from implementing various effective service concepts. To do this, the research team (1) assessed the total potential ridership of each concept, (2) evaluated the equity and effectiveness of each effective service concept, and (3) used these assessments to give some idea of the relative magnitude of societal benefits offered by each effective service concept.

The research team concluded that the service concepts which provide the greatest societal benefits—that is, are the most equitable and efficient—are those that can affect the largest absolute number of riders. These concepts are as follows:

- Reverse-commute services,
- Services to large employers (including universities),

- Vanpool incentives,
- Route restructuring, and
- Feeder services.

Less efficient and equitable services are those which affect a much smaller subset of the population (even in cases where a higher percentage of those groups become transit riders). These services are as follows:

- Express buses,
- Light rail,
- Commuter rail, and
- Park-and-ride.

The assumptions on which these conclusions are based are controversial—the conclusions depend on currently observed ridership patterns—not on potential ridership. Rail systems, in particular, are said to be able to create major transit ridership by changing land use and so forth.

CHAPTER 5: IMPLICATIONS FOR TRANSIT AGENCIES AND THE INDUSTRY

To use the study findings successfully, transit systems must reconsider their traditional strategies, focusing first on rider needs and then on system constraints and resources. This often conflicts with how they have traditionally operated. Yet the study findings are as auspicious as they are pessimistic; operators can attract new riders, target new markets, and slow erosion of their ridership base.

Implementing many of the effective service options will pose multiple and serious challenges to many transit systems. But few of these challenges are as drastic or potentially devastating as the ones which await operators who do nothing to deal with the major changes in the travel patterns of most Americans. Unless they respond to their markets, most transit systems will see their ridership erode—and their public and political support with it.

Because this study raises many questions, the research team recommends appropriate agencies consider additional research aimed at the following:

- Refining the transit market groups identified in this study by using more sophisticated statistical methods to analyze current transit ridership patterns;
- Projecting the actual magnitude of changes in ridership in individual transit markets, assuming different societal trends;
- Identifying market patterns in a sample of individual metropolitan areas, using both aggregate and disaggregate data;
- Preparing comprehensive case studies of the implementation of effective (or promising) service concepts; and
- Conducting ongoing assessments of the outcome of implementing various market-driven service concepts.

CHAPTER **1**

CURRENT TRANSIT MARKETS

INTRODUCTION

Current transit markets were identified using a four-part sequential process of

- Identifying those groups more likely to use transit than average in the aggregate of all metropolitan areas in the United States,
- Controlling for household income to identify those groups still more reliant on transit,
- Evaluating if groups more reliant nationally when controlling for income were still more reliant on transit when controlling for the population and density of metropolitan areas, and,
- Determining whether those groups remained more reliant on public transit when controlling simultaneously for income, metropolitan population, and metropolitan density.

The analyses were based on simple factor-by-factor cross-tabulations and indexes, although the 5 percent sample is so large that all relationships are statistically significant.

These analyses are described in the following four major sections. The first major section describes the data sources on which the analyses are based. The second major section focuses on current national home-to-work transit patterns, first in the aggregate and then by the type of transit and household income. The third major section explains how the research team divided all metropolitan areas into 14 service environments, categorized by population and density, and then examines home-to-work patterns in these environments. Current patterns are first examined in the aggregate within each category of service environment and then by income. The fourth major section presents a roughly comparable analysis of non-work travel patterns nationally in the aggregate and by income. Unfortunately, it was not possible to divide non-work trip patterns into service environments.

The last major section of the chapter summarizes current transit markets in the United States.

DATA SOURCES

The analyses were based on three major *user-reported* data sources: the 1990 U.S. Census 5 percent Public Use Microsample (PUMS) files, the 1991 American Housing Survey (AHS), and the 1990 Nationwide Personal Transportation Study (NPTS); a full discussion of these data sources and their strengths and weaknesses are given in Appendix A. Overall, the data presented five major problems.

First, the research team could not analyze work trip patterns within urbanized areas. The inability to incorporate density data at the urbanized area level forced the research team to focus on metropolitan-level data in the Census and the AHS. (The research team members were able to use urbanized area data in the NPTS.) Second, two of the three data sets—the Census and the AHS—ask for the "usual" or "principal" mode of travel; this approach undercounts people who occasionally use transit, make a multi-modal trip where the transit segment is shorter than the other segment(s), or take transit 1 or 2 days a week but not every day. Third, all of these databases underreport transit use because they undercount certain market groups such as poor people and illegal immigrants. Fourth, the Census and the AHS have data only on work trips. Finally, sample size problems arise when disaggregating the AHS and the NPTS transit data (for example, by sex, race, and income).

In the end, the research team relied largely on the Census data to identify work markets and on the NPTS to identify non-work transit markets. One advantage of the research team's reliance on the Census data is that, although the research team's analysis did not involve tests of the statistical significance of the differences in transit use rates, the metropolitan sub-sample of the 1990 PUMS Census data is so large—more than three million respondents—that almost all of the differences the research team describes would be statistically significant.

NATIONAL HOME-TO-WORK TRANSIT PATTERNS

Overall Patterns

To identify markets relatively more reliant on public transit, the research team indexed transit use patterns for various demographic groups to the average transit use rate for all metropolitan areas in the United States (6.86 percent), as shown in Table 1. This is actually a conservative estimate of

TABLE 1 Transit use by various market niches indexed to average metropolitan transit use

Market Niches	MSA Transit Index
Sex	
Men	.85
Women	1.18
Race and Ethnicity	
White	.68
Black	2.72
Hispanic (all races)	1.73
Asian	1.74
Vehicle Ownership	
No Car	5.76
One or More	.68
Age of Worker	
17-29	1.14
30-39	.96
40-49	.87
50-59	.92
60-64	1.07
65-69	1.10
Education	
No School	2.59
Elementary	2.08
Junior High	1.69
Some High School	1.25
High School	.91
Some College	.82
College	1.05
Graduate School	1.06

Market Niches	MSA Transit Index
Household Income	
< $5k	1.23
$5 - 10k	1.24
$10 - 15k	1.08
$15 - 20k	1.04
$20 - 25k	.97
$25 - 30k	.90
$30 - 40k	.78
$40 - 50k	.77
$50 - 60k	.84
$60 - 70k	.91
$70 plus	.95
Immigration Status	
Non-immigrant	.84
Immigrant	2.08
Years in US	
< 5	3.01
5 - 10	2.25
10 - 15	1.74
15 - 20	1.89
20 - 25	1.88
25 - 30	1.49
30 - 40	1.48
40+	1.80
Limitations	
Work Limitation	1.25
Mobility Limitation	2.41

Source: Unpublished tape readable data from the 1990 US Census, 5% PUMS

transit reliance because the average mode split for all metropolitan areas, 6.86 percent of workers, includes those groups more likely to use transit. However, this is a relative rating; transit use is fairly low in the United States so even groups shown to be disproportionately more reliant on transit may not use transit very much.

Those groups in Table 1 with an index above one were more likely than average to commute using transit in 1990; conversely those with an index below one were less likely than average to commute using transit.

The index is also an indicator of the magnitude of transit reliance; the higher the index, the greater the dependence on transit—workers in a group with an index of 2 were twice as likely as the average metropolitan worker to commute using transit. For example, those with no cars had an index of 5.76—which means that the percentage of workers with no cars who used transit was 5.76 times as high as the percentage of all metropolitan workers who commuted using transit.

The Census analysis shows that 14 groups were more likely than average to use transit as their principal mode for commuting to work in U.S. metropolitan areas in 1990. These 14 groups are as follows:

- Women,
- Blacks,
- Hispanics,
- Asians,
- Workers without household cars,
- Workers age 17 to 29,
- Workers age 60 and over,
- Workers with less than high school education,
- Workers with some high school but no degree,
- Workers with a college degree,
- Workers with graduate school education,
- Workers with household incomes below $20,000,
- Immigrants (regardless of the number of years that they have been in the United States), and
- Workers with a work or mobility limitation.

Some of these findings are expected; market groups long dependent on public transit were still disproportionately more likely to commute using transit in 1990. Almost 19 percent of Black workers, for example, used transit for their work trip in 1990 as did 13 percent of Hispanic workers and 12 percent of Asian workers. However, some of these findings are unexpected, including the greater relative dependence on transit among those with college education as well as among immigrants who have been in the United States for many years. That almost 17 percent of workers who reported a mobility limitation used transit may also be surprising.

Figure 1 illustrates one of the more unexpected patterns seen in Table 1, showing that transit use was substantially higher among both male and female immigrants than among non-immigrant travelers, regardless of how long the immigrants had been in the United States. Although transit use for the work trip was highest among recent immigrants, it never fell below 12.3 percent of female immigrants and 8.4 percent of male immigrants.

Moreover, immigrants who had been in the United States the longest—more than 30 years—were actually more likely to be transit users than those who had been in the United States for 10 to 30 years (although here the research team may be confounding immigration status with the age of worker because Table 1 also indicates that all older workers were more likely than average to use transit).

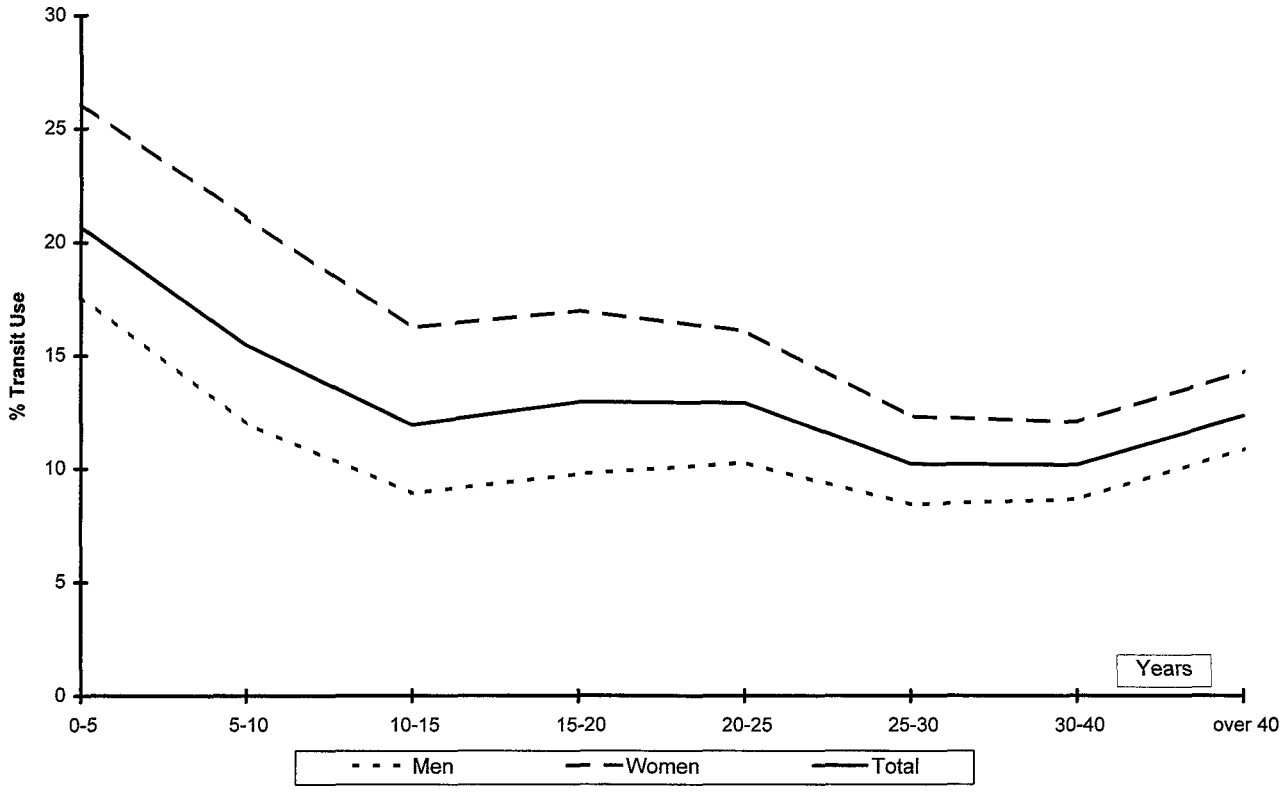
Patterns by Type of Transit

Perhaps some of the most surprising of the preceding analyses are those that show disproportionate transit use among more educated workers. When transit use is disaggregated by the specific transit mode—as described in the Census—and then by education, a more complicated picture emerges.

Figure 2 shows that the disproportionate reliance on transit among those with higher education actually reflects a growth in the use of subway and commuter rail. Among those with a college degree, almost 50 percent of all those using public transit were using the subway; roughly 25 percent were using commuter or heavy rail. In contrast, among those with a high school degree, subway use accounted for roughly 29 percent and rail for roughly 5 percent of all transit ridership.

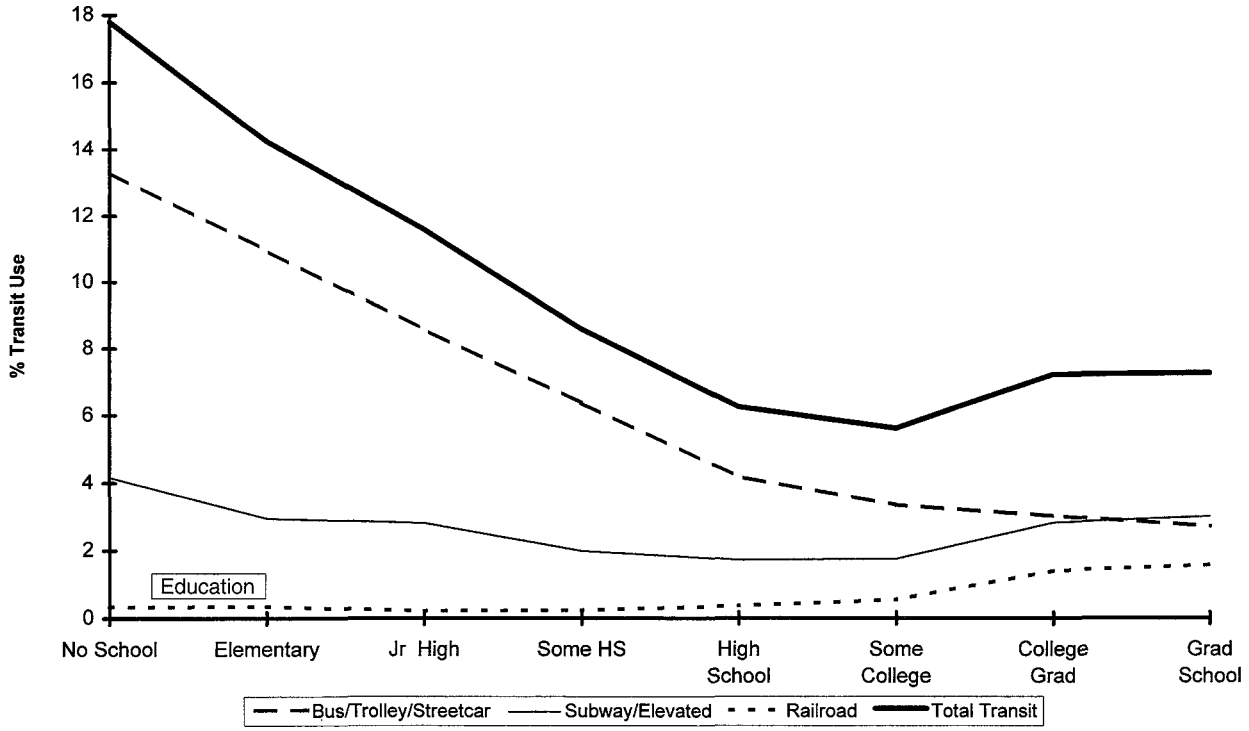
Figure 3 shows similar transit patterns related to income: as workers' household incomes increase, they become more reliant on commuter rail; almost all of the increase in transit use seen among those with incomes above $40,000 was the result of increased commuter and heavy rail use. Roughly 40 percent of the total transit ridership of those with incomes above $70,000 was on commuter rail. In fact, more than 70 percent of the total ridership of that group was either on the subway or commuter rail. Conversely, bus and trolley use dropped fairly rapidly as income increased although the drop was far slower after incomes of $30,000 to $40,000.

On the other hand, increased transit use with the increasing age of the worker held constant, even when the research team examined for the use of various modes. The increase in transit use after 40 was the result of the growth in the use of all modes—with bus, trolley, and streetcar use increasing most sharply. In fact, as Figure 4 shows, almost 5 percent of workers 65 to 69 used just these combined modes (that is, without rail or subway) to go to work.



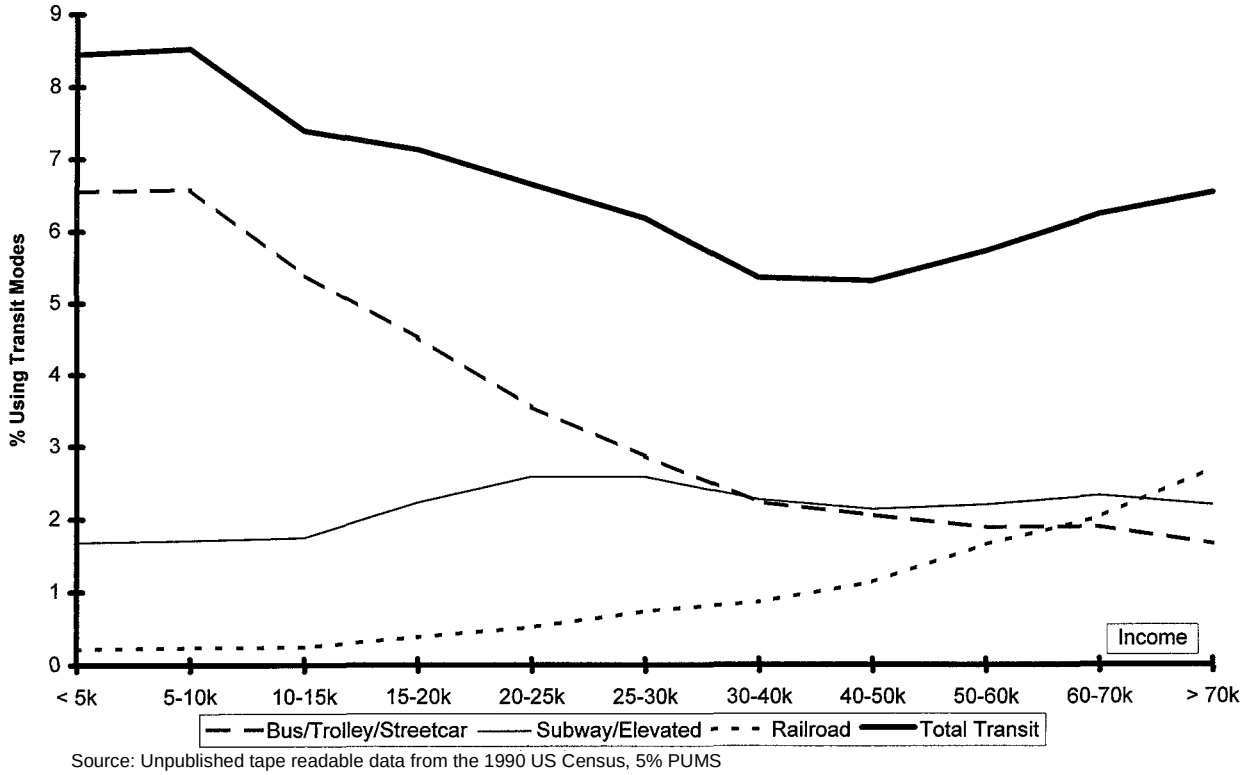
Source: Unpublished tape readable data from the 1990 US Census, 5% PUMS

Figure 1. Transit use to work in metropolitan areas by immigrants, by sex and number of years in the United States.



Source: Unpublished tape readable data from the 1990 US Census, 5% PUMS

Figure 2. Transit use to work in metropolitan areas, by education and type of transit.



Source: Unpublished tape readable data from the 1990 US Census, 5% PUMS

Figure 3. Transit use to work in metropolitan areas, by type of transit and household income.

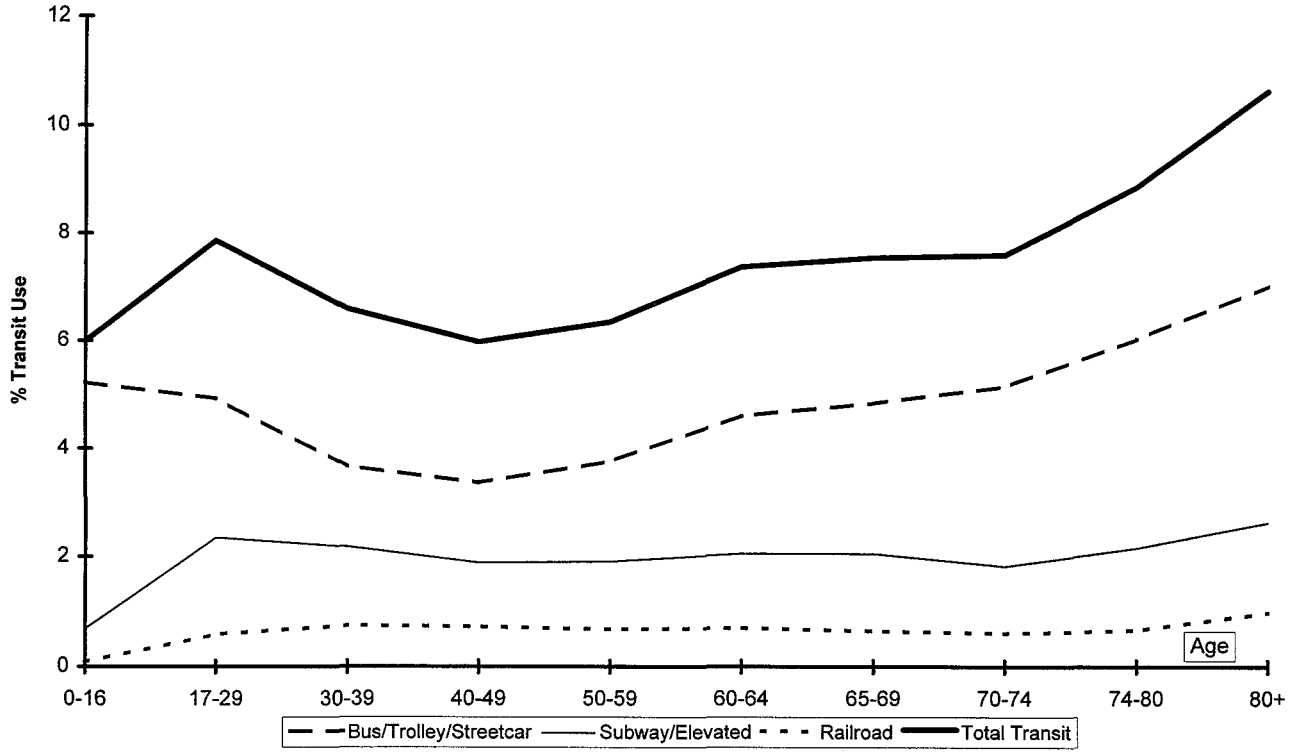


Figure 4. Transit use to work in metropolitan areas, by age and type of transit.

