RESPONDING TO CHANGING COMMUTER MARKETS: PRESERVING MOBILITY THROUGH PUBLIC AND PRIVATE INITIATIVES

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ABSTRACT

This report examines demographic, economic, and spatial factors that have threatened mobility in many U.S. metropolitan areas and that have fundamentally changed the market for mass transportation services. Four key factors are examined: 1) general population and employment growth, coupled with modest expansion of roadway capacity; 2) demographic trends that are resulting in a more auto-reliant commuting population, in particular the trend toward smaller, middle-age, dual-wage earner households; 3) the decentralization of employment, which has spawned an increase in intrasuburban commuting; and 4) widening jobs-housing imbalances that have further reinforced auto-dependency. In general, all of these forces have worked in favor of auto-commuting and, accordingly, have rendered conventional public transit services less attractive.

Using empirical data for the 31 largest metropolitan areas in the U.S., exclusive of New York City, a statistical analysis is carried out to study how these factors have impacted transit's market share. It is found that general regional growth, increases in auto ownership rates, and the migration of commute trips to the suburbs are most highly correlated with public transit's shrinking market share. If the same rate of change that occurred in the 1970s continues in the 1980s for these variables, it is estimated that transit's average share of commute trips in these 31 metropolitan areas will drop from 7.76 percent in 1980 to 6.23 percent in 1990.

While troubling, these trends provide a unique opportunity to introduce major policy reforms within the nation's transit industry that could make it more productive and more efficient. The rationale for building rigid, fixed-guideway systems in an era when trip patterns are becoming more and more dispersed needs to be reappraised. Where new rail systems are built, it is imperative that higher-density, mixed-use projects be developed around transit stations. For transit to effectively compete with the private automobile, moreover, it is essential that traditional radial services be reconfigured into multi-focal, timed-transfer networks. Busways and expanded paratransit services should also play a prominent role in serving future commute trips.

The best hope for responding to rapidly changing market structures lies with initiatives that are carried out by the private sector. The profit motive encourages private entrepreneurs to keep close track of shifting market demands and to respond with the kinds of service innovations that will appeal to customers who seem to increasingly want higher quality services. In particular, competitive contracting offers the kind of inherent flexibility that is needed to bring about innovation, along with the market discipline necessary to ensure such services are cost-effective and financially sound.

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I. INTRODUCTION

Over the past few years, transportation, or the lack thereof, has been cited by local residents as the number one problem in over a dozen metropolitan areas. It has eclipsed crime, unemployment, and air pollution as the biggest public menace by a margin of two-to-one in greater San Francisco and Atlanta. This widespread dissatisfaction reflects, in part, the fact that congestion seems to afflict nearly all commuters to some degree -- whether headed downtown, reverse-commuting, or traveling on a secondary cross-town artery. While only a decade ago congestion burdened mainly downtown commuters, today it pervades throughout the freeway networks of most big cities.

The costs of congestion are mounting, not only in the way of lost travel and leisure time, but also in terms of increased day-to-day stress, declining worker productivity, and a deteriorating quality-of-life. It is because of this perception that quality-of-life is slipping that more and more communities are passing Draconian no-growth measures, aimed squarely at limiting the number of new commuters entering their municipal boundaries. Indeed, congestion has become, at least in the collective minds of the public, such a grievous problem in such a short period of time that responsive and responsible public and private actions are sorely needed.

This report examines the factors that have given rise to growing urban mobility problems, focusing on how macro trends like demographic and employment shifts have fundamentally altered commuting patterns. The implications of these trends on the demand for mass transportation services are also probed. Using 1970 and 1980 journey-to-work and socio-demographic data, relationships between changing megatrends and commuting behavior are statistically examined. How these trends bode for future transit patronage are also explored. The report concludes with an analysis of what policy reforms seem necessary to adapt transit services to changing market structures, with particular attention given to the role of the private sector in responding to shifts that are presently under way.

II. FORCES BEHIND WORSENING CONGESTION PROBLEM AND CHANGING COMMUTING MARKETS

Four major factors are profoundly changing the market for metropolitan commuting and are fueling, in large part, the mobility crisis in our cities: 1) regional population and

employment growth; 2) demographic shifts, in particular the trend toward smaller, dual wage-earner households; 3) the decentralization of employment; and 4) a widening jobs-housing imbalance. All of these trends are resulting in greater automobile dependency while at the same time discouraging usage of traditional public transit services.

II.1. Regional Population and Employment Growth

In many of the faster growing metropolitan areas in the U.S., growth itself, coupled with a slow-down in new road construction, has created more congestion. During the decade of the seventies, for instance, population and employment grew by 32.1 percent and 59.7 percent, respectively, in the twelve largest MSAs (metropolitan statistical areas) in the nation's South and West, the regions normally associated with the sunbelt boom [Cervero, 1986A]. This pace has continued into the eighties, with New England experiencing some of the healthiest gains in more recent years [Garnick, 1986].

Regional population and employment growth have increased ambient levels of congestion, in part because highway and transit service mileage have increased at a far slower rate. From 1978 to 1983, total highway mileage in the U.S. increased by slightly more than 1 percent. During the same period, traffic volumes on urban interstate increased 7 percent [Dunphy, 1985]. The nation's highway construction program has been the victim of sharp inflation (which has devalued the highway dollar), eroding gas tax revenues, and government spending limits, such as California's Proposition 13. However one works the mathematics, increased demand combined with a fairly stagnant supply of new facilities adds up to growing congestion.

II.2. Demographic Shifts

Growth alone is not responsible for the crippling mobility problems facing our cities. Powerful demographic shifts are spawning an urban society that is more reliant than ever on the private automobile. In particular, the rapid increase in middle-age, dual-worker households with fewer children has led to greater auto-dependency.

Take the case of the San Francisco Bay Area, for instance. Over the period 1981 to 1985, the annual growth rate of population was 1.4 percent, while employment and households grew 2.4 percent and 2.1 percent annually (see Table 1). During this same period, however, the number of vehicles, number of drivers, and vehicle miles traveled (VMT) increased between 2.8 percent and 4.5 percent annually. Thus, the number of autos, drivers, and miles of travel grew roughly 50 to 100 percent faster than the number of new residents and workers over the first half of the eighties. Similar patterns occurred in Los Angeles and Orange County, California during the 1981-1985 period.

Table 1

Growth Rates in the San Francisco Bay Area, 1981-1985

Growth Factor	Average Annual Rate of Growth
General Growth Indicators:	
Employment	2.4%
Households	2.0%
Population	1.4%
Travel Indicators:	
Vehicle Miles Travelled (VMT)	4.5%
Licensed Drivers	2.9%
Automobiles in Use	2.8%
Transit Ridership	-0.8%

Sources: VMT: 1981-1985, Caltrans; Employment: 1980-86, California Employment Development Department; Households: 1980-86, Urban Decision Systems; Licensed Drivers: 1981-85, Caltrans; Automobiles in Use, 1980-1986: Urban Decision Systems; Population, 1980-86: California Department of Finance; Transit ridership (based on five largest agencies), 1982-85: Caltrans.

Clearly, the growth in travel during the eighties has not been due to macroeconomic forces (i.e., regional population and employment growth) alone.

Why have the number of licensed drivers grown faster than population? Primarily because today there are relatively more people of driving age -- people between the ages of 21 and 35, the "baby boomers", have been the nation's fastest growing cohort. Why have the number of privately owned automobiles outpaced population growth? Income is the key factor here. As people prosper, they travel more: in 1983, households with annual incomes under $10,000 averaged 1.9 trips per day, compared to 6.2 daily trips for the typical household earning over $40,000 [USDOT, 1986]. In 1983, the nation averaged one vehicle per licensed driver, compared to a rate of only .7 fourteen years previously. The number of households with three or more cars, moreover, shot up from 10 percent in 1970 to 16 percent in 1980. Income is a also one of the chief determinants of mode choice -- in 1983, 82 percent of workers from households with annual incomes over $40,000 drove to work, compared to only 61.7 percent of workers from families with annual incomes below $10,000 [USDOT, 1986].

Why, moreover, are proportionally more miles being logged on our highways -- i.e., more VMT? In part, because of more vehicles and drivers, and in part, because of longer average trips. The mean journey-to-work for those living in MSAs rose from 9.2 miles in 1977 to 9.8 miles in 1983. The 21-to-35 baby boomers, which again is the fastest growing segment of the nation's population, have also contributed to rising VMT levels: in 1983, they averaged 3.5 trips per day, more than any other age cohort.

Perhaps the demographic force that has had the most dramatic effect on commuting behavior has been the trend toward smaller families. The fact that the number of new households has outpaced population growth in every major metropolitan area across the country means that family sizes are shrinking. Between 1970 and 1980, the average U.S. household size declined from 3.11 to 2.75. This trend seems to be continuing. In the San Francisco Bay Area, household size shrunk from 2.58 to 2.50 just in the four year period from 1981 to 1985. While fewer trips are generated by smaller households, they almost always produce more trips per person, because:

* With fewer children at home, women tend to work more. And working women tend to make more triangulated (i.e., linked) trips, such as between work, a child-care center, and a store. These are the very types of trips which normally require private automobile usage.

* There are more non-traditional households, notably those with two or more unrelated adults. In these households, each adult frequently works at a separate location and thus relies on his or her own means of transport. Also, single-parent

households are becoming more commonplace -- single-parent female-headed households increased by over 55 percent during the seventies, while single-parented male-headed households rose 39 percent [Bureau of Census, 1982A].

A final demographic shift that has significantly altered commuting behavior has been the trend toward dual wage-earner households. We're witnessing a feminization of the workplace -- more than two-thirds of women between the ages of 25 and 44 now work, compared to only one-third 25 years ago [Bureau of Census, 1982]. With both spouses working, there becomes a greater tendency for both families to live somewhere between the two jobs. Often, this means both husband and wife need access to their own car to get to work.

Overall, the family unit is becoming more independent and more atomistic. The shift to smaller, middle-age, dual-worker households has resulted in greater automobility, and correspondingly, more traffic.

II.3 Decentralization of Employment

The suburbanization of congestion, it is fair to say, has followed the suburbanization of jobs, what has been termed the "second wave" of suburban growth. Nationwide, the share of total office floorspace outside of central cities rocketed from 25 percent in 1970 to around 60 percent today [Lindsey, 1985]. In the Bay Area, some 100 companies have moved over 18,000 jobs from downtown San Francisco to suburban Contra Costa County just in the past two years. There has been a similar exodus in other regions, such as greater St. Louis and Philadelphia, where suburban employment has growth 17 and 8 percent respectively between 1982 to 1986, compared to a loss of central city jobs over the same period [Orski, 1986A]. Columnist Neal Peirce has aptly characterized this trend as the transformation of suburbia from "bedroom to boardroom".

Corporate America has flocked to suburbia for a host of reasons, with the cheaper cost of land and closer proximity to labor (especially married women willing to take on lower paying clerical jobs) usually heading the list of reasons for office relocation. Underlying this, however, has been major structural changes in the nation's economy that has enabled firms to relocated more easily. In particular, the changeover from a smokestack economic base to one devoted to the production of ideas and information has made many firms "footloose" -- free to move wherever they can maximize their net advantage, which more and more has become the lower-cost suburbs. Telecommunication advances, moreover, have allowed many firms to spin-off their back-office functions to outlying office parks, linked to the main corporate office via cable.

