Technical Report Documentation Page

| 1. Report No. | 2. Government Accession No. | 3. Recipient's Catalog No. |
|---|---|---|
| FHWA/TX-99/1821-2 | | |

| | |
|---|---|
| 4. Title and Subtitle<br>COMMUTING IN TEXAS: PATTERNS AND TRENDS | 5. Report Date<br>May 1999 |
| | 6. Performing Organization Code |
| 7. Author(s)<br>Dennis G. Perkinson, Ph.D. | 8. Performing Organization Report No.<br>Report 1821-2 |
| 9. Performing Organization Name and Address<br>Texas Transportation Institute<br>The Texas A&M University System<br>College Station, Texas 77843-3135 | 10. Work Unit No. (TRAIS) |
| | 11. Contract or Grant No.<br>Project No. 0-1821 |
| 12. Sponsoring Agency Name and Address<br>Texas Department of Transportation<br>Office of Research and Technology Transfer<br>P. O. Box 5080<br>Austin, Texas 78763-5080 | 13. Type of Report and Period Covered<br>Research:<br>June 1998 - May 1999 |
| | 14. Sponsoring Agency Code |

15. Supplementary Notes

Research performed in cooperation with the Texas Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration
Research Study Title: Commuting in Texas: Patterns and Trends

16. Abstract

There have been significant changes over the past two decades in Texas commuting patterns. The expansion and changing nature of the workforce has resulted in an increase in commute trips and vehicle ownership. The growth in suburban and exurban employment and residential development has further changed commuting patterns. In many urban areas, the traditional work trip from the suburbs to downtown has been replaced by suburb to suburb commutes. More people are also choosing to live in smaller communities or rural areas and are driving longer distances to their places of employment. These trends, that are expected to continue, have major implications for traffic congestion, the environment, the quality of life, and transportation investments. Obtaining a better understanding of these patterns and trends is critical for the Texas Department of Transportation (TxDOT) and other groups responsible for maintaining all aspects of the transportation system.

| 17. Key Words | 18. Distribution Statement |
|---|---|
| Commute Patterns, Commuting, Journey to Work | No Restrictions. This document is available to the public through NTIS:<br>National Technical Information Service<br>5285 Port Royal Road<br>Springfield, Virginia 22161 |

| 19. Security Classif.(of this report) | 20. Security Classif.(of this page) | 21. No. of Pages | 22. Price |
|---|---|---|---|
| Unclassified | Unclassified | 78 | |

**Form DOT F 1700.7** (8-72) **Reproduction of completed page authorized**

# COMMUTING IN TEXAS: PATTERNS AND TRENDS

by

Dennis G. Perkinson, Ph.D.
Associate Research Scientist

Research Report 1821-2
Research Study Number 0-1821
Research Study Title: Commuting in Texas: Patterns and Trends

Sponsored by the
Texas Department of Transportation
In Cooperation with
U.S. Department of Transportation
Federal Highway Administration

May 1999

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135

# IMPLEMENTATION STATEMENT

Over the past two decades there have been significant changes in Texas commuting patterns. More people are choosing to live in smaller communities or rural areas and are driving longer distances to the places of employment. These trends are expected to continue and have major implications for traffic congestion, the environment, the quality of life, and transportation investments. Obtaining a better understanding of these patterns and trends is critical for the Texas Department of Transportation (TxDOT) and other groups responsible for maintaining all aspects of the transportation system. The results of this research will provide TxDOT with a better understanding of these patterns and enable the department to ensure that limited resources are allocated to maximize the benefits to all user groups.

# DISCLAIMER

The contents of this report reflect the views of the author who is responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect official views or policies of the Federal Highway Administration or the Texas Department of Transportation. This report does not constitute a standard, specification, or regulation. Additionally, this report is not intended for construction, bidding, or permit purposes. Dennis G. Perkinson, Ph.D., associate research scientist, prepared the report and was the Research Supervisor for this project.

# ACKNOWLEDGMENTS

The author acknowledges the support of Carol Rawson, P.E., project coordinator, and Rick Collins, P.E., project director, for their assistance with this project. Additionally, the author would like to thank Celia G. Boertlein, Statistics Branch, U.S. Department of Commerce, Bureau of the Census, for her invaluable assistance in retrieving journey-to-work data.

# TABLE OF CONTENTS

## LIST OF FIGURES

**Figure** **Page**

## LIST OF TABLES

# SUMMARY

There have been significant changes over the past two decades in Texas commuting patterns. The expansion and changing nature of the workforce has resulted in an increase in commute trips and vehicle ownership. The growth in suburban and exurban employment and residential development has further changed commuting patterns. In many urban areas, the traditional work trip from the suburbs to downtown has been replaced by suburb to suburb commutes.

More people are also choosing to live in smaller communities or rural areas and are driving longer distances to their places of employment. These trends, that are expected to continue, have major implications for traffic congestion, the environment, the quality of life, and transportation investments. Obtaining a better understanding of these patterns and trends is critical for the Texas Department of Transportation (TxDOT) and other groups responsible for maintaining all aspects of the transportation system. A better understanding will ensure that limited resources are allocated to maximize the benefits to all user groups.

This research clearly demonstrates that Texas commuting patterns and trends do not mirror the rest of the nation. More specifically, Texas commute patterns and trends are unique compared to national patterns in that:

- the central city is currently a significant element in the commute patterns of Texas cities, and is likely to remain so for sometime;
- growth in commuting is most likely to be concentrated in and around existing central cities;
- congestion is most likely to occur along more or less traditional commuting patterns (i.e., within the central city and between the central city and the suburbs); and
- consequently, demand for improvements is likely to be greatest on internal central city links and central city to suburban links, contrary to national trends. Improvements contrary to this trend (i.e., development of external links to facilitate commuting outside the MSA of residence) would tend to encourage longer commutes and would have less impact on overall congestion.

# CHAPTER 1. INTRODUCTION

There have been significant changes over the past two decades in Texas commuting patterns. The expansion and changing nature of the workforce has resulted in an increase in commute trips and vehicle ownership. The growth in suburban and exurban employment and residential development has further changed commuting patterns. In many urban areas, the traditional work trip from the suburbs to downtown has been replaced by suburb to suburb commutes. More people are also choosing to live in smaller communities or rural areas and are driving longer distances to their places of employment. These trends, that are expected to continue, have major implications for traffic congestion, the environment, the quality of life, and transportation investments. Obtaining a better understanding of these patterns and trends is critical for the Texas Department of Transportation (TxDOT) and other groups responsible for maintaining all aspects of the transportation system. A better understanding will ensure that limited resources are allocated to maximize the benefits to all user groups.

This research analyzes and documents commuting patterns in Texas. The study uses previous research and available data to examine the changing nature of commuting patterns and trends in the state. The trends and patterns experienced in Texas are compared to national patterns and trends to the extent possible.

# CHAPTER 2. LITERATURE REVIEW

Preparatory to anything, a review of the available literature on commute patterns and trends was conducted. The review includes Texas as well as national commute research. The national coverage is of necessity more general and aggregate, since national commute data will be used only as a comparison for Texas commute characteristics and trends. The focus of the literature review is on the identification of previous empirical studies of commuting patterns and trends, as well as the identification of factors influencing commuting behavior in general.

In addition, a review of existing data sources on commuting patterns and trends was conducted. The Census Transportation Planning Package (CTPP) data and recent urban area travel surveys for Texas will be the primary data sources, along with historical Texas travel surveys and formally compiled congestion indices. National data sources were also identified for use as a comparison for the Texas data.

## PRIOR RESEARCH ON COMMUTING PATTERNS AND TRENDS

National level research on commuting patterns and trends is captured by several important documents summarized below. Recent commute research specific to Texas is discussed separately.

### National Commute Patterns and Trends

At the national level, the radial route, central business district (CBD) oriented commute, while still valid for some, has been replaced by new more complex travel patterns for many (Taaffe et al. 1996:184-187). These changes in the way we commute are the result of three demographic changes. Following Pisarski (Pisarski 1987 & 1996), these may be summarized as follows:

- Increase in workers. There have been dramatic increases in the number of work trip commuters. This growth has been much greater than population growth.

- Increase in suburban commuting. Jobs have tended to locate in the suburbs, following the population shift to the suburbs. This has made suburb to suburb commuting the dominant-commuting pattern nationally.

- Increase in private vehicles. Increases in the availability of private vehicles have increased the predominance of the private vehicle as the mode of choice for the journey to work.

*Increase in Workers*

The nation has experienced rapid growth in the number of jobs available, along with growth in people of working age to fill those jobs. Between 1969 and 1990 households increased 49% and the number of workers increased 56%. More importantly, the number of prime working age persons (ages 20-34) increased to almost 25% of the total population. Another way of describing the situation is that over the 20-year period employment grew over 2% per year while the population grew at less than 1% (Hu and Young 1992). In some instances, jobs increased even where total population declined (Pisarski 1987 & 1996).