National Home-to-Work Patterns by Income

To the extent that transit use tends to drop with increasing income, some or all of the behavior of various groups seen in aggregate national analyses could reflect differences in household income. However, Table 2 shows that, of the 14 groups identified in the aggregate patterns as more likely to use transit than the metropolitan average, all 14 remain more reliant on transit even when controlling for household income.

The only group among whom the aggregate pattern does not hold is those with some high school education but no degree; only workers in this group with household incomes below $40,000 were more likely than average to use public transit.

Specifically, the analyses in Table 2 compared ridership for each market niche with the metropolitan average transit use for each of 11 specific household income categories as follows:

- Under $5,000: 8.45 percent,
- $5 – 10,000: 8.52 percent,
- $10 – 15,000: 7.39 percent,
- $15 – 20,000: 7.13 percent,
- $20 – 25,000: 6.65 percent,
- $25 – 30,000: 6.18 percent,
- $30 – 40,000: 5.36 percent,

$40 – 50,000: 5.31 percent,
$50 – 60,000: 5.73 percent,
$60 – 70,000: 6.24 percent, and
$70,000 plus: 6.54 percent.

The percent of transit use among each of these groups was indexed—within the 11 income categories—to the percentages listed above. For example, the percentages of Black, Hispanic, and female workers making less than $5,000 who used transit to commute to work were indexed to 8.45 percent. The research team members consider that a market niche had higher than average reliance on public transit controlling for income category if the index was higher than 1 in more than 8 to 9 categories. This is indicated in the second column in Table 2. Notable exceptions are also shown in Table 2. For example, although women were more likely to use transit than comparable male workers in 9 of the 11 income categories, they were not more likely to do so at incomes under $10,000.

Figure 5 illustrates one of the interesting patterns seen in Table 2. Workers with a mobility limitation were more likely to use transit than the average metropolitan worker at most income levels, sometimes by a factor of 2 or 3.

Table 2 makes it clear that workers in all 14 groups (including, by definition, the low-income group itself) were more likely to use transit than the average metropolitan worker controlling for income. These analyses directly

TABLE 2 Higher than average transit use to work in metropolitan areas

Potential Market Niches	Higher Than Metropolitan Average	Higher When Controlling for Income	Higher When Controlling for Mode and Income		
			Bus/Streetcar	*Subway*	*Rail*
Sex					
Men				● under $15k	
Women	●	●	●	● over $15k	● over $15k
Race & Ethnicity					
White					● over $40k
Black	●	●	●	● under $50k	● under $40k
Hispanic (all races)	●	●	●	●	
Asian	●	●	●	●	●
Vehicle Ownership					
No Car	●	●	●	●	●
One or more					
Age of Worker					
17-29	●	●	● over $30k	●	●
30-39		● over $50k		● under $10k over $40k	● over $30k
40-49					
50-59			● under $50k		
60-64	●	● under $50k	●	●	
65-69	●	●	●		
Limitations					
Work Limitations	●	● under $40k	●		
Mobility Limitations	●	●	●	●	
Education					
No School	●	●	●	●	
Elementary	●	●	●	●	
Junior High	●	● under $30k	●	●	
Some High School	●	● under $25k	●		
High School					
Some College					
College	●	●	● over $25k	●	●
Graduate School	●	●	● over $30k	●	●
Immigration Status					
Non-Immigrant					
Immigrant	●	●	●	●	●
Years in the U.S.					
< 5	●	●	●	●	●
5-10	●	●	●	●	●
10-15	●	●	●	●	● under $50k
15-20	●	●	●	●	●
20-25	●	●	●	●	●
25-30	●	●	●	●	●
30-40	●	●	●	●	●
40+	●	●	●	●	●

(continued on next page)

respond to the question of whether ethnic and racial minorities are really more likely to be transit users than the average traveler—given that so many ethnic and racial minorities are poor. The table shows that the income patterns of these groups are not obscuring different behavior among workers of color with higher incomes. Regardless of income, Black, Hispanics, and Asians are all more likely to use public transit than the average metropolitan worker.

Figure 6 illustrates these patterns. At all household income levels, Blacks, Hispanics, and Asians were more likely to commute using public transit than were Whites (and than the national average of all metropolitan workers). At the same

TABLE 2 *(continued)*

Potential Market Niches	Higher Than Metropolitan Average	Higher When Controlling for Income	Higher When Controlling for Mode and Income		
			Bus/Streetcar	*Subway*	*Rail*
Household Income		N/A			
< $5k	●		●		
$5-10k	●		●		
$10-15k	●		●		
$15-20k	●		●	●	
$20-25k				●	
$25-30k				●	●
$30-40k				●	●
$40-50k				●	●
$50-60k				●	●
$60-70k				●	●
$70k +				●	●

* higher than national average for mode for these income categories only
Source: Unpublished tape readable data from the 1990 US Census, 5% PUMS

time, of course, transit use did drop with increasing income among minority workers—it just never dropped as low as among other metropolitan workers with comparable incomes. Moreover, transit use patterns stabilized among workers of color at household incomes of roughly $40,000 but actually rose for White workers.

Hidden within the indexes in Table 2 are also some surprising patterns related to income. Although higher income groups were not more likely to use transit than the average metropolitan worker, they were at the same time, more likely to do so than middle income workers. For example, workers in households making $60,000 to $70,000 were more likely to commute using transit than were workers in households making $25,000 to $30,000.

Figure 7 illustrates these anomalies, showing that, although low-income people of both sexes were more likely to use transit than those with higher household income, (1) there were substantial differences between men and women and (2) transit use rose for both sexes at income levels above $40,000. As a result, women with incomes above $30,000, for example, were more likely to commute using transit than women making $10,000 to $15,000.

Figures 2 and 3 suggested that greater transit use among those with higher incomes and higher educational attainment might be the result of a greater dependence on commuter rail and rapid rail transit. The third column of Table 2 describes the results of an analysis of the interaction of income and the specific mode of transit used (again as described in the Census). These analyses show that, even though these groups make most of their transit trips on these modes, they are still generally more likely to use buses and so forth than the average metropolitan worker. For example, at incomes over $25,000, those with a college degree make more bus and streetcar trips to work than the metropolitan average; those with graduate training make disproportionately more bus trips than other workers at incomes above $30,000.

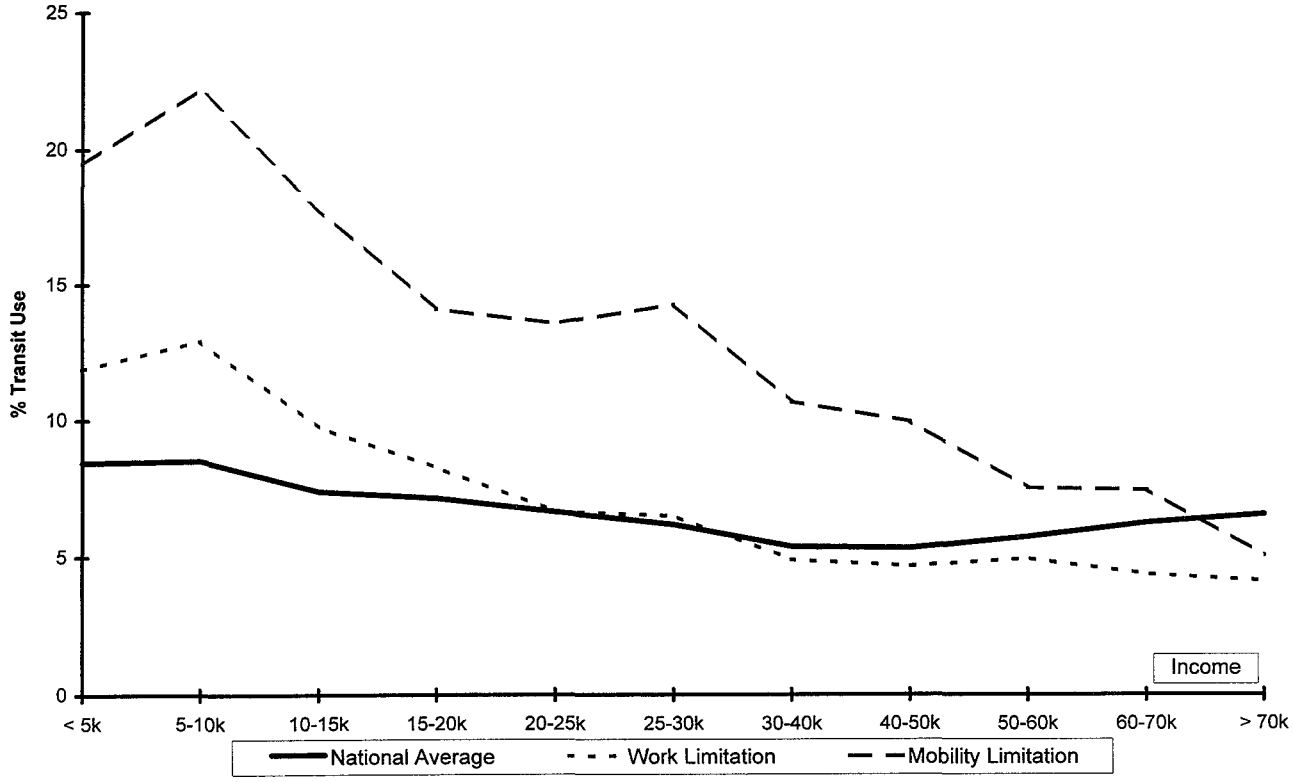
Summary

Relatively regardless of income, 14 overlapping groups of people compose the national market for public transit for the home-to-work trip. Although many of these groups have traditionally been more reliant on transit (e.g., minorities, women, and older travelers), it is surprising that their disproportionate reliance holds when income is also considered. Perhaps most surprising is the heavy reliance on transit by higher income immigrants.

HOME-TO-WORK PATTERNS IN INDIVIDUAL SERVICE ENVIRONMENTS

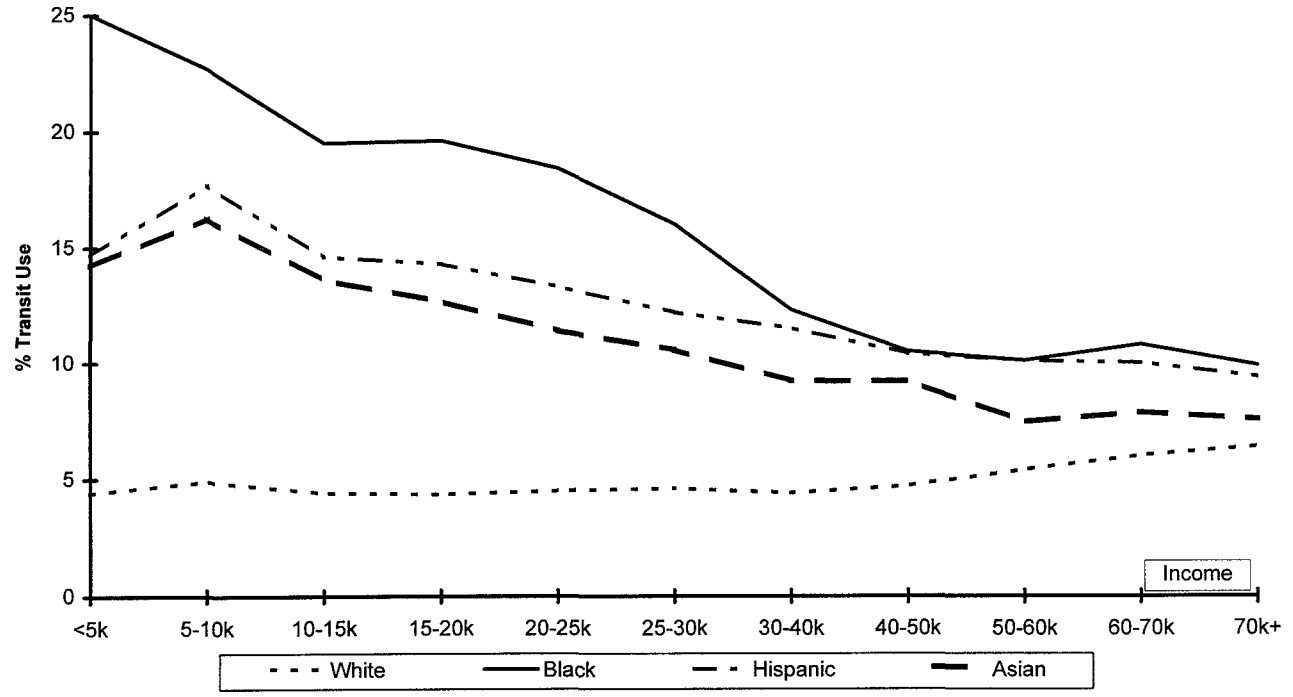
In the metropolitan areas of the United States, land use patterns, population density, racial and ethnic diversity, and the kind and amount of transit services available all differ remarkably. Therefore, the market groups just identified, such as Blacks or Hispanics or highly educated people, are only more likely to use transit than the average worker in aggregate national data because so many live in New York, Chicago, Philadelphia, or other major cities.

It would be expected that people living in areas with substantially more public transit services and higher density origin-destination (O-D) patterns would show higher than national average use of transit. Although such groups may not rely more on transit than other workers in their specific



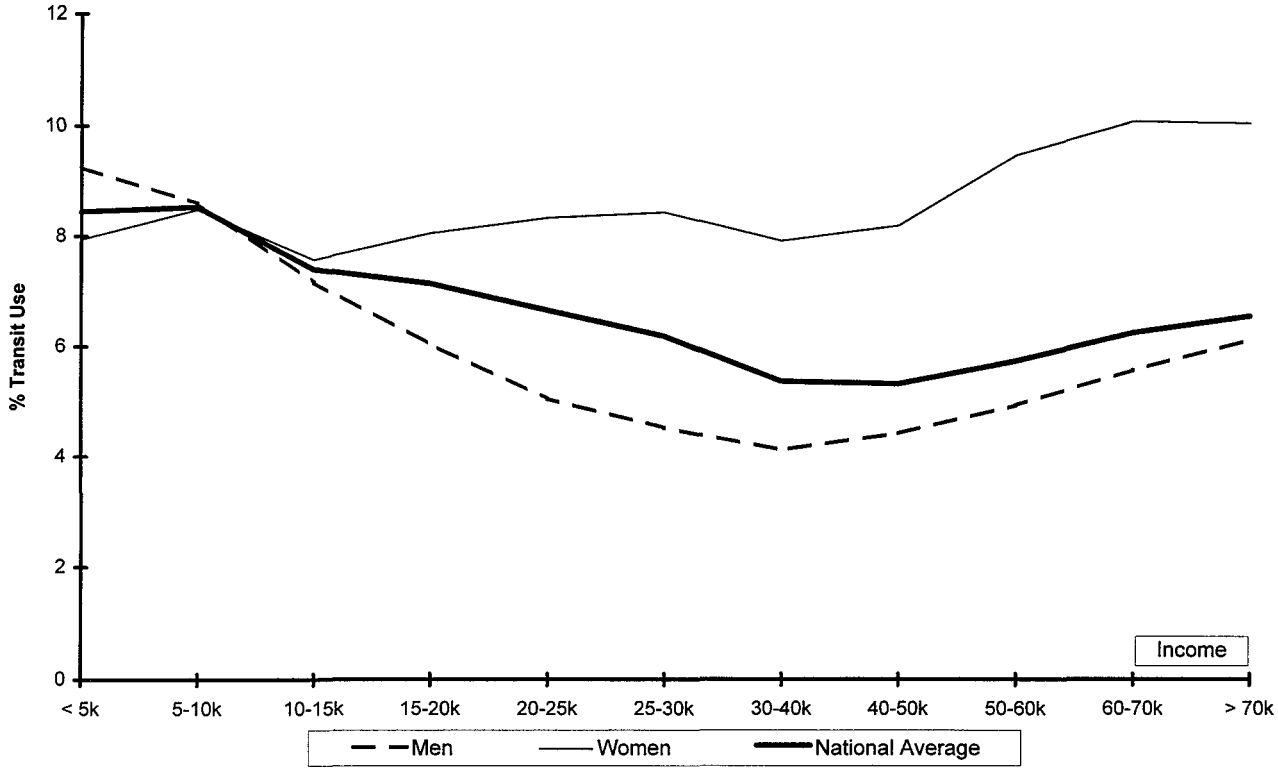
Source: Unpublished tape readable data from the 1990 US Census, 5% PUMS

Figure 5. Transit use to work in metropolitan areas by income, work limitation status, and mobility limitation status.



Source: Unpublished tape readable data from the 1990 US Census, 5% PUMS

Figure 6. Transit use to work in metropolitan areas, by race, ethnicity, and household income.



Source: Unpublished tape readable data from the 1990 US Census, 5% PUMS

Figure 7. Transit use to work in metropolitan areas, by sex of worker and household income.

metropolitan region, it may appear as if they do in unweighted national averages.

Therefore, it is important to investigate home-to-work travel patterns in different kinds of metropolitan areas. A metropolitan-level analysis should make clear which patterns seen in the national data represent simply the mathematical dominance of major cities, such as New York City and Chicago in national transit use data—and which patterns are seen in other metropolitan areas. However, it was beyond the scope of this study to look at every metropolitan area in the United States. To undertake the metropolitan analyses, the research team divided U.S. metropolitan areas into 14 specific service environments, categorized by both population and density.

Defining Service Environments

To develop individual service environments, the research team divided metropolitan areas into four population categories and then again into four density categories. The population categories were as follows:

- 50,000 to 200,000,
- 200,00 to 500,000,
- 500,000 to 1,000,000, and
- 1,000,000 and over.

The research team computed metropolitan area density data—available only at the county level—from the 1990 Census Summary Tape File STF3 and imported them into the 5 percent PUMS data. Because most communities in the United States have very low average density, the research team used only the following four categories:

- Very low: less than 50 people per sq. mile,
- Low: 50–1,000 people per sq. mile,
- Medium: 1,000–2,000 people per sq. mile, and
- High: more than 2,000 people per sq. mile.

Chicago and New York were evaluated as separate service environments—both because they are very different from most other U.S. metropolitan areas and because these two metropolitan areas together account for a substantial proportion of all transit ridership in the United States. Although there were 18 possible service environments (4 population categories multiplied by 4 density categories plus New York and Chicago), actual metropolitan areas existed only in 14 of the categories.

The research team members believe this approach is reasonable and useful, although it has problems. Using such large categories and categorizing as high density those cities with only 2,000 people per sq. mile may introduce some large biases. A bigger problem is using county-level density data because even very dense cities may be surrounded by low-density development, which artificially lowers metropolitan density as is the case in New York City. In addition, some service environments as defined here contain many apparently similar metropolitan service areas (MSAs) while other service environments have only a few, seemingly dissimilar, MSAs.

However, although the research team personnel recognize that these categories are far from perfect, the categories are a good first approach to understanding transit use in specific environmental contexts.

Identifying Transit Markets

In order to identify market groups disproportionately more likely to use transit within various metropolitan environments, the research team compared the specific service environment transit use of each of the 14 national market groups with average transit ridership in that service environment. The research team members first did so without controlling for income within service environments and then controlling for income categories. The aggregate analysis appears in this section, the income analysis in the next.

Table 3 summarizes the aggregate service environment analyses. A dot indicates that workers in the market niche in question were more likely to use public transit than the average worker in that service environment (that is, that the index was above 1). Table 3 shows that, of the 14 groups identified as more likely to use transit than the average metropolitan worker, most remained more likely to do so even when controlling for service environment. Twelve of the 14 groups were disproportionately more reliant on public transit for their work commute in 10 or more categories (or more than 70 percent of the metropolitan environments).

Of the 14 environments, four of the groups—women, immigrants, workers with no household car, and those with incomes below $10,000—were disproportionately more reliant on public transit for their commute than the average worker in their specific service environments.

Of the 14 groups, the following were more likely to use transit in 10 to 13 of the 14 service environments: workers ages 17 to 29, workers with less than high school education, workers with some high school education but no degree, workers with work and mobility limitations, Asians, Blacks and Hispanics. Older workers and those more highly educated were more likely to use transit than the average worker in 5 to 7 service environments.

At the same time, low income was associated with transit markets in most service environments. Those with incomes less than $15,000 were likely to create transit markets in almost every service environment—the exceptions tended to be in the smallest environments. At the same time, in the aggregate national figures, those with incomes as high as $20,000 were seen as more dependent on transit. This suggests that transit use among low-income workers in Chicago, New York, and so forth mathematically distorted the national indexes—even though those groups did not constitute higher than average ridership in those service environments.