Job dispersal has had a profound effect on commuting patterns. What once was a predominantly radial, downtown-focused

stream of travel has been overlayed by a patchwork of complex, criss-cross, and seemingly random movement paths over the past two decades. As Table 2 indicates, 42 percent of all work trips in U.S. metropolitan areas with populations above 250,000 both began and ended in the suburbs in 1980, a 5.8 percentage point increase over the 1970 rate. In metropolitan Boston, Detroit, St. Louis, and Pittsburgh, moreover, the suburbs; share of total commute trips presently exceed 60 percent [Fulton, 1986].

This trend, of course, does not square well with the transportation infrastructure of most of our cities, which tend to be of a hub-and-spoke variety, designed to serve downtowns. Consequently, those making cross-town and lateral journeys are all too often forced onto secondary arteries and ring roads that were never designed or oriented to serve large volumes of traffic. Circuitous trips and congestion have resulted. This trend does not bode well for mass transit either -- in 1980, only 1.6 percent of all commute trips that were made from suburb-to-suburb, which again is the fastest growing market, were via public transit [Fulton, 1986].

Most suburban jobs have ended up in one of three types of workplaces, each of which poses different and unique mobility challenges:

1) Suburban Corridors: These tend to be loosely organized strips of smaller, independent office and commercial developments, usually aligned along axial freeways and major arteries. Boston's Route 128 and Princeton's Route 1 "Zip Strip" are classic examples. While the traffic impact of any one project tends to be modest, the cumulative effects of numerous unrelated projects frequently jam nearby roadways.

2) Master-Planned Business Parks: Numerous campus-style office parks have been built along the fringes of metropolitan areas in recent years, designed to provide a high-quality, idyllic-like work environment for a highly-skilled, professional work force. These projects are characterized by low employment densities, plentiful parking, and a single predominant use (with office space often taking up 85% or more of built floorspace). Many are effectively pre-ordained for automobile access. While ample on-site and near-site improvements are frequently built for these projects, their traffic impacts normally reverberate 5 to 10 miles downstream throughout the road network.

3) Suburban Downtowns: Also referred to as urban villages, these employment clusters often resemble the downtowns of many medium-sized cities in both scale and density. The archetype urban village is City Post Oak, some six miles west of downtown Houston where 30 million square feet of mixed-use floorspace is nearing completion. While traditional downtowns have evolved gradually,

Table 2

Changes in Geographic Setting of Journey-to-Work within MSAs with Populations of 250,000 or More: 1960-1980

Geographic Type:	Percent			Percentage Point Change	
	1960	1970	1980	1960-70	1970-80
Within Central City	47.2	37.6	31.7	-9.6	-5.9
Central City to Suburbs	5.2	7.5	6.6	2.3	-0.9
Suburbs to Central City	17.1	18.6	19.8	1.5	1.2
Within the suburbs	30.5	36.3	41.9	5.8	5.6

Note: MSA boundaries as defined at the time of each census; 1970 and 1980 data are for workers 16 years and older, while 1960 data are for workers 14 years and older; data are only for workers who both lived and worked in MSA.

Source: Philip Fulton, "Changing Journey-to-Work Patterns: The Increasing Prevalence of Commuting within the Suburbs in Metropolitan America". Paper presented at the Annual Meeting of the Transportation Research Board, Washington, D.C., January, 1986.

suburban downtowns have sprouted in as few as five years, adding as much as 10 million square feet of new buildings where land was previously vacant. Such rapid growth has all too often overwhelmed the local infrastructure, with clotted streets being perhaps the biggest problem. "Instant downtowns" typically produce "instant congestion".

II.4. Jobs-Housing Imbalance

The final major contributor to metropolitan commuting problems has been the widening mismatch between where people live and work -- what planners call "jobs-housing" imbalance. While one might suspect that more people would live closer to their jobs as offices migrated out to the suburbs, this is not always the case. Figure 1 compares the 1980 trip length distribution for the 28 Bay Area suburban census tracts with the largest employment concentrations to the Bay Area commuting population at large. The figure shows that those working in the largest suburban work centers, most of which were in the Silicon Valley in 1980, averaged longer trips. In particular, there were larger shares in the 8 to 18 mile range, a distance that has historically been shown to encourage the most auto-commuting -- i.e., it's a distance that is too long to walk or bike, yet too short to efficiently carpool or vanpool since the time spent picking up others becomes too burdensome for moderate-length trips. Nationwide, the average suburb-to-suburb commute increased from around 14 minutes to 18.8 minutes between 1970 and 1980, the product of lengthening trips (in that travel speeds remained fairly constant over this period) [O'Hare and Morris, 1985; Bureau of the Census, 1982B].

The jobs-housing imbalance problem is linked, in part, to the fact urban communities are becoming increasingly bifurcated -- some are predominantly bedroom communities while others are mainly corporate enclaves. Many planners consider a community to be "balanced" when the ratio of jobs to housing units is roughly between .75 and 1.25 [Margolis, 1973]. Of the 22 largest Bay Area cities, six fall below and seven fall above this .75-to-1.25 threshold -- i.e., over half are "unbalanced". A shorthand reason for such imbalances is that ad hoc, market forces have shaped our cityscape, with little regional land use coordination. Underlying this, however, have been several other important contributors:

1) Fiscal Zoning: As the taxing powers of local governments have been constrained and as inter-governmental transfer payments have fallen, more and more communities are zoning for fiscal purposes -- i.e., they are inviting new uses which promise to fatten local tax coffers. Normally, this involves zoning primarily for office and commercial uses while underzoning for housing, usually on the grounds that residential growth costs far more to serve (e.g., schools, libraries, etc.) than the tax dollars they generate. An example of such zoning is in Santa Clara County California,

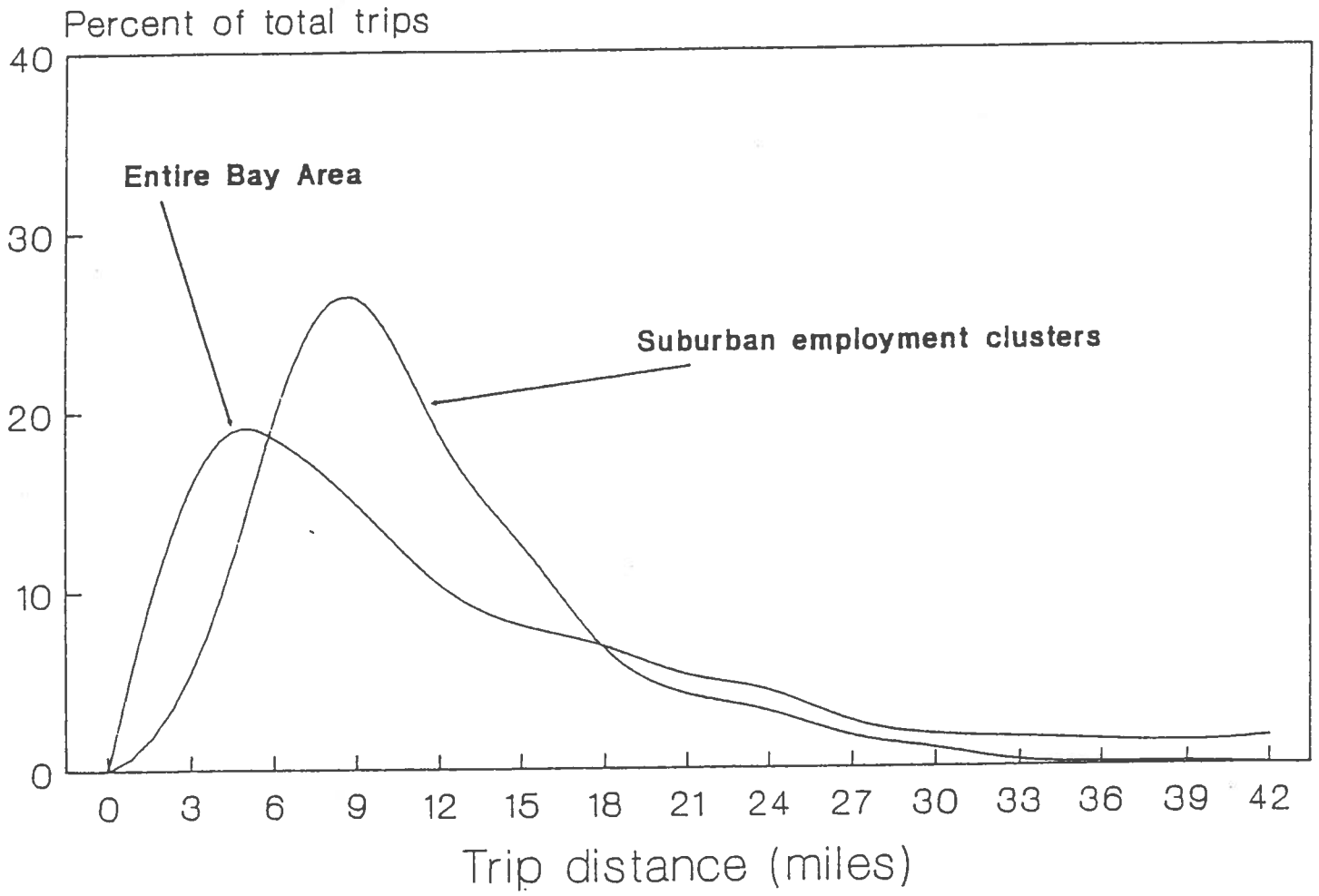

Figure 1. Work Trip Length Distributions for Employees of the 28 Largest Suburban Employment Centers and for the Entire Labor Force in the San Francisco Bay Area

where the General Plan calls for 250,000 new jobs but only 75,000 new housing units by the year 2000 [Dowall, 1984]. In the competition for revenue-generating commercial and office uses, the "winners" have typically become corporate centers while the "losers" have ended up as dormitories for displaced workers.

2) Lack of Affordable Housing: Around two-thirds of new suburban jobs have been in the clerical and service-industry sectors, occupations that usually earn modest incomes. Frequently, a home near suburban downtowns and campus-style office parks cost far more than most of these workers can afford, forcing many to move to the exurbs and beyond. In Contra Costa County, the Bay Area's fastest growing county, the average home costs around $150,000 which requires approximately $50,000 in annual income to qualify for. Yet the average worker in the county earns around $27,000. Around one-quarter of the workers in the 160 square-mile county presently reside outside of it, and the percentage continues to grow [Cervero, 1986B].

3) Increases in Dual Wage-Earner Households: Nationwide, the share of households with two or more wage earners rose from 42.7 percent in 1960 to 68.5 percent in 1984 [Bureau of Census, 1984]. With two people working, more families are apt to live somewhere in between the workplaces of both wage-earners.

4) More Frequent Job-Turnover: Today's workers changes jobs more frequently than in year's past. The average worker had 3.8 jobs over his or her career in 1960. Today, the rate has nearly doubled, to 6.6 jobs. Macroeconomic changes account for some of this, as the post-industrialization of the nation's economy has required more career and company shifts. Corporate mergers have also spawned more job turnover. As people move from job to job more often, it clearly becomes more difficult to choose a permanent residence close to one's workplace.

The mobility implications of increasing jobs-housing imbalances are clear. As people are forced to live farther from suburban workplaces, they are likely to become more auto-reliant, in part because transit connections in many of these settings tend to be poor or non-existent.