Part of the explanation of where this labor force came from is the post-war baby boom. The baby boom increased the proportion of the population of working age. However, percentages mask the real magnitude of the increase. In 1990 there was a working age population (age 20-64) of 142 million (59%) in 1990 versus 103 million (52%) in 1969 (Hu and Young 1992).

Another significant part of the explanation is the unprecedented number of women entering the labor market. In 1960, women constituted only 32% of the labor force. By 1990 women made up 46% of the labor force, nearly doubling the actual number of women in the labor force (Rossetti and Eversole 1993). Of the approximately 50 million new workers since 1960, over 31 million are women (Hu and Young 1992, Rossetti and Eversole 1993).

Whatever the explanation, between 1960 and 1990 the population increased almost 40% (179 million to 249 million) and the number of households increased over 70% (53 million to 92 million). Household size decreased from 3.33 to 2.63 persons per household (Rossetti and Eversole 1993). During this period, workers commuting by private vehicle increased over 135% (43 million to 101 million). By 1990, private vehicle commuting accounted for 88% of all commute trips (Rossetti and Eversole 1993). Beyond the obvious increase in commute (and other) trips, one significant impact of these factors for the transportation professional has been to make population alone an unreliable predictor of employment change and commuting behavior (Pisarski 1987 & 1996).

*Increase in Suburban Commuting*

The suburbanization of the population is old news. Movement from rural areas to cities and urban centers predates recorded history. Since the mid-1940s, urban growth has been focused in the surrounding suburbs. The suburbs that accounted for only 23% of the population in 1950 now account for over half. This is the result of over 85% of population growth during the same period occurring in the suburbs (Pisarski 1987 and Cervero 1986).

Along with the suburbanization of the population has gone the suburbanization of jobs. In other words, jobs have followed the population to the suburbs. Just as the population was suburbanized over the past 40 years, employment has been suburbanized over the past 20 years (Cervero 1988). Metropolitan suburbs now have about 60% of metropolitan workers and 67% of job growth. Whether this suburbanization of jobs is an isolated event or part of an evolutionary process determines how one should view the "traditional commute" between the suburbs and CBD. One argument for the evolutionary perspective is that the suburbanization of commuting is rational. Rational or not, commute patterns are changed, however, and not likely to return to the "traditional pattern" (Garreau 1991).

Finally, the suburbanization of commuting has gone along with the suburbanization of population and jobs. The number of suburb to suburb commute trips is now a substantial portion of total commute trips (about 33%). These trips have also experienced the greatest growth compared to other types of commute trips (suburb to CBD, intra CBD, CBD to CBD, etc.). (See Pisarski 1987, as well as Ford and Lomax 1989.)

Thus, commuting growth has concentrated in the suburbs as both residences and jobs have shifted increasingly to suburban areas. The origins and destinations of commuting trips have become more suburban. The suburbanization of jobs has followed the suburbanization of the population. Current commuting patterns are less homogeneous than in the past. More importantly, these trips are likely to stay mixed, with suburb to suburb trips dominating, but with central city to central city trips and trips between metropolitan areas making up significant portions. Workers whose jobs were located outside their counties of residence (i.e., suburban) more than tripled (9 million to 27.5 million, an increase of 206%) between 1960 and 1990 (Rossetti and Eversole 1993). (Note that "CBD" and "central city" are not the same. "Central city" refers to the primary city in an MSA and is defined by the legal city limits. "CBD" is undefined for census MSA-level data.)

*Increase in Automobile Availability*

Automobile availability has increased. There has been an increase both in vehicles per worker (distribution) and in vehicle ownership (absolute numbers). Household vehicles grew from almost 55 million in 1960 to over 152 million in 1990 (Rossetti and Eversole 1993). Vehicles available per worker increased from 0.96 in 1969 to 1.40 in 1990. Vehicles available per household grew from 1.03 in 1960 to 1.66 in 1990. The number of vehicles overall has increased from about 73 million in 1969 to over 165 million in 1990. The number of two-vehicle households increased by 117% and three-vehicle households by over 500% (Hu and Young 1992). Note that the substantial growth in households (49%) and the decline in persons per household (from 3.33 to 2.63) mask the magnitude of the increase in vehicle availability. Because of all this, there is now more than one vehicle available for every licensed driver.

Automobile commuting is more prevalent. The automobile's share of work trips has grown from 83% in 1969 to 92% in 1990. It is estimated that half of the growth in the automobile share is attributable to growth in commuting. The other half is a mode shift to automobile from other modes (Pisarski 1987).

There has been a decline in the use of alternatives to the automobile, even where feasible. Alternatives declined as percentage of commute and in absolute numbers. Public transit specifically carried a smaller share (5.5% versus 8.4%) and a smaller number (2.30 million versus 2.33 million) of work trips in 1990 than it did in 1960. This is true even though the number of workers increased by 43 million (Hu and Young 1992).

Thus, use of private vehicles for work trips has exceeded the growth in commuting by increasing its share of total travel as all other modes declined in share. Between 1960 and 1990 vehicle availability per household increased. Furthermore, the substantial growth in households and the decline in persons per household actually obscure the extent of the growth of private vehicle use and availability. Over the period noted, the number of vehicles available more than doubled (178%) and vehicles available per person almost doubled (97%), while workforce growth during this period was only 78%. Increases occurred even in areas of population decline.

*Changes in Work Trip Length*

Work trip length has been increasing, though the travel time associated with these trips has changed little (i.e., decreased slightly) (Hu and Young 1992). Some have argued that the suburbanization of both jobs and residences spreads travel patterns over a wider area and may allow people to live further away from activity centers (Morrison and Abrahamse 1982, Gordon and Richardson 1994). (See Table 1.)

**TABLE 1**
**Location of Employment (MSA)**

| Location of Employment | 1980 | | 1990 | |
|---|---|---|---|---|
| | Persons (million) | Percent | Persons (million) | Percent |
| Outside MSA of Residence | 4.8 | 5.4% | 8.7 | 7.6% |
| In MSA / Not Living in an MSA | 2.0 | 2.3% | 2.9 | 2.5% |
| Total | 6.8 | 7.7% | 11.6 | 10.1% |

The increase in employment in a Metropolitan Statistical Area (MSA) for those not residing in that MSA indicates an increase in commute trip length. Increases in employment in an MSA other than the MSA of residence is especially indicative of increased commute trip length (though MSA jurisdictional changes may account for some of the 1980 to 1990 changes). Even greater commute trip lengths are indicated by a journey to work for employment outside of the county of residence or outside the state of residence. (See Table 2.)

**TABLE 2**
**Location of Employment (County)**

| Location of Employment | 1980 | | 1990 | |
|---|---|---|---|---|
| | Persons (million) | Percent | Persons (million) | Percent |
| Outside County of Residence | 15.6 | 17.7% | 23.5 | 20.4% |
| Outside State of Residence | 2.8 | 3.1% | 4.0 | 3.5% |
| Total | 18.4 | 20.8% | 27.5 | 23.9% |

Whatever the reason, work trip length has increased in all areas, regardless of size, from 8.4 miles to 10.5 miles (Hu and Young 1993a and Vincent et al. 1994), while average speed has also increased (Hu and Young 1993b). This results in virtually unchanged average commute time (< 1.2 minutes) for most commuters (i.e., private automobile). Based on U.S. Census statistics, between 1980 and 1990 the mean journey-to-work travel time increased less than one minute (from 21.7 minutes to 22.4 minutes). The National Personal Transportation Survey (NPTS) shows a similar pattern (Hu and Young 1993b). (See Table 3.)

These aggregate statistics, however, mask deteriorating conditions in many (perhaps most) urban areas. In 50 of the largest urban areas (including seven of the largest Texas urban areas), congestion is recognized as a serious problem (Schrank and Lomax 1997a and 1997b), resulting in significant annual costs in delay, wasted fuel, and additional emissions.

**TABLE 3**
**NPTS National Journey to Work 1983 Versus 1990**

| Category | Private Automobile | | All Modes | |
|---|---|---|---|---|
| | 1983 | 1990 | 1983 | 1990 |
| Percent of Workers | 86.1% | 82.9% | 100.0% | 100.0% |
| Average Trip Length (miles) | 8.9 | 11.0 | 8.5 | 10.7 |
| Average Commute Time (minutes) | 17.6 | 18.9 | 18.2 | 19.7 |
| Average Travel Speed (MPH) | 30.2 | 34.7 | 28.2 | 33.3 |

**Texas Commute Patterns and Trends**

Texas commute patterns and trends are examined in two steps. First, Texas is compared with the United States as a whole. Second, individual Texas cities or metropolitan areas are examined and compared.

Statewide, commute patterns and trends in Texas are generally consistent with the national trends described above. Consequently, as shown in Table 4, the commuting situation in Texas resembles the nation as a whole (Ford and Lomax 1989a, Schrank and Lomax 1997a).