In addition, these analyses show that immigrants who had been in the United States more than 10 years created only a few transit markets, even though these indexes were all greater than 1 in the national analyses. This suggests again that high transit use among long-term immigrants in some markets mathematically distorted the national indexes—even if long-term immigrants did not rely on transit more than others in those markets. However, unlike those with low income, immigrants in the United States for more than 10 years had high relative ridership in lower density service environments. This may reflect the movement of Asians and Hispanics—the largest groups of immigrants from abroad—to such communities in the South and West.

These analyses also reveal some markets not shown in the national analyses. There were three service environments where high-income workers were more reliant on transit than the average worker and not in Chicago and New York as might have been expected. In those service environments, travelers with high incomes were less likely to use transit than the average. Rather high-income travelers created a market in both medium- and high-density service environments between 500,000 and 1,000,000 and in mediumdensity environments between 200,000 and 500,000.

Because the magnitude of the reliance of various market groups is of interest, the detailed analyses on which Table 3 is based are shown in Tables 4 and 5. Table 4 covers metropolitan areas less than one-half million while Table 5 covers metropolitan areas larger than one-half million (including New York and Chicago). An index of more than 1 indicates that the group in question used transit for the work trip more than the average of all workers in that service environment. Numbers below 1 indicate that group used transit less than the average worker in that service environment.

These tables show that not only were Black workers, for example, more reliant on public transit than the average worker—they were many times more likely to use transit in most service environments and generally much more reliant in less dense communities. For example, Black workers in very-low-density metropolitan areas under 200,000 were almost 5 times as likely to use transit as the average worker. In fact, the percentage of Black workers using transit was more than 3 times as high as the average percentage in six

TABLE 3 Home-to-work transit markets by service environments

Market Niche ↓ / Population Density	50,000-200,000			200,000-500,000			500,000-1,000,000			over 1,000,000			Chicago	New York
	very low	low	medium	very low	low	medium	low	medium	high	low	medium	high		
Sex														
Men														
Women	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Race & Ethnicity														
White														
Black	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Hispanic (all races)	●	●	●	●	●	●	●	●		●	●	●	●	●
Asian		●	●	●	●	●	●	●	●	●	●		●	●
Vehicle Ownership														
No Car	●	●	●	●	●	●	●	●	●	●	●	●	●	●
One or More														
Age of Worker														
17-29	●	●	●	●	●	●	●		●	●	●	●	●	●
30-39	●								●					●
40-49														
50-59			●					●						
60-64		●	●	●			●	●		●				
65-69		●	●	●	●		●	●		●				
Limitations														
Work Limitations	●	●	●	●	●	●	●	●		●	●	●	●	
Mobility Limitations	●	●		●	●	●	●	●		●	●	●	●	●
Education														
No School	●	●	●	●	●	●	●	●		●	●	●	●	●
Elementary	●	●	●	●	●	●	●	●		●	●	●	●	●
Junior High	●	●	●	●	●	●	●	●		●	●	●	●	●
Some High School	●		●	●	●	●	●	●		●	●	●	●	●
High School	●			●			●			●				●
Some College		●							●	●				
College			●			●			●		●		●	●
Graduate School		●				●		●	●				●	
Immigrant Status														
Non-Immigrant														
Immigrant	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Years in the U.S.														
< 5	●	●	●	●	●	●	●	●	●	●	●	●	●	●
5-10					●	●	●	●	●	●	●	●	●	●
10-15	●		●					●						
15-20	●		●											
20-25				●										
25-30			●						●					
30-40														
40+					●				●					

(continued on next page)

TABLE 3 (*continued*)

Market Niche ↓	Population Density	50,000-200,000			200,000-500,000			500,000-1,000,000			over 1,000,000			Chicago	New York
		very low	low	medium	very low	low	medium	low	medium	high	low	medium	high		
Income															
< $5k		●	●		●	●	●	●	●		●	●	●	●	●
$5-10k		●	●	●	●	●	●	●	●	●	●	●	●	●	●
$10-15k				●	●	●	●	●	●		●	●	●	●	●
$15-20k					●				●		●	●		●	●
$20-25k				●								●			●
$25-30k										●					●
$30-40k															
$40-50k										●					
$50-60k							●								
$60-70k							●								
$70k +							●		●	●					

● = higher than service environment average transit use = transit market
Source: Unpublished tape readable data from the 1990 US Census, 5% PUMS
The cities in each Service Environment are listed in Appendix B

more than 3 times as high as the average percentage in six service environments and 2 times as high in three more.

Other minority groups were also substantially more likely to use public transit than the average worker. Hispanic workers were 3 times as likely as the average worker to use transit in four service environments—generally the smallest and least dense. Moreover, Hispanic workers were more reliant on public transit than Black workers in four service environments.

Workers with either work or mobility limitations were also very reliant on public transit, particularly in metropolitan areas under one half million. For example, in low-density metropolitan areas under 200,000, workers with a mobility limitation were more than 10 times as likely to use public transit as the average worker in that service environment.

Tables 4 and 5 also show that poor educational attainment was much more linked with transit use than was low income. In most service environments, those with no more than a junior high education were 5 to 7 times more likely to use transit than the average worker. Those with incomes under $10,000, however, were "only" about 75 percent more likely to use transit. Several of the groups more reliant on transit were not a great deal more likely to do so. Female workers were only slightly more likely to use transit—their indexes ranked from 1.42 to 1.05. Young workers (i.e., those age 17 to 29) were only 25 percent more likely to use public transit than the average worker in most service environments.

The preceding analyses show that groups long thought to be more reliant on transit indeed used transit relatively more in most service environments—even smaller, lower density communities. These groups—women, those with no car, and ethnic and racial minorities—had indexes more than 1 in the national analyses because they were genuinely more likely to use public transit than comparably situated workers in many different kinds of metropolitan areas. Young and older workers and even the more highly educated were also genuinely more likely to use transit in several individual service environments.

The Effect of Income

However, the analyses above did not evaluate the effect of income within the 14 service environments. Even though the reliance of these groups on transit held when controlling for income in national patterns, higher transit ridership may be income-based within individual service environments but is distorted in aggregate numbers. Table 6 summarizes the analyses of the effect of income on transit ridership within the 14 individual service environments.

As in previous analyses, the transit patterns of each market niche were compared with average transit ridership within each service environment by income category. A market group was considered to show greater relative use of transit if that group's average ridership exceeded the income-specific service environment average in at least 8 of the 11 income categories.

Table 6 shows that income differences did not generally explain the dominance of most market niches, although the number of service environments where some groups had disproportionate transit use did drop. Eleven of the 14 national transit markets (the low-income categories are included by definition) were more reliant on public transit in most service environments (7 or more) even when controlling for income. Overall, aggregate transit rates within each service environment were not generally obscuring lower ridership among higher income people in these groups (even though few

TABLE 4 Transit use to work indexes by service environment in metropolitan areas under 500,000

Market Niches ↓ • population • density • average transit use	50-200,000			200-500,000		
	very low	low	medium	very low	low	medium
	.80%	1.60%	3.32%	3.60%	1.55%	4.40%
Sex						
Men	.95	.82	.62	.96	.79	.82
Women	1.06	1.22	1.42	1.05	1.25	1.20
Race and Ethnicity						
White	.93	.81	.81	.92	.75	.83
Black	4.99	3.03	3.45	2.11	3.23	2.40
Hispanic (all races)	.84	3.97	3.03	3.34	2.28	3.10
Asian	.96	3.15	2.52	1.04	1.83	1.55
Vehicle Ownership						
No Car	13.45	7.06	7.15	7.43	10.88	4.93
One or More	.69	.48	.75	.69	.68	.83
Age of Worker						
17-29	1.25	1.30	1.15	1.20	1.26	1.05
30-39	1.02	.81	.80	.76	.88	1.01
40-49	.69	.80	.87	.94	.83	.91
50-59	.82	.82	1.09	.99	.86	.69
60-64	.50	1.00	1.02	1.03	.97	1.11
65-69	.50	1.49	2.16	1.88	1.16	1.88
Education						
No School	7.46	4.59	1.37	7.83	12.80	1.18
Elementary	1.89	2.24	1.31	7.45	7.74	1.34
Junior High	2.46	1.71	1.51	2.44	.96	1.07
Some High School	1.39	1.53	1.36	2.01	.20	1.19
High School	1.07	.95	.92	1.02	.05	.65
Some College	.58	.88	.86	.73	.84	.73
College	.57	.84	1.18	.66	.76	1.44
Graduate School	.73	1.03	.51	.43	.90	1.58
Limitations						
Work Limitation	5.20	3.49	2.29	2.33	2.76	1.61
Mobility Limitation	14.68	10.48	.47	6.44	7.61	2.60
Household Income						
< $5k	1.90	1.83	.91	1.49	1.79	1.09
$5 - 10k	1.71	1.86	1.87	1.99	1.78	1.16
$10 - 15k	.91	1.01	1.54	1.40	1.22	1.05
$15 - 20k	.95	.74	.91	1.17	.80	.91
$20 - 25k	.30	.45	1.28	.51	.59	.75
$25 - 30k	.20	.49	.78	.32	.47	.63
$30 - 40k	.46	.52	.48	.39	.47	.70
$40 - 50k	.80	.64	.58	.28	.66	.94
$50 - 60k	.37	.50	.83	.33	.56	1.15
$60 - 70k	--	.80	.31	.60	.68	1.82
$70 plus	.20	.65	.91	--	.53	2.32
Immigration Status						
Non-immigrant	.88	.64	.95	.81	.95	.93
Immigrant	2.15	1.13	1.30	3.29	1.69	1.47
Years in US						
< 5	1.09	2.66	1.61	1.94	2.03	1.59
5 - 10	.81	.92	.98	.90	1.15	1.24
10 - 15	1.97	.56	1.05	.67	.75	.81
15 - 20	1.12	.69	1.53	.09	.82	.79
20 - 25	.69	.77	.11	1.33	.73	.93
25 - 30	.34	.56	1.36	.46	.52	.90
30 - 40	.50	.45	.48	.66	.55	.46
40+	--	.97	--	--	1.03	.72

(--) = too few entries

Source: Unpublished tape readable data from the 1990 US Census, 5% PUMS

Note: Transit use for each niche is divided by metropolitan average; unshaded numbers are indexes, not percentages.

market niches were more reliant on public transit at household incomes above $60,000 to $70,000).

Aggregate rates were just as likely to obscure higher income transit use among certain groups—college educated workers, workers with graduate school, and Hispanics—as the reverse. Two of the national market groups were reliant on transit in more service environments than in the aggregate analyses when income was taken into account. Those with a college education were more likely than average to use transit in all 14 service environments when controlling for household income.

The market niches with the most significant drop in the number of affected service environments tended to be those traditionally thought to be captive riders—those with work or mobility limitations, those with less than high school education, and those with some high school but no degree. The analyses suggest that these groups were more likely to use public transit only when they were poor, regardless of the service environment in which they lived.

The analyses also show that low income among several other groups was strongly linked to transit ridership. The last column of Table 6 indicates that in some service environments, older workers and immigrants in the United States for less than 10 years were more likely to be transit users only when they were poor. On the other hand, the table shows that low income rarely explained greater transit reliance among Blacks, Hispanics, or Asians. That is, among some of the 14 groups, income overlapped (or co-varied) with factors such as age or low educational attainment. But among other large groups, income did not significantly overlap other variables associated with transit use. In short, race, ethnicity, sex, higher educational attainment, and even immigrant status were often indicators of transit use where low income was not.

The most important question is not whether "only" poor people use transit. Whether or not any given group is more reliant on public transit "only" because they have low income, they are still important markets for public transit. This analysis only pursues these issues to indicate if there are unexpected or unexplored market segments among higher income workers. If so, these higher income groups are additional markets on whom transit operators could or should focus attention. Low-income workers remain a major transit market.

Overall, the four-part sequential analyses strongly indicated that some groups were genuinely more likely to use transit to commute to work than others of comparable incomes in many different kinds of metropolitan areas. Greater transit use among these groups was not generally explained by (1) differences among individual metropolitan areas which were otherwise mathematically obscured in national aggregate analyses or (2) differences explained by income within metropolitan areas. Although poor people and those living in large dense metropolitan areas were often more likely to use transit, neither income nor service environment explained higher than average transit use among Blacks, Asians, Hispanics, women, or those more highly educated, within most environments.

NON-WORK TRAVEL PATTERNS

To conduct a roughly comparable analysis of non-work trip patterns, the research team used urbanized area data from the 1990 NPTS. The NPTS is a very useful data set but it was not possible to use density data, so research team personnel were only able to conduct two of the three major analyses performed on the home-to-work data. (The NPTS is discussed in Appendix A.)

The NPTS records trips—not users. The data reflect not how people "usually" went shopping or "generally" got to the doctor but how they actually traveled on the day in question if they made such a trip. People who either made no non-work trips or those who traveled in a way out of the ordinary (for example, using a taxi because the car was broken) are recorded as if those patterns represented what they usually did. Moreover, the NPTS did not break out Asian travelers or immigrants.

Overall, transit use for all non-work trips in central cities is substantially below the work trip rate. Roughly 1.9 percent of all non-work trips are made using any transit mode—roughly one third the Census commute figure. Blacks and Hispanics are much more likely to use transit for their non-work trips than other travelers but not nearly as much as they are for work trips; 5.9 percent of the non-work trips of Blacks and 4.4 percent of the non-work trips of Hispanics are made using public transit.

Table 7 summarizes the non-work trip analyses; the first column shows that many groups who depend disproportionately on transit for the home-to-work trip also do so for non-work trips: those with incomes under $20,000, women, Blacks, Hispanics, those with no car, young travelers, and those with a high school degree or less. Strikingly, slightly higher income individuals are also more likely to use transit for non-work trips; those with household incomes as high as $30,000 are more reliant on transit. School-aged children are also more likely to use transit than other travelers in urbanized areas (these data excluded school bus travel, including only public transit modes, although respondents might have confused them).

However, in contrast to the commuter analyses, those with higher educational attainment are not more likely to use transit for non-work trips. In fact, such people are only more likely to use subways (and rail) than people with comparable incomes for non-work trips. Elderly people are not more likely to use transit for non-work trips, but older workers are more likely to do so to commute to work.

The second column of Table 7 also shows that almost all of the groups more likely to use transit for non-work trips in the aggregate continued to be more likely to do so when con-

TABLE 5 Transit use to work indexes by service environment in metropolitan areas over 500,000

Market Niches ↓ • population • density • average transit use	500-1,000,000 low	500-1,000,000 medium	500-1,000,000 high	Over One Million low	Over One Million medium	Over One Million high	Chicago	New York
	2.35%	6.73%	28.81%	4.53%	10.40%	6.74%	16.75%	45.87%
Sex								
Men	.80	.76	.85	.79	.83	.95	.84	.91
Women	1.24	1.30	1.18	1.25	1.19	1.06	1.18	1.10
Race and Ethnicity								
White	.67	.69	.93	.63	.75	.80	.79	.84
Black	3.31	1.41	1.25	3.35	2.34	1.61	1.87	1.29
Hispanic (all races)	2.74	2.73	.53	1.91	2.33	1.71	1.59	1.20
Asian	1.38	1.55	1.27	1.18	1.42	.80	1.01	1.09
Vehicle Ownership								
No Car	10.17	5.14	1.78	8.14	4.46	2.24	3.45	1.48
One or More	.68	.86	.81	.71	.77	.32	.77	.74
Age of Worker								
17-29	1.21	.98	1.17	1.20	1.22	1.21	1.22	1.12
30-39	.86	.86	1.05	.95	.99	.95	.99	1.02
40-49	.84	.95	.89	.84	.85	.87	.84	.91
50-59	.95	1.16	.80	.87	.85	.84	.84	.92
60-64	1.22	1.46	.79	1.00	.92	.99	.91	.92
65-69	1.24	1.33	.76	1.06	.89	.86	.89	.94
Education								
No School	2.96	2.55	.80	2.40	1.89	3.10	1.40	1.22
Elementary	2.78	2.88	.86	2.09	1.41	2.56	1.05	1.12
Junior High	1.91	2.54	.77	1.71	1.34	2.22	1.11	1.13
Some High School	1.54	1.32	.84	1.43	1.22	1.32	1.02	1.09
High School	1.04	.90	.81	1.03	.94	.88	.86	1.00
Some College	.85	.81	1.01	.85	.89	.69	.96	.98
College	.69	.92	1.44	.84	1.07	.93	1.12	1.03
Graduate School	.68	1.13	1.20	.88	.98	.75	1.11	.83
Limitations								
Work Limitation	2.20	1.58	.89	1.56	1.19	1.23	1.25	.99
Mobility Limitation	4.53	1.81	.78	2.97	1.75	2.05	1.50	1.02
Household Income								
< $5k	1.79	1.43	1.18	1.54	1.22	1.62	1.19	1.04
$5 - 10k	1.76	1.39	1.05	1.56	1.27	1.79	1.16	1.07
$10 - 15k	1.25	1.29	.98	1.31	1.23	1.24	1.14	1.09
$15 - 20k	.91	1.25	.87	1.11	1.18	.82	1.14	1.14
$20 - 25k	.67	.79	.87	.88	1.08	.63	.97	1.09
$25 - 30k	.50	.70	1.02	.72	.95	.61	.93	1.06
$30 - 40k	.46	.58	.87	.57	.78	.63	.79	.93
$40 - 50k	.55	.47	.90	.54	.69	.68	.78	.82
$50 - 60k	.60	.61	1.15	.59	.72	.81	.87	.77
$60 - 70k	.66	.57	.98	.62	.77	.91	.93	.81
$70 plus	.67	1.16	1.26	.48	.71	.97	.95	.82
Immigration Status								
Non-immigrant	.96	.82	1.00	.96	.95	.30	.99	.93
Immigrant	1.62	1.90	1.01	1.38	1.29	.64	1.03	1.12
Years in US								
< 5	1.67	1.50	1.18	1.82	1.47	1.74	1.40	1.12
5 - 10	1.16	1.19	1.05	1.13	1.01	1.10	1.09	1.04
10 - 15	.91	1.09	.98	.82	.90	.76	.92	.98
15 - 20	.81	.93	.87	.82	.95	.69	.86	.97
20 - 25	.75	.62	.87	.71	.90	.61	.89	.99
25 - 30	.65	.57	1.02	.57	.78	.54	.80	.90
30 - 40	.78	.53	.87	.60	.63	.50	.79	.88
40+	.90	.47	1.07	.69	.74	.61	.97	.85

Source: Unpublished tape readable data from the 1990 US Census, 5% PUMS
Note: Transit use for each niche is divided by metropolitan average; unshaded numbers are indexes, not percentages.

TABLE 6 Summary of transit patterns in 14 service environments, by income

National Market Niche	Number of Service Environments Where National Market Niche:			
	Has Greater Relative Transit Use	Has Greater Relative Transit Use, Controlling for Income within Environment	Exceptions	Has Greater Relative Transit Use at Low Incomes Only
Women	14	12	-not under $10,000	none
Immigrants	14	8	-under $60-70,000	3
with <10 Years in US	11	8	-under $60-70,000	5
Workers with no Household Car	14	11		none
Workers with Household Income				
< $10,000	14	-	-	-
< $15,000	12	-	-	-
Workers 17-29	13	12	-not under $25-30,000	none
Workers with less than High School	13	5		7
Workers with				
- mobility limitations	13	5	-under $60-70,000	3
- work limitations	12	7	-under $50-60,000	4
Asians	12	9	-under $60-70,000	3
Workers with some High School	12	3	-under $60,000	9
Blacks	11	10	-under $60-70,000	1
Hispanics (all races)	13	13	-under $70,000	1
Workers 60+	7	5	-under $50,000	6
Workers with College	6	14	-not under $15-20,000	none
Workers with Graduate School	5	10	-not under $15-20,000	none

Source: Unpublished tape readable data from the 1990 US Census, 5% PUMS

trolling for the same 11 categories of household income used in the commuter analysis.* Only young children (age 5 to 12) were dropped as non-work market groups when income was considered.

Finally, Table 7 suggests that non-work travel is slightly less sensitive to the actual mode of transit used than are work trips. At the same time, those with higher educational attainment are more likely to use the subway than the average resident of urbanized areas (sample size problems precluded an analysis of all transit modes represented in the NPTS survey).

Figure 8 illustrates the effect of income on mode choice for non-work trips. As suggested by Table 7, there are important differences between and among the racial and ethnic groups. Transit use is never very high among White travelers, even among those with low household incomes, while relatively high for low-income Blacks and Hispanics. At the same time, the percentage of all trips taken using transit is relatively stable for Whites at household incomes over $30,000 while falling among Blacks and Hispanics.

The sharp hills and valleys in Figure 8 reflect sample size problems. However, it appears that Hispanics and Blacks are

* a) Under $5,000, b) $5 – 10,000, c) $10 – 15,000, d) $15 – 20,000, e) $20 – 25,000, f) $25 – 30,000, g) $30 – 40,000, h) $40 – $50,000, i) $50 – 60,000, j) $60 – 70,000, and, k) $70,000 plus.

substantially more likely to use public transit for non-work trips than comparable Whites at almost every income level but the highest. At the same, time low-income Hispanics are substantially more likely to use transit than comparable Whites or Blacks.