II.V. Summary Implications of Trends

Together, these demographic and economic forces have profoundly reshaped the nature and character of commuting in America's metropolitan areas. A labyrinth of commute patterns now exists. Today's households are more auto-reliant than ever. Many urbanized regions are becoming more and more fractured, resulting in the displacement of residents from jobs sites.

The impacts of these trends are reflected in journey-to-work statistics. According to the National Personal Transportation Survey, public transportation's share of total person-trips fell from 3.4 to 2.5 percent between 1977 and 1983. While nationwide ridership rose in the early 1980s, transit still claims fewer than 7 percent of all work trips for the country as a whole [Dunphy, 1986; Fulton, 1983]. Nearly everywhere, moreover, public transportation carries only a minuscule share of work trips made to the suburbs -- in Orange County and Contra Costa County, two of California's fastest growing counties, fewer than two percent of all work trips are via transit. Among those who live in suburbia, moreover, transit's market share fell from 4.6 percent in 1977 to 3.3 percent in 1983 [USDOT, 1986].

Other forms of mass transportation -- namely, carpools and vanpools -- have likewise suffered in recent years. In part because of falling gasoline prices and the perception that the energy crises of the 1970s are over, interest in ridesharing has waned in many parts of the country. The average car occupancy for home-to-work trips remained steady at 1.4 persons between 1969 and 1977, but then slipped to 1.3 by 1983 [USDOT, 1986].

Differences in travel time no doubt account for changing market shares among modes. According to the NPTS, auto commuters traveled an average of 8.3 miles and 17 minutes in 1983. In marked contrast, bus riders required twice as long -- 34 minutes -- to cover a slightly shorter distance -- 7.6 miles. For bus riders who lived in the suburbs, the mean travel time was 49 minutes.

All of these trends cast serious doubts over the ability of conventional mass transit and other shared-ride modes of transportation to retain their customer base, much less win over solo-drivers. Given the diffusion of travel and the trend toward more atomistic family units, successful transportation systems of tomorrow will have to be fairly ubiquitous -- capable of covering a vast territory efficiently and quickly. The most competitive modes and services will emulate the ubiquity and interconnectivity of a telephone network. Today, only the private automobile offers the high service qualities and flexibility that will be necessary to serve the metropolises of the 1990s and beyond.

III. RELATIONSHIP OF DEMOGRAPHIC AND ECONOMIC TRENDS TO TRANSIT PATRONAGE

To gauge the magnitude of the mobility challenges which the public transportation faces, a number of statistical analyses were carried out. Changes in transit patronage between 1970 and 1980 were correlated with changing market trends, where markets were defined in terms of salient demographic, economic, and spatial variables. Statistical relationships were then used to extrapolate forward to 1990, focusing on likely changes in public

transit's market share given powerful growth and demographic trends presently under way.

The analysis was based largely on patronage, demographic, and economic trends in the 31 largest MSAs in the U.S., exclusive of the greater New York metropolitan area. (The New York MSA was omitted since its patronage and service levels are so high compared to other MSAs so as to make it a highly unrepresentative case.) Since the analysis focused on rates of change between 1970 and 1980, it provides more of a dynamic, longitudinal perspective on the interrelationship of the many causal factors discussed in section II.

Data that were used in the analysis are summarized in Table A.1 in the Appendix. Table 3 presents descriptive summaries of the population, employment, and ridership trends of these 31 MSAs.

Simple linear regression analysis was used to explore the association of changes in transit patronage during the 1970s with a number of explanatory variables which relate to the demographic, economic, and spatial factors discussed in section II. The policy (dependent) variables that were studied were:

TRANWORK% = Percent change in share of work trip via public transportation from 1970 to 1980;

TRANTOT% = Percent change in total transit trips from 1970 to 1980;

TRANSUB% = Percent change in transit ridership in suburbs (non-central city) from 1970 to 1980; and

TRANWORK80 = Percent of work trips via public transportation in 1980.

TRANTOT80 = Total transit trips in 1980, in millions;

The explanatory variables that were used were:

Growth Variables:

POP% = Percent change in MSA population, 1970-1980;

POPSUB% = Percent change in non-central city population, 1970-1980;

EMP% = Percent change in MSA employment, 1970-1980;

Demographic Variables:

VEH/HH% = Percent change in average vehicles per household, 1970-1980;

Table 3
Summary Travel, Growth, and Demographic Statistics for 31 MSAs

	Unweighted Average	Standard Deviation
TRANSIT RIDERSHIP		
% workers commuting by transit, 1980	7.76%	4.45%
Percentage point change in workers commuting by transit, 1970-80	-1.89%	2.63%
1980 transit trip, (millions)	84.13	77.71
GENERAL GROWTH		
1980 population, (thousands)	2,267.10	1,579.08
% population change, 1970-80	12.12%	17.10%
1980 employment, (thousands)	923.03	677.59
% employment change, 1970-80	9.80%	15.78%
DEMOGRAPHIC INDICATORS		
1980 vehicles per household	1.53	.16
% change in vehicles per household, 1970-80	22.62%	4.69%
1980 persons per household	2.72	.11
% change in persons per household, 1970-80	-11.64%	3.72%
1980 workers per household	1.26	0.08
% change in workers per household, 1970-80	-6.02%	3.92%
SPATIAL INDICATORS		
% of 1980 work trips made within suburbs	44.89%	13.02%
Percentage point change in trips made with suburbs	6.38	4.34

PER/HH% = Percent change in average persons per household (i.e., family size), 1970-1980;

WORK/HH% = Percent change in average workers per household (i.e., measure of dual-wage earner households), 1970-1980;

Spatial Variables:

SUBCOM% = Percentage point change in share of journey-to-work trips made within suburbs, 1970-1980.

For all of the explanatory variables, where the analysis was conducted for 1980 alone, the variable names are distinguished by a suffix of '80' in place of the '%' sign. While many other variables were examined during the analysis, only the above ones proved to yield reasonably significant statistical results. In all of the below cases, explanatory variables were statistically significant at the .05 probability level.

III.1 Ridership and Population-Employment Growth

Influences of Population Growth

The best-fitting equations for studying the effects of secular population growth on ridership in these 31 MSAs were:

$$TRANWORK\% = -2.77 + 1.71(POP\%) \qquad R^2 = .260 \qquad (1)$$

$$TRANTOT\% = -.053 + 1.806(POP\%) \qquad R^2 = .372 \qquad (2)$$

$$TRANSUB\% = .121 + 1.796(POPSUB\%) \qquad R^2 = .220 \qquad (3)$$

Influences of Employment Growth

The best-fitting equations for examining how employment growth has affected ridership were:

$$TRANWORK\% = -3.639 + 2.446(EMP\%) \qquad R^2 = .257 \qquad (4)$$

$$TRANTOT\% = -.166 + 1.247(EMP\%) \qquad R^2 = .238 \qquad (5)$$

$$TRANSUB\% = -.051 + 1.796(EMP\%) \qquad R^2 = .181 \qquad (6)$$

$$TRANWORK80 = 4.982 + .0031(EMP80) \qquad R^2 = .219 \qquad (7)$$

These seven equations indicate that general population and employment growth has exerted a statistically positive influence on public transit usage and should be expected to continue to do so in the future. In general, continued healthy population and employment growth in these 31 MSAs should be expected to increase

travel on all modes, transit included. Overall, transit patronage seems to respond positively to secular regional growth forces.

III.2 Ridership and Rates of Vehicle Ownership

The best-fitting equations were:

$$\text{TRANWORK\%} = 2.21 - .769(\text{VEH/HH\%}) \qquad R^2 = .266 \qquad (8)$$

$$\text{TRANWORK80} = 33.95 - 17.09(\text{VEH/HH80}) \qquad R^2 = .389 \qquad (9)$$

Figures 2 and 3 further confirm the significance of the vehicle ownership variable. Figure 2 reveals that for the 31 largest MSAs, as the average vehicles per household rose from 1.51 to 1.86 between 1970 and 1980, transit's share of work trips shrunk from 9.65 percent to 7.76 percent. Figure 3, a scatterplot of equation 9, depicts the strength of the inverse relationship between ridership and vehicle ownership for these 31 MSAs in 1980. Overall, increased automobility has had and can be expected to continue to have a depressing effect on transit patronage. To the extent this is an indicator of income effects, one can further infer that as Americans continue to gain in prosperity, patronage in our largest metropolitan regions can be expected to fall even more.

Using equation 8, moreover, one can extrapolate out to 1990, assuming the rate of increase in vehicle ownership in these 31 MSAs would continue at the same pace during the 1980s -- a 10-year 22.6 percent increase. Based on equation 8, one would project that transit's share of work trips would fall by around 15 percent during the 1980s if the rate of increase in vehicles per household were to continue, ceteris paribus. This would translate into a decline in transit's work trip market share in these 31 MSAs from 7.76 percent in 1980 to an estimated 6.59 percent.

III.3 Ridership and Household Size

Equation 10 presents the best-fitting relationship:

$$\text{TRANWORK\%} = 1.03 + .239(\text{PER/HH\%}) \qquad R^2 = .043 \qquad (10)$$

The association between changes in persons per household (an indicator of changing family size) and ridership was fairly weak. Still, the sign met a priori expectations, suggesting that, in general, as household size as fallen, so has transit ridership. Because of the poorness of fit, however, it would be difficult to infer a meaningful statistical relationship between these two variable, much less to project into the future.