**TABLE 4**
**Texas Versus National Journey to Work 1990**

| Location | Workers (million) | Mode % | | | | Mean travel time to work |
|---|---|---|---|---|---|---|
| | | SOV | Carpool | Transit | Other | |
| Texas | 7.61 | 76.5% | 14.9% | 2.2% | 6.4% | 22.2 |
| US | 115.07 | 73.2% | 13.4% | 5.3% | 8.2% | 22.4 |

Similarly, as shown in Table 5, there is little variation among Texas cities in the essential factors relating to commuting and the journey to work.

**TABLE 5**
**Texas Journey-to-Work Mode Share and Travel Time**
**(1990 Census)**

| Location | Workers (million) | Mode % | | | | Mean travel time to work |
|---|---|---|---|---|---|---|
| | | SOV | Carpool | Transit | Other | |
| Houston | 1.58 | 75.7% | 14.6% | 4.1% | 5.5% | 26.4 |
| Dallas | 1.31 | 77.6% | 14.0% | 3.2% | 5.3% | 24.6 |
| Ft. Worth | 0.66 | 80.9% | 13.5% | 0.6% | 4.9% | 23.0 |
| San Antonio | 0.57 | 74.6% | 14.8% | 3.7% | 7.0% | 21.9 |
| Texas | 7.61 | 76.5% | 14.9% | 2.2% | 6.4% | 22.2 |

As at the national level, location of employment is also a factor in changes in commute trip length and travel time at the state level. For the period 1960 to 1980, the trend for three Texas cities is obvious (Rossetti and Eversole 1993). (See Table 6.)

**TABLE 6**
**Texas Journey to Work 1960 - 1980**

| City | Percent Living and Working in Different County | | | Percent by Private Owned Vehicle | | |
|---|---|---|---|---|---|---|
| | 1960 | 1970 | 1980 | 1960 | 1970 | 1980 |
| Dallas | 11.8% | 16.9% | 24.2% | 76.3% | 87.9% | 91.6% |
| Houston | 8.7% | 13.3% | 21.3% | 74.5% | 86.7% | 91.6% |
| San Antonio | 6.4% | 8.8% | 12.7% | 66.4% | 80.1% | 87.0% |
| Total | 9.7% | 14.3% | 21.4% | 73.9% | 86.2% | 91.0% |

Limited increases in commute time notwithstanding, of the seven Texas urban areas (Austin, Corpus Christi, Dallas, El Paso, Fort Worth, Houston, and San Antonio), all but Houston experienced an increase in congestion in 1994 (Schrank and Lomax 1997a). (See Table 7.)

**TABLE 7**
**Congestion Indices for Texas Urban Areas**

| Urban Area | Year | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1982 | 1986 | 1988 | 1990 | 1992 | 1993 | 1994 |
| Austin | 0.84 | 0.94 | 0.96 | 0.94 | 0.95 | 0.95 | 0.97 |
| Corpus Christi | 0.67 | 0.71 | 0.70 | 0.72 | 0.74 | 0.75 | 0.76 |
| Dallas | 0.84 | 1.04 | 1.02 | 1.05 | 1.07 | 1.07 | 1.09 |
| El Paso | 0.63 | 0.75 | 0.74 | 0.74 | 0.76 | 0.77 | 0.78 |
| Fort Worth | 0.76 | 0.87 | 0.87 | 0.90 | 0.94 | 0.95 | 0.97 |
| Houston | 1.17 | 1.21 | 1.15 | 1.12 | 1.12 | 1.13 | 1.12 |
| San Antonio | 0.77 | 0.88 | 0.86 | 0.88 | 0.90 | 0.91 | 0.92 |
| Texas | 0.81 | 0.91 | 0.90 | 0.91 | 0.93 | 0.93 | 0.94 |
| Region | 0.83 | 0.93 | 0.91 | 0.93 | 0.95 | 0.96 | 0.97 |
| Total | 0.86 | 0.95 | 0.99 | 1.01 | 1.03 | 1.04 | 1.05 |

For the Roadway Congestion Index (RCI) a value of 1.0 or greater implies systemic (i.e., areawide) congestion. The RCI is a measure of system design capacity and is based on a modified version of volume to capacity logic (an index based on daily vehicle miles traveled per lane-mile of roadway). Thus, areas with values of 1.0 or greater may experience periods of relatively uncongested traffic flow and areas with values of less than 1.0 may experience periodic localized congestion (Schrank and Lomax 1997b).

Full journey-to-work profiles are available for a few Texas areas (Table 8). These provide an initial set of parameters to assess area journey to work (Rossetti and Eversole 1993).

**TABLE 8**
**Comparison of Selected Texas Urban Areas**

| Parameter | Area | | |
|---|---|---|---|
| | D/FW | Houston | San Antonio |
| Area Population (million) | 3.9 | 3.7 | 1.3 |
| Central city population | 47.7% | 75.9% | 91.0% |
| Suburban population | 52.3% | 24.1% | 9.0% |
| Live in central city | 47.7% | 77.1% | 90.8% |
| Live & work in central city | 43.3% | 73.6% | 88.3% |
| Live in suburbs | 52.3% | 22.9% | 9.2% |
| Live in suburbs / work in central city | 14.1% | 9.2% | 2.6% |
| Live & work in suburbs | 33.6% | 12.5% | 5.1% |
| Trips within central city | 43.3% | 73.6% | 88.3% |
| Trips within suburbs | 33.6% | 12.5% | 5.1% |

Other profiles of Texas commute patterns are available. An evaluation of urban travel in Texas (Pearson et al. 1996) was based on five travel surveys (Amarillo, Brownsville, San Antonio, Sherman-Denison, and Tyler) conducted in 1990 and 1991. Average home based work (HBW) trip length (a fundamental parameter of commute pattern) was summarized. (See Table 9.) Note that average trip length in these analyses is based on highway network link distances and travel times rather than directly reported travel times.

An earlier summary of urban travel in Texas (Pearson 1993) was based on eight travel surveys (including the five discussed above) and included an assessment of changes in travel behavior over time (i.e., 1960 to 1990). The analysis was separated by area size (less than 200,000 population and 200,000 or greater population). The difference by area size in essential commute behavior parameters is summarized below. (See Table 10.)

**TABLE 9**
**HBW Average Trip Length for Selected Texas Urban Areas**
**(Travel Survey Data)**

| City | Average Work Trip Length | | | | | |
|---|---|---|---|---|---|---|
| | Automobile Driver | | | All Modes | | |
| | Minutes | Miles | Speed | Minutes | Miles | Speed |
| Amarillo | 9.3 | 5.4 | 34.6 | 9.4 | 5.5 | 34.8 |
| Brownsville | 6.4 | 3.9 | 36.7 | 6.2 | 3.8 | 36.3 |
| San Antonio | 16.3 | 8.6 | 31.8 | 11.9 | 6.0 | 31.6 |
| Sherman-Denison | 9.3 | 5.9 | 37.6 | 9.2 | 5.8 | 37.4 |
| Tyler | 7.0 | 4.5 | 38.3 | 7.0 | 4.4 | 38.1 |

**TABLE 10**
**Texas Work Trips per Household by Area Size**
**(Travel Survey Data)**

| 1990 Work Trip Type per HH | Area Size | | | |
|---|---|---|---|---|
| | Large ≥ 200,000 | | Small < 200,000 | |
| | Trips | Percent | Trips | Percent |
| Person Trips | 1.9 | 21.0% | 1.5 | 15.7% |
| Vehicle Trips | 1.6 | 25.0% | 1.4 | 20.0% |

The long-term trend in commute parameters is summarized below (Table 11), again based on the eight recent travel surveys and all available prior travel surveys (Pearson 1993).

**TABLE 11**
**Long-Term Trends in Texas Journey-to-Work Parameters**
**(Travel Survey Data)**

| Work Trip Parameter | Percent Change 1960 - 1990 | |
|---|---|---|
| | Large ≥ 200,000 | Small < 200,000 |
| Person Work Trips per Household | 6.1% | 5.9% |
| Vehicle Work Trips per Household | 18.1% | 24.1% |
| Person Work Trips per Person | 28.2% | 20.7% |
| Vehicle Work Trips per Person | 41.7% | 41.7% |

Finally, many of the original Texas travel studies are still available for examination, although the datasets themselves are not. The primary source for this information is the printed final report documenting the travel study. (Note that some of these are incorporated in the summaries described above. This discussion relates specifically to the individual reports.) While these historical reports, taken by themselves do not address commute trends directly, commute related parameters could be extracted from them. The proportion of all trips that are HBW is shown below (Table 12) for each study, along with the proportion of HBW trips that are external to the study area (meaning origin or destination is outside the designated study area). The former provides a rough measure of the relative importance of commuting in overall travel, while the latter is a surrogate for trip length. While the absolute value of the latter measure (external HBW trips) is sensitive to the definition of the study area, definitions of internal versus external still represent relative remoteness and distance, however subjective.