SUMMARY

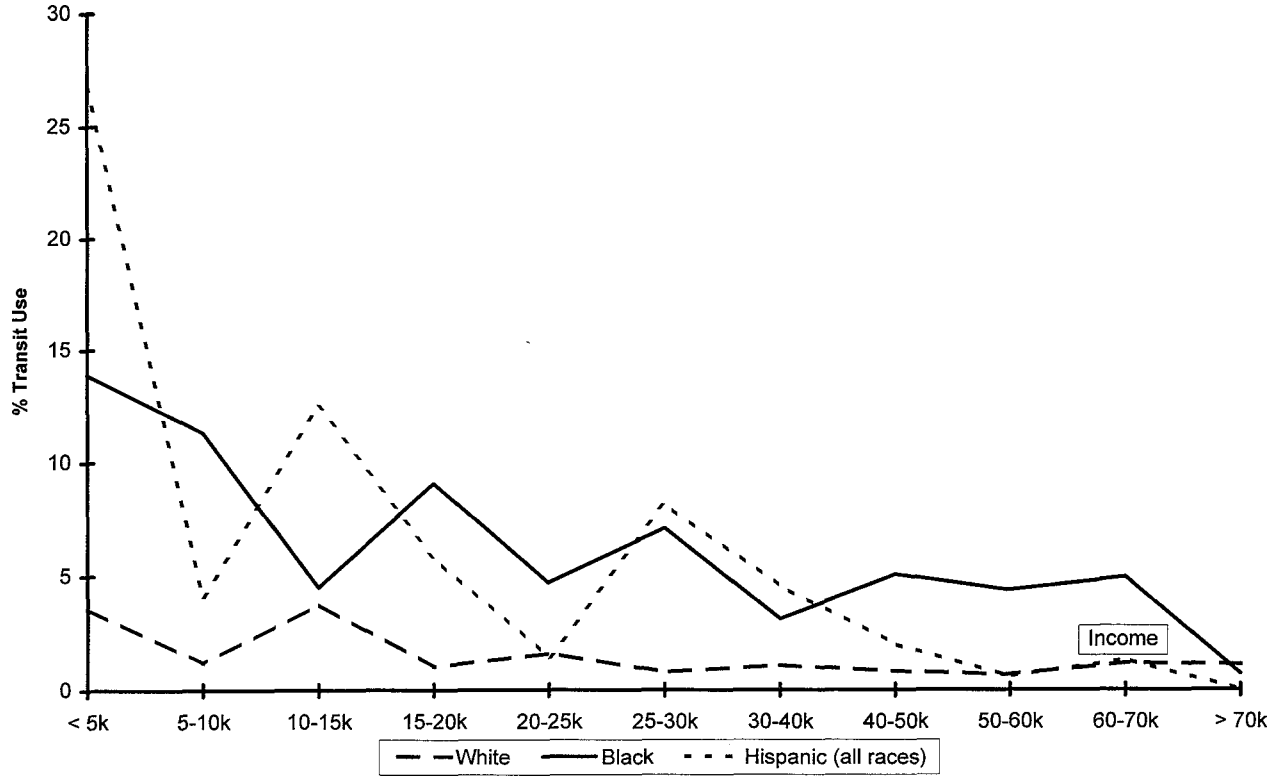
The analyses in this chapter show that there are clear transit market groups among current riders, even when allowing for income and for size and density of metropolitan areas. Eleven niches constituted a transit market for work trips—that is, the workers had higher than average transit use in most service environments when controlled for income. These niches are as follows:

- Workers with low incomes (**NW**),
- Workers with no household cars (**NW**),
- Blacks (**NW**),
- Women (**NW**),
- Hispanics (**NW**),

TABLE 7 Non-work transit markets in urbanized areas

Potential Market Niches	Higher Than Urbanized Average (All Non-Work Trips)	Higher When Controlling for Income (All Non-Work Trips)	Higher When Controlling for Mode and Income	
			Bus/Streetcar	*Subway*
Sex				
Men				
Women	●	●	●	●
Race & Ethnicity				
White				
Black	●	●	●	●
Hispanic (all races)	●	●	●	●
Vehicle Ownership				
No Car	●	●	●	●
One or More				
Age				
5-12	●		●	
13-16	●	●	●	
17-29	●	●	●	●
30-39				
40-49				●
50-59				
60-64				
65-69				
Education				
No School	●	●	●	
Elementary	●	●	●	
Junior High	●	●	●	
Some High School	●	●	●	●
High School				
Some College				●
College				●
Graduate School				●
Household Income				
< $5k	●			
$5-10k	●			
$10-15k	●	N.A.	N.A.	
$15-20k	●			
$20-25k	●			
$25-30k	●			
$30-40k				
$40-50k				
$50-60k				
$60-70k				
$70k+				

Source: Unpublished tape readable data from the 1990 NPTS



Source: Unpublished tape readable data from the 1990 Nationwide Personal Transportation Survey

Figure 8. Transit use for non-work trips in urbanized areas, by household income, race, and ethnicity.

- Workers with graduate school education (**NW**),
- Workers age 17 to 29 (**NW**),
- Workers with college education (**NW**),
- Asians,
- Immigrants, and
- Workers with work limitations.

Those groups that were also a non-work transit market are identified by a **NW**; no data were available to evaluate the non-work market status of the other three groups listed above.

Three additional groups constituted a transit market for work trips in three to five service environments when controlling for income:

- Workers with mobility limitations,
- Workers age 60 and over, and
- Workers with some high school education (**NW**).

The approach used in this chapter shows quickly which groups rely more on public transit for work and non-work trips. Although the quantitative analyses performed have been limited, research team personnel have identified such clear patterns of transit use—some quite surprising—that they provide a sound basis for additional analyses. Local transit operators could easily perform similar evaluations using their own area-specific Census data and should undertake such analyses as part of their marketing and planning efforts.

At the same time, these kind of analyses provide the groundwork for more detailed quantitative studies, on the basis of either national or local data, which use statistical techniques which allow researchers to analyze the simultaneous interaction of variables (e.g., race and education) and the effect of co-variance (e.g., race and income). By suggesting some areas to explore, these analyses should serve as a guide for more ambitious statistical tests and evaluations beyond the scope of this project.

CHAPTER 2

SOCIETAL TRENDS: THEIR EFFECTS ON CURRENT AND EMERGING MARKETS

INTRODUCTION

This chapter summarizes an evaluation of how a range of projected societal trends—sociodemographic, economic, social, and policy—affect the current transit markets identified in Chapter 1. The full evaluation appears in Appendix C.

Although the research team focuses on national trends and effects, two points should be kept in mind. First, transit use is uneven; in all metropolitan areas combined, it accounts for less than 3 percent of all trips and 7 percent of work trips. However, ridership is substantially higher in certain areas. In communities as disparate as San Francisco, Pittsburgh, Atlanta, and Boston more than 20 percent of all workers take transit to work. Therefore, aggregate societal trends are unlikely to have the same effect on each metropolitan area. Second, although most trends have a negative effect on overall transit use, some give individual operators opportunities to increase ridership—at least in certain service areas or among certain riders—by targeting key markets with appropriate service options.

The first section below summarizes the effect of various societal trends on the current transit markets identified in Chapter 1. The second section evaluates the relative effect on transit ridership which might be expected from positive and negative societal trends. The third section summarizes this chapter's findings.

EFFECTS ON CURRENT MARKETS

The sections below summarize five aggregate categories of trends likely to affect the demand for transit in the future:

- Economic,
- Demographic,
- Social,
- Land use, and
- Transport policy.

The analyses in this chapter attempt to give a general indication of the effect of each set of trends on the current transit markets identified in Chapter 1. Each section following summarizes the likely effect of a key societal change on the absolute number of affected people using transit ("Total") and the percentage of each transit market ("Share") using transit. These indicators are only assessments of the implications of hundreds of intertwined changes, modifications, and shifts in dozens of overlapping societal arenas.

Although the summaries attempt to give some idea of the magnitude of the likely positive and negative effects, the standards the research team uses are actually qualitative assessments and relative ones at best. Positive effects are indicated by positive signs; strongly positive effects are indicated by multiple positive signs. Negative effects are indicated by minus signs; strongly negative effects by multiple minus signs. However, given the resources and focus of this study, there is no way to equate any of these signs to one another, except in the most general way.

Economic Factors

Four significant economic trends are likely to have important implications for transit markets and users:

- Industrial restructuring,
- Flexible labor force,
- Work at home and telecommuting, and
- Women's labor force participation.

The likely effect of these trends on current transit markets is shown in Table 8. The Total and Share indicators can be moving in opposite directions; the share or percentage of any market group using transit can fall while the total number increases (or vice versa). The net outcome can only be estimated at a gross scale; such an estimate appears in the next section of this chapter.

The major transportation and, ultimately, transit effects of the overall restructuring of national and international industry will arise from (1) different locational decisions made by service firms and industries; (2) growing income disparities; (3) the drop in the number of home-to-work trips; (4) wide variations in many individuals' work schedules and job locations; and (5) the complicated travel patterns of working parents, particularly women and single parents.

One major aspect of industrial restructuring is the growth of the service sector, which, in turn, has important transportation implications; the growing suburbanization and even exurbanization of jobs is linked closely to the growth of the service sector. Service industries tend to be smaller and, because they do not need to co-locate, tend to be widely dis-

TABLE 8 Effect of economic trends on transit markets

Transit Market (Service Environments)	Riders	Industrial Restruc-turing	Flexible Work-force	Work-at-Home	Women's Employ-ment	Service Sector Growth
Low Income (14)	Total:	++	−	−	+	+
	Share:	−−	−−	−	−−	++
Workers with College (14)	Total:	+	−	−	−	−
	Share:	−	−	−	−	−
Hispanics (13)	Total:	+	−	−	+	−
	Share:	+	−	−	−−	−−
Workers 17-29 (12)	Total:	+	−	−	+	−
	Share:	−	−	−−	−	−−
Women (12)	Total:	+	−−−	−	+	−−−
	Share:	−−	−−	−	−	−−
Workers without Household Car (11)	Total:	++	−−	−	−	−
	Share:	−	−−	−	−	−−
Blacks (10)	Total:	+	−	−	−	−
	Share:	−	−	−	−	−
Workers with Graduate School (10)	Total:	+	−−	−	+	−
	Share:	−	−	−−	−	−
Asians (9)	Total:	+	−	−	−	−
	Share:	−	−	−	−	−
Immigrants (8)	Total:	+	−	−	−	−
	Share:	−	−	−	−−	−
Workers with Limitations (7)	Total:	+	−	−	−	−
	Share:	−−	−	−	−	−
Workers 60+ (5)	Total:	+	−	−	−	−
	Share:	−−	−	−	−	−
Workers with less than High School (5)	Total:	+	−	−	−	−
	Share:	−	−	−	−−	−
Workers with some High School (3)	Total:	+	−	−	−	−
	Share:	−	−	−	−−	−

persed within metropolitan and even exurban areas, rather than clustered and concentrated in the core of the city.

Dispersed employment locations can create nontraditional commute patterns. For example, the commutes of suburban and rural residents are twice as likely to be destined for suburban and rural work places as they are for the central city. All of these patterns are difficult to serve with transit; as they increase, transit use will fall.

Some economic effects might have a positive effect on transit use—the growing wage gap accompanying restructuring could increase the number of low-income workers. This might increase transit ridership because those with lower incomes have a greater tendency to use transit for both work and non-work trips.

On the other hand, the location of even low-paying service sector jobs may not be well served by transit; it is difficult to provide traditional service in low-density communities. The growing number of service workers with low or falling incomes may actually have to travel further to work simply because most available jobs are widely dispersed in suburban and even rural communities. Although more women are entering the labor force and the absolute number of women using transit may go up in the near future, over time, the percentage of working women using public transit may drop substantially, given the other pressures they face.

Chapter 1 showed that those with higher educational levels are more likely to use transit in most service environments—transit may be able to attract some higher income service workers, particularly those commuting to downtown. However, as Table 8 suggests, most of the economic trends will work against public transit operators. Although some trends may increase the absolute number of people in a current transit market, the same set of forces may decrease the percentage of those workers able or willing to use transit. For example, although the growing wage gap will probably increase the total number of low-income workers and create more transit riders among the poorly educated, most of the accompanying economic trends will substantially lower the percentage of those very workers able to use transit.

Demographic Factors

There are six major demographic factors underlying population change and diversity in the United States; these factors, which help to explain individual differences in travel patterns, are as follows:

- Growth of the aging population,
- Growth of single-parent households,
- Growth of single-adult households,
- Suburbanization,
- Migration (internal migration), and
- Immigration (external migration).

Table 9 summarizes the expected effect of these six trends on current transit markets, both absolutely and relatively.

Most demographic trends work against public transit. One of the few positive trends for transit is the growth of immigration. If current immigration policies continue, migration will have a substantial favorable effect, even in the absence of new services. The potential growth in young people and single-parent households might also lead to increased transit ridership, especially in the face of real income losses because of industrial restructuring.

However, it is not clear that transit will capture a larger share of these growing market niches. Most of the other societal trends are likely to adversely affect transit ridership—in the absence of new or different services—even among most groups proportionately more likely to use transit and even if the total population within each group increases.

The aging of the population may increase transit ridership but only for a short time, in the absence of new service arrangements, even though older people currently constitute a strong transit market. Most higher ridership by older people is probably a generational artifact—there is no evidence that people rely more on transit as they age. It is more likely that the higher transit use now seen among the elderly reflects the "transit habit" of a previous generation.

Moreover, almost all older people will be licensed in the near future and most will live in suburban or rural communi-

TABLE 9 Effect of demographic trends on transit markets

Transit Market (Service Environments)	Riders	Aging Pop.	Single Parent HH	Single Adult HH	Suburb-anization	Migration Internal	Migration External
Low Income (14)	Total:	+	+	+	−	−	+
	Share:	−	−	−	−−	−	
Workers with College (14)	Total:	−−	−	−	+	−	−
	Share:	−−	−−	−−	−	−	−
Hispanics (13)	Total:	−	−	−	+	−	++
	Share:	−	−−	−−	−	−	−
Workers 17-29 (12)	Total:	−	−	−	−	−	+
	Share:	−	−−	−−	−	−	−−
Women (12)	Total:	−−	−−	−−	−	−	−
	Share:	−−−	−−−	−−−	−−−	−−−	−
Workers without Household Car (11)	Total:	−	−	−	−	−−	−
	Share:	−	−	−	−−	−−	−−
Blacks (10)	Total:	−	−	−	−	−	−
	Share:	−	−	−	−−	−−	−−
Workers with Graduate School (10)	Total:	−−	−	−	+	−	−
	Share:	−−	−−	−−	−	−	−
Asians (9)	Total:	−	−	−	+	−	++
	Share:	−−	−	−	−	−−	
Immigrants (8)	Total:	+	−	−	+	−	+
	Share:	−	−	−−	−−	−	
Workers with Limitations (7)	Total:	+	−	−	−	−	−
	Share:	−	−	−	−	−	−
Workers 60+ (5)	Total:	+	−	−	−	−	−
	Share:	−−	−−	−−	−−	−	−
Workers with less than High School (5)	Total:	+	−	−	−	−	+
	Share:	−−	−	−	+	−	−
Workers with some High School (3)	Total:	+	−	−	−	−	+
	Share:	−−	−	−	+	−	−

ties with few alternatives to driving alone. Although older people who are poor may continue to depend disproportionately on transit, the percentage of older travelers who are poor has declined substantially.

The growth in the number of households is linked to the growth in per capita car ownership; that growth rate alone poses serious problems for transit operators. Once any traveler has bought a car, the marginal cost of additional trips may be small; the cost of driving may even be perceived as less than the cost of a transit fare.

The growth in the number of single-parent households may increase total transit ridership because so many are poor; however, other societal trends act in ways likely to lead to lower market share among single parents. The continuing suburbanization of the low-skill jobs available to many single female parents, the need to reverse commute, and the demands created by balancing work and home without a resident partner may well sharply decrease the share of this market using transit, even as the total numbers of people in the market increase.

Suburbanization coupled with migration to the lower density West and South of both residents and immigrants will work against transit use. Suburban sites are not well served by traditional transit options, even if immigrants and others choose to live in higher density suburbs. Transit may increase total ridership from the growing number of low-income reverse commuters, but—in the absence of new service arrangements—it is also likely that transit will lose market share among those reverse commuting, because these trips are often the most difficult to take using traditional transit alternatives.

As Table 9 suggests, the most potentially positive demographic trends for transit are the aging of the population and continued immigration. Even these trends contain the seeds of their own destruction. The rest of the demographic trends will work against transit.

Land Use Factors

Land use patterns and density significantly affect transit markets; the following four major changes in land use affect current transit markets:

- Decreasing population density,
- Decreasing employment density,
- Increasing downtown employment density, and
- Increasing density in older suburbs.

Table 10 suggests that most land use trends work against public transit; however, a few hopeful situations exist. Growing suburbanization generally provides limited opportunities for transit use, but increasing population concentrations in some older suburbs and concentrated suburban employment sites provide greater suburban destinations for transit operators than in the past. In addition, the central city remains the destination of a larger and absolutely growing number of jobs—thus providing another growing market for transit service.

A signal feature of industrial restructuring is that the jobs in the traditional core of the city have changed from production to high-end service jobs—in banking, insurance, communication, and public administration. These jobs are filled by more highly educated workers, who already are more likely to use public transit than the average worker. This current market may well grow as the number of downtown jobs grows.

At the same time, new immigrants are largely settling in the suburbs, despite historical patterns to the contrary. In many places, they are settling in inner suburbs, which have denser land use development to begin with; when these suburbs become enclaves of immigrants, population density often climbs. The combination of these forces provides a more attractive climate for the provision of transit services.

Overall, however, Table 10 shows that most of the urban land use changes will have negative consequences for transit operators. At the same time, some transit operators may be able to take advantage of new pockets of potential riders in older suburbs and among downtown commuters.

Transport Policy Factors

Four major policy trends are likely to affect transit ridership in the coming decade:

- Decreasing federal transit assistance,
- Relaxation of transportation control mandates,
- Service to people with disabilities, and
- Diversion of highway funding ("flexing").

The effect of each of these trends is shown in Table 11. Reductions in federal transit financial assistance are making it more difficult for transit systems to maintain existing markets, let alone to develop new markets. On the other hand, transit agencies are required to provide a significant level of service to people with disabilities, which has increased transit ridership among people with disabilities, either directly or indirectly. The costs of such services are high, however, and often come at the expense of transit services targeted at other market groups.

A hopeful sign is that ISTEA permits the "flexing" or diversion of highway funds to projects supporting transit; several cities are planning to use these funds to build joint developments, park-and-ride facilities, and childcare centers at transit stations.

At the same time, however, the ridership effect of the kind of efforts associated with flexible Federal funds is either not high or not known. For example, while many analysts hold high hopes for childcare centers, even if they are wildly successful in converting car users into transit riders, each childcare center can only affect the travel patterns of a few dozen

TABLE 10 Effect of land use trends on transit markets

Transit Market (Service Environments)	Riders	Declining Density		Increasing Density	
		Population	Employment	Downtown Employment	Older Suburbs
Low Income (14)	Total:		−−		
	Share:	−−			+
Workers with College (14)	Total:	−	−−	+	
	Share:	−−	−−−	+	
Hispanics (13)	Total:	−	−−	+	++
	Share:	−−−	−−−	+	+
Workers 17-29 (12)	Total:		−−		
	Share:	−−	−−−		
Women (12)	Total:	−−	−−		
	Share:	−−−	−−−		
Workers without Household Car (11)	Total:	−	−−	+	
	Share:	−−−	−−	+	
Blacks (10)	Total:	−			
	Share:	−−−	−−−		
Workers with Graduate School (10)	Total:	−	−	+	
	Share:	−	−	+	
Asians (9)	Total:	−		+	++
	Share:	−−−	−−	+	+
Immigrants (8)	Total:	−	−	+	++
	Share:	−−	−−	+	+
Workers with Limitations (7)	Total:	−	−		
	Share:	−	−		
Workers 60+ (5)	Total:	−	−		
	Share:	−−	−−		
Workers with less than High School (5)	Total:	−	−−−	+	
	Share:	−	−−−	+	
Workers with some High School (3)	Total:	−	−−−	+	
	Share:	−	−−−	+	

commuters. Joint developments can take years to come to fruition, so, even if very successful, their effect will be a long time in the future.

Most existing policy trends have little to no effect on most current transit markets or they have considerable negative effects.

Social Factors

Americans have changed the way they relate to one another within the family and outside it. The aging of society, the growing number of two-worker households, the large number of mothers (of young children) who have salaried employment—all interact to affect current transit markets. Three sets of interpersonal relationships affect transit use:

- Family support relationships,
- Division of household responsibilities, and
- Perception of crime.

Table 12 summarizes the effect of these sets of relationships on current transit markets. None of the interrelated trends is likely to increase either current markets or the percentage of those riders who use transit.

Family members caring for older parents, people being afraid of traveling, working parents whose multiple responsibilities constrain their mode choice—all have a net negative effect on fixed-route transit ridership. Overall, fewer elderly people will be inclined to use public transit; as their mobility declines, their children and younger relatives will transport them. As a result, transit ridership may not only drop among the elderly but among their caregivers as well.

Two-worker families, especially with young children, have a different set of constraints that act to reduce transit use. The need to link trips to work with trips to carry out childcare or other domestic responsibilities substantially reduces the attractiveness of public transit to many current transit markets (e.g., women, low-income workers, and ethnic and racial minorities). If these families are also caring for older relatives, the demands on their time effectively preclude the use of transit.

In addition, people's fear of crime is growing. Women, the elderly, and those with work or mobility limitations may feel more vulnerable to street crime and may attempt to reduce

TABLE 11 Effect of transportation policy trends on transit markets

Transit Market (Service Environments)	Number of Riders	Decreasing		Increasing	
		Federal Funding	Transportation Control Measures	Service to People with Disabilities	Diversion of Highway Funding
Low Income (14)	Total:	−−		+	
	Share:	−−−		+	
Workers with College (14)	Total:	−	−		
	Share:	−	−−		+
Hispanics (13)	Total:	−−	−		
	Share:	−−−	−		
Workers 17-29 (12)	Total:	−			
	Share:	−−			
Women (12)	Total:	−			
	Share:	−			+
Workers without Household Car (11)	Total:	−	−−		
	Share:	−−	−−		
Blacks (10)	Total:	−−			
	Share:	−−−			
Workers with Graduate School (10)	Total:	−	−		
	Share:	−	−−		+
Asians (9)	Total:	−	−		
	Share:	−	−		
Immigrants (8)	Total:	−			
	Share:	−			
Workers with Limitations (7)	Total:	−		+	
	Share:	−−		++	
Workers 60+ (5)	Total:	−		+	
	Share:	−		+	
Workers with less than High School (5)	Total:	−−			
	Share:	−−−			
Workers with some High School (3)	Total:	−−			
	Share:	−−−			

their street exposure. In most metropolitan areas, that would translate into substantial reductions in the share of each market using public transit.