Transit Commute Share and Vehicles per Household

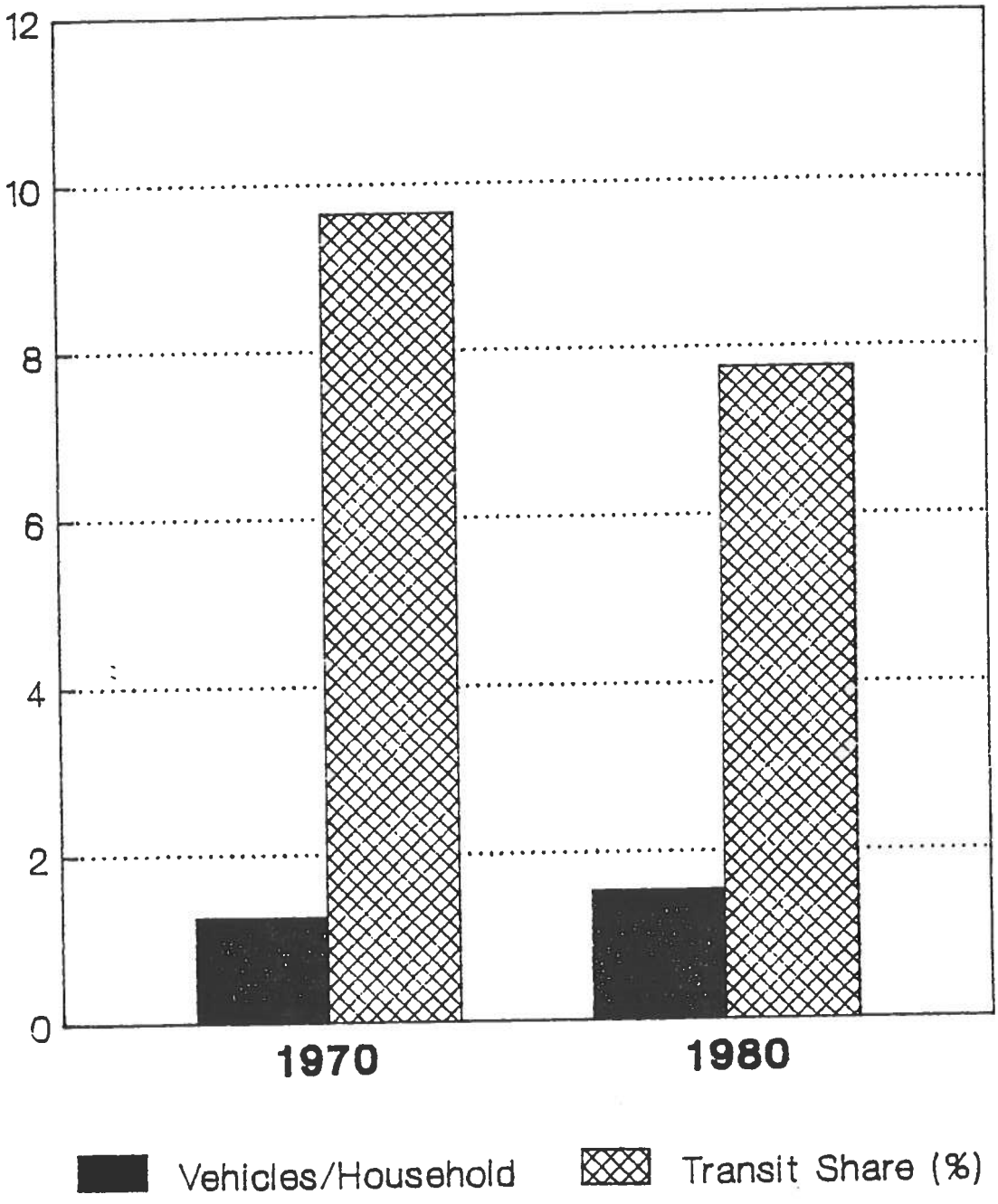

Figure 2. Comparison of Transit Market Share for Work Trips and Average Vehicles per Household for 31 Largest MSAs, 1970 and 1980

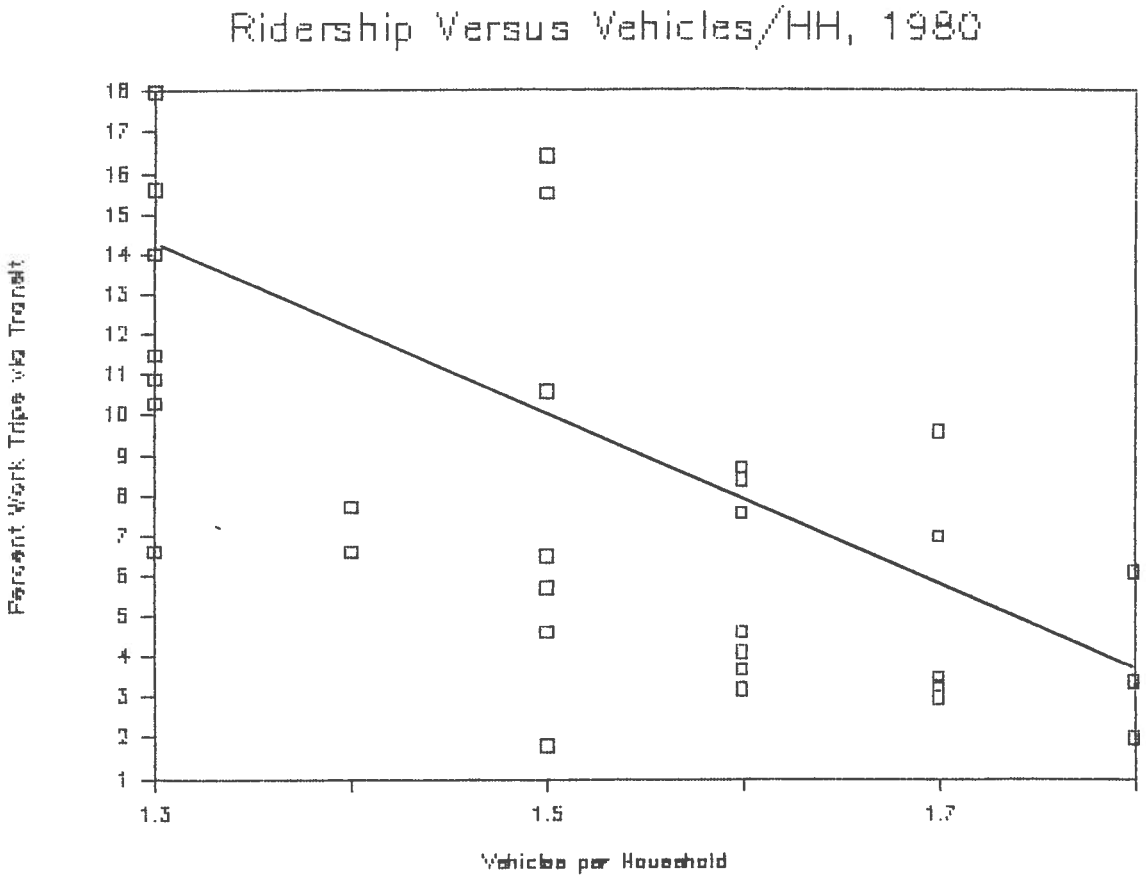

Figure 3. Scatterplot of Vehicles per Household and Percent Work Trips by Transit for 31 Largest MSAs, 1980

III.4 Ridership and Employees Per Household

This variable sought to gauge the effects of the trend toward two-wage-earner households on ridership. Strangely, it was found that for these 31 MSAs, the average workers per household actually dropped from 1970 to 1980 -- from 1.35 to 1.26. This seems somewhat counter-intuitive, though it probably reflects several factors. One, the trend toward two-wage earner households in general, and the labor force entry of married women in particular, has accelerated most quickly during the 1980s. Thus, the data in Table A.1 of the appendix likely predate the period of the most rapid growth in dual wage-earner households. Second, 1980 was the beginning of a recessionary swing in the business cycle, particularly for some of the MSAs in the North Central region, such as greater Detroit and Cleveland. Thus, the decline in workers per household in these places likely reflects the influences of higher unemployment, coupled with a fairly stagnant population base.

The best overall equation that was fitted was:

$$\text{TRANWORK\%} = .424 - 5.069(\text{EMP/HH\%}) \qquad R^2 = .034 \quad (11)$$

This equation suggests that transit ridership would increase as the share of dual-wage-earner households increased. Again, because of the spurious nature of the data, little can be inferred from these results.

III.5 Ridership and Commuting Patterns

The two best-fitting equations for assessing the affects of increased intrasuburban commuting on transit patronage trends were:

$$\text{TRANWORK\%} = 5.32 - .96(\text{SUBCOM\%}) \qquad R^2 = .124 \quad (12)$$

$$\text{TRANTOT80} = -49.35 + 2.97(\text{SUBCOM80}) \qquad R^2 = .182 \quad (13)$$

Equation 12 confirms the proposition that transit's market share is negatively correlated with the shift toward intrasuburban commuting. Although the fit is somewhat marginal, the sign nonetheless supports the argument that transit has been and will continue to be vulnerable to increases in suburb-to-suburb commuting. Figure 4 offers a graphic perspective of the overall trend. While the mean share of work trips that were suburb-to-suburb grew from 38.5 percent to 44.9 percent between 1970 and 1980 in these 31 MSAs, over the same period transit ridership fell at roughly the same rate, from a market share of 9.65 percent of work trips in 1980 to 7.76 percent in 1980.

Using equation 12, one can extrapolate out transit's estimate market share in 1990, assuming the growth in intrasuburban commuting will continue at the same pace in these

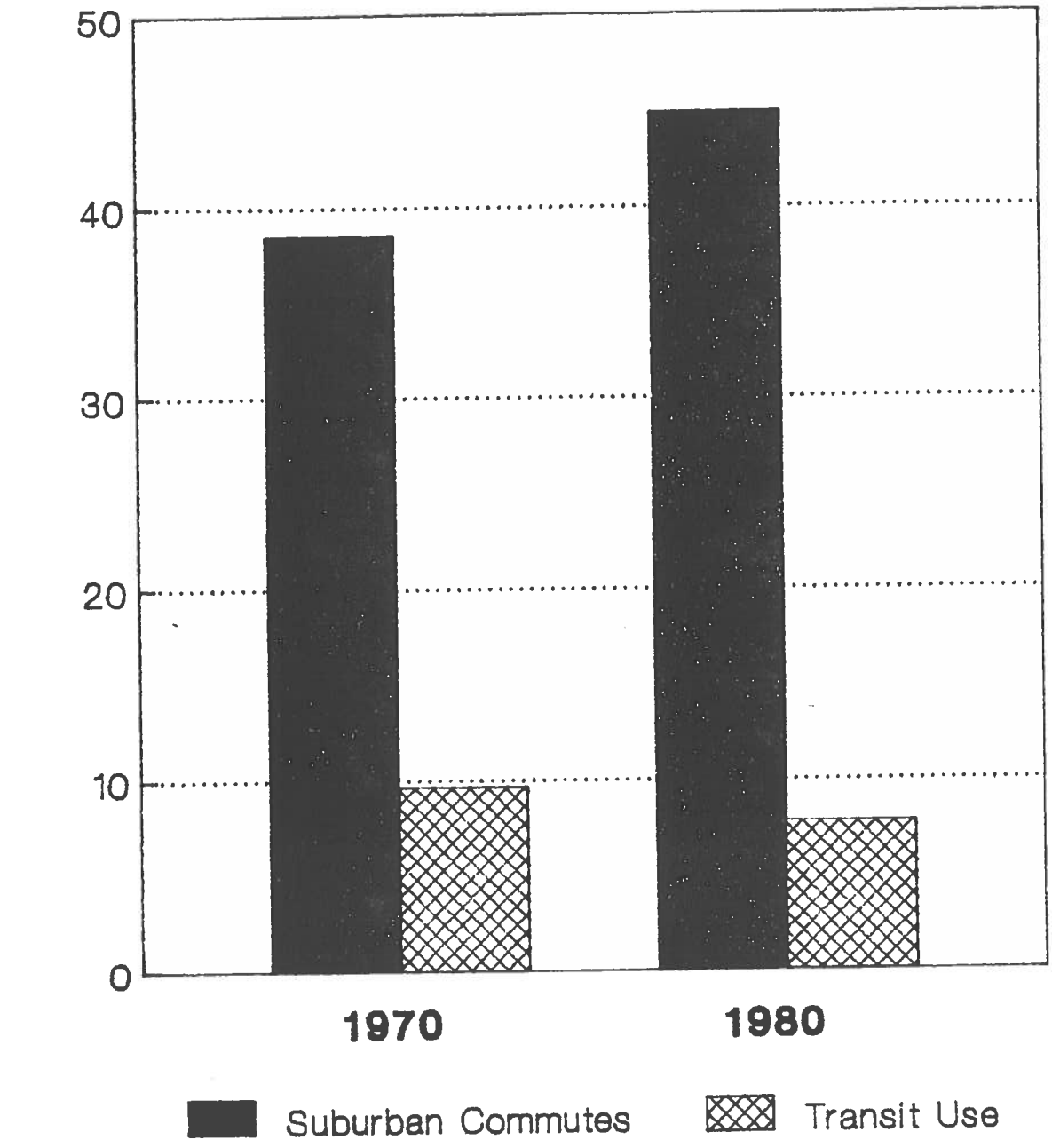

Figure 4. Comparison of Transit Market Share for Work Trips and Percent of Work Trips Within Suburbs for 31 Largest MSAs, 1970 and 1980

31 MSAs during the eighties. If the share of work trips that are intrasuburban were to grow at the seventies' pace of 16.6 percent during the 1980s, then from equation 12, one would expect transit's market share in these 31 MSAs to drop from 7.76 percent in 1980 to 6.94 percent in 1990, all other factors held equal.