The overall (internal trips all purposes) automobile mode share and overall automobile occupancy is also shown. Automobile mode share and automobile occupancy are of interest because of what they say about the nature of travel behavior (including the commute trip), even though these measures are only available for all trip purposes. Taken as a group, these commute parameters (HBW percentage, external HBW percentage, all-purpose automobile mode share, and all-purpose automobile occupancy) provide some feel for the general direction commuting is taking in Texas over an extended period.

**TABLE 12**
**Summary of Texas Historical Travel Study Commute Data**

| Location | Year | HBW All Modes | External HBW | Automobile Mode All Purposes | Occupancy All Purposes |
|---|---|---|---|---|---|
| Dallas | 1950 | 31.8% | 9.6% | 84.0% | 1.35 |
| San Antonio | 1956 | 26.8% | 6.2% | 87.9% | 1.46 |
| Corpus Christi | 1961 | 20.5% | 15.4% | 95.9% | 1.50 |
| Austin | 1962 | 19.4% | 10.6% | 95.6% | 1.46 |
| Corpus Christi | 1963 | 19.9% | 11.6% | 95.0% | 1.50 |
| Jefferson-Orange | 1963 | 15.4% | 5.3% | 94.6% | 1.51 |
| Amarillo | 1964 | 15.5% | 5.8% | 98.4% | 1.54 |
| Dallas/Fort Worth | 1964 | 18.3% | 2.0% | 95.9% | 1.51 |
| Galveston County | 1964 | 13.9% | 10.9% | 94.5% | 1.61 |
| Houston-Harris Cty | 1964 | 16.5% | 42.9% | 93.4% | 1.50 |
| Laredo | 1964 | 15.4% | 9.8% | 86.4% | 1.60 |
| Lubbock | 1964 | 16.3% | 10.6% | 98.6% | 1.40 |
| San Angelo | 1964 | 16.2% | 10.4% | 97.5% | 1.45 |
| Tyler | 1964 | 15.7% | 28.7% | 97.8% | 1.50 |
| Waco | 1964 | 18.5% | 10.0% | 96.7% | 1.46 |
| Wichita Falls | 1964 | 14.9% | 11.0% | 98.3% | 1.56 |
| Abilene | 1965 | 14.6% | 8.5% | 98.4% | 1.43 |
| Harlingen-San Benito | 1965 | 16.7% | 18.5% | 93.0% | 1.47 |
| Midland-Odessa | 1965 | 15.5% | 12.2% | 93.6% | 1.20 |
| Sherman-Denison | 1968 | 16.7% | 28.0% | 98.5% | 1.37 |
| San Antonio | 1969 | 20.9% | 4.6% | 93.8% | 1.46 |
| Brownsville | 1970 | 16.2% | 9.7% | 93.3% | 1.55 |
| Victoria | 1970 | 15.9% | 18.2% | 96.3% | 1.56 |

**Aggregate Commute Trends**
Even at this preliminary stage (i.e., literature and data source identification), key parameters relating to commute trends through out the nation as well as in Texas can be summarized in the aggregate. In general, and without regard to specific period of time, commute trip length has increased, and the average speed of the commute trip has increased. The percentage of total trips that are work trips has decreased, and the average commute travel time is unchanged. These trends are true of the nation as a whole, as well as for Texas.

**A Note on Method**
A substantial part of the data for this study is previously analyzed and published studies. The extraction and synthesis of these data will be guided by the principles of research synthesis (sometimes called "meta-analysis" or the analysis of analyses), though the data used will not be strictly limited to summary statistics from previous studies. Meta-analysis refers to the statistical analysis of a collection of analytical results from individual studies for producing integrated findings that go beyond those of the original studies. (Cooper and Hedges 1994) This form of analysis is a significant improvement on the usual narrative discussion of disparate published reports (such as that typically contained in a review of the literature). (Wang and Bushman 1999)

**DATA SOURCES**
Researchers identified four primary data sources. These are the CTPP journey-to-work data, recent Texas travel surveys (for which machine readable data is available), formally compiled congestion indices, and historical Texas travel surveys (for which only the hardcopy published reports are available). Each is discussed separately below.

**CTPP Data**
The transportation portion of the Census is relatively new. The transportation related questions have been asked only on the past three Censuses (since 1970). The transportation related Census data is compiled into a separate database, the CTPP. This database provides respondent estimates of the journey-to-work pattern (zone to zone), travel time, and means of travel (mode), as well as other demographic and travel information. (See Robertson 1971, Shunk 1971, and Law 1975 on considerations relating to the use journey-to-work data for transportation planning.) Census journey-to-work data, however, are unique in several ways.

Many of the transportation related Census questions are open-ended and some respondent interpretation is required. Specifically, Census questions assume direct trips from the respondent's residence to the workplace and do not inquire about intermediate stops. In addition, respondents are asked about their travel behavior for "the past week," as opposed to a specific day. Additionally, most commuters round off their estimates of travel time. Therefore, data based on these estimates (e.g., trip length frequency distributions [TLFD]) show peaks at 15, 30, and 45 minutes. Furthermore, because of confidentiality requirements, Census data is reported in aggregated zones and not as single households. Finally, Census sampling is based on one in six households receiving the travel questions (the long form) so very few households can represent the travel time (to other zones) for the entire zone. The relatively aggregate Census journey-to-work data will be used to augment and verify patterns and trends indicated by the less aggregate travel survey data discussed next.

The CTPP is a set of special tabulations sponsored by the Department of Transportation in each state and designed to meet the data needs of transportation planners. The Statewide Element of the CTPP contains data for standard census geographic areas like states, counties, and MSAs, or some variant of the MSA, such as Consolidated MSA (CMSA) or Primary MSA (PMSA). (Note that "CBD" is not defined for MSA-level CTPP data. "Central city" refers to the primary city in the MSA and is defined by the legal city boundary.)

The CTPP contains Parts 1, 2, and 3 of the Urban Element for one or more CTPP regions. Part 1 contains data for housing units, households, persons, and workers located in or living in the region, tabulated for various types of geographic units. The different types of geography are called summary levels. The counts are based on the sample or long-form data from the 1990 census, and may therefore differ from the 100% 1990 census counts.

In Part 2 (tabulations by area of work), the CTPP provides data for workers who worked in the region. This means that residents of the region who worked outside it are excluded from Part 2. Conversely, non-region residents who worked inside the region are included in the Part 2 numbers. Since the universes for Part 1 and Part 2 are so different (residence-based versus workplace-based), for any geographic unit the part totals will not be equal.

Part 3 (tabulations of residence area by work area) includes workers who lived or worked in the region. The tables in Part 3, however, are restricted to workers who did not work at home. Therefore, any at-residence or at-work summaries calculated from the commuter flow data in Part 3 will not equal the all-worker counts in Part 1 (by place of residence) or Part 2 (by place of work).

**Travel Surveys**

Travel surveys are the informational basis for developing trip generation models and, in some instances, may be used to study and/or analyze travel patterns within an urban area. In the 1960s and early 1970s, surveyors conducted home interviews in randomly selected homes throughout an urban area. This method provided the most reliable and accurate information; but it required a great deal of time, manpower, and money. These first surveys were designed to gather information on the characteristics of the household and the number, purpose, and mode of travel for each trip made by persons five years and older in the household. The survey covered a 24-hour period, typically during the middle of the week. The information gathered from the surveys and from secondary sources (e.g., employment) was used to develop trip production models and trip attraction models. These models were used to predict future trip productions and attractions by assuming that trip-making characteristics remain stable over time with any increase/decrease in travel being caused by changes in either households and/or land use activities.

In Texas, the Dallas/Fort Worth and Houston areas were the first to update their regional travel surveys in the mid-1980s. The Dallas/Fort Worth survey was actually several distinct independent surveys. It included a household travel survey, a workplace survey (of both employees and individuals traveling to the workplace for reasons other than work), and a special generator survey. The Houston travel survey was primarily a household travel survey. In 1989, a travel survey was also conducted in Texarkana, Texas. These surveys and the experience gained in their implementation subsequently led to a consistent survey methodology for use in conducting similar travel surveys.

As a result of the Dallas/Fort Worth, Houston, and Texarkana surveys and the recognition that the basis for the travel demand models was questionable due to the age of much of the data, TxDOT funded and supervised extensive travel surveys. These travel surveys were conducted in several urban areas of different sizes throughout the state. The intent was to compile a comprehensive database on travel where travel demand models used for transportation planning could be updated using the latest techniques and data available. The San Antonio urban area was selected as the first site and subsequent surveys were conducted in Tyler, Amarillo, Brownsville, Sherman-Denison, and Beaumont-Port Arthur.