As Table 12 indicates, these social forces interact to substantially reduce the share and, perhaps, the number of people who will consider transit as a viable option for either their work or non-work trips.

POTENTIAL MAGNITUDE OF RIDERSHIP EFFECTS

The analyses above have focused on which current market groups are likely to grow or decline and which are likely to use transit more or less because of societal trends. But the rapid growth in transit use by a very small group may have little effect on total system ridership while the slight drop in transit use of a very large group may have drastic implications. Therefore, it is important to give some idea of the dimensions of the market groups studied.

This study was not charged with analyzing historical trends in the size of various groups or in projecting the population numbers in each group into the future. Moreover, many of the groups described overlap substantially—young workers and women, those with low incomes and minorities, and so forth. However, Table 13 gives some idea of the current size of each overlapping market group and of its relative effect on current transit ridership.

Women, Blacks, Hispanics, Asians, and immigrants constitute a relatively larger share of transit riders than they do of workers. Although the analyses in Chapter 1 would appear to indicate that relationship, what they did not cover was the magnitude of the ridership effect. For example, Hispanics constituted just less than 10 percent of the U.S. workforce in 1990 but accounted for almost 17 percent of transit riders. Immigrants accounted for roughly 13 percent of the labor force but more than 27 percent of all transit riders. More than one-half of all transit riders live in households earning less than $20,000.

Table 13 shows that most current transit markets—as defined in Chapter 1—even the less traditional ones, consti-

TABLE 12 Effect of social trends on transit markets

Transit Market (Service Environments)	Number of Riders	Family Support Relationships	Household Responsibilities	Perception of Crime
Low Income (14)	Total:			-
	Share:	-	-	--
Workers with College (14)	Total:	-	-	-
	Share:	--	--	--
Hispanics (13)	Total:	--		
	Share:	---		
Workers 17-29 (12)	Total:		-	
	Share:		--	-
Women (12)	Total:	---	---	--
	Share:	---	---	---
Workers without Household Car (11)	Total:			
	Share:			
Blacks (10)	Total:			
	Share:			
Workers with Graduate School (10)	Total:		-	-
	Share:		--	--
Asians (9)	Total:	--		
	Share:	---		
Immigrants (8)	Total:			
	Share:			
Workers with Limitations (7)	Total:			--
	Share:			--
Workers 60+ (5)	Total:			--
	Share:	+		---
Workers with less than High School (5)	Total:			-
	Share:			-
Workers with some High School (3)	Total:			-
	Share:			-

tute a very large share of current transit ridership. College-educated and graduate-school-trained workers, for example, account for almost 28 percent of all metropolitan transit riders. Workers under 30 composed roughly 35 percent of all transit riders.

On the other hand, some of the more traditional, or at least more expected, transit markets, were not very important segments of current ridership. Workers over 60 and workers with mobility or work limitations, together, did not account for 10 percent of all current riders.

These numbers suggest that a relatively small increase in the number of workers in some groups—Blacks, Hispanics, immigrants, and low-income workers, for example—would have a disproportionately larger effect on transit ridership. Thus the societal trends which increase labor force participation by these groups will have a very positive effect on transit—while any trends which cause reductions in labor force participation will have very immediate and disproportionate negative effects on transit.

Continued immigration will continue to fuel transit growth as will any of the industrial trends which create low-income jobs. However, if immigration policies are changed or industrial trends reduce the total number of U.S. jobs (at any salary level), transit ridership would fall substantially.

Conversely, trends such as mandates on transport for people with disabilities, will have relatively little direct effect on transit ridership, even if both the number of such workers, and their transit share, increase remarkably (and the indirect effect may be negative).

SUMMARY OF SOCIETAL EFFECTS

Most of the societal trends analyzed work to the detriment of public transit. Many economic trends make transit less useful or even less feasible by

- Increasing trip length,
- Increasing trip variability,
- Producing non-peak and widely variable work schedules,
- Decreasing the size of individual firms, and
- Increasing suburban and even rural employment.

TABLE 13 Size and relative importance of current transit markets

Transit Markets	1990 Workers in Metropolitan Areas		Transit Use Patterns		
	Number (000)	Percentage of Total Workers	Percent Using Transit for Work Trip	Number of Transit Users (000)	Percent of Total Transit Users *
Women	36,272	45.41%	8.13%	2,948	53.74%
Blacks	8,866	11.10%	18.67%	1,653	30.13%
Hispanics (all races)	7,828	9.80%	11.88%	926	16.88%
Asians	3,035	3.80%	11.91%	361	6.58%
Workers without Household car	4,414	5.60%	45.32%	1,983	36.61%
Immigrants	10,568	13.23%	14.25%	1,506	27.46%
Workers with					
- mobility limitations	457	.57%	16.53%	76	1.38%
- work limitations	2,854	3.58%	8.57%	245	4.46%
Workers 17-29	23,883	29.90%	7.85%	1,877	34.22%
Workers 60-64	3,035	3.80%	7.36%	225	4.10%
Workers 65-69	1,358	1.70%	7.54%	105	1.92%
Workers with					
- less than High School	3,355	4.20%	13.21%	436	7.96%
- some High School	9,266	11.60%	8.58%	796	14.51%
- College Degree	13,420	16.80%	7.23%	972	17.73%
- Graduate School	7,190	9.00%	7.28%	524	9.55%
Workers with Household Income					
- under 5,000	9,346	11.70%	8.45%	790	14.39%
- $5-10,000	9,027	11.30%	8.52%	767	13.98%
- $10-15,000	10,385	13.00%	7.39%	766	13.96%
- $15-20,000	10,145	12.70%	7.14%	726	13.24%

Source: Unpublished tape readable data from the 1990 US Census, 5% PUMS

* = Percentages not additive.

Together these patterns are difficult to serve with most forms of traditional transit service. Moreover, workers may incur substantial time penalties over driving if they use transit where it is available.

Most demographic trends adversely affect transit ridership by

- Increasing the number of trips people link together,
- Increasing the need to chauffeur children and aging parents,
- Increasing the number of households with cars,
- Increasing the number of cars among current market groups, and
- Increasing low-density residential development.

Together these patterns make the car much more attractive to many users, including groups (e.g., women and older people) who are currently more dependent on public transit. Although increased immigration has increased transit ridership in some communities, immigrants are subject to the same pressures affecting most travelers; after 10 years in the United States, immigrants are less likely than average to use public transit, unless they are poor.

Most social trends only accelerate the negative effect on transit of other societal patterns by

- Increasing the obligations of working women and
- Making travelers feel unsafe while walking, waiting, or riding transit.

Most land use trends are a complement of the economic and demographic trends which act to strongly reduce transit ridership by

- Increasing low-density suburban residential development and
- Decreasing employment density.

Small land use changes, however, may provide additional riders in some communities, including the growing concentration of high-end service-sector jobs in downtowns and substantial suburban employment concentrations, like regional malls or hospitals.

Finally, it is easy to see that the strongest transport policy trends are those which further reduce transit's role and opportunities by

- Decreasing transit funding while enacting unfunded mandates and
- Focusing traffic control programs on making cleaner cars rather than forcing people to give them up.

Table 14 summarizes the likely effect on transit ridership of changes in individual travel patterns created by these major societal trends, given the current relative contribution each market group makes to total transit ridership. The dots indicate an effect in the column and row in which they appear; the size of the dot indicates our assessment of the magnitude of the effect.

In general, Table 14 suggests that overall transit ridership may increase in absolute terms among some groups, simply because the population is growing or because certain niches more likely to use transit—immigrants, for example—are increasing in number. However, these market changes may not translate into greater total ridership because the group's relative contribution is so small or the share of each group riding transit may be decreasing even as the group increases in size.

TABLE 14 Overall effect of societal trends on transit ridership

Major Societal Trends	Positive		Negative	
	Increase in Absolute Ridership	Increase in market Share	Decrease in Absolute Ridership	Decrease in Market Share
Economic				
Industrial Restructuring		●	●	
Flexible Labor Force			●	●
Work-at-home / Telecommuting			●	●
Women's Increasing Labor Force Particpation	●			●
Growth of Service Sector Employment	●			●
Demographic				
Aging Population	●			●
Single Parent Households	●			●
Single Adult Households			●	●
Increased Suburbanization			●	●
Internal Migration			●	●
External Migration	●			●
Land Use				
Decreasing Population Density	●			●
Decreasing Employment Density			●	●
Increasing Downtown Employment Density	●	●		
Increasing Density in Older Suburbs	●	●		
Social				
Family Support Relationships			●	●
Household Responsibilities			●	●
Perception of Crime			●	●
Transportation Policy				
Decreasing Federal Funding			●	●
Relaxation of Transportation Control Mandates			●	●
Service to People with Disabilities	●	●		
Diversion of Highway Funding	●	●		

In short, the societal trends described in this report may slightly increase total transit ridership by some market groups in the near term simply because their total population is increasing and they constitute a major share of current transit riders. However, the same set of trends will generally adversely affect the percentage of those who will use transit among people already doing so—in the absence of new, different, or improved ways of delivering transit services.

Transit operators must not be lulled by any temporary improvements in ridership created by, for example, the growth of a local immigrant population. All indications are that transit's share of the immigrant market will constantly fall without a change in the way most operators do business. Transit operators must make special efforts to maintain their share of existing markets and find ways to recognize and provide appropriate transit service options to potential users.

Those already using transit more than average are an important group on which to focus efforts to increase aggregate ridership over the long run. Transit operators need to explore service options which could increase market share among groups already having a greater propensity to ride and attempt to increase ridership among groups not now dependent on transit.

CHAPTER 3

PROMISING SERVICE CONCEPTS: THEIR EFFECTS ON CURRENT AND EMERGING MARKETS

INTRODUCTION

Few societal trends maintain existing ridership or create new or expanded ridership alone—although they may alone lead to declines in ridership. But some societal trends may offer the opportunity to maintain or expand a current transit market or create a new market; in most cases, these markets can only be realized by providing new or different types of transit services.

The research team's analysis has two parts. In the first part, the research team identifies some promising transit service concepts that might be used to maintain or increase transit ridership among different market groups. In the second part of the analysis, the research team personnel identify transit operators who had implemented any of these concepts—or others—in a way which increased ridership or developed new market niches.

The first section below focuses on the kind of attributes that current and potential markets might seek from transit, matching them to promising transit service concepts. The second section describes those service concepts where sufficient ridership data existed to determine that transit ridership had increased, and among which current or potential markets. The third major section describes a preliminary assessment of the cost-effectiveness of implementing the effective options. The full case studies and descriptions of service concepts on which these analyses are based appear in Appendix E.

SERVICE ATTRIBUTES SOUGHT BY TRAVELERS

Most of the societal trends discussed in the previous chapter put transit at a distinct disadvantage, largely because they create new and different travel patterns which traditional transit options ill serve. Many travelers increasingly require transit services geared to their personal needs and to their new and varying schedules and destinations. To maintain existing markets and develop new ones, transit systems must focus on service concepts which do the following:

- Make transit faster or more direct for an individual traveler,
- Make transit more convenient for an individual traveler,
- Make transit cheaper for an individual traveler, and
- Make transit feasible and practical for an individual traveler.

Service Concepts and Traveler Needs

Table 15 lists many promising service concepts identified in the literature, widely discussed in the industry, or suggested by the TCRP Project Panel. These service concepts fall into four categories, depending on how they affect travelers.

Options which make transit faster or more direct generally work in one of six ways; they

- Give priority to transit vehicles,
- Significantly reduce the number of stops made by a transit vehicle,
- Streamline the route,
- Reduce boarding time,
- Decrease overall travel time, or
- Reduce headways and increase increase frequency of service.

Service concepts which make transit service more convenient generally involve changes to existing traditional services, that is, modifications to current fixed-route scheduled services. They generally do not overcome nontransportation barriers to transit use, such as childcare needs. These options make service more convenient in one of six major ways; they

- Make it easier to pay for service,
- Change traditional service characteristics to meet user needs,
- Adapt traditional services to changing situations,
- Bring traditional services closer to the user,
- Provide demand-responsive options, or
- Offer more alternatives for any given trip.

Service concepts making transit cheaper do so in one of two ways; they

- Directly reduce the cost of traditional services or
- Indirectly reduce the cost of less traditional services

Finally, service concepts making transit feasible and practical address the more basic problems which many people

TABLE 15 Promising transit service concepts

MAKING TRANSIT FASTER AND MORE DIRECT	MAKING TRANSIT MORE CONVENIENT	MAKING TRANSIT CHEAPER	MAKING TRANSIT FEASIBLE
• HOV Lanes	• Route Deviation Services	• Fare Incentives	• Reverse Commute
• Busways	• Flex Routes	• Transfer Policies	• Feeder Routes
• Park and Ride Facilities	• Route Extension/Turn Back	• Vanpool / Carpool Subsidy	• Service to Large Employers / Universities
• Express/Limited Stop Service	• Late Night Request-a-Stop		• Park and Ride Facilities
• Priority Bus Traffic	• Service Routes		• Guaranteed Ride Home
• Route Restructuring	• Community Bus Service		• Childcare Facilities
• Interlining	• Downtown Loops/Circulators		• Concierge Services
• Suburb-to-suburb Service	• Neighborhood Loops / Circulators		• Travel Training Programs
• Crosstown Service	• Taxi Substitution / Jitneys		• Transit Familiarization Programs
• Suburban Transit Centers	• Public Dial-a-Ride		• Marketing and Advertising
• Facilitating Transfers	• Use of Smaller Transit Vehicles		• Joint Development
• Light Rail	• "Smart" Card / Fare Boxes		• Transit Supportive Neighborhoods
• Heavy / Commuter Rail			
• Low Floor Buses			

have in using mass transportation. Most of these problems fall into three categories: (1) they cannot travel on transit because it does not support other decisions they have made (from riding a bike to choosing a certain eldercare facility for aging parents), (2) they cannot use transit because it does not serve their destination(s), and (3) they cannot use transit because they do not know enough (or anything) about how to use it. The service concepts in this category are often mutually supportive; for example, a park-and-ride lot can be made attractive for a potential rider if childcare or concierge services are provided at the site.

The concepts in this category, then, make transit feasible and practical in five ways; they

- Facilitate bicycling and park-and-ride use;
- Work with employers to provide new transit services;
- Address nontransportation barriers to transit use;
- Provide information, education, and training on transit use; and
- Change land use patterns so transit can or does serve more destinations.

Service Attributes Sought by Current Market Groups

To maintain transit ridership among current riders in the face of societal trends or to attract new riders from groups less reliant on public transit, it is necessary to adopt specific service concepts that meet the actual needs of current or potential riders. Table 16 suggests how individual service concepts might respond to the needs of the market groups identified in Chapter 1.

Women

Women, as a group more likely to use public transit for both work and non-work trips, require both new transit services and various nontransportation services to even maintain their current ridership patterns. Many women are service workers who will require direct service to large employers and feeder routes to and from their work site that connect with existing services. These transit services must be matched to their work schedules, which are often not in the traditional hours. In addition, many women will require services that address their domestic concerns—childcare at transit stations (or near the work site), guaranteed-ride-home programs to allow them to attend to ill children or parents if they take transit to work, and concierge services (e.g., dry cleaning, postal services, and banking).

Female workers will require transit concepts reflecting the suburban or low-density character of either their origin or destination, their concerns about personal security, and the nontraditional times at which they may commute. Transit concepts which will extend or deviate to their homes or the

TABLE 16 Promising service concepts matched to current market groups

	POTENTIAL SERVICE OPTIONS BY TYPE OF TRIPS	
	WORK TRIPS	NON-WORK TRIPS
WOMEN		
FEASIBLE	• Service to Large Employers • Reverse Commute • Childcare Facilities • Concierge Service • Guaranteed Ride Home • Joint Development • Feeder Routes	• Transit Supportive Neighborhood • Joint Development
MORE CONVENIENT	• Route Deviation • Flex Routes • Route Extension • Night Request Stops • Downtown Loops • SmartCard/Fare Boxes • Low Floor Buses	• Community Bus Service • Taxi Substitution • Advanced DAR • Neighborhood Loops • Smaller Transit Vehicles • Low Floor Buses
FASTER AND MORE DIRECT	• Priority Bus Traffic • Route Restructuring • Suburban Transit Centers • Facilitating Transfers	• Suburban Transit Centers • Route Restructuring
PEOPLE WITHOUT CARS; HOUSEHOLD INCOME <$15,000		
FEASIBLE	• Feeder Routes • Reverse Commute • Service to Large Employers • Joint Development • Concierge Service • Marketing and Advertising	• Transit Supportive Neighborhood • Joint Development • Marketing and Advertising
MORE CONVENIENT	• Route Deviation • Flex Routes • Downtown Loops	• Taxi Substitution • Service Routes • Community Bus Service • Neighborhood Loops
FASTER AND MORE DIRECT	• Route Restructuring • Facilitating Transfers • Suburban Transit Centers • Priority Bus Traffic • Bus Ways	• Suburban Transit Centers • Facilitating Transfers • Route Restructuring
CHEAPER	• Fare Incentives • Vanpool/Carpool Subsidy • Transfer Policies	• Fare Incentives • Transfer Policies
BLACK; HISPANIC; ASIAN		
FEASIBLE	• Reverse Commute • Service to Large Employers • Feeder Routes • Joint Development	• Transit Supportive Neighborhood • Joint Development

(*continued on next page*)

TABLE 16 (*continued*)

	POTENTIAL SERVICE OPTIONS BY TYPE OF TRIPS	
	WORK TRIPS	NON-WORK TRIPS
BLACK; HISPANIC; ASIAN (continued)		
MORE CONVENIENT		
CHEAPER	• Route Deviation • Feeder Routes • Downtown Loops • Flex Routes • Night Request Stop	• Neighborhood Loops • Community Bus Service
	• Fare Incentives • Vanpool/Carpool Subsidy • Transfer Policies	• Fare Incentives • Transfer Policies
COLLEGE AND GRADUATE SCHOOL ED.		
MORE CONVENIENT		
FASTER AND MORE DIRECT	• Flex Routes • Late Night Request Stop • Smaller Transit Vehicles • Advanced DAR • Route Extension • Downtown Loops	• Taxi Substitution • Community Bus Service • Smaller Transit Vehicles
FEASIBLE	• HOV Lanes • Express/Limited Stops • Route Restructuring • Priority Bus Traffic • Light Rail • Low Floor Buses	• Suburban Transit Center • Low Floor Buses • Priority Bus Service
	• Service to Large Employers • Park and Ride Facilities • Feeder Routes • Joint Development • Concierge Service • Childcare Facilities • Guaranteed Ride Home	• Transit Supportive Neighborhood • Joint Development
PEOPLE 17-29; HIGH SCHOOL		
FEASIBLE		
FASTER AND MORE DIRECT	• Feeder Routes • Service to Large Employers • Park and Ride Facilities • Joint Development • Marketing and Advertising	• Transit Supportive Neighborhood • Joint Development
CONVENIENT	• Route Restructuring • Facilitating Transfer • Suburban Transit Center • Express/Limited Stops • Bus Ways	• Suburban Transit Center
	• Route Deviation • Feeder Routes • Flex Routes • Downtown Loops • Night Request Stop	• Neighborhood Loops • Community Bus Service

(*continued on next page*)

TABLE 16 (*continued*)

	Potential Service Options by Type of Trips	
	WORK TRIPS	**NON-WORK TRIPS**
IMMIGRANTS		
FEASIBLE	• Service to Large Employers • Feeder Routes • Reverse Commute • Park and Ride Facilities • Joint Development • Marketing and Advertising	• Transit Supportive Neighborhood • Joint Development
CHEAPER	• Fare Incentives • Transfer Policies • Vanpool/Carpool Subsidy	• Fare Incentives • Transfer Policies
FASTER AND MORE DIRECT	• HOV Lanes • Route Restructuring • Express/Limited Stops • Facilitating Transfers • Priority Bus Traffic	• Route Restructuring • Facilitating Transfers
PEOPLE 65+		
FEASIBLE	• Park and Ride Facilities • Feeder Routes • Transit Supportive Neighborhood	• Travel Training Program • Transit Familiarization • Transit Supportive Neighborhoods • Marketing and Advertising
FASTER AND MORE DIRECT	• Priority Bus Traffic • Low Floor Buses • Suburban Transit Centers • Route Restructuring	• Low Floor Buses • Facilitating Transfers • Route Restructuring • Suburban Transit Centers • Priority Bus Traffic
MORE CONVENIENT	• Route Deviation • Route Extension • Flex Routes • Smaller Transit Vehicles • Downtown Loops • Community Bus Service	• Smaller Transit Vehicles • Community Bus Service • Service Routes • Taxi Substitution • Advanced DAR • Neighborhood Loops

door of the firm at which they work, particularly late at night, might induce more women to use transit while holding on to current riders. Concepts which enable working women to do mid-day shopping—such as downtown circulators—might maintain current market share.

Transit concepts which increase the speed and the ease of their trip will positively affect working women. The destinations of many service workers of both sexes are not well served by traditional routes focused on the historic downtown or those focused only on a few large employers. With route restructuring, a system may be able to better serve suburban destinations and less concentrated employment sites while making the system easier to understand and use. Although transit use drops sharply when people are forced to transfer, some of this loss among women can be prevented by better synchronizing transfers and by providing safe and sheltered places—such as suburban transit centers—in which to transfer.

People Without Cars; People With Low Incomes

Because they overlap with women and with one another—people without cars and those with household income below $15,000 need services with similar attributes. Services which provide more direct access to their work sites or address their

domestic needs might maintain ridership among these groups. More convenient services—route deviation and flex routes—might serve additional destinations and increase ridership.