It should be noted that equation 13 runs counter to the findings in equation 12. This, no doubt, reflects the fallacy of carrying out any cross-sectional analysis in studying the effects of powerful spatial trends on ridership. This equation indicates that in 1980, higher rates of intrasuburban commuting are correlated with higher rates of transit patronage. A simple explanation for this is that older east coast and mid-west cities with relatively high rates of transit patronage tend to also have the highest shares of intrasuburban commuting. As Table A.1 in the Appendix shows, in greater Boston, Detroit, St. Louis, Pittsburg, Washington, D.C., Cleveland, Cincinnati, and Buffalo, over half of 1980 work trips occurred wholly within suburbs. These, of course, are also the cities that tend to have relatively high patronage levels. The high rate of intrasuburban commuting reflects, in part, the fact that the central-city areas of these MSAs tend to be far more contained than those of southern and western MSAs, many of which have annexed surrounding territories. This finding, then, demonstrates how sensitive these statistical results can be to the somewhat shaky definition of what constitutes a central city versus suburb.

III.6 Joint Effects of Factors: Multiple Regression Analysis

A final model was run, testing how accurate the three most significant explanatory variables -- POP%, VEH/HH%, and SUBCOM% -- were, in tandem, in predicting changes in transit's commuter market share -- TRANWORK%. A multiple regression framework is appropriate for partialing out the unique effects of each explanatory variable, controlling for the influence of the others. Equation 14 shows the results:

$$\text{TRANWORK\%} = -.342 + .829(\text{POP\%}) - .245(\text{SUBCOM\%}) - 1.12(\text{VEH/HH\%}) \qquad R^2 = .382 \quad (14)$$

All three explanatory variables were statistically significant at the .05 level. The R-squared statistic did not increase dramatically from the simple regression equation because of the moderate degree of intercorrelation amongst explanatory variables. Partial correlations indicated that the marginal explanatory power of the other two variables was modest once a variable entered the equation.

By extrapolating the rate of change in population, intrasuburban commuting, and vehicle ownership rates during the seventies for these 31 MSAs into the 1980s, equation 14 can be used to project transit's likely market share in 1990. Doing so,

one obtains an estimated transit work trip market share of:

Projected change in percent of work trips made by transit between 1980 and 1980 =

-.342% + .829(12.1%) -.245(16.6%) - 1.12(22.6%) = -19.69%.

That is, if population, demographic, and spatial trends of the 1970s continue through the 1980s in these 31 MSAs, one would expect public transportation's market share to decline 19.7 percent, or from 7.76 percent of all work trips in 1980 to an estimated 6.23 percent.

Figure 5 provides a visual perspective of the projected trend in transit patronage under the assumed continuation of growth, demographic, and spatial trends of the 1970s. The figure indicates that the results of the regression demand model call for a fairly steady straight-line drop-off in patronage in the 1980s. To the extent many of the demographic changes are occurring at an even more rapid pace in the 1980s than the 1970s, which many observers believe to be the case, then the decline in public transportation's market share could be expected to be even greater than that suggested by Figure 5 -- perhaps as low as five percent in some metropolitan areas.

IV. MOBILIZING PUBLIC AND PRIVATE SECTOR POLICY RESPONSES

It is becoming increasingly apparent that major policy reforms are needed in how public transportation services are structured and delivered if transit is retain its customer base and effectively compete with the private automobile. In this section, policy directions for adapting public transportation services to better serve changing market structures are presented. The first set of options address how services might be fundamentally reconfigured in light of changing market trends. The second set of options explore the possible role that the private sector might play in supporting viable transit services. In all, these policy and programmatic reforms could give rise to service changes, new technologies, innovative financing, and land use actions that are consonant with transit's changing market structure.

IV.1 Public Policy Considerations for Adapting Transit Services

IV.1.A Reassessing Capital Investment Policy and Fixed Guideway Programs

Presently, a dozen or so metropolitan areas are seriously considering new rail starts or substantial modernization projects. Because of the vast sums of money that would be needed to pay for these projects, it is imperative that the most

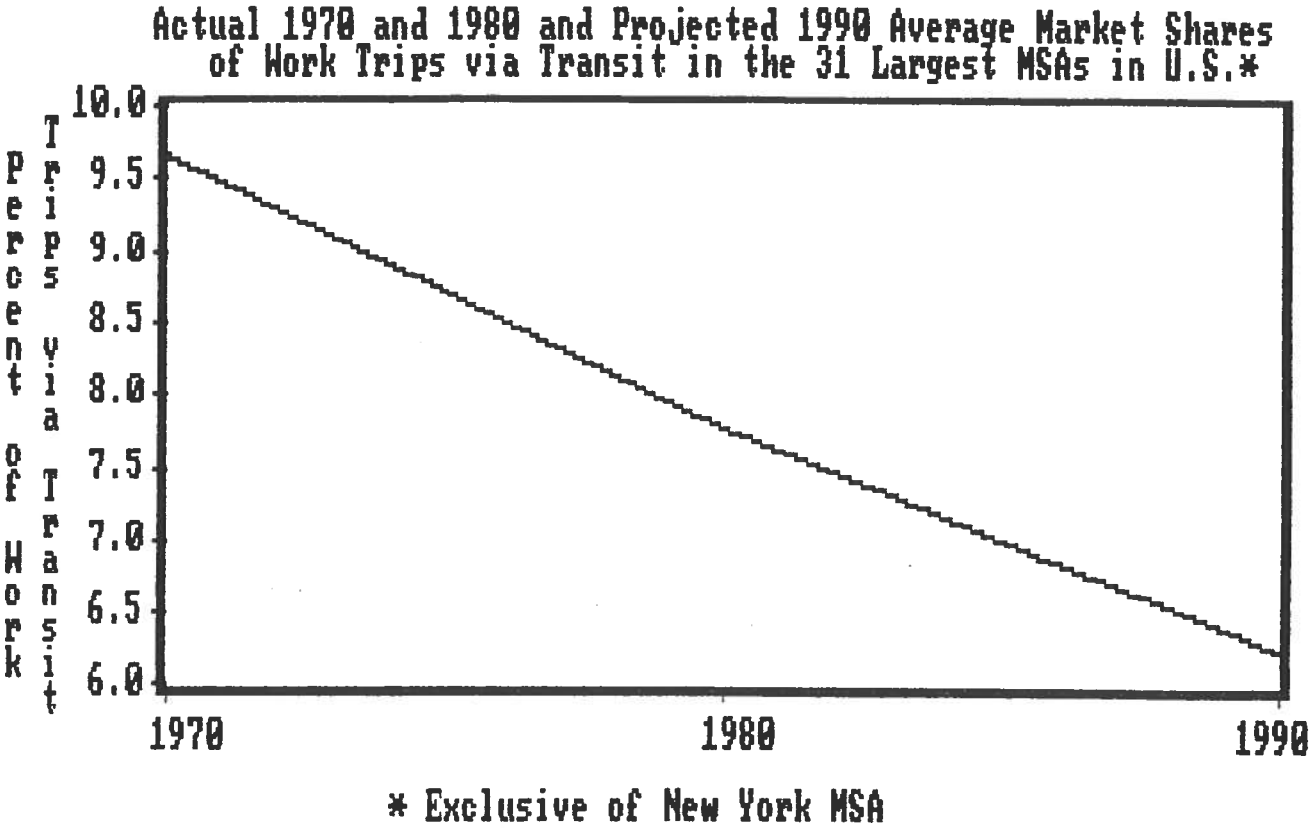

Figure 5. Comparison of Actual 1970 and 1980 and Projected 1990 Average Market Share for Work Trips for 31 Largest MSAs

stringent cost-benefit calculus be applied in evaluating each project's feasibility, and that serious attention be designing fixed guideway investments that are compatible with emerging demographic and settlement patterns.

Table 5 presents summary statistics on commuting and transit ridership trends for 13 cities that have approached UMTA for capital assistance and that have been examined by UMTA's Office of Planning Assistance and Office of Methods and Support in the New Start Ratings for FY 1986 [UMTA, 1985]. The table indicates that many experienced rapid increases in intrasuburban commuting, with the percentage point increase between 1970 and 1980 exceeding 10 percent in Atlanta, Chicago, Detroit, and Minneapolis. The average percentage point change in the share of work trips that were intrasuburban was 7.0, higher than for the nation's 31 largest MSAs, wherein the mean percentage point change was 6.3. Thus, in general, these thirteen MSAs seeking new capital funding have witnessed a stronger trend toward suburbanization of commuting than peer MSAs which are not pursuing rail investments.

Table 5 further reveals that transit's market share dropped in most of these 13 metropolitan areas during the seventies and that many have experienced substantial ridership losses during the first half of the 1980s. St. Louis, for instance, lost nearly one-third of its passenger base during the first five years of the 1980s. St. Louis witnessed decentralization of jobs in the seventies and continues to experience a sharp growth in intrasuburban commuting. Some of the cities which have enjoyed marked ridership increases in the 1980s, it might be noted, such as Atlanta and Detroit, opened new rail systems. Other places with new rail projects, like Baltimore and San Diego, however, have been unable to stem the tide of declining ridership (although in the case of San Diego, much of the drop-off in the regional transit district's ridership can be attributed to the competitive contracting out of services). While many other factors, such as changing service, fare, and gasoline price levels, have no doubt exerted strong influences on ridership in many of these areas, the rationale for building new fixed guideways systems in an era when commuting continues to suburbanize and market shares are declining must be called into question.

If new fixed-guideway systems are to be viable in many of these places, coordinated land use programs that encourage high-density and mixed-use growth around station areas will be necessary. Just building mid-rise office towers around rail stations will not be enough, however. Experiences in the Washington, D.C. and San Francisco Bay Area, for instance, indicate that fewer than 2 percent of office personnel working near most suburban transit stations patronize rail services [Baker, 1983; Cervero, 1986C]. The simple reason why few suburban office workers are opting for rail transit is that few lines come close to where most live and because most have a free, guaranteed parking space. Unless there is clustering of

Table 5

Summary Statistics of
Commuting and Transit Ridership Trends for 31 MSAs

	1970-1980 Percentage Point Change in Share of Work Trips:		Annual Public Transit Ridership (millions)		
	Within Suburbs	Made by Transit	1980	1984	% Chang
Atlanta	15.2	-0.8	108.1	123.7	14.4%
Baltimore	7.0	-3.5	118.7	98.7	-16.8%
Chicago	10.3	-5.3	720.8	684.8	-5.0%
Columbus	1.0	-2.8	19.1	23.8	24.6%
Detroit	13.1	-4.2	128.6	145.2	12.9%
Houston	0.5	-2.4	37.9	55.3	45.9%
Los Angeles	1.5	1.4	396.6	415.8	4.8%
Minneapolis	12.4	0.2	105.2	76.3	-27.5%
New York	6.8	-7.4	2021.3	2579.6	27.6%
Portland	6.8	2.4	46.8	47.1	0.6%
St. Louis	9.1	-2.3	82.2	56.5	-31.3%
San Diego	2.1	-1.0	34.5	26.5	-23.2%
Seattle	5.1	2.5	74.2	60.6	-18.3%
Unweighted Average	7.0	-1.8	299.5	338.0	0.7%
Standard Deviation	4.7	2.9	531.1	672.3	22.8%

residential development around stations as well as other auxiliary uses, most suburban office workers will continue solo-commuting to work, especially when a free or subsidized parking space awaits them.