The travel surveys conducted in San Antonio became the preliminary design tool for the travel surveys that would follow. Using the information and knowledge gained in previous surveys, the San Antonio travel survey was structured to consist of five distinct travel surveys (household, workplace, special generator, external travel, and truck travel). This study will utilize the household surveys for San Antonio, Amarillo, and Brownsville as the basis for three case studies.

**Urban Congestion Indices**

There are a number of urban congestion indices, the foremost of which was developed by TTI (Schrank and Lomax 1997). Various congestion-related measures are available for the period 1982 - 1994 for 50 urban areas (seven in Texas). While this information does not directly address commute patterns, it does provide an overview of general trends in congestion. In addition to estimates of the actual delay experienced due to congestion, growth in congestion, speeds, and roadway capacity increases are available, as well as the congestion index itself.

This information is valuable to the analysis of commute patterns and trends in Texas in several ways. First, it provides measures of the impacts of congestion. Second, it provides those measures over time. Finally, it provides comparative measures over a wide range of geographic areas allowing Texas areas to be compared with the rest of the nation.

**Historical Travel Surveys**

Published reports of previous travel surveys and traffic studies are another potential data source. Direct access to the data from these studies is typically not available. Any analysis must rely on the published statistical summaries. This kind of secondary analysis is sometime called "meta-analysis" and has established precedent in various fields. Specific guidelines and procedures exist for the use of such secondary data and its analysis. In spite of the limitations, this is a potentially valuable data source because of its longitudinal nature. (These were discussed and summarized in some detail above, in the context of Texas commute trends. They are mentioned here in their capacity as a potential data source for subsequent analysis.)

# CHAPTER 3. COMMUTING PATTERNS IN TEXAS

This section presents two comparisons. First, aggregate commuting patterns in Texas are compared with national patterns. (See Ford and Lomax 1989.) Second, commuting patterns for 1980 are compared with those for 1990. In both comparisons, Texas patterns are separated by urban area size categories. Following these aggregate (i.e., national and statewide) comparisons, three Texas urban areas are examined in more detail.

Tables 13 and 14 document two dimensions of commute pattern changes at the national level. Table 13a shows nationwide MSA commute patterns for 1980 and 1990. There are two major divisions provided: workers living within an MSA and workers living outside an MSA. Workers living within an MSA are further divided into those working within their MSA of residence, those working in another MSA, and those working outside any MSA. Each segment is discussed separately.

Workers living in MSAs increased from 77% to 80% from 1980 to 1990. This modest increase is most likely due to the expansion of MSA boundaries. The commuting patterns of those working in their MSA of residence are virtually unchanged from 1980 to 1990. However, for those working outside their MSA of residence there was a significant increase (from 5% to 8%). This increase is reflected in all the commute pattern categories (commuting to a different MSA, to the central city, and to the suburbs). There was no change in the proportion of workers living in an MSA and working outside any MSA.

The number of workers living outside MSAs declined proportional to the increase in those living in an MSA. Similarly, those workers living outside an MSA and working outside any MSA declined proportional to the increase in those living in an MSA. There was no change in those commuting to central city or suburban locations within an MSA. Finally, note that total workers for 1980 is actually 96,672,203. The 88,382,539 shown in Table 13 is the number reporting their place of work. The increase in total workers from 1980 to 1990 is therefore 19%.

Table 14 presents similar information for Texas. However, only MSAs are represented. Again, two aspects are represented, central city versus suburb, and 1980 versus 1990. Focusing first on the central city versus suburb dimension, researchers found that in 1980 most workers living in MSAs in Texas lived and worked in the central city. By 1990, that has declined somewhat, however there has been a dramatic decrease in workers commuting outside their MSA. Given that this table is for workers living in MSAs only, the decrease in workers commuting outside their MSA implies a slowing of the more extreme forms of suburbanization (i.e., "ruralization"). (See Long and DeAre 1983 and 1988 on this.) This is contrary to national trends.

## TABLE 13
## National Commuting Patterns 1980 Versus 1990

| Commute Pattern | 1980 | | 1990 | |
|---|---|---|---|---|
| | Workers (000) | Pct | Workers (000) | Pct |
| **LIVING IN MSA** | 67,903 | 77% | 91,515 | 80% |
| **Working in MSA of residence** | 63,126 | 71% | 82,808 | 72% |
| Commuting to central city | 33,570 | 38% | 43,286 | 38% |
| Commuting to suburbs | 29,556 | 33% | 39,522 | 34% |
| **Working outside MSA of residence** | 4,777 | 5% | 8,707 | 8% |
| Commuting to different MSA | 3,673 | 4% | 7,415 | 6% |
| Commuting to central city | 1,644 | 2% | 3,185 | 3% |
| Commuting to suburbs | 2,029 | 2% | 4,230 | 4% |
| **Worked outside any MSA** | 1,104 | 1% | 1,292 | 1% |
| **LIVING OUTSIDE MSA** | 20,480 | 23% | 23,555 | 20% |
| **Worked in an MSA** | 1,991 | 2% | 2,895 | 3% |
| Commuting to central city | 860 | 1% | 1,390 | 1% |
| Commuting to suburbs | 1,131 | 1% | 1,505 | 1% |
| **Worked outside any MSA** | 18,489 | 21% | 20,661 | 18% |
| **TOTAL REPORTING PLACE OF WORK** | 88,383* | 100% | 115,070 | 100% |

* Note that 88,382,539 workers out of a total of 96,672,203 reported their place of work for 1980. The increase in total workers from 1980 to 1990 is therefore slightly over 19%.

**TABLE 14**
**Texas MSA Commuting Patterns 1980 Versus 1990**

| Commute Pattern | 1980 | | 1990 | |
|---|---|---|---|---|
| | Workers (000) | Pct | Workers (000) | Pct |
| **LIVING IN CENTRAL CITY** | 3,049 | 58% | 3,629 | 56% |
| Commuting within central city | 2,379 | 45% | 3,020 | 47% |
| Commuting to suburbs | 282 | 5% | 424 | 6% |
| Commuting outside MSA | 388 | 8% | 185 | 3% |
| **LIVING IN SUBURBS** | 2,182 | 42% | 2,800 | 44% |
| Commuting to central city | 910 | 17% | 1,263 | 20% |
| Commuting within suburbs | 977 | 19% | 1,284 | 20% |
| Commuting outside MSA | 295 | 6% | 253 | 4% |
| **TOTAL WORKERS LIVING IN AN MSA** | 5,231 | 100% | 6,429 | 100% |

Table 15 further refines our picture of Texas workers within MSAs, this time showing commute patterns by MSA size (small <200,000, medium 200,000 to 1,000,000, and large >1,000,000). In addition to the MSA size dimension, there is a 1980 versus 1990 dimension, highlighted by Table 16. As expected, for 1980 the pattern is similar to that of Table 14 except for the addition of MSA size. As shown in Table 15 (and confirmed by the analysis in Ford and Lomax 1989), small and medium sized MSAs have similar commute patterns for 1980 for central city commuting. Suburban commuting, however, increases with MSA size (16%, 20%, and 27% respectively). In addition, small MSAs have a greater proportion of workers commuting outside the MSA than medium or large MSAs (18% versus 13% and 12%).

While it is difficult to assign specific increments of these changes to specific causes, subsequent analysis showed that some of the observed shift from small MSAs to medium and large MSAs is attributable to differential growth (i.e., population growth and / or migration causing an MSA to move to another size category). Two Texas MSAs changed size categories between 1980 and 1990. Galveston moved from small to medium and Fort Worth moved from medium to large. Table 16 adjusts for these changes, i.e., the 1980 categories of MSA size are retained.

**TABLE 15**
**Texas MSA Commuting Patterns 1980 Versus 1990 by Area Size**

| Area | Commute Pattern | 1980 | | 1990 | |
|---|---|---|---|---|---|
| | | Workers (000) | Pct | Workers (000) | Pct |
| Small MSA | **Workers Living in MSA** | 802 | 100% | 445 | 100% |
| | Commuting to central city | 531 | 66% | 352 | 79% |
| | Commuting to suburbs | 125 | 16% | 62 | 14% |
| | Commuting outside MSA | 146 | 18% | 31 | 7% |
| Medium MSA | **Workers Living in MSA** | 1,092 | 100% | 1,274 | 100% |
| | Commuting to central city | 726 | 67% | 893 | 70% |
| | Commuting to suburbs | 221 | 20% | 310 | 24% |
| | Commuting outside MSA | 145 | 13% | 71 | 6% |
| Large MSA | **Workers Living in MSA** | 3,337 | 100% | 4,710 | 100% |
| | Commuting to central city | 2,030 | 61% | 3,037 | 65% |
| | Commuting to suburbs | 913 | 27% | 1,336 | 28% |
| | Commuting outside MSA | 394 | 12% | 336 | 7% |
| TOTAL MSA | **Workers Living in MSA** | 5,231 | 100% | 6,429 | 100% |
| | Commuting to central city | 3,287 | 63% | 4,282 | 66% |
| | Commuting to suburbs | 1,259 | 24% | 1,708 | 27% |
| | Commuting outside MSA | 685 | 13% | 438 | 7% |

Key: Small = less than 200,000 population
Medium = 200,000 to 1,000,000
Large = greater than 1,000,000

An initial aggregate comparison of 1980 with 1990 is provided in Table 16, adjusted for category shift. Incorporating adjustments for shifts in area size categories, the proportion of workers living in large MSAs is constant from 1980 to 1990 (64%). The proportion of workers living in medium size MSAs increased moderately from 1980 to 1990 (21% to 28%). There is a corresponding decline in workers living in small MSAs (15% to 8%). Table 16 also compares the distribution of workers between MSA size categories. This provides a backdrop for the changes and trends observed in Table 15. The dramatic drop in workers in small MSAs (802 to 546, a 32% decrease) from 1980 to 1990 is corrected of changes in size category and illustrated clearly in this table, along with the drop in the relative proportion of workers in small MSAs noted previously.