But there are also differences. Many low-income and carless workers may live in or near the central core of the city but commute to suburban areas. Although some of this "reverse commuting" is very short—just over the border of the central city to a close-in suburb, much of it is quite lengthy travel to suburban employment complexes such as hotels, medical centers, and malls. These patterns can be seen in the Census data on low-income workers, particularly women. Feasible service for such workers would be relatively direct reverse-commute services, feeder services, or both from suburban transit stops and stations to their actual employment sites.

Such workers might also require additional or targeted service information. Marketing and advertising services—in conjunction with the other service improvements geared to desired attributes—might also increase or maintain ridership among low-income and carless households for both work and non-work trips.

Low-income and carless travelers tend to be more responsive to transit fare levels than other travelers. Fare reductions and free transfer options might maintain their transit use despite societal trends encouraging them to use the car. In addition, some of these workers might be induced to use a subsidized vanpool.

Blacks, Hispanics, and Asians

Ethnic and racial minorities—Blacks, Hispanics, and Asians—are substantially more likely to use transit, even when controlling for income. Many of the transit concepts previously discussed (e.g., reverse-commute, services to large employers, various route deviation and flex services, and fare incentives) would meet the service attributes required by these travelers.

However, Hispanic and Asian populations are becoming more concentrated in older suburbs and may present special challenges to transit operators; route restructuring might better meet their transit needs. In addition, Hispanics are substantially more likely to carpool than other ethnic groups; subsidized vanpools may meet even more of their needs.

Travelers with College and Graduate School Training

One of the more surprising groups disproportionately dependent on transit are those with a college degree and some graduate school training. These travelers seem particularly well served by transit concepts which personalize efforts or provide a higher level of service, particularly providing direct service to their employers and offering various deviation and flex services. In addition, such riders may be more sensitive to time and speed, as well as the ease of using a system; route restructuring (which often makes service more rational), park-and-ride, express buses, and high-occupancy vehicle (HOV) lanes may all provide the kind of service attributes which such travelers require. Riders with higher educational attainments have also been disproportionately more likely to use light rail and commuter rail services. These travelers are also over-represented in downtown circulator and loop systems, suggesting that they need mobility in mid-day for shopping, eating, and personal business.

Young Workers and Workers With High School Degrees

Table 16 shows that two additional groups of travelers—people 17 to 29 and people with a high school degree—also overlap significantly with most of the market niches already discussed. As such, many of the same transit concepts will provide the service attributes they seek: direct services to employers, flexible and route deviation services, and express services. At the same time, these groups will be slightly more responsive to cost attributes and may be very responsive to fare incentives, relaxed transfer policies, and subsidized van and carpools.

Immigrants

Immigrants are a very important group because they remain more likely to use transit, even after years in the United States and even when their income increases substantially. They overlap substantially with groups already discussed—those under 30, those with low incomes, those with no cars, and Hispanics and Asians. As such, most of the service concepts previously discussed will provide the service attributes such travelers seek. However, it may be very important for transit systems to target and market these service concepts to the actual origins and destinations and schedules of immigrant workers, rather than assuming such workers will continue to support the current services offered.

Older Workers

Finally, Table 16 suggests that, although people over 65 are more likely to use transit for work and non-work trips, the market share among this market niche is falling in most service environments. On the other hand, elderly people are very responsive to certain service concepts, at least for non-work trips. Those that provide some of the convenience and safety of the car—like taxis and demand-responsive services—are very attractive to such users. However, elderly travelers have also been drawn to customized but regular transit concepts such as service routes, community buses, and deviation services of several types.

Service Attributes Sought by New or Expanding Market Groups

Table 17 focuses on groups less dependent on public transit but who are often thought to be "captive riders" because of their personal characteristics or who could be transit riders if given the correct service concepts. This set of travelers includes

- Women with incomes below $10,000,
- People with some high school education (no degree),
- People age 50 to 59 with incomes below $20,000,
- People with no high school education,
- People with some college education (no degree),
- People with incomes between $20,000 and $40,000,
- Children age 12 to 16, and
- People with one household car (in 2+ person households).

Women with low incomes are a group routinely assumed to depend disproportionately on public transit. In fact, such women are more likely to drive than men with low incomes or than women making more money, probably because women with low incomes have multiple domestic obligations and face the suburbanization of so many job opportunities. Women with low incomes share the need for transit service geared to suburban as well as central city employment concentrations with other groups erroneously thought to be more dependent than average on transit—people with some high school, people with less than a high school education, and people 50 to 59 with incomes less than $20,000.

All of these potential market groups would be better served by direct routes to large employers, by appropriately scheduled and provided reverse-commute services (direct bus lines, for example, rather than feeders to and from suburban terminals), and by route restructuring with service focused on new development and employment patterns. These could be provided in regular buses or in van pools.

Given the suburban locations of so many jobs, as well as the early morning and late night shifts they often work, these four groups of people might respond to optional route extensions, flex routes, and route deviation services. Female workers in these market niches might find childcare and concierge services to be very important to their modal choices. All four groups would be responsive to fare incentives, but probably only if provided in conjunction with one or more of the other service concepts relevant to their needs.

Table 17 also focuses on potential market niches of those living in a household with at least one car, people with some college education, and people with moderate household income ($25,000 to $40,000 per year). These people will also be relatively unmoved by fare incentives but may be very responsive to services targeted directly to their employers as well as services which save them time, like HOV lanes or priority transit treatments. Route restructuring concepts (e.g., crosstown services and suburban services) may also increase both the speed and the convenience of transit for these travelers. They may be even more responsive to flexibility in service delivery—guaranteed-ride-home programs, flex routes and route extensions, and route deviation services.

Finally, Table 17 highlights a group which is a heavy user of transit service in other countries—school children 12 to 16. To gain additional ridership from these travelers, transit systems will have to satisfy the young riders themselves and their parents. This group is known to be extremely responsive to fare incentives and special passes; moreover, given the neighborhood base of most school and other trips, they would be well served by flexible and demand-responsive services.

Transit systems may also gain substantial ridership from these travelers by rerouting buses to serve schools, rescheduling buses to coordinate with school opening and closing times, and working with school districts on pass programs. To the extent that such services reduced parents' worries about security and so forth, they would help create additional ridership; such programs are likely to increase ridership for nonschool activities as well.

EFFECTIVE SERVICE CONCEPTS

In the second part of the analysis described in this chapter, the research team interviewed many transit operators who had increased transit ridership, were known to be implementing some of the promising service concepts identified above, or both.

To identify operators who might have captured new markets or expanded existing ones, the research team used Section 15 data to identify communities with significant increases in ridership, effectiveness, or cost effectiveness in 19 different service environments. Specifically, the research team identified transit systems in communities of different sizes and population densities

- Having the greatest change in ridership per revenue vehicle hour (PRVH), 1989–93;
- Achieving the highest ridership PRVH in 1993;
- Displaying the lowest costs per passenger mile in 1993, or,
- Experiencing the lowest cost per passenger in 1993.

The Section 15 calculations appear in Appendix D.

These calculations were used to select 17 sites for detailed case studies. Eight sites were chosen for either having increasing PRVH over a 5-year period or high PRVH in 1993; nine sites were chosen on the basis of one or more of the other Section 15 cost or effectiveness measures, alone or in combination with high hourly ridership. An additional 5 sites were studied on the recommendation of research team or panel members.

The research team developed a list of data sought of each site and obtained that in several lengthy phone interviews. To

TABLE 17 Promising service concepts matched to potential transit markets

	Potential Service Options by Type of Trips	
	WORK TRIPS	**NON-WORK TRIPS**
WOMEN WITH INCOME <$10,000; PEOPLE WITH SOME HIGH SCHOOL		
PEOPLE 50-59 WITH INCOMES <$20,000		
PEOPLE WITH LESS THAN H.S. EDUCATION		
Feasible		
Faster and More Direct	• Service to Large Employers • Reverse Commute • Feeder Routes • Child Care Facilities • Concierge Service	• Transit Supportive Neighborhood • Joint Development • Marketing and Advertising
Cheaper	• Route Restructuring • Facilitating Transfers • Suburban Transit Centers • Priority Bus Traffic	• Suburban Transit Center • Facilitating Transfers • Route Restructuring
More Convenient	• Fare Incentives • Vanpool/Carpool Subsidies • Transfer Policies	• Fare Incentives
	• Route Deviation • Flex Routes • Downtown Loops • Feeder Routes • Route Extension	• Neighborhood Loops • Route Deviation
HOUSEHOLD WITH ONE CAR; PEOPLE WITH SOME COLLEGE		
HOUSEHOLD INCOMES $25,000 - $40,000		
Feasible		
More Convenient	• Service to Large Employers • Feeder Routes • Joint Development • Concierge Service • Guaranteed Ride Home	• Transit Supportive Neighborhood • Joint Development
Faster and More Direct	• Flex Routes • Late Night Request Stop • Smaller Transit Vehicles • Route Extension • Downtown Loops	• Smaller Transit Vehicles • Taxi Substitution • Community Bus Service • Neighborhood Loops • General Public DAR
	• HOV Lanes • Route Restructuring • Park and Ride • Low Floor Buses • Priority Bus Traffic	• Priority Bus Traffic • Suburban Transit Center • Low Floor Buses
CHILDREN 12-16		
Feasible	School	
Faster and More Direct	• Transit Supportive Neighborhood • Marketing and Advertising	• Transit Supportive Neighborhood • Marketing and Advertising
Cheaper	• Route Restructuring • Facilitate Transfers	• Route Restructuring • Facilitating
More Convenient	• Fare Incentives • Transfer Policies	• Fare Incentives • Transfer Policies
	• Flex Routes • Neighborhood Routes • Route Extension • General Public DAR	• Flex Routes • Neighborhood Loops • Route Extension • General Public DAR

ensure the accuracy of reporting, the research team submitted each case study to each of the officials to whom the research team personnel spoke, asking them to verify the data and descriptions. The full case studies appear in Appendix E.

In addition, the research team identified some transit systems implementing service concepts thought to be able to maintain or increase transit markets. Because not all promising concepts were represented in the 23 detailed case studies, the research team contacted more than 40 systems experimenting with one or more specific service concepts to determine their ridership experiences. Information from the 40 additional interviews is given in this chapter and in Appendix G, which contains the full details of service options implemented.

However, obtaining disaggregated data on transit ridership at the system level was not easy. Most transit operators do not obtain ridership data at the level of detail the research team sought; they rarely collect data on age or sex or income of their riders, let alone race, ethnicity, or immigration status. So, although operators often had an idea of who they were serving, they could rarely state definitively which riders contributed to any particular service's success.

As a result of these problems, the research team often could not get very detailed assessments of ridership or ridership linked to service concepts. At the same time, many systems had destination-specific information; they knew that services provided to a suburban mall or a university had high ridership, although they rarely knew whether their riders were going shopping or to work, were young or old, or were male or female.

Operational Patterns Reported by Transit Operators

Table 18 details the kinds of operational patterns which transit systems reported as effective in increasing ridership. Some systems found that shopping malls, large employers (such as public agencies), hospitals, and universities provided a useful destination on which to focus transit services; there are indications that such sites offered both work and nonwork destinations.

Systems in several service environments reported increased ridership for special events like conventions and football and baseball games. In some cases, the transit system had supplied additional or special services; in other cases, they simply noticed that ridership increased. Several systems, such as Broward, Tucson, and Phoenix, reported that ridership increased substantially during the winter months when local populations swelled with "snow birds." Other systems reported that ridership increased when weather was very bad or when there were smog and ozone alerts.

TABLE 18 Transit markets reported by transit operators

Service Environments	Work Trip	Non-Work Trip	Destinations	Special Circumstances
50,000 - 500,000				
• *very low density*	University Faculty and Staff			
• *low density*	University Faculty and Staff	University Students Disabled Travelers Preschool and School Children	Large Employers/ Universities	Sporting Events
• *medium density*				
• *high density*				
500,000 - 1 million				
• *low density*	University Faculty and Staff	University Students; Families; Single Parents; School Age Children; Riders 70+ Years Old; Disabled Riders	Social Service Agencies Shopping Malls Large Employers/ Universities Industrial Sites; Grocery Stores	Winter Visitors / "Snowbirds" Sporting Events
• *medium density*		Public School Students	Shopping Malls	Poor Weather Conditions
• *high density*				
Over 1 million				
• *low density*	University Faculty and Staff	Tourists; School Age Children; University Students; Disabled Riders 70+ Years Old	Large Employers/ Universities; Shopping Malls; Social Service Agencies; Military Bases	Winter Visitors/ "Snowbirds" Sporting Events
• *medium density*	Hospital Employees University Faculty and Staff	Tourists; Disabled Riders; Riders 70+ Years Old University Students	Senior Centers; Universities; Hospitals/ Medical Centers Trailer Parks Regional Shopping Centers	Conventioneers
• *high density*	University Faculty and Staff	University Students; Tourists	Hospitals; Larger Employers; Beaches	"Accidental" Reverse Commuters

A subset of properties reported increased ridership by the elderly and those with disabilities. In some cases, this was a response to accessible buses or special marketing or training programs; in other cases it seemed to be occurring in the absence of special measures. Several systems reported increasing ridership among school children—in some cases, this was the result of school districts ending their own transportation programs; in other cases, it was the result of conscious service decisions targeting school children.

Summary of Ridership Experiences

Roughly 75 percent of the systems or services the research team described above had some ridership information; roughly 40 percent had data about ridership trends over time. Only a handful of systems provided the kind of socio-demographic data needed to determine which of the promising service concepts could maintain or increase ridership or create new markets from among the market groups identified in Chapter 1.

Transit operators have useful ridership data—their own operational needs require them to characterize and, to a lesser extent, measure their ridership, in terms of location or direction of service, time of service, frequency of service, and the kind of trip they are serving. Although such information is useful in addressing operational concerns, except for a few service concepts and market niches, this information was not particularly useful for the types of analyses performed for this study.

On the basis of the case studies and contact with approximately 40 additional transit systems, the research team concluded that 13 transit service concepts increased total transit system ridership as follows:

- Feeder services,
- Express buses,
- Services to large employers,
- Reverse-commute services,
- Vanpool incentives,
- Park-and-ride services,
- Fare incentives,
- Travel training and transit familiarization,
- Light rail,
- Commuter rail,
- Route restructuring,
- Community buses and service routes, and
- Special event services.

That is, these service concepts did more than show positive ridership increases; their overall effect on the system was positive—new ridership did not (all) come from existing services or routes. The magnitude of ridership response varied greatly (as did the inputs required to achieve that response). Moreover, not all of these services increased system ridership in every service environment or every application; both reverse-commute and targeted employer services, for example, were sometimes very effective and other times not.

These ridership increases were usually found in the following six operational patterns:

- Suburb to suburb,
- Service to large suburban trip generators,
- Central city to suburb,
- Special sporting and recreational events,
- Suburb to central city, and
- Service to universities (generally suburban campuses).

Given the limited information which transit systems could provide, the research team also knows some of the markets which were expanded, often significantly, by the implementation of a series of these service concepts. These market niches include

- People with disabilities,
- People age 17 to 25 (particularly university students),
- Children age 5 to 12,
- Blacks (particularly inner-city residents),
- Hispanics (particularly inner-city residents),
- Immigrants,
- People age 65 and older,
- People with high incomes,
- People age 50 and older, and
- Men.

People with disabilities have been induced to make greater use of fixed-route transit, generally using the total system more than when they were paratransit users (if they were) by the provision of passes or free fares, travel training, vanpool incentives, downtown and neighborhood circulators, general public dial-a-ride (DAR), and smaller buses.

Young people (age 17 to 25), particularly those who are university students, were an important market in many service environments when provided with free or fare-free passes, restructured services (i.e., better routing, scheduling, timed transfers, and suburban transfer stations), and feeder or shuttle services from rail and regional bus.

School children (age 12 to 16 and even age 5 to 12) are a growing market in some service environments; they have been attracted to transit by the provision of free or fare free passes, transit familiarization programs, general public DAR, and restructured services.

Blacks and Hispanics, particularly those with low incomes and living in the inner city, have expanded their use of transit when provided with direct service to suburban and central city employers, reverse-commute services—direct and feeder, and vanpool incentives.

Immigrants, a market niche overlapping with Hispanics, were very responsive to service concepts which focused on employment locations, including reverse-commute options and direct employer services.

People over 65 have helped systems increase total ridership when offered passes and discount fares, transit familiarization sessions, general public DAR, low-floor buses, and smaller buses. Older people who are members of racial or ethnic minorities have also been attracted by jitneys.

Men, those with high incomes, and those age 50 and older were attracted to several service concepts including light and heavy rail services.

Although the research team has little evidence that those with higher educational attainment were also attracted by some of these service concepts, it is likely. In fact, the case studies suggest some reasons for greater relative reliance on transit among those with college and graduate school education. The case studies found that many transit systems had substantial success in providing one or more transit service concepts—from fare concessions to express services to route restructuring—to universities, large private employers, and large public agencies.

Such large organizations often put a high value on reducing drive-alone commutes and were willing to subsidize transit ridership or pass costs in an effort to do so. Some also substantially restricted parking, for environmental reasons or space constraints or policy mandates (e.g., no student parking). Ultimately these kind of programs may have effectively targeted more highly educated workers.

Overall, these analyses, and their findings, may be seriously constrained by the lack of data. Other service concepts may have been effective in increasing transit ridership and/or other market niches may have been expanded—the research team simply has no data which prove this.

Table 19 describes the research team's educated assessments of each service concept's

- Overall effect on service ridership,
- Diversionary effects,
- Effect on total system ridership,
- Work and non-work ridership characteristics, and
- Special O-D characteristics which might bear on ridership.

The first column of Table 19 summarizes the effect on ridership, of the actual service concept—that is, increased feeder route or vanpool ridership. Of course, some concepts, such as travel training, are not themselves services. The second column of the table describes what the research team knows about how much a new service gained ridership at the expense of other routes or services. This is not always negative—some systems are searching for ways to divert riders from ADA-mandated paratransit to fixed-route services; others may be seeking to reduce their peak-period load.

The third column details whether a service which itself attained new ridership actually contributed to total system ridership (e.g., if a feeder service increased ridership on the rail or bus system it was feeding) and whether the net effect on ridership was positive (i.e., if there were ridership gains when diversions were subtracted from ridership increases on the new service). Of course, even services which divert some riders from other routes or modes can still increase total system ridership.

The fourth column of Table 19 identifies the market niche(s) actually accounting for the ridership increases on the service itself or the system overall. As suggested by both the previous section of this report, and the discussion above, the research team does not know a great deal about who accounts for most ridership gains. Transit systems typically have considerable information about elderly riders and riders with disabilities—largely because the costs of providing ADA-related paratransit services have encouraged transit operators to find ways to divert paratransit riders to fixed-route services.

The fifth column on Table 19 describes special O-D patterns or special trip characteristics, which define or explain the service concept's effectiveness in increasing ridership. Often this kind of information was the only ridership data which transit systems could provide.

Research team personnel were very limited by how little information operators were able to provide. This report only indicates that a service concept increases ridership if the research team obtained operational data showing that it did so. In addition, this approach slights promising concepts which have not yet reached their potential (e.g., joint developments or transit-supportive neighborhoods), those where it is hard to separate out or measure the effects on ridership (e.g., marketing and advertising), or those the research team did not uncover in the literature search, the case studies, or additional interviews.

PRELIMINARY ASSESSMENT OF COST EFFECTIVENESS

Some transit service concepts increase ridership at a very high cost; others do so relatively cheaply. This study was not charged with evaluating the costs of providing each option—it would have been extremely difficult to do so, because most systems had few cost details—however, the research team does provide a preliminary assessment of the relative short- and long-term costs of each service concept using a simple, qualitative scale.

Table 20 compares the capital and operating costs for each new trip gained for a transit system by each transit service concept, both initially and over time. Low costs are those roughly equivalent to the average cost of providing peak-period bus service. Although some authorities would not find these costs to be low, they do suggest the relative costs to a system from implementing one of the options either in addition to, or instead of, current bus services. Very low costs are those which are less than average peak-period bus service costs.