There are numerous precedences where mixed-use development has spawned around transit stations [Witherspoon, 1983]. Some of the approaches that have proven successful and that should be encouraged for any new rail start program are:

Incentive zoning: density bonuses, air rights provisions, and mixed-use zoning.

Fiscal incentives: tax increment financing, tax-exempt bond financing, and creation of enterprise zones.

Joint development and Cost-sharing: co-development, supplemental property leasing, and land dedication.

All of these measures can attract private capital to station areas and invite the types of land developments that are consonant with successful rail transit operations. The best barometer of how interested private developers are in building around new transit stations is their willingness to enter into cost-sharing and benefit-sharing agreements. The most common approach to cost-sharing is where communities make use of the leverage inherent in their powers to grant discretionary development approvals, with the issuance of use and building permits usually made contingent upon some private contributions. Only in such circumstances where developers are willing to contribute toward the financing of a project would it appear that the market is firm enough to attract the kind of higher density, mixed-use development that is necessary to sustain a rail investment. Several recent examples of developer contributions are noteworthy. In Miami, the developer of the Datran Center, a major mixed-use project near the Dadeland South Metrorail station, has agreed to dedicate one acre of land needed for the station site, to construct a 1,000-space parking garage, and to pay an annual rent to the county equal to 4 percent of all gross income from the project [Orski, 1985; Sedway Cooke Associates, 1984]. In Los Angeles, benefit assessment districts are being created around each station of the proposed Wilshire Line to help cover 5 percent of the $3.4 billion project.

Perhaps the most ambitious approach toward linking new capital rail projects with land development and exacting substantial contributions from developers is being pursued in Japan. There, the cost of suburban rail construction is internalized in the cost of land development. Around greater Tokyo, Osaka, and other major centers, private land companies are linking new satellite communities together as well as with the traditional downtown cores via rail transit lines. The cost of suburban rail construction is being wholly absorbed as part of the overall development costs of the new towns, just as the

cost of roads and other essential features of infrastructure are.

Strong consideration should be given to including criteria that gauge the extent to which coordinated land use planning is being carried out in evaluating the feasibility of future rail investments. Only where the legislative and institutional apparatuses are in place will the kind of land development evolve to sustain new rail investments in many rapidly suburbanizing areas. Consideration should be given to expanding the definition of "local commitment" to include the introduction of appropriate institutional mechanisms and land use programs that are supportive of capital-intensive investments.

IV.1.B. Restructuring Conventional Transit Services

In light of emerging demographic and economic trends, conventional fixed-route, set-schedule bus transportation services are in dire need of a major overhaul, the kind that will transform and re-invigorate the industry so as to make it more competitive with the private automobile. Serious consideration needs to be given to the replacement of radial systems by grids that offer high degrees of route interconnectivity to better serve the continuing dispersion of regional commuting. Only this kind of network eases the burden of transferring. Urban villages, office parks, shopping malls, and other activity centers form natural building blocks for creating multifocal, timed-transfer networks. Additionally, systems that combine the line-haul and feeder functions of mass transportation, namely busways, warrant serious consideration as viable alternatives to more rigid fixed-guideway investments.

Multi-Centered Transit Networks and Timed-Transfer Systems

The transit network which best emulates the diffusion of commute paths is a multi-centered transit network, integrated through careful coordination of schedules. Schneider et al. [1981] offer an in-depth analysis of how transit services should be adapted to the polynucleated city through building a network of transit centers that are integrated through timed-transfer scheduling. Many urban transit route structures in the U.S. could be reconfigured to function as timed-transfer systems at a reasonable cost. The payoff in increased ridership, particularly among the suburb-to-suburb commute market, would in the vast majority of cases cover the additional cost.

Perhaps the timed-transfer system that has been most successful to date is Edmonton's. In the mid-1970s, Edmonton Transit reconfigured its bus routes to feed, in synchrony, into 19 dispersed transit centers. At present, anywhere from five to ten bus routes converge simultaneously on one of Edmonton's transit centers precisely 5 and 35 minutes after the hour during the off-peak and at 15- to 20- minute intervals during the peak. Those patrons continuing their trip scramble to another bus to make their connections, and, like clockwork, buses depart 3 to 5 minutes later. Pulse scheduling and timed transfers have enabled

Edmonton Transit to adapt its service to best mimic the area's dominant crosstown commuting pattern. As a result, Edmontonians can today reach nearly 90 percent of a 130 square mile service area within 50 minutes or less during the midday via transit [Bakker, 1981]. Over the 1975-1980 period when most of the timed-transfer network was built, Edmonton Transit's ridership rose 45 percent. Although it is difficult to attribute this increase directly to the timed-transfer program (since an LRT line was also introduced and the region's economy was rapidly expanding during this period), the meteoric rise in ridership was certainly not coincidental.

Busways

Since the seminal work of Meyer, Kain, and Wohl [1964], transit planners have been talking about dedicated busways as a viable alternative to heavy rail transit systems. The advantage of busways is that they allow buses to perform both collection-distribution and line-haul functions. Specifically, they remove the burden of transferring, what many consider to be the chief deterrent to transit ridership [Wachs, 1976].

The most successful busway system in North America is presently taking form in Ottawa, Canada. In the early 1980s Ottawa introduced a timed-transfer network similar to Edmonton's, with the notable exception that a mostly grade-separated, exclusive busway serves as the main-line connector between outlying transit centers and downtown. The transitway operates just like any other rapid transit facility, with vehicles, in Ottawa's case buses, stopping at every station. Special ramp access from criss-crossing surface streets is provided at most stations so that feeder buses can connect directly into the main-line without any transfers having to be made.

What makes Ottawa so unusual is that, after completing a detailed alternatives analysis, it opted for busways over the eminently more popular LRT technology. Ottawa's primary reason for choosing busways over LRT is compelling: by best estimates, the busway would cost 50 percent less to construct and 20 percent less to operate and would provide roughly the same capacity [Bonsall, 1985]. Because buses can also feed into Ottawa's sprawling residential neighborhoods whereas LRT would rely on transfers, the busway was also deemed superior in terms of overall service quality. By all accounts, Ottawa's busway, coupled with other supportive programs such as restricted downtown parking, has been an unqualified success. More than 30 percent of all vehicle trips in the region and 60 percent of downtown-destined peak-hour journeys are current made via public transit, a phenomenal achievement for a bus-only community. Transit's share of shop trips, moreover, has eclipsed the one-third mark at several retail malls, including the Rideau Centre Complex, a major focal point for downtown bus connections.

Judging by experiences in both Ottawa and Edmonton, it is evident that a suburban environment and viable public transit are

indeed compatible. Both cities have demonstrated that people will opt for bus transit as long as services compare favorably with the automobile in terms of speed and reliability.

Flexible Mass Transportation

Studies show that timed-transfer systems do not necessarily work well everywhere. Residential densities above 3,000 persons per square mile are needed to operationalize these networks [Newman, et al., 1983]. Below this threshold, more flexible modes of mass transportation are needed, either as feeders into timed-transfer centers or else as direct connectors to workplaces themselves. Paratransit services, such as shared-ride taxis and private commuter buses, are best suited to providing services in such low-density settings. Besides eliminating the hassle of transferring, paratransit offer some of the flexibility and convenience of the private automobile combined with the mass-carrying features of buses.

One of the chief inhibitors to more widespread operation of paratransit has been government controls over the entry and pricing of these modes. By squelching free enterprise and competition, entry restrictions have led to a highly centralized, monolithic form of mass transportation -- namely, fixed-route, fixed-schedule, downtown-destined, 48-passenger bus connections. Deregulation, it can be argued, could markedly widen the number of service options available to commuters.

Places where restrictions on shared-ride taxis, bus pools, and other paratransit options have been eased offer valuable lessons. In the city of Chesapeake, Virginia, two lightly used bus routes were replaced by shared-ride taxis in 1979, leading to a 30 percent increase in patronage within one year combined with a 43 percent drop in the average operating cost per passenger [Echols, 1985]. A growing roster of transit agencies are discovering that paratransit providers are not competitors who "skim the cream" off their business, but rather they are friends who actually skim deficits.

Summary of Public Sector Policy Reforms

In sum, changing demographic, economic, and commuting trends require that serious attention be given to reforming public transit services and policies. Four fertile areas for reform are: 1) reassessing fixed-guideway programs and securing guarantees that proper land use programs will be put into place so as to make any rail transit investments viable; 2) reconfiguring traditional radial services into multi-focal, timed-transfer networks; 3) pursuing dedicated busway systems as lower-cost options to rail projects that offer potentially superior service features; and 4) encouraging more flexible, de-scaled service options to bus transportation, namely paratransit.

IV.2 Private Sector Initiatives and Involvement

IV.2.A Competitive Contracting

One of the most promising trends toward revitalizing transit services that seems well-suited to serving changing market structures is the trend toward competitive contracting. Competitive contracting has been shown to offer a number of substantial benefits: cost savings and cost containment; higher productivity; and service flexibility [Giuliano and Teal, 1985; Main, 1984; Dodd, 1985].

It is the gains in service flexibility that makes competitive contracting so well suited to serving changing market structures. With contracting, transit agencies are free to experiment more freely with new services. If a service proves to be unproductive, it can be eliminated by discontinuing the contract. If it is successful, the contract can be renewed. Such flexibility is generally not possible with traditional transit services operated by public agencies. Politicians often fight efforts to discontinue services in their districts, regardless how unproductive they might be, arguing that their constituents are entitled to their fair share of services. Transit managers also usually face union resistance when efforts are made to trim services. In short, public transit agencies are often so entrenched and co-opted by special interests that they are incapable of adapting swiftly to changing commuter market structures.

It is because transit markets are changing so rapidly that a more responsive institutional mechanism is called for. Private service-providers, competitively bidding for contracts, could be expected to respond to the shifting needs and demands of commuters creatively. They would have to; otherwise would go out of business. In a competitive environment, successful contractors are forced to hold the line on costs, to maintain lean overheads, and to tailor their capital acquisitions so as to maximize their net yields. They are also more inclined to aggressively pursue new customers and carve out new market niches. Studies have found, for instance, that some resourceful private firms have purchased luxury buses for charter services during the midday, evening, and weekends that also serve as premium-service commuter buses; thus, contracting allows charter companies to efficiently utilize available capacity over the entire week [Giuliano and Teal, 1985].

Because changing commuter markets offer so many opportunities for innovation, the dynamic of competitive contracting could redound significant benefits to the public sector as well. As private operators sought to innovate new types of services, public agencies could be expected to emulate their actions. Studies have shown that competitive contracting produces such "ripple effects" as containment of wage costs in public agencies and service improvements along traditional corridors [Talley, 1986]. In fact in Tidewater, Virginia and

San Diego, the public agency was able to win back contracts previously letted to private firms because they were able to win important wage and work rule concessions [Cervero, 1986B]. With the discipline of competition, public transit no doubt could be expected to devise better ways of delivering and pricing its services to the benefit of everyone.