**TABLE 16**
**Workers Living in Texas MSAs 1980 Versus 1990 by Area Size**
**(Adjusted for Area Size Category Shift)**

| MSA | 1980 | | 1990 | | Change | |
|---|---|---|---|---|---|---|
| | Workers (000) | Pct | Workers (000) | Pct | Workers (000) | Pct |
| **Small** | 802 | 15% | 546 | 8% | -256 | -32% |
| **Medium** | 1,092 | 21% | 1,790 | 28% | 698 | 64% |
| **Large** | 3,337 | 64% | 4,093 | 64% | 756 | 23% |
| **TOTAL** | 5,231 | 100% | 6,429 | 100% | 1,198 | 23% |

Similarly, the changes in commute patterns between 1980 and 1990 summarized in Table 17 could be influenced by changes in the MSA boundaries. There were in fact several changes in Texas MSA boundaries between 1980 and 1990. Abilene, Dallas/Fort Worth, Texarkana, and Wichita Falls MSAs all lost rural counties between 1980 and 1990. In the Houston area, Brazoria became a separate MSA. The exact impact of these changes is impossible to determine, given the aggregate nature of the data (i.e., MSA level). However, the loss of outlying counties would inflate external commuting estimates, understating the extent of the dramatic decline observed in Texas for external commuting. The change relating to Brazoria would compensate for this somewhat. Thus, if anything, these changes in MSA geography understate the observed decline in external commuting.

Finally, the commute patterns shown in Table 17 themselves could be influenced by changes in central city boundaries (i.e., jurisdictional expansion) or the way decisions regarding city boundaries are made (i.e., annexation policy). Since central cities are defined by city jurisdictional boundaries (i.e., city limits), changes in these boundaries and/or the way boundary decisions are made could influence the definition of central city commuting versus suburban commuting and explain some of the predominance of central city commuting observed in Texas. Thus, while it is true that all central cities are defined by the same standards in the Census data and central city commuting in Texas is very different from the nation, it is also true that the physical commute as defined by criteria other than jurisdictional boundaries (e.g., traffic volume, delay, or trip length) may be less different.

The issue is not that these changes are greater in Texas than in the rest of the nation. This would be an inherently circular argument, since the conclusion drawn from these differences is that Texas is different from the rest of the nation. In addition, there is no evidence that Texas is unique in central city expansion. The physical area has changed in some Texas cities, as well as in other cities across the nation. Thus, the real issue is whether the inherent variability of Census geography invalidates any conclusions regarding central city commuting. Even though the differences in commute patterns and their change may be influenced by changes in central city jurisdictions, comparisons between Texas and the nation remain valid. However, as interesting and technically valid as these observations may be in the aggregate for state policy purposes (e.g., central city commuting in Texas versus the nation), decisions regarding individual MSAs should not be based on a single data source, especially one as aggregate as Census data. In fact, to try to infer the characteristics of individual MSAs from aggregate (i.e., state) statistics would be inappropriate and logically invalid (i.e., the ecological fallacy).

**TABLE 17**
**Summary of Texas and National Commuting Patterns**
**(Workers Living in an MSA 1980 and 1990)**

| Area | Year | Workers (000) | CC to CC | CC to Sub | CC to Out | Sub to CC | Sub to Sub | Sub to Out |
|---|---|---|---|---|---|---|---|---|
| **Texas** | 1980 | 5,231 | 2,379 | 282 | 388 | 910 | 977 | 295 |
| | | 100% | 45% | 5% | 8% | 17% | 19% | 6% |
| | 1990 | 6,429 | 3,020 | 424 | 185 | 1,263 | 1,284 | 253 |
| | | 100% | 47% | 6% | 3% | 20% | 20% | 4% |
| **National** | 1980 | 67,903 | 20,900 | 4,200 | 1,200 | 12,700 | 25,300 | 3,700 |
| | | 100% | 31% | 6% | 2% | 19% | 37% | 5% |
| | 1990 | 91,515 | 26,893 | 6,322 | 2,170 | 16,393 | 33,200 | 6,537 |
| | | 100% | 29% | 7% | 2% | 18% | 36% | 8% |

Key: CC = central city
Sub = suburb
Out = outside MSA of residence

Comparing 1980 commute patterns with 1990 using the more dissaggregate Table 15 shows the same pattern regarding suburban commuting increasing with MSA size for 1990 (14%, 24%, and 28% respectively) that appeared for 1980 (16%, 20%, and 27% respectively). Table 15 also shows a dramatic increase (66% to 79%) in central city commuting for small MSAs from 1980 to 1990, at the "expense" of work trips outside the MSA. There is a corresponding decline in outside commuting for small MSAs from 1980 to 1990 (18% to 7%). For medium-sized MSAs there is an increase in suburban commuting (from 20% to 24%). The relatively greater proportion of workers in small MSAs commuting outside the MSA which was observed for 1980 (18% versus 13% and 12%) is gone for 1990 (7% versus 6% and 7%). Finally, in the aggregate, across all sizes of MSA, external commuting declined from 1980 to 1990 (from 13% to 7%).

Table 17 summarizes the national and Texas commute patterns for workers living in an MSA revealed in Tables 13-16. The trends between 1980 and 1990 contained in Tables 13-16 are shown more clearly. The difference between Texas and national central city residence is more obvious in Table 17. This is reflected in the central city to central city commute statistics (45% and 47% for Texas versus 31% and 29% for the nation, for 1980 and 1990 respectively). This observation is confirmed by the relatively lower percentage of suburb based commuting in Texas (the suburb to suburb commute pattern, 19% and 20% for Texas versus 37% and 36% for the nation, for 1980 and 1990 respectively).

Texas commuting trends also differ from national trends in the decline of workers commuting outside of the MSA of residence (8% and 6% in 1980 for central city and suburban based outside commutes declining to 3% and 4% in 1990). Texas trends also differ when compared to no decline or an increase nationally (2% and 5% in 1980 for central city and suburban based outside commutes compared to 2% and 8% in 1990). While MSA boundaries can influence the interpretation of flows between broad sub-regional categories such as these, there appears to be a clear trend away from outward bound commuting in Texas. This trend is interesting given that in 1980 Texas had a higher percentage of workers making outward bound commutes than the nation as a whole (8% versus 2% for central city and 6% versus 5% for suburban based outside commutes).

Workers residing in an MSA in Texas exhibit the following trends:

- commuting outside the MSA of residence is declining for all sizes of MSA, in some cases dramatically;
- suburban commuting has increased with MSA size for 1980 and 1990;
- small MSAs lost workers during the 1980 to 1990 period; and
- medium and large MSAs gained workers between 1980 and 1990.

Compared with aggregate nationwide commuting trends for the same period, workers residing in an MSA in Texas differ as follows:

- central city commuting is more prevalent in Texas than in the nation as a whole;
- suburb to suburb commuting is less prevalent in Texas than nationwide; and
- there is a general decline in commuting outside the MSA in Texas, while there has been a moderate increase nationwide during the same period.

In interpreting these results, it is important to keep in mind the nature of aggregation and statistics. The unit of analysis here is the state as opposed to the MSA and inferences cannot be made from state level statistics to individual MSAs (the ecological fallacy). Also keep in mind the peculiar nature of Census geography, particularly the central city (defined by legal city limits and not the same as the CBD). As noted earlier, city limits are a function of annexation policy, which is in turn influenced by the availability of open real estate. Thus, while it is true that all central cities are defined by the same standards in the Census data and central city commuting in Texas at this level appears different from the nation, it is also true that the physical commute as defined by criteria other than jurisdictional boundaries (e.g., traffic volume, delay, or trip length) may be less different. In any case, to try to infer the characteristics of individual MSAs from aggregate (i.e., state) statistics would be inappropriate and logically invalid (i.e., the ecological fallacy). (Recent commute patterns for selected individual Texas MSAs are shown in the appendix.)