Moderate costs are those up to 50 percent greater than unit costs for peak-period bus service; high costs are those up to

TABLE 19 Effective service concepts; effect on ridership

	INCREASED RIDERSHIP			MARKET NICHE SERVED		
	Service Itself	Without Drawing Riders from other Transit	System-Wide	Work	Non-Work	Destination/ Events
FARE INCENTIVES	N A	Yes	Yes	Work Not fully known • Colleges and Graduate School • People with Disabilities School • People 17-29 • Children 6-16	• People 65+ • People 17-29 • Children (5+) • People with Household Incomes < $15,000 • People with Disabilities	• Special Events • Universities • Schools • Tourist Sites
FEEDER ROUTES	Yes	Possible Diversion	Yes	• Women • People 17-44 • People with Household Incomes < $25,000 • People with Household Incomes > $50,000	• Women • People 17-44 • People with Household Incomes < $25,000 • People with Household Income s> $50,000	• Special Events
HEAVY / COMMUTER RAIL	Yes	Some Diversion	Yes	Not Fully Known: • High Income Workers • People 50+		
LIGHT RAIL	Yes	Some Diversion	Yes	Not Fully Known: • High Income Workers • People 50+	Not Fully Known: • High Income Workers • People 50+	
LOW FLOOR BUSES	Possible	Possible	Possible	Unknown	Unknown	
REVERSE COMMUTE	Yes	Possible Diversion	Yes	• People 17-44 • People with Household Incomes > $15,000 • College and Graduate School Edcuation • High Income • Women with Household Incomes < $20,000 • Blacks • Immigrants • Hispanics		• Medical Complexes • Hotels • Malls • Employment Complexes
ROUTE RESTRUCTURING PACKAGE	Yes	Yes	Yes	Unknown	Unknown	• Suburban Medical Complexes • Universities • Suburban Employ-ment Sites
ROUTE RESTRUCTURING CONCEPTS						
CROSS TOWN BUSES	Yes	Possible Diversion	Yes	Largely Unknown: • People 17-29 • People with Low Income • Blacks • Hispanics	Unknown	• Suburban Attractors
SUBURB - TO - SUBURB SERVICE	Yes	Yes	Yes	Largely Unknown: • People 17-29 • People with Low Income • Blacks • Hispanics	Unknown	• Suburban Attractors

(*continued on next page*)

TABLE 19 (*continued*)

	INCREASED RIDERSHIP			MARKET NICHE SERVED		
	Service Itself	Without Drawing Riders from other Transit	System-Wide	Work	Non-Work	Destination/ Events
ROUTE RESTRUCTURING CONCEPTS (continued)						
SUBURBAN TIMED TRANSFER CENTERS	Yes	Yes	Yes	Unknown	Unknown	• Universities
SERVICE TO LARGE EMPLOYERS ETC.						
	Yes	Yes	Yes	School • People 17-24 Work High Income Workers Highly Educated Workers		•Universities • Schools • Medical Complexes • Individual Employers • Malls
SERVICE ROUTES / COMMUNITY BUSES						
	Yes	Desirable Diversion from Paratransit Services	Yes		• People 65+ • People with Disabilities	
SMALLER TRANSIT VEHICLES						
	Yes	Yes	Yes	Unknown	Unknown	
TRAVEL TRAINING						
	N.A	Desirable Diversion from Paratransit Services	Yes	• People with Disabilities	• People with Disabilities	
TRANSIT FAMILIARIZATION						
	N.A.	No	Yes	• People 65+ • People with Disabilities • Children 12-17	• People 65+ • People with Disabilities • Children 12-17	
VANPOOL INCENTIVES						
	Yes	Possible	Yes	• People with Low Incomes • Blacks • People with Moderate and High Incomes • People with Disabilities		• Reverse Commute Flows • Medical Complexes • Suburban Empolyers

100 percent greater than peak-period bus service unit costs. Very high costs are those more than 100 percent greater than current peak-period bus service costs per passenger.

These are rough measures; unit bus costs for both "traditional" peak-period services and those service concepts considered here will vary substantially with ridership. Capital (and sometimes operating) differentials will depend on whether these service concepts are provided in addition to or instead of traditional bus service—thus determining whether new equipment and facilities are needed or whether existing resources can be used.

Moreover, some of the service concepts are not designed to be provided during peak periods, so the comparison may not be relevant. Some service concepts may have a greater fare recovery than others or than traditional bus service—including express buses and service to special attractions and sporting events (where riders are willing to pay higher than average fares as long as they are less than parking costs, private sponsors may cover some of the operating costs, or both).

In addition, the actual cost ranges may be significant. Building a new rail system or expanding an existing one is remarkably more expensive than adding new bus service. Thus capital-intensive options such as light and commuter rail are initially enormously more expensive per new trip than are other options; however, if they continue to attract new riders, their average unit costs might drop substantially.

TABLE 20 Preliminary cost-effectiveness of successful service concepts

Successful Service Concepts	Estimated Cost Per Net New Trip					
	Initially			Long -Term		
	Capital	*Operating*	Total	*Capital*	*Operating*	Total
Feeder Services	None to Low	Low to Moderate	**Low**	Low	Low to Moderate	**Low**
Services to Large Employers	None to Low	Low to Moderate	**Low to Moderate**	Low	Low to Moderate	**Low to Moderate**
Express Buses	None to Low	Moderate	**Low to Moderate**	Low	Moderate	**Moderate**
Reverse Commute Services	None to Low	Low	**Low**	Low	Low	**Low**
Vanpool Incentives	Low to Moderate	Very Low to Low	**Low**	Low to Moderate	Very Low	**Low**
Fare Incentives	N.A.	None to Low	**Very Low to Low**	N.A	Very Low to Low	**Low**
Park-n-Ride	Moderate to High	Moderate	**Moderate to High**	Low	Moderate	**Moderate**
Travel Training	N A.	Low to Moderate	**Low**	N A	Low	**Low**
Route Restructuring	None to Low	None to Low	**Low**	Low	Low	**Low**
Community Buses	Moderate	Low to Moderate	**Moderate**	Moderate	Low to Moderate	**Moderate**
Special Events	Low to Moderate	Low	**Low**	Low	Low	**Low**
Commuter Rail	Very High	High to Very High	**Very High**	Low to Moderate	High	**Moderate to High**
Light Rail	High to Very High	High to Very High	**High to Very High**	Low to Moderate	Moderate to High	**Moderate to High**

Note: Compared to average peak period bus service unit costs.

In fact, even though the scale is very different, the long-term costs of even bus-based concepts could well depend on whether they continued to increase ridership. Travel training programs, for example, are very cheap if riders with disabilities continue to use fixed-route service in preference to complementary paratransit; however, if trained passengers immediately stop riding regular buses (or require continual re-training), average costs per trip would be moderate rather than very low.

Moreover, the cost of some concepts is linked to actual rider characteristics. Some fare incentives increase net ridership without almost any cost—for example, offering lower fares to older people in the off-peak rarely affects existing ridership. Providing cut-rate monthly transit passes can be costly if some current riders who are paying full fare buy the reduced rate passes—even if total net ridership increases. Finally, some or all of these concepts could be implemented together which might substantially raise total cost, initially and over time—but also substantially increase overall ridership counts, perhaps above that which could be achieved by any single concept alone.

The assessments shown in Table 20 are a first attempt at providing a way for transit systems to evaluate the relative costs of promising options—if they keep in mind all the oper-

ational details which determine both the initial and long-term costs of current service options and promising options.

SUMMARY

Thirteen service concepts have been shown as effective in increasing transit ridership—most in several service environments. These concepts are as follows:

- Feeder services,
- Express buses,
- Services to large employers,
- Reverse-commute services,
- Vanpool incentives,
- Park-and-ride services,
- Fare incentives,
- Travel training and transit familiarization,
- Light rail,
- Commuter rail,
- Route restructuring,
- Community buses and service routes, and
- Special event services.

The ridership increases linked to these effective concepts occurred in the following 10 transit niches and markets:

- People with disabilities,
- People age 17 to 25 (particularly university students),
- Children age 5 to 12,
- Blacks (particularly inner-city residents),
- Hispanics,
- Immigrants,
- People age 65 and older,
- People with high incomes,
- People age 50 and older, and
- Men.

Although the success of the 13 service concepts is probably not limited to these 10 niches, they are, however, the only ones on which the research team has ridership data.

The preliminary cost-effectiveness assessments suggest that some of the effective concepts are often relatively inexpensive to implement in many cases (e.g., travel training, vanpool incentives, reverse commute, and route restructuring). Others are very expensive per ride and should be carefully considered before being implemented as a way to target new markets.

These analyses have been severely hampered by the lack of good ridership data. Many systems indicated that other service concepts had been successful in increasing ridership but they had no evidence to document those increases, let alone data on the sociodemographic characteristics of riders gained. Other transit operators indicated that some service concepts not listed here had been effective in creating a positive image for transit or in laying the groundwork for ridership increases in the future. Again, lacking ridership data, the research team could not determine whether or not those concepts were effective.

CHAPTER **4**

SOCIETAL EFFECTS OF IMPLEMENTING PROMISING SERVICE CONCEPTS

INTRODUCTION

The research team was charged with examining the overall societal effects of providing the service concepts described in Chapter 3. Most transit services are subsidized because policymakers recognize them as an important governmental function—transit can increase the access and mobility of many groups while encouraging others to drive less. Those who use buses, subways, and trains benefit society as well as themselves. The potential benefits of transit use range from reduced congestion and pollution to decreased medical and welfare costs.

The direction of the societal effects arising from implementing any of the transit concepts is clear—it would be positive; however the effective service concepts identified in the previous chapter do not offer the same degree of mobility to all travelers and would not have the same effect on the travel patterns of all market groups. Providing an attractive transit service to a suburban worker with multiple household cars may not have the same overall effect as providing a service which allows a low-income worker to get to a suburban job. Thus, the magnitude of societal changes is far less clear.

To complicate matters, the 13 service concepts shown to be effective in increasing or maintaining ridership have widely varying costs per average rider and per new rider. It is very expensive to provide commuter rail services which attract high-income male workers but relatively inexpensive to provide services targeted to specific large employers serving low- and moderate-income workers. So, even less clear is the cost-to-benefit ratio of the effective service concepts, even if measured only in qualitative terms and only for aggregate societal benefits.

Finally, given that most new transit services come at the expense of other transit services, many users are in competition with one another (whether they know it or not) for concepts which better meet their needs. Moreover, transit service ultimately comes at the cost of other public programs ranging from parks to pre-natal health care—providing one type of service may prevent an operator from providing others, creating what economists call opportunity costs. These opportunity costs must be considered in the assessment of societal benefits.

The following section considers the total effect on ridership of implementing various service concepts; this analysis is the basis for subsequent work. The second section presents an overview of the equity and effectiveness of each service concept. The research team uses these assessments to give some idea of the relative magnitude of societal benefits offered by each service concept.

MAGNITUDE OF RIDERSHIP EFFECTS

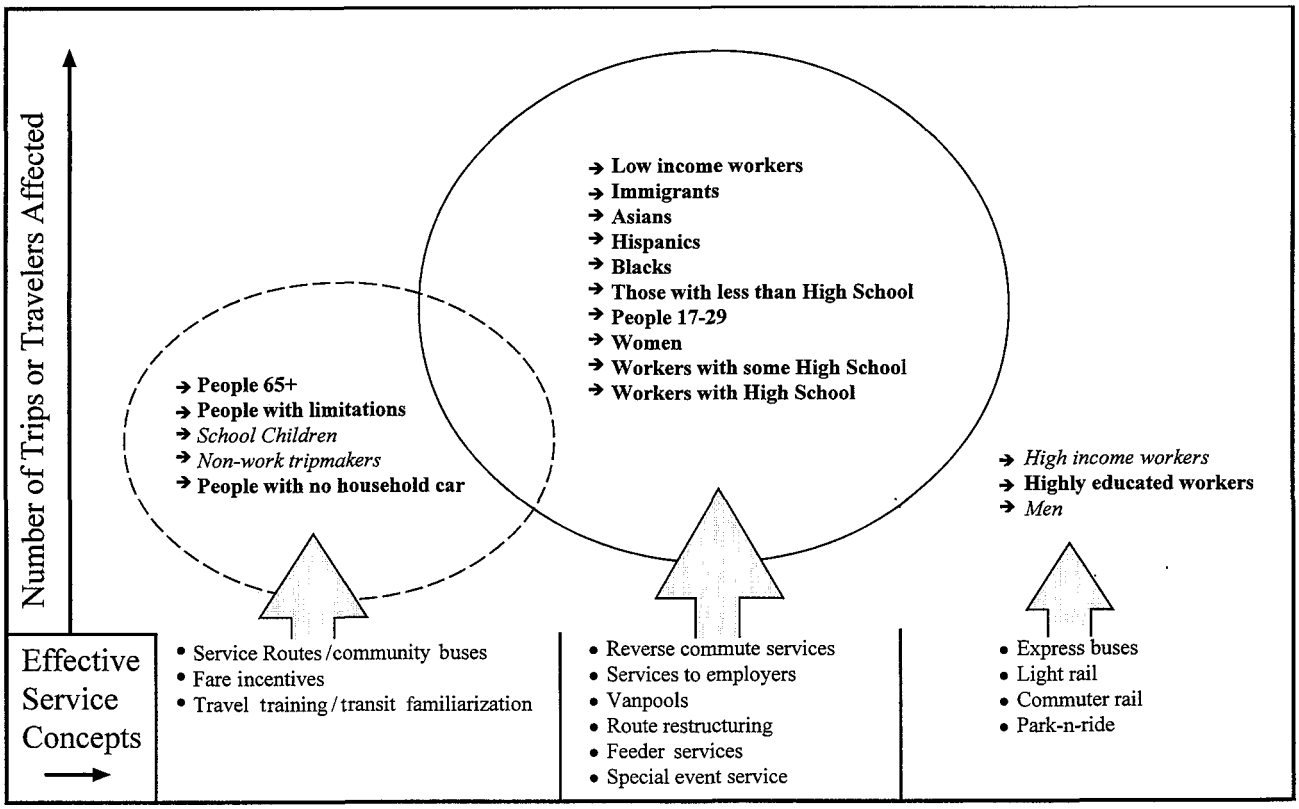
In Chapter 3, there was a brief analysis of the cost per new ride generated by each of the service options, without directly considering how many riders total, or total trips, would be affected by the concepts, which would maintain or expand current markets (as identified in Chapter 1), and which would create new markets? Figure 9 shows estimates of the likely ridership effects of each concept.

The analyses in Figure 9 depend on several assumptions which may not be realistic, which may change over time, or which may vary with the metropolitan area. These assumptions are as follows:

- They are all based on current ridership experiences as described in Chapter 3.
- They are all based on the qualitative cost-effectiveness assessments presented in Chapter 3.
- They all assume a comparable level of effort for each service concept—whether it is a vanpool program or a light rail system.

Given these assumptions, the greatest ridership effect would be seen from implementing services which target either specific work places or specific workers: vanpool incentives, reverse-commute services, and so forth. These kinds of services have been attractive to many market niches (remembering that many overlap substantially, such as women and low-income workers, or Hispanics and workers age 17 to 29); the markets affected constitute roughly 70 percent of all workers. Moreover, these concepts serve routine, frequent trips—those for work. Many workers would probably use these services for most of their weekly work trips.

Some of these concepts could create transit markets from groups not more reliant on transit, such as university students, school children, and high-income individuals. Route restructuring, for example, allows a wide range of students to use transit; special event services have attracted higher



Note: *Italized text* = Not currently a transit market.

Figure 9. Societal implications of implementing effective service concepts.

income, often male, riders who do not generally consider transit a viable option. Overall the number of individual riders and the number of rides each would take could be high for such service concepts.

The next largest ridership effect would probably result from services that target non-workers, or workers for non-work trips. Options such as community buses and travel training have attracted groups not currently constituting a transit market, such as children and older people. In addition, given their heavy reliance on public transit for commuting, immigrants to the United States (particularly women immigrants and those in the United States less than 10 years) may find such service concepts to be more attractive for their non-work trips.

Although there are 4 times as many non-work trips as there are work trips, riders attracted by options, such as community buses and travel training, probably would not use them routinely and frequently; therefore, such options would have less ridership effect than seen with commuter options. However, much of the population cannot drive or often seeks relief from driving—within a few years, one out of five Americans will be over 65 years of age. Successfully capturing only a small percent of the trips of this growing market might ensure ridership for decades to come.

The smallest effect would be seen among the group of largely commuter-oriented options which target groups not traditionally thought of as more likely to use transit (e.g., men, especially those who are highly educated or have high household incomes). Such workers constitute no more than 25 percent of the labor force; moreover, it is very unlikely that they will depend on the transit concepts considered every day even though they may commute (they may take the car several days a week or carpool). Although light and heavy rail options have had substantial effects on ridership in older, dense communities where they have existed for decades, the national effects are substantially smaller. If these options are being considered as new concepts, their effects overall would be slight.

The relevancy of the preceding assessments depends on the scale of services offered. One or two vanpools will not achieve the daily ridership of one light rail line, even if the vanpools are completely full and the light rail cars almost empty. The same level of effort (resources) must be committed to implementing each concept for these general comparisons to be of value. If rail systems achieve much higher ridership, some of these assessments would change as well.

EQUITY AND EFFICIENCY CONSIDERATIONS

To evaluate the magnitude of the societal effects of implementing various service concepts research team personnel

analyze both their equity and efficiency. Equity is a complicated concept; for many people, it implies a sense of equality or justice in spending or outcome. In general, the more equitable an outcome, the greater the benefit to society. Efficiency, also a complicated concept, is used here to mean some measure of how well a transit system meets its goals with a given amount of resources. The public, and transit systems themselves, have multiple goals for transit services. These goals include inducing automobile drivers to use transit, encouraging paratransit riders to use fixed-route services, and providing incentives for transit riders to take more trips or to make their trips in less congested times or along different routes. The more these desired outcomes are achieved, the more society benefits. Public policy decisions must be evaluated against many criteria; however, important criteria can conflict—something can be efficient without being equitable or equitable without being efficient.

Equity

Policymakers use many, often conflicting, definitions of equity. For those who see equity as a general measure of fairness, concepts that are expensive, serve fewer people, and are targeted at higher income individuals would be considered an inequitable way to spend public money. The same set of transit service concepts would also be judged inequitable by those who believe that equity means conditioning service on income or need (e.g., disability status), because this would generally require expending funds for those with the lowest income or greatest need. Similarly, if equity is seen as equality of input or output, the same set of transit service concepts would be inequitable. That is, providing all users with the same level of service or spending resources so that all users gain the same thing from service (e.g., number of trips) might be equitable regardless of the input. By these preceding definitions, service concepts such as park-and-ride lots and new rail systems might be seen as inequitable.

On the other hand, other definitions can lead to other assessments. It was not within the scope of this study to provide a comprehensive analysis of equity issues. Perhaps high-income users pay more of the taxes and fees which support public transit while low-income users pay little or none. If so, other definitions of equity might find that spending public money for rail systems was progressive, a standard some consider a working definition of equity. A progressive policy is one which redistributes resources; for these analysts, public transit spending would be equitable if low-income people got more than they paid for and high-income people less—relatively independent of the actual amount of benefit received.

The preceding evaluations are very sensitive to the reported ridership and market effects. The concepts considered might well have different effects in different communities. For example, even though research team personnel found no examples, park-and-ride services may be attractive to low-income rural residents commuting to metropolitan areas in some regions while express buses may serve low-income central city workers commuting to suburban jobs in other communities. In addition, over time, new rail systems may gain substantial ridership, both because ridership grows and because the system is expanded, permitting travel to more destinations.

Equity is not the only issue on which any public expenditure can be judged. Lawsuits are pending in several communities in which minority advocacy groups are suing transit systems over their expenditures for rail and other services targeted at "choice" riders. Complainants in one community, however, recently ended their suit in an out-of-court settlement in which the transit system agreed to lower fares and provide more bus services. Many involved parties were not sure that the equity argument would be successful in court. They believed that the community transit operator might successfully argue that rail systems had the potential to create new, denser land use patterns which would ultimately generate more transit riders, thus making more livable communities and reducing pollution.

However, when viewing equity alone, it appears that given limited resources and current ridership patterns, certain service concepts probably have much greater positive societal effect than others. These include service options, such as reverse-commute service, services targeted to employers, and route restructuring (which respond to the needs of many low- and moderate-income workers), or those, such as service routes, fare incentives, and, travel training (which respond to the needs of those who cannot drive or maintain a car).

Efficiency

Transit systems have many goals for their services, including gaining public recognition and political support, increasing total ridership, and redistributing ridership patterns (generally out of the period where they have too many riders to those where their vehicles and facilities have excess capacity). These goals may conflict. For example, services that are visible to the public and that the public supports may be favored over others, even if the favored services carry far fewer riders or cost far more.

The public also has expectations of a transit system which overlap only partially with those of any individual system. Voters and policymakers rarely see transit ridership as an end in itself; rather it is seen as a measure of the attainment of some other goal, such as reduced traffic congestion or environmental pollution, increased access to jobs by low-income workers, or increased mobility by the elderly and those with disabilities.

The efficiency of various service concepts in assisting transit systems to meet the major societal goals of reducing drive-alone commuting and supporting welfare reform are evaluated here.

Reducing Drive-Alone Commuting (Single-Occupant Vehicles [SOVs])

Reducing drive-alone commuting is generally seen as a way to decrease peak-period congestion, environmental pollution, and consumption of nonrenewable natural resources. But not all transit concepts gain their new riders from SOVs; some concepts, such as special event services or fare incentives, may encourage people to take new trips. Other concepts, such as vanpools or community buses, may simply take people away from other modes (e.g., carpools and paratransit services). The concepts most likely to gain riders from among car drivers are those geared to "choice" riders (e.g., light and heavy rail, express buses, and park-and-ride services).

However, even if such concepts gained a substantial percentage of their new riders from among car drivers, they would not better reduce SOVs if the total number of diverted riders was small relative to other concepts. Again, as suggested by Figure 9, some options reach so many more riders that the absolute number of diverted riders is probably higher, even if the percentage of any group affected is lower. Overall, the concepts which attract the largest total number of riders are the most likely to help communities reduce SOVs.

Even if the effective concepts gained all their new transit riders from among SOV drivers, they would still vary in the extent to which they achieved the goal of reducing driving—let alone congestion and pollution. The extent to which reducing SOV use actually reduces congestion, pollution, or energy consumption depends largely on the actual trip conditions and what happens to the car not driven to the final destination.

For example, policies can reduce SOV use during peak periods by moving those trips to other times; this would reduce congestion but would have negligible positive effects on pollution or resource consumption. Similarly, one driver in the family may switch to transit leaving the household car to be used more intensely by other members of the family; the effect on pollution, consumption, and congestion would vary with the use other family members made of the car. Providing park-and-ride lots in suburban locations might have negligible effects on pollution, even if it reduced peak-period congestion in the downtown or along major arteries.

Thus it is difficult—and well beyond the scope of this study—to fully determine the effects of any transit policy on the real goals most policymakers have in reducing SOV use. However, analysis suggests that those service concepts which are the most efficient at reducing SOV use are the ones targeted at low- and middle-income workers and at specific employment sites.

Welfare Reform

As described in Appendix C, one result of suburbanization and industrial restructuring has been that low-income people with poor skills are left in central cities while jobs matched to their skill levels have been moved to the suburbs. As more and more people no longer qualify for public assistance, transit agencies should assess how public transit could address the needs of this potential market.