IV.2.B Private Service Providers

In addition to receiving contracts from public agencies, a growing number of private bus firms are showing that they are capable of starting up new services of their own that operate at a profit. In the Los Angeles area, for instance, hundreds of subscription buses provide comfortable connections to employment centers scattered throughout the region for over 5,000 daily customers. Commuter Bus Lines, Inc. operates intercounty routes of 30 to 50 miles in length, connecting several large work sites [Giuliano and Teal, 1985]. Profitable inter-city commuter bus services also thrive in Westchester County, NY, Fairfax, VA, and Marin County, CA. The fact that entrepreneurs are making profits in all of these settings indicates that there is a ready market of workers who will patronize suburban bus transportation and pay fares as high as $5 per trip given good quality service. Indeed, premium service features -- from the provision of roomy seats with padded headrests to the convenience of front-door drop-offs at customers' offices -- have been the hallmark of all successful suburban bus operations to date.

More and more developers are operating transit services as well. Thirty-five miles east of San Francisco, developers of the 800-acre Bishop Ranch Business Park and the nearby 1200-acre Hacienda Business Park have recently purchased a combined total of six premium-type coaches to run to and from nearby BART stations. In Las Colinas, Texas, the master-planned new town midway between Dallas and Fort Worth, a privately financed fixed-guideway system was recently completed. In both of these cases, private developers felt that public transit was in the best interest of their urban projects and followed through in inaugurating their own services without any public funding assistance [Cervero, 1986B].

Whether private services are initiated through competitive bidding or private companies seeking out customers on their own, there is ample evidence to conclude that entrepreneurs are uniquely suited for responding promptly and creatively to changing commuting market structures. By removing entry restrictions and allowing the marketplace to exert its prowess, mass transportation could once again become far healthier than in years past and win back some of its lost market shares.

IV.2.C Transportation Management Associations

Within the past few years, a number of private organizations, called Transportation Management Associations (TMAs), have formed to deal with common transportation problems.

TMAs have typically formed around suburban work centers and urban villages, where transit connections connections tend to be poor and the congestion menace is reaching crisis proportions. They have formed for different reasons. In some cases, such as Tysons Corner in northern Virginia, one of the largest and most traffic-clogged suburban centers in the United States, the catalysts were local employers and property-owners, who feared that traffic conditions could stifle future economic growth [Orski, 1986B]. In other cases, such as Pleasanton, California, TMAs arose from local ordinances that set a legal cap on traffic volumes. Elsewhere, such as the North Dallas Parkway area, developers and local governments got together to form a TMA as a vehicle for addressing complex traffic issues on a subregional level.

One of the primary charges of TMAs has been to launch traffic management programs, such as vanpool and ride-matching services. The Greater Princeton TMA, for instance, coordinates a staggered work hours program among its corporate members and helps underwrites the cost of purchasing vans. Some TMAs, such as in Pleasanton and Tysons Corner, also operate internal circulators and park-and-shuttle systems.

Private employers and developers are clearly in the best position to respond to and influence the travel behavior of their employees and tenants. Rideshare participation rates of over 40 percent, for example, have been achieved by Rockwell International in Golden, Colorado, Fluor Industries in Irvine, California, and Lawrence Livermore Laboratory in Alameda County, California [Cervero, 1986C]. Most of these successful programs have been launched in outlying settings, moreover, demonstrating that substantial numbers of suburban workers can be lured out of their automobiles if suitable service options are provided and private interests become actively involved. TMAs are particularly well-suited for mitigating traffic congestion along suburban corridors where the cumulative impacts of numerous independent developments are substantial.

Summary of Private Sector Initiatives

The private sector holds the resources and wherewithal to respond effectively to the changing market for urban and suburban commuting. Through joint development and cost-sharing programs, they are in a position to help finance improvements and bring about the kinds of land use changes that could make transit capital investments viable. Private bus companies, moreover, have shown that they are adept at introducing the kinds of service innovations that are becoming increasingly necessary to maintain mass transit's customer base. Increased competitive contracting would give rise to greater experimentation and creativity, the very things that are needed given the rapid changes that are taking place within the commuter population.

V. SUMMARY AND CONCLUSION

Powerful demographic, economic, and spatial forces are changing commuting behavior in very fundamental ways. Americans are becoming more auto-dependent than ever before, for a host of reasons:

* decentralization of jobs has led to a more diffuse pattern of commuting that the private automobile best serves;

* the trend toward more middle-aged, smaller, and dual-wage-earner households has given rise to a commuter population that tends to be more prosperous and independent, resulting in greater automobile usage;

* the widening spatial mismatch in where people are living and working has increased trip distances, furthering the automobile-reliance of many Americans.

Congestion has worsened in most U.S. metropolitan areas, in part because of these factors, in addition to several other influential trends. One has been the fact that population and employment have grown steadily in most major U.S. metropolitan areas during the eighties, while new highway construction has slowed considerably. Continued growth combined with stable transportation capacity has increased ambient levels of congestion. Other factors, such as the entry of proportionally more adults of driving age (i.e., the 21-35 baby-boomer cohort), have similarly added more cars onto highways.

Based on the analysis of the 31 largest MSAs in the U.S., excluding New York, it was found that general population growth, the trend toward more vehicles per household, and the trend toward more intrasuburban commuting were the factors that were most strongly correlated with the decline in public transit's share of the commuter market. Should these factors continue to change at the same pace in the 1980s as they did in the 1970s, then it is estimated that the average share of work trips that will be served by public transportation will slip from 7.76 percent in 1980 to 6.23 percent in 1990. Since the rate of increase in vehicle ownership and intrasuburban commuting appears to be occurring faster during the 1980s than the previous decade, transit's share of the commuter market in these 31 MSAs could slip even more by 1990, perhaps as low as 5 percent, on average.

The policy implications of these trends are serious. Major policy reforms need to be introduced, and soon, if public transportation services are to hold their market share and remain reasonably competitive with the private automobile. In the public sector realm, the efficacy of building rigid fixed-guideway systems in an environment where trip patterns are becoming more and more dispersed needs to be seriously reassessed. Only those fixed guideway projects which call for careful integration of mixed land-use development around stations and private sector funding participation should be considered.

Public transit agencies need to pay closer attention to how their services are configured and delivered as well. As our cityscapes become increasingly multi-centered, transit services need to be redesigned to more closely emulate the diffusion of trip patterns. Multi-focal, timed-transfer networks, integrated busways, and responsive paratransit services seem best suited for serving emerging commute patterns.

Perhaps the best hope for responding to changing market structures and preserving regional mobility lies with initiatives that are carried out by the private sector. The private sector has consistently demonstrated its skillfulness in providing innovative and cost-effective services. The profit motive encourages private entrepreneurs to keep close track of changing market demands and to respond with the kinds of services that customers will consume. Whether services are competitively bidded out to private firms by public agencies or if they are initiated and sponsored wholly by developers or private companies, free enterprise exerts a market discipline that spurs innovation and encourages productivity. In an era when so many demographic and economic forces are profoundly altering commuting behavior, only the private sector offers the flexibility and resourcefulness that is necessary to effectively adapt to changing needs. Of all of the possible policy options, competitive contracting and the removal of entry barriers among private service-providers probably offers the best hope for preserving urban mobility and maintaining, and perhaps even increasing, mass transit's share of the commuter market.

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APPENDIX

Table A1

Original Demographic, Employment, and Commuting Data for 31 Largest MSAs in the United States

SMSA	Pop in1000s 1970	Pop in1000s 1980	Pop Chnge	Pop Chnge %	Pop NonCity % Chnge	Employ in1000s 1970	Employ in1000s 1980	Employ Chnge	Employ Chnge %	Percent SubComm 1970	Percent SubComm 1980	Percent SubComm Change
Detroit	4435	4353	-82	-1.8%	7.8	1650	1598	-52	-3.2%	50.8	63.9	13.1
Atlanta	1596	2030	434	27.2%	45.8	668	794	126	18.9%	42.7	57.9	15.2
Minnpols	1965	2113	148	7.5%	20.6	815	956	141	17.3%	36.2	48.6	12.4
Wash DC	2910	3061	151	5.2%	12.5	1195	1019	-176	-14.7%	50	56.3	6.3
Chicago	6975	7104	129	1.8%	13.6	2852	3008	156	5.5%	38.4	48.7	10.3
St. Louis	2411	2356	-55	-2.3%	6.3	914	910	-4	-0.4%	53.2	62.3	9.1
Cleveland	2064	1899	-165	-8.0%	0.9	829	819	-11	-1.3%	43.4	54.4	11
New Orleans	1387	1187	-200	-14.4%	38.9	368	428	60	16.3%	25.5	35.4	9.9
Buffalo	1349	1243	-106	-7.9%	-0.2	510	429	-81	-15.9%	46.4	53.9	7.5
DenBldr	1240	1621	381	30.7%	59.9	497	662	165	33.2%	26.6	37	10.4
Seattle	1425	1607	182	12.8%	26	557	643	86	15.4%	43	48.5	5.5
Phila	4824	4717	-107	-2.2%	5.4	1878	1652	-226	-12.0%	46	55.2	9.2
Milwaukee	1404	1397	-7	-0.5%	10.8	573	613	40	7.0%	30.8	37.9	7.1
Baltimore	2071	2174	103	5.0%	19.1	810	688	-122	-15.1%	39	46	7
Tampa	1089	1569	480	44.1%	78.4	365	448	83	22.7%	32.2	43.3	11.1
Portland	1007	1243	236	23.4%	39.6	400	473	73	18.3%	35.5	42.3	6.8
KanCity	1274	1327	53	4.2%	14.6	527	560	33	6.3%	36.1	43.1	7
Cincin	1387	1401	14	1.0%	8.8	523	543	20	3.8%	48.2	54.3	6.1
Boston	2899	2763	-136	-4.7%	-2.6	1190	1533	343	28.8%	64.5	68	3.5
DalFtWth	2378	2975	597	25.1%	47.9	998	1247	249	24.9%	26.2	32.4	6.2
SF	3109	3251	142	4.6%	10	1268	1306	38	3.0%	50.3	53.6	3.3
Miami	1268	1626	358	28.2%	37.1	513	621	108	21.1%	42.9	45.1	2.2
LA	7042	7477	435	6.2%	7.2	2827	3139	312	11.0%	44.6	46.1	1.5
San Diego	1358	1862	504	37.1%	49.4	430	507	77	17.9%	31.3	33.4	2.1
Phoenix	971	1509	538	55.4%	92.1	362	517	155	42.8%	24.5	29.7	5.2
Sacto	804	1014	210	26.1%	35	287	255	-32	-11.1%	36.4	46.2	9.8
Pittsbgh	2401	2264	-137	-5.7%	-2.2	871	850	-21	-2.4%	58.8	60	1.2
ClabsO	1018	1093	75	7.4%	10.6	404	409	5	1.2%	30	31	1
Houston	1999	2905	906	45.3%	71.2	802	1226	424	52.9%	25.5	26	0.5
Indpls	1111	1167	56	5.0%	24.5	444	454	10	2.3%	21.9	20	-1.9
SanAntonio	888	1072	184	20.7%	22.4	285	308	23	8.1%	13	11.1	-1.9
Unweighted Average:	2195.45	2367.10	171.65	0.12	26.17	858.45	923.03	64.58	0.10	38.51	44.89	6.38
Std. Dev.:	1582.31	1579.08	260.04	0.17	24.29	645.02	677.59	138.26	0.16	11.44	13.02	4.34

Table A1 (cont.)