## OVERVIEW OF URBAN TRAVEL SURVEY METHODS

The 1990-1991 household surveys in San Antonio, Amarillo, and Brownsville all used the same methodology and the same survey instruments. The only differences were the sample sizes. The stratification regimes were the same. The actual number of households varied from 2,643 households surveyed in San Antonio to 1,411 in Brownsville. Amarillo was in between with 2,590 households surveyed. (Pearson and Dresser 1994:31)

The methodology used in the household surveys was the same for all three urban areas (Pearson and Dresser 1994:31). Households were randomly selected, contacted by telephone, and asked to participate in the survey. Participating households were assigned a travel day and mailed a packet of travel diaries for every household member over five years old. They were asked to record all their trips on the assigned day. The household was contacted after their travel day and the survey data retrieved by telephone interviewers. The diaries were returned for documentation. (See Parsons et al. 1991a, 1991b, 1991c).

Subsequent analysis of travel survey data can provide additional detail regarding essential commute pattern parameters, in particular trip chaining, sub-regional commute patterns (i.e., to and from CBD, suburbs, and beyond), and ultimately trip frequency distribution. (See Strathman and Dueker 1995 on trip chaining.)

Trip chaining refers to the linking of trips of various purposes. In the case of commuting this means stops along the way to work. The entire trip, from origin to destination regardless of mode changes or other diversions, is referred to as a linked trip. An unlinked trip is therefore the individual segments of the linked trip. Trip segments are typically used to describe and document mode changes, however, they can also be used to describe diversions for other purposes or a combination of purposes in a single trip. (Such multi purpose trips are typically labeled using the predominant purpose, meaning the destination purpose.) Trip chaining is a subtle reflection of a refinement of travel behavior that may indicate many things about the traveler. In the case of commute pattern analysis, increased trip chaining indicates a longer and more complex commute trip, whatever the behavioral or life style reasons behind the chaining.

Sub-regional commute patterns are more straight forward, but no less important as an indicator of commuting patterns. Sub-regional commute patterns group the study area into a few (in this case, three) concentric areas and summarize commuting trip flows in terms of these areas. In this way, an analysis of commute patterns at this level clearly reflects trends and changes in the regional pattern over time.

Finally, trip frequency distributions are a summary of the aggregate trip length. They are literally the frequency distribution of trip lengths (usually in miles, but also in minutes). TLFDs are usually used to validate travel demand models (i.e., as a reality check on the aggregate performance of the model when compared to empirical data). Here average trip length in time (minutes) and distance (miles) is used to summarize regional commute patterns (speed is also reported). All the TLFD parameters (i.e., time and distance) are available directly from the 1990 and 1991 travel survey data. They are estimated from earlier surveys that reported only average trip length time using a method that infers speed from travel model analyses and then calculates the distance based on an assumed TLFD.

## AMARILLO

### 1964 Travel Survey

The 1964 Amarillo origin-destination survey incorporated a 201-square mile study area. This area had a residential population of 156,356 persons, housed in 50,817 dwelling units and owning 64,524 automobiles (implying household size of 3.08 persons and automobile ownership of 1.27 vehicles per household). The study area was divided into 355 survey zones, aggregated into 63 districts.

The survey estimated 493,925 average weekday person trips, of which 98.4% were made by automobile. Automobile drivers accounted for 316,438 of these average weekday automobile trips (implying an automobile occupancy ratio of 1.54). Peak hour volume in the study area was 7.7% of the 24-hour volume and occurred from 4:00 to 5:00 p.m. The morning peak hour volume was 6.4% of the 24-hour volume and occurred from 7:00 to 8:00 a.m.

Between 7:00 a.m. and 6:00 p.m. 149,938 vehicles either entered or left the CBD. Of these 120,584 (80%) were automobiles and 29,354 (20%) were commercial vehicles. On an average weekday, the CBD was a destination for 37,041 vehicles, more than the next two largest traffic generators combined (two shopping centers). Of the 395,500 average weekday internal and external vehicle trips, 93% (365,913) had both trip ends within the study area.

Average weekday external trips (i.e., entering or leaving the study area) were 34,400. There are two external stations (US 87 and I-40 west) that accounted for almost half (43%) of all external trips. Of the external trips, 24,774 (72%) had either an origin or destination within the study area.

Home-based trips accounted for 75% of all internal person trips. Work trips accounted for 13% (66,132) of internal person trips and 24% (4,465) of the 18,425 external vehicle trips with destinations in the study area. Of the 30,433 internal automobile driver trips to the CBD, 40% (12,135) were for work.

**1990 Travel Survey**

In 1990, the population of the Amarillo study area (that is coincidental with the MSA) was estimated to be 187,547 persons, housed in 72,252 households. Based on the household survey, residents over five years old made 704,097 internal person trips on an average weekday (3.8 trips per person). Of these trips, 97% were made in a private automobile, either as a driver or as a passenger. There were 127,152 average daily person work trips (home based work), of which 98% were by private automobile (either as driver or passenger).

Average trip length for work trips for all modes was 9.42 minutes or 5.47 miles (implying an average speed of 34.8 MPH). For automobile drivers the work trip took 9.27 minutes or 5.35 miles (implying a speed of 34.6 MPH). Automobile passengers' work trips took an average of 11.94 minutes and covered 7.41 miles (implying 37.2 MPH).

Table 18 summarizes the comparison of the two Amarillo travel surveys. (See also Tables 21 and 22 that summarize the subsequent analysis discussed below.)

**TABLE 18**
**Amarillo Commute Pattern Summary**
**(Travel Survey Data 1964 Versus 1990)**

| Commute Parameter | 1964 | 1990 |
|---|---|---|
| Population | 156,356 | 187,547 |
| Dwelling Units | 50,817 | 72,252 |
| Household Size | 3.08 | 2.60 |
| Automobiles per Household | 1.27 | 1.80 |
| Automobiles per Person | 0.41 | 0.69 |
| Person Trips | 493,925 | 704,097 |
| Work Trips (HBW Person Trips) | 66,132 | 127,152 |
| Percent Work Trips | 13.4% | 18.1% |
| Automobile Occupancy (All Trips) | 1.54 | 1.35 |
| Automobile Occupancy (Work Trips) | NA | 1.07 |
| Work Trip Length (minutes) | 10.1 | 9.3 |
| Work Trip Length (miles) | 4.9 | 5.4 |
| Work Trip Speed (MPH) | 29.2 | 34.6 |

## BROWNSVILLE

### 1970 Travel Survey

The 1970 Brownsville origin-destination survey incorporated a 81-square mile study area. This area had a residential population of 65,018 persons, housed in 17,896 dwelling units and owning 16,810 automobiles (implying household size of 3.63 persons and automobile ownership of 0.94 vehicles per household). The study area was divided into 299 survey zones, aggregated into 51 districts.

The survey estimated 232,557 average weekday person trips, of which 93.3% were by automobile. Automobile drivers accounted for 139,636 of these average weekday automobile trips (implying an automobile occupancy ratio of 1.55). Peak hour volume in the study area was 8.3% of the 24-hour volume and occurred from 4:00 to 5:00 p.m. The morning peak hour volume was 5.6% of the 24-hour volume and occurred from 7:00 to 8:00 a.m.

Between 7:00 a.m. and 6:00 p.m. 72,786 vehicles either entered or left the CBD. Of these 58,229 (80%) were automobiles and 14,557 (20%) were commercial vehicles. On an average weekday the CBD was a destination for 35,498 vehicles, of which 30,433 (86%) were automobiles. Of the 30,433 internal automobile driver trips to the CBD, 40% (12,135) were for work.

Average weekday external vehicle trips (i.e., entering or leaving the study area) were 29,620. There were two external stations (border crossings) that accounted for 16,470 (56%) of all external trips.

(These 16,470 trips were up from 4,620 recorded at these two locations in 1953.) Of the external vehicle trips, 25,948 (88%) had either an origin or destination within the study area.

Home-based trips accounted for 40% of all internal person trips (232,557). Work trips accounted for 13% (30,529) of internal person trips and 24% (4,465) of the 18,425 external vehicle trips with destinations in the study area.

**1990 Travel Survey**
In 1990, the population of the Brownsville-Harlingen MSA was estimated to be 260,120. The study area identified for the travel survey is somewhat smaller than the MSA, with a population of 98,962 housed in approximately 26,519 households. Based on the household survey, residents over five years old made 292,996 internal person trips on an average weekday (3.0 trips per person). Of these trips, 92% were made in a private automobile, either as a driver or as a passenger. There were 44,633 average daily work trips (home based work), of which 96% were by private automobile.

Average trip length for work trips for all modes was 6.24 minutes or 3.77 miles (implying an average speed of 36.3 MPH). For automobile drivers the work trip took 6.38 minutes or 3.90 miles (implying a speed of 36.7 MPH). Automobile passengers' work trips took an average of 6.17 minutes and covered 3.60 miles (implying 35.0 MPH).