For more than two decades, some policymakers concerned with the spatial mismatch of workers and jobs have seen transportation as the only or the most important factor explaining unemployment among inner-city residents. This assumption has been constantly challenged, and scholarly literature suggests that many factors affect unemployment. However, most reverse-commute services provided by transit operators have been effective in increasing transit ridership, whether or not they actually increased employment. These services provide an important equity function for society, even if they only provide better or faster services for already employed workers who are otherwise disadvantaged. In addition, it seems logical to assume that, if the cost of transportation to a suburban work site falls—in terms of money or time—more inner-city residents might see such jobs as worth the trip—even in the absence of welfare reform.

However, to be either more equitable about or more efficient at assisting welfare recipients to get jobs, transit operators would have to provide better reverse-commute services than they now do. As described in Appendix F, many reverse-commute services carry more passengers per hour with a higher recovery cost than with-flow services, but many transit agencies make more stringent demands on the services. For example, some transit systems will not provide new reverse-commute services unless they can recover 100 percent of operating costs from fares or employer subsidies.

In addition, many reverse-commute services are not provided directly from inner-city to suburb, although they could be. Workers take rail or bus service to suburban destinations and then transfer to feeder or suburban buses to finish their journeys; many have to transfer twice to make their work trip. Moreover, many systems accidentally have built up substantial reverse-commute ridership but refuse to change schedules or make concessions to the needs of inner-city riders. Without such service changes, transit agencies are not able to efficiently meet these reverse-commute needs.

SUMMARY

Given the assumptions on which the analyses in this chapter are based, the service concepts that could affect the most riders are those which provide more societal benefits, in terms of equity and efficiency. These service concepts are as follows:

- Reverse-commute services,
- Services to specific employers and universities,
- Vanpool incentives,
- Route restructuring, and
- Feeder services.

The least efficient and equitable services are those targeted at a few high-income or highly educated, largely male, workers. These concepts are as follows:

- Express buses,
- Light rail,
- Commuter rail, and
- Park-and-ride.

Consequently, the first group of services are those which confer the greatest societal benefits.

The assumptions on which these conclusions are based are extremely controversial. Most analysts would probably agree with the research team's assessments of current ridership patterns—which drive all the evaluations in this chapter—but many would disagree with the research team's assessments of the potential long-term effects of some concepts. Rail systems, in particular, are said to have the potential to facilitate major changes in land use, which could ultimately lead to greater ridership from among many different groups of users for both work and non-work trips. Whether such concepts can or will live up to this potential is the subject of debate in many metropolitan areas and within the transportation planning community and cannot be resolved here or within the resource constraints of this study.

CHAPTER 5

IMPLICATIONS FOR TRANSIT AGENCIES AND THE INDUSTRY

INTRODUCTION

Traditionally, transit operators have focused on providing services which target a certain type of trip—the work commute, for example—but not on targeting certain types of rider. They often concentrate on serving specific geographic areas, such as downtown or suburban malls, but not on serving specific market niches. They frequently gear services to specific land use patterns—such as low-density communities—without gearing service to specific user groups. Overall, transit systems have attempted to maintain and increase ridership by identifying trip purposes and destinations common to many, largely undifferentiated users and then providing a service that meets the minimum needs of as many of those users as possible.

The research team's analyses of societal trends shows that a different way of thinking about service planning and delivery will be required to maintain current markets, let alone increase market share or total ridership, and that an alternative approach may ultimately yield greater ridership gains. Rather than assuming that all travelers want, or can be made, to travel at the same time or along the same routes, the study findings suggest that transit systems would do better to find out where large market groups, such as Blacks, Hispanics, and immigrants, want to go and when, and fashion services accordingly.

Operators will have to re-think their traditional strategies, focusing first on rider needs and then on system constraints and resources. This approach often conflicts with the traditional way transit systems have operated. Marketing in most systems, for example, consists of efforts to convince the user (often in several languages and Braille) to ride the service already being provided—rather than on changing the service to meet the user's needs.

Providing a range of different services oriented to different markets may strain the resources of most existing transit providers. Current transit organizations often have a hierarchical structure well suited to building and expanding traditional transit services but unwieldy in delivering niche-oriented options. Some experts believe that older transit agencies may not be able to respond rapidly to the changes required by a market-driven approach to service provision.

In the following sections, the changes transit systems may have to make and the stresses they may have to face, both initially and over time, if they structure their services to focus first on the needs of specific market segments areoutlined.Discussion of the implementation issues relevant to each service concept—which is beyond the scope of this study—can be found in separate TCRP and other agency reports. The following sections describe the problems or challenges common to the implementation of many of the 13 service concepts.

The first major section below describes six major areas within the organization of a system where stresses may occur. The second section below describes three sets of external relationships which must be developed or strengthened. This chapter ends by describing the research issues that the transit industry may need to explore.

EFFECTS WITHIN THE SYSTEM

Implementing effective service concepts geared to market needs creates two challenges for most transit operators: deriving operational patterns from traveler requirements and implementing effective service concepts to serve those patterns. To respond to the needs of specific transit markets, most transit systems will have to change not only the way they think about service delivery but the actual organization of the following six specific system functions:

- Planning and marketing;
- Operations, including routing and scheduling;
- Capital acquisition;
- Maintenance;
- Labor issues; and
- Financial issues.

Planning and Marketing

To develop market-appropriate services effectively, transit systems must first know more about who uses their services and when and why. It is not possible to maintain current ridership without knowing more about current riders. In addition, it is often easiest to increase per capita ridership among those currently more reliant on public transit.

The study found that most systems had very little demographic data about their own ridership patterns. Some systems felt that it was inappropriate to gather data by race or

ethnicity; others thought it too expensive to conduct the kinds of surveys which could gather more extensive rider information. But, given that different market groups have distinct travel patterns, transit operators should strive to know the kinds of services to which different markets currently respond.

Next, transit systems must know something about the characteristics of their service environment—both to better understand their current riders and to identify new markets or opportunities for expanding current markets. Much important metropolitan level data are probably already available from the metropolitan planning organization (MPO) and in city and county transportation and planning departments. Many transit systems do not take advantage of the relatively sophisticated data analysis and geographic information system (GIS) capabilities of other transportation or planning agencies in their region.

To understand their service environment, with or without the assistance of other planning organizations, transit systems should use Census and other available data to conduct analyses similar to those presented in Chapter 1 and to identify, where possible, the major O-D patterns of different market groups, within their own service area. The Census prepares metropolitan and urbanized area data in formats suitable for reasonably fine-grained analyses.

A transit system's goal should be to determine the characteristics of those who use transit and those who do not, which groups are more reliant on transit, and which specific services are used by which market groups. In addition, operators should attempt to identify geographic clusters of actual and potential market groups, as well as differences in their observed O-D patterns. Using such an approach, a transit operator can identify concentrations of individuals large enough to support various effective service concepts and a few concentrated destinations which attract them. For example, the routes of community buses designed to serve older people are routinely identified this way in most Canadian cities; Ann Arbor also used such a process before implementing their service routes. Many of the market groups likely to respond to the effective service concepts do not have the same O-D patterns as the average traveler or as the routes of traditional services.

Economic development projects and community groups often attempt to conduct informal O-D surveys of the travel patterns of inner-city workers, the elderly, single heads of households, or women—groups that have been induced to use transit more than average when provided with appropriate services. Several large communities which instituted major route restructuring based it, in part, on studies of the individual and specific travel patterns of various markets, rather than aggregating all trip patterns into the lowest common denominator.

In a related approach, systems have conducted GIS analyses of people with disabilities in order to identify or give priority to planned improvements in transit or pedestrian facilities. Although the motivating factor has generally been a need to reduce expensive paratransit costs, many systems have been surprised at the large ridership response of those with disabilities to such changes in traditional service.

Another important step is to conduct marketing and other in-depth studies among large local market groups and among those who could be market groups. The aggregate data analyses suggested above should be supplemented with qualitative and small-scale quantitative analyses of user preferences, needs, attributes, and patterns. This "fills out" the user profile in a way that can be used to design specific services for those markets. It also provides information useful in the design of advertising and informational campaigns targeted to specific users.

If new services are developed in response to the needs of specific market groups, such services must be monitored effectively. The transit operator must develop a set of standards against which to measure ridership performance and other objectives important to system management—from riders per revenue hour to percentage cost recovery. If ridership is less than expected, it is crucial to discover why.

Who is given these responsibilities will have a significant effect on their outcome. It is best if transit systems organize their planning and marketing departments to highlight these tasks, rather than distributing them among departments or adding them to other professional activities underway. These kind of activities need not dominate all other functions but they cannot be viewed as marginal to the organization or as a temporary exercise.

The location of user-centered planning and marketing activities within a transit system hierarchy says a great deal about how important a rider-oriented approach is to system management, governs how well market and rider issues are integrated into evaluations of service needs, and ultimately determines if the new approach really makes a difference in actual service and operational decisions, both initially and over time.

Operations

Although all of the effective service concepts identified in Chapter 3 have been implemented by one or more transit operators, they may be new—and challenging—to any given transit system. Or, more likely, an operator may have tried a concept on a very small scale, perhaps in response to an operational problem in one small area or in order to develop new service in another. In those cases, a significant increase in the amount of service is what poses the challenge. For example, most systems have a few reverse-commute routes, but should the system be pressed to develop many such routes, substantial routing and scheduling changes might be required.

Operators like to provide uniform service. By providing new or different service concepts, operators face a sometimes steep learning curve on the "new" services as well as the need

to learn how to balance different types of services, each with different parameters. Schedulers, for example, who are used to traditional services, may be uneasy at having to master three or four different types of scheduling algorithms, each matched to a different concept.

Some service concepts, such as route restructuring, inherently test the old way of scheduling and routing buses. Even if tried in a small area or just in certain sectors of the city, this kind of service concept calls for major changes in dozens of interrelated operational decisions, from where to garage and gas vehicles to how to organize driver shifts. If route restructuring is implemented in part (just route alignment or opening a suburban transit station, for example) or if it is implemented in just one sector of the entire service area, transit personnel may have to deal with different and changing services at the same time.

Of course, dramatic increases in the kind or variety of service create major and long-term learning and training issues. Several operators which developed light rail systems created entirely new service and scheduling departments to deal with the operational difficulties posed by a rail system.

Capital Acquisitions

The effective service options as a group pose special problems for those undertaking capital budgeting for a transit system. First, some of the vehicles used do not last as long as a traditional transit coach; both smaller buses and vans (used in vanpool programs) must be replaced much more frequently. In addition, as suggested above, they may have different maintenance and repair needs which require additional garages or special garage equipment.

Second, some of the service concepts are inherently capital intensive, requiring years to arrive at the construction phase and more years to construct and complete. A bus-only system will face entirely new programming and budgeting schedules, requirements, and development phases in implementing light or commuter rail projects. Building a rail system, and then buying rail cars, is very different from designing a route and then buying buses to run on that route.

Maintenance

Some of the effective service concepts identified in Chapter 3 require smaller or different vehicles than those operated by most transit systems. Community buses, for example, are thought to owe their popularity among riders in part to the greater attractiveness of a smaller vehicle.

Requiring an operator to mix several different kinds of vehicles in a fleet, especially if that fleet had been relatively uniform prior to the implementation of the new concept, poses maintenance and training difficulties as well as parts inventory problems. The number of different individual vehicle types may be too small to warrant keeping appropriately trained mechanics or sufficient parts either at all or throughout a large service area.

In addition, smaller buses, vans, and after-market bus and van conversions are expensive and difficult to maintain. This may require operators to keep a larger spare fleet than would otherwise be required. In addition, the manufacturers of many of these vehicles are small operations; they may no longer be in business when parts or new vehicles are needed, further complicating the task of maintaining and repairing vehicles and the vehicle fleet mix.

Labor Issues

Transit systems, in striving to be more responsive to their customers, sometimes forget to be more responsive to their employees. Employees can be valuable allies in a system's attempt to be customer-oriented and to develop services to meet user needs. First, system personnel can provide additional information on the needs and patterns of various markets. Second, their cooperation and support is needed to implement effective concepts. Third, they can help monitor services as they are implemented, suggesting changes and modifications.

Drivers and other personnel who deal daily with the public may have a wealth of information about who rides various routes, the services they value, and the policies and schedules which would better meet their needs. These same personnel may have practical advice about the organization and implementation of new concepts, and they are in the best position to see the real effect of the new services.

In addition, almost all service changes, particularly largescale changes, can substantially disrupt the work lives of drivers, mechanics, supervisors, trainers, schedulers, marketers, and so forth. If employees are not given adequate notice, training, and time to absorb and learn what is coming and what is expected of them, the implementation of the new service concept and overall system performance may be adversely affected.

Some effective service concepts require new or modified work rules, even for bus-based services in a bus-only system. Operating reverse-commute or feeder services or express buses may create the need for split shifts or other personnel arrangements which do not conform to current work rules or labor agreements (or they may require overtime or premium wages). More major service changes, such as route restructuring, may totally change existing work patterns and schedules. These kinds of changes must be negotiated well ahead of service implementation.

Organized labor may be opposed to a given service concept. New services which come at the expense of old ones, as well as those requiring new skills or new duties of drivers, are likely to create concerns. Replacing traditional fixedroute services with community buses, for example, may cause concern because drivers may have new duties (e.g., helping older people onto the bus).

Those service concepts which reduce the number of system employees and/or give jobs to the private sector will be fought by current system personnel and their unions. In general, it will be easiest to implement services contracted to the private sector if they are additional rather than replacement services.

Financial Issues

In 1993, transit systems covered, on average, 37 percent of their operating costs from the farebox, a figure which has been growing steadily as federal and other external sources of funding have declined. This increasing reliance on fares leads transit systems to avoid many market-focused services because they either are, or are believed to be, more expensive per passenger, with lower cost recovery, than more traditional fixed-route services.

Some services are more expensive on average than traditional services. They may not be more expensive, however, than poorly used traditional routes. Thus, the ultimate test should be to compare new service to the current actual costs of serving a specific area, clientele, or destination with traditional services—not to the average cost of fixed-route buses. For example, several areas surveyed used community bus services to replace low-performing traditional routes. The systems considered these services to be effective because they cost less per passenger than had the services they were replacing (and generally increased ridership).

Having various service options in their arsenal can enable transit operators to save money. By focusing on who is actually being served by current services and who could be served by alternative options, transit operators can deliver the most cost-effective services to the markets and users being served. For example, seven passengers per vehicle hour is at the high end of paratransit but the low end of traditional transit service; at the same time, most traditional service costs between $80 and $120 per vehicle hour while most paratransit service costs less than $35 per vehicle hour. Although transit agencies would not replace a heavily loaded peak-period transit coach with paratransit service, few operators consider replacing an off-peak bus carrying three passengers per hour with a paratransit vehicle—even if the latter might double ridership and more than halve costs.

The biggest implementation problem facing most transit operators is that they are asked to try most service concepts in addition to existing services. In these cases, it makes no difference whether the new service costs more or less—net—than traditional services because the system must still have more money to operate. Without funds to test new ideas or demonstrate new concepts, many transit systems will be limited to implementing promising concepts only when the transit systems can immediately replace some existing, poorly performing service.

At the same time, changes to policy are creating different standards to use in evaluating the costs of various services. For example, the travel demand management programs required of regions not in conformity with Federal clean air standards, the growing interest in toll roads and congestion pricing of highway facilities, and the use of HOV and other preferential treatments for transit and carpools—all create a different policy environment in which to judge the costs of transit service provision. These may interact to create greater incentives for individual employers or groups of employers to work with local transit operators to develop responsive services, services whose cost-recovery factors may be well below those seen on more traditional services but which are subsidized by those employers.

Moreover, the effect of the Americans with Disabilities Act of 1990 (ADA) may change the way systems compare costs—providing service routes or travel training which encourage ADA-eligible travelers to use fixed-route service for any given trip may be substantially cheaper than providing them with paratransit service. The study survey of promising concepts found that more than a dozen small- to medium-sized communities decided to provide general public paratransit in all or part of their service area because it is cheaper—not than traditional fixed-routes service—but than the combined cost of providing both fixed-route and complementary paratransit services as required by the ADA.

EXTERNAL RELATIONSHIPS

Implementing many of the effective service concepts requires transit systems to deal in new ways with other agencies, individuals, and organizations or to intensify existing external relationships. Relationships with the following might be created, stressed, or highlighted with the implementation of new services:

- The private sector,
- Other operating agencies, and
- Other public agencies.

Private Sector

Several service concepts require transit operators to work with various groups within the private sector. There are several reasons why this is so. Some concepts will be more effective, cheaper, or both if provided under contract to the transit operator by a private entity (e.g., transportation entrepreneurs and private non-profit agencies). Some cities providing vanpool incentives contract with private companies to handle all details of vanpool provision from the vehicles to maintenance. Community buses and service routes as well as feeder services are logical candidates for private contract provision.

Second, some services have unique or very specific maintenance or operational needs which are best handled by the private sector. For example, rather than developing in-house

mechanics and parts inventories for specialized vehicles, many transit operators contract out maintenance and repair of just those vehicles to private vendors. Many systems which provide travel training also contract out this function to private consultants or to public or private agencies. In such cases, transit operators will have to develop a defensible, intelligent way of identifying those services best provided by the private sector and will need both the skill and the will to forge financial and service arrangements with private sector providers, employers, and organizations.

Third, several service concepts can only work well if they are coordinated with large employers or large destinations. To be effective, any service concept which provides direct service to a specific employer, such as reverse-commute and feeder services or vanpooling, must coordinate the location of stops, the hours and days of service, the route taken, and so forth with the employer(s) in question. Ridership will be enhanced if the private (or public) employer actively promotes the service to workers. In addition, in some cases, coordination with private entities can lead to cost-sharing.

For example, the survey found that when Sears relocated its Chicago headquarters, Sears worked with local transit operators to establish vanpools and nine subscription services for Sears' employees. SEPTA and New Jersey Transit have also been very effective in working with individual employers to develop reverse-commute services.

Other successful examples involve transit passes subsidized by large employers, either in conjunction with new, more site-focused services, or alone. The ridership increases occurring in university-campus-focused transit services are attributable to a combination of service and fare changes. The scheduling and route changes designed to more directly serve the universities in question made bus service a viable option for many more people; the fare incentives, largely paid for by the schools themselves (generally through student fees) made it both cheaper and more convenient.

Other Operating Agencies

People's travel patterns often cross jurisdictions and mandated service areas, especially because of the suburbanization of jobs and homes. Thus transit services targeted to their needs probably cross many jurisdictions. A central city system may have to operate within the jurisdiction of a suburban operator or develop joint-service agreements to provide or facilitate many of the effective service concepts. For example, transit operators in suburban Atlanta have worked with MARTA to facilitate feeder and reverse-commute services. To facilitate fare incentives in large metropolitan areas, a number of operators may have to develop joint pricing policies and fare systems.

Some service concepts, such as light and commuter rail, require the development of feeder services and coordinated scheduling. To do so, transit operators have to work with one another.

Public Agencies

To develop a system of services across a region and to achieve financing for services which cross multiple jurisdictions or serve multiple markets, transit operators may need to work with one or more MPOs, city councils, county commissioners courts, the state DOT, and other public and private bodies (from major public utilities to the local Chamber of Commerce).

Moreover, systems which attempt to provide effective services such as travel training for those with disabilities will have to work with agencies and providers totally outside of the transportation community. To do so will require learning a new vocabulary and responding to an entirely different set of rules and regulations.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) provides challenges to regional transportation planning agencies and offers individual transit systems a greater role in regional planning strategies. The mandated coordination between regional transportation planning and environmental planning efforts allows transit operators to become more involved in these issues, and, ultimately, facilitating the planning, development, and delivery of effective service concepts.

INDUSTRY RESEARCH NEEDS

Future action-oriented research on critical transit issues should consider how to do the following:

- Refine the definitions of the transit market groups which were identified in this study, by analyzing current transit ridership patterns by using more sophisticated statistical methods (e.g., analysis of variance, factor analyses, and regression, and so forth) to clarify overlapping characteristics such as race, education, and so forth;
- Project the actual magnitude of changes in ridership in individual transit markets, assuming different societal trends by using time series data and various appropriate statistical methods;
- Identify market patterns in a sample of individual metropolitan areas, using both aggregate and disaggregate data, following the format used in this study, and then using Census Transportation Planning Package (CTPP) data for a finer level of disaggregation, using both the descriptive method used here and more sophisticated statistical methods;
- Prepare comprehensive case studies of the implementation of effective (or promising) service concepts by conducting detailed before and after ridership evaluations and cost studies that focus on several systems implementing the same concepts or on individual systems implementing different concepts; and
- Conduct ongoing assessments of the outcome of implementing various market-driven service concepts.

SUMMARY

Transit operators must develop a more user-based approach to planning and delivering services. Most transit systems today provide a few services to many users with widely varying needs. At best, systems tinker with their services at the margins to respond to the differences among specific market groups—lengthening a schedule here, adding an extra vehicle trip there. The alternative user-driven approach requires transit systems to provide many expensive services to a few clients. The research team's analyses suggest that many effective services are no more expensive to provide than traditional services and can reach more riders.

Implementing many of the effective service options probably will pose multiple, serious challenges to many transit systems, but few of these challenges are as drastic or potentially devastating as the ones awaiting operators who fail to deal with the transformation in American travel patterns. Major societal upheavals in the United States have very negative implications for most transit systems. Unless they respond to the real, rapidly changing needs of the American traveler, most transit systems will see their ridership decline—and their public and political support with it.

Transit operators are seriously constrained in their struggle to compete with the options available to most travelers. Yet if individual operators, and the industry as a whole, do not respond to their markets, they will continue to lose market share.

SELECTED BIBLIOGRAPHY

1. Edmondson, B. "Alone in the Car," *American Demographics* (June 1994), p. 57.
2. "Putting People First," *Progress*, Vol. IV, No. 7, Surface Transportation Policy Project (September 1994), p. 1.
3. U.S. Department of Transportation, Federal Transit Administration, *National Transit Summaries and Trends for the 1993 National Transit Database, Section 15 Report Year*, Washington, DC (1994).