SMSA	% Change SubComm Percent	LiveWork Pop1000s 1970	LiveWork Pop1000s 1980	LiveWork Pop Change	LiveWork Pop % Chnge	PTUsers SMSA 1970	PTUsers SMSA 1980	PTUsers Change	PTUsers % Chnge	%Wrkers Transit 1970	%Wrkers Transit 1980	%Wrkers Transit Chnge	% Change Share Wrk Transit	PTUsers NonCity 1970	wrkers hh % chnge
Detroit	25.8%	1429	1680	251	17.6%	125	64	-61	-48.8%	7.9	3.7	-4.2	-53.2%	27	-7.7%
Atlanta	35.6%	605	853	248	41.0%	55	72	17	30.9%	8.4	7.6	-0.8	-9.5%	12	-7.1%
Minnpols	34.3%	746	967	221	29.6%	67	91	24	35.8%	8.5	8.7	0.2	2.4%	13	0.0%
Wash DC	12.6%	1097	1384	287	26.2%	203	241	38	18.7%	16.3	15.5	-0.8	-4.9%	203	0.0%
Chicago	26.8%	2473	2807	334	13.5%	167	183	16	9.6%	23.3	18	-5.3	-22.7%	167	-7.1%
St. Louis	17.1%	830	906	76	9.2%	71	57	-14	-19.7%	8	5.7	-2.3	-28.7%	24	-7.7%
Cleveland	25.3%	720	838	118	16.4%	107	87	-20	-18.7%	13.4	10.6	-2.8	-20.9%	45	-7.7%
New Orleans	38.8%	331	404	73	22.1%	74	53	-21	-28.4%	20.4	10.9	-9.5	-46.6%	10	0.0%
Buffalo	16.2%	466	463	-3	-0.6%	52	33	-19	-36.5%	10.5	6.6	-3.9	-37.1%	16	-15.4%
GenBldr	39.1%	466	729	263	56.4%	22	50	28	127.3%	4.4	6.1	1.7	38.6%	4	-7.1%
Seattle	12.8%	511	941	430	84.1%	38	74	36	94.7%	7.1	9.6	2.5	35.2%	5	-13.3%
Phila	20.0%	1591	1842	251	15.8%	383	275	-108	-28.2%	20.7	14	-6.7	-32.4%	109	-7.7%
Milwaukee	23.1%	524	585	61	11.6%	67	49	-18	-26.9%	12	7.7	-4.3	-35.8%	11	-7.1%
Baltimore	17.9%	753	802	49	6.5%	113	99	-14	-12.4%	13.8	10.3	-3.5	-25.4%	20	-7.1%
Tampa	34.5%	333	534	201	60.4%	11	11	0	0.0%	3	1.8	-1.2	-40.0%	2	-7.7%
Portland	19.2%	364	503	139	38.2%	23	48	25	108.7%	6	8.4	2.4	40.0%	6	-7.7%
KanCity	19.4%	472	555	83	17.6%	28	25	-3	-10.7%	5.4	4.1	-1.3	-24.1%	6	0.0%
Cincin	12.7%	462	626	164	35.5%	42	38	-4	-9.5%	8.3	6.5	-1.8	-21.7%	16	-7.7%
Boston	5.4%	1059	1412	353	33.3%	224	204	-20	-8.9%	19.7	15.6	-4.1	-20.8%	122	-7.1%
DalFtWth	23.7%	914	1316	402	44.0%	50	50	0	0.0%	5.1	3.4	-1.7	-33.3%	4	0.0%
SF	6.6%	1128	2189	1061	94.1%	194	256	62	32.0%	15.5	16.4	0.9	5.8%	57	0.0%
Miami	5.1%	446	986	540	121.1%	46	48	2	4.3%	9.1	6.6	-2.5	-27.5%	21	-7.7%
LA	3.4%	2486	4639	2153	86.6%	154	235	81	52.6%	5.6	7	1.4	25.0%	43	0.0%
San Diego	6.7%	507	745	238	46.9%	23	28	5	21.7%	4.3	3.3	-1	-23.3%	8	-7.1%
Phoenix	21.2%	335	586	251	74.9%	5	13	8	160.0%	1.3	2	0.7	53.8%	1	-7.7%
Sacto	26.9%	270	377	107	39.6%	7	15	8	114.3%	2.3	3.5	1.2	52.2%	2	-7.7%
Pittsbgh	2.0%	754	826	72	9.5%	123	105	-18	-14.6%	14.6	11.5	-3.1	-21.2%	68	-8.3%
ClabsO	3.3%	364	483	119	32.7%	29	23	-6	-20.7%	7.4	4.6	-2.8	-37.8%	4	-7.1%
Houston	2.0%	688	1306	618	89.8%	42	43	1	2.4%	5.4	3	-2.4	-44.4%	3	0.0%
Indpls	-8.7%	410	475	65	15.9%	25	17	-8	-32.0%	5.8	3.2	-2.6	-44.8%	2	-7.1%
SanAntonio	-14.6%	310	404	94	30.3%	18	21	3	16.7%	5.6	4.6	-1	-17.9%	1	-7.1%
Unweighted Average:	16.6%	769.16	1069.77	300.61	39.3%	83.48	84.13	0.65	16.6%	9.65	7.76	-1.89	-13.6%	33.29	-6.0%
Std. Dev.:	13.2%	553.51	857.55	397.25	29.9%	81.39	77.71	33.11	51.8%	5.76	4.45	2.63	30.0%	49.73	3.9%

Table A1 (cont.)

SMSA	PTUsers NonCity 1980	PTUsers NonCity Change	PTUsers NonCity %Chnge	veh hh 1970	veh hh 1980	veh hh change	veh hh % Chnge	persons hh 1970	persons hh 1980	persons hh change	persons hh % chnge	wrkers hh 1970	wrkers hh 1980	wrkers hh change
Detroit	20	-7	-25.9%	1.3	1.6	0.3	23.1%	3.27	2.9	-0.37	-11.3%	1.3	1.2	-0.1
Atlanta	30	18	150.0%	1.4	1.6	0.2	14.3%	3.19	2.8	-0.39	-12.2%	1.4	1.3	-0.1
Minnpols	32	19	146.2%	1.3	1.6	0.3	23.1%	3.2	2.7	-0.5	-15.6%	1.4	1.4	0
Wash DC	241	38	18.7%	1.2	1.5	0.3	25.0%	3.1	2.7	-0.4	-12.9%	1.4	1.4	0
Chicago	183	16	9.6%	1	1.3	0.3	30.0%	3.13	2.8	-0.33	-10.5%	1.4	1.3	-0.1
St. Louis	26	2	8.3%	1.2	1.5	0.3	25.0%	3.15	2.8	-0.35	-11.1%	1.3	1.2	-0.1
Cleveland	46	1	2.2%	1.2	1.5	0.3	25.0%	3.12	2.7	-0.42	-13.5%	1.3	1.2	-0.1
New Orleans	8	-2	-20.0%	1	1.3	0.3	30.0%	3.23	2.8	-0.43	-13.3%	1.2	1.2	0
Buffalo	11	-5	-31.3%	1.1	1.3	0.2	18.2%	3.15	2.7	-0.45	-14.3%	1.3	1.1	-0.2
DenBldr	21	17	425.0%	1.4	1.8	0.4	28.6%	3.04	2.6	-0.44	-14.5%	1.4	1.3	-0.1
Seattle	26	21	420.0%	1.3	1.7	0.4	30.8%	2.94	2.6	-0.34	-11.6%	1.5	1.3	-0.2
Phila	92	-17	-15.6%	1.1	1.3	0.2	18.2%	3.16	2.8	-0.36	-11.4%	1.3	1.2	-0.1
Milwaukee	10	-1	-9.1%	1.2	1.4	0.2	16.7%	3.17	2.7	-0.47	-14.8%	1.4	1.3	-0.1
Baltimore	24	4	20.0%	1	1.3	0.3	30.0%	3.22	2.8	-0.42	-13.0%	1.4	1.3	-0.1
Tampa	4	2	100.0%	1.3	1.5	0.2	15.4%	2.66	2.7	0.04	1.5%	1.3	1.2	-0.1
Portland	21	15	250.0%	1.3	1.6	0.3	23.1%	2.89	2.5	-0.39	-13.5%	1.3	1.2	-0.1
KanCity	6	0	0.0%	1.3	1.6	0.3	23.1%	3.02	2.6	-0.42	-13.9%	1.3	1.3	0
Cincin	15	-1	-6.3%	1.2	1.5	0.3	25.0%	3.14	2.7	-0.44	-14.0%	1.3	1.2	-0.1
Boston	120	-2	-1.6%	1	1.3	0.3	30.0%	3.11	2.8	-0.31	-10.0%	1.4	1.3	-0.1
DalFtWth	6	2	50.0%	1.5	1.8	0.3	20.0%	3.1	2.7	-0.4	-12.9%	1.4	1.4	0
SF	97	40	70.2%	1.2	1.5	0.3	25.0%	2.79	2.5	-0.29	-10.4%	1.3	1.3	0
Miami	27	6	28.6%	1.2	1.4	0.2	16.7%	2.9	2.7	-0.2	-6.9%	1.3	1.2	-0.1
LA	79	36	83.7%	1.4	1.7	0.3	21.4%	2.83	2.8	-0.03	-1.1%	1.3	1.3	0
San Diego	10	2	25.0%	1.4	1.7	0.3	21.4%	2.95	2.7	-0.25	-8.5%	1.4	1.3	-0.1
Phoenix	3	2	200.0%	1.5	1.8	0.3	20.0%	3.14	2.7	-0.44	-14.0%	1.3	1.2	-0.1
Sacto	9	7	350.0%	1.4	1.7	0.3	21.4%	3.06	2.6	-0.46	-15.0%	1.3	1.2	-0.1
Pittsbgh	58	-10	-14.7%	1.1	1.3	0.2	18.2%	3.1	2.7	-0.4	-12.9%	1.2	1.1	-0.1
ClebsO	4	0	0.0%	1.3	1.5	0.2	15.4%	3.1	2.7	-0.4	-12.9%	1.4	1.3	-0.1
Houston	5	2	66.7%	1.4	1.7	0.3	21.4%	3.21	2.8	-0.41	-12.8%	1.4	1.4	0
Indpls	1	-1	-50.0%	1.3	1.6	0.3	23.1%	3.14	2.7	-0.44	-14.0%	1.4	1.3	-0.1
SanAntonio	2	1	100.0%	1.3	1.6	0.3	23.1%	3.38	3.1	-0.28	-8.3%	1.4	1.3	-0.1
Unweighted Average:	39.90	6.61	75.8%	1.25	1.53	0.28	22.6%	3.08	2.72	-0.36	-11.6%	1.35	1.26	-0.08
Std. Dev.:	54.74	13.30	126.3%	0.14	0.16	0.05	4.7%	0.15	0.11	0.12	3.7%	0.07	0.08	0.05