Table 19 summarizes the comparison of the two Brownsville travel surveys. (See also Tables 23 and 24 that summarize the subsequent analysis discussed below.)

**TABLE 19**
**Brownsville Commute Pattern Summary**
**(Travel Survey Data 1970 Versus 1991)**

| Commute Parameter | 1970 | 1991 |
|---|---|---|
| Population | 65,018 | 98,962 |
| Dwelling Units | 17,896 | 26,519 |
| Household Size | 3.63 | 3.73 |
| Automobiles per Household | 0.94 | 1.56 |
| Automobiles per Person | 0.26 | 0.42 |
| Person Trips | 232,557 | 292,996 |
| Work Trips (HBW Person Trips) | 30,529 | 44,633 |
| Percent Work Trips | 13.1% | 15.2% |
| Automobile Occupancy (All Trips) | 1.55 | 1.49 |
| Automobile Occupancy (Work Trips) | NA | 1.18 |
| Work Trip Length (minutes) | 6.5 | 6.4 |
| Work Trip Length (miles) | 3.5 | 3.9 |
| Work Trip Speed (MPH) | 32.4 | 36.7 |

## SAN ANTONIO

### 1969 Travel Survey

The 1969 San Antonio origin-destination survey incorporated all of Bexar County, a 1,247-square mile study area. This area had a residential population of 825,843 persons, housed in 255,276 dwelling units and owning 299,102 automobiles (implying household size of 3.24 persons and automobile ownership of 1.17 vehicles per household). The study area was divided into 2,539 survey zones, aggregated into 425 districts.

The survey estimated 2,280,492 average weekday person trips, of which 93.8% were made by automobile. Automobile drivers accounted for 1,465,605 of these average weekday automobile trips (implying an automobile occupancy ratio of 1.46).

Peak hour volume in the study area was 8.8% of the 24-hour volume and occurred from 7:00 to 8:00 a.m. The evening peak hour volume was 8.5% of the 24-hour volume and occurred from 4:00 to 5:00 p.m.

Between 7:00 a.m. and 6:00 p.m. 414,272 persons either entered or left the CBD. Of these, 79% were in automobiles. On an average weekday, the CBD was a destination for 50,725 vehicles. Of these CBD vehicle trips, 22,746 (45%) were for work.

Average weekday external trips (i.e., entering or leaving the study area) were 72,370. Of the external trips, 66,110 (91%) had either an origin or destination within the study area.

Home-based trips accounted for 80% of all internal person trips. Work trips accounted for 15% (348,603) of internal person trips and 24% (4,465) of the 18,425 external vehicle trips with destinations in the study area.

### 1990 Travel Survey

In 1990, the population of the San Antonio MSA was estimated to be 1,302,099. The study area identified for the travel survey was somewhat smaller with an estimated population of 1,185,394, housed in 409,606 households. Based on the household survey, residents over five years old made 3,802,409 internal person trips on an average weekday (3.2 trips per person). Of these trips, 88% were made in a private automobile, either as a driver or as a passenger. There were 787,401 average daily work trips (home based work), of which 93% were by private automobile.

Average trip length for work trips for all modes was 15.82 minutes or 8.34 miles (implying an average speed of 31.6 mph). For automobile drivers the work trip took 16.25 minutes or 8.62 miles (implying a speed of 31.8 mph). Automobile passengers' work trips took an average of 14.76 minutes and covered 7.58 miles (implying 30.8 mph).

Table 20 summarizes the comparison of the two San Antonio travel surveys. (See also Tables 25 and 26 that summarize the subsequent analysis discussed below.)

TABLE 20
**San Antonio Commute Pattern Summary**
**(Travel Survey Data 1969 Versus 1990)**

| Commute Parameter | 1969 | 1990 |
|---|---|---|
| Population | 825,843 | 1,185,394 |
| Dwelling Units | 255,276 | 409,606 |
| Household Size | 3.24 | 2.89 |
| Automobiles per Household | 1.17 | 1.63 |
| Automobiles per Person | 0.36 | 0.56 |
| Person Trips | 2,280,492 | 3,802,409 |
| Work Trips (HBW Person Trips) | 348,603 | 787,401 |
| Percent Work Trips | 15.3% | 20.7% |
| Automobile Occupancy (All Trips) | 1.46 | 1.36 |
| Automobile Occupancy (Work Trips) | NA | 1.10 |
| Work Trip Length (minutes) | 13.5 | 16.3 |
| Work Trip Length (miles) | 10.1 | 8.6 |
| Work Trip Speed (MPH) | 44.7 | 31.8 |

Note that in general the Census journey-to-work data finds slightly shorter commutes than the travel surveys. In addition, the 1969 implied speed for the work trip in the travel survey data for San Antonio seems high itself and should probably be used with caution.

**SUBSEQUENT ANALYSIS**

Subsequent analysis of both survey datasets provides additional commute pattern detail in the form of trip chaining and sub-regional commute patterns, in addition to average trip length for the earlier period (reported above). Trip chaining is reported in terms of the proportion of work trips (percentage) in each of four trip categories based on number of stops. Sub-regional commute patterns are reported in terms of percentage of work trips between area sub-regions.

The subsequent analysis of commute patterns for all three case studies shows a trend toward more complex work trips (i.e., more trip chaining). There are many interpretations of trip chaining and the resulting increase in the complexity of the commute trip (e.g., lifestyles that are more complex, the rise of single parent households, the increase in two worker households, etc.). Whichever interpretation is selected choose, an increase in work trip chaining clearly increases the trip length in time, and probably in distance (though not necessarily proportionately), with a resulting reduction in average speed for the work trip.

The subsequent analysis of commute patterns for all three case studies also shows a trend away from central city residence and work to residence and work in suburban and outlying areas. This is consistent with other data (both Texas and national, e.g., Pisarski 1987 and Garreau 1991) that indicates the U.S. population is becoming increasingly suburban (while at the same time becoming less rural). In one sense, this growth is transitional. As the areas outside MSAs (i.e., the more distant suburbs) grow, they become incorporated into the MSA, usually through the redefinition of the MSA. In another sense, the transition may be more permanent, in that the abandonment of the central city as a place of residence is unlikely to be reversed. Thus, the growth of workers residing outside an MSA may be interpreted as reflecting the high growth potential of the extra-MSA suburbs. The ultimate resolution of this area will be either incorporation into an expanded MSA (i.e., workers would then work in the central city of the MSA of residence), or become an outlying area to suburb commute as the central city jobs themselves move to the suburbs (if we are to believe Garreau).

**TABLE 21**
**Summary of Amarillo Work Trip Chaining**
**(Travel Survey Data)**

| Stops | 1964 | 1990 |
|---|---|---|
| 0 | 87% | 73% |
| 1 | 9% | 19% |
| 2 | 3% | 6% |
| 3+ | 1% | 2% |

**TABLE 22**
**Summary of Amarillo Work Trip Flows**
**(Travel Survey Data)**

| Sub-Region | 1964 | | 1990 | |
|---|---|---|---|---|
| | To | From | To | From |
| 1 (CBD) | NA | | 4% | 4% |
| 2 (Suburban) | | | 91% | 90% |
| 3 (Outlying) | | | 5% | 6% |

**TABLE 23**
**Summary of Brownsville Work Trip Chaining**
**(Travel Survey Data)**

| Stops | 1970 | 1991 |
|---|---|---|
| 0 | 86% | 74% |
| 1 | 10% | 19% |
| 2 | 3% | 5% |
| 3+ | 1% | 2% |

**TABLE 24**
**Summary of Brownsville Work Trip Flows**
**(Travel Survey Data)**

| Sub-Region | 1970 | | 1991 | |
|---|---|---|---|---|
| | To | From | To | From |
| 1 (CBD) | 20% | 21% | 8% | 9% |
| 2 (Suburban) | 68% | 67% | 65% | 63% |
| 3 (Outlying) | 12% | 12% | 27% | 28% |

**TABLE 25**
**Summary of San Antonio Work Trip Chaining**
**(Travel Survey Data)**

| Stops | 1969 | 1990 |
|---|---|---|
| 0 | 87% | 76% |
| 1 | 9% | 17% |
| 2 | 3% | 5% |
| 3+ | 1% | 2% |

**TABLE 26**
**Summary of San Antonio Work Trip Flows**
**(Travel Survey Data)**

| Sub-Region | 1969 | | 1990 | |
|---|---|---|---|---|
| | To | From | To | From |
| 1 (CBD) | 8% | 7% | 5% | 5% |
| 2 (Suburban) | 74% | 74% | 52% | 52% |
| 3 (Outlying) | 18% | 19% | 43% | 43% |

*San Antonio Detailed Trip Length Frequency Distribution Analysis*
The TLFD describes the percentage of trips that occur by time period in a given geographic study area. These distributions are extremely data intensive, typically requiring extensive and expensive origin-destination surveys. (Luszcz et al. 1992) TLFDs are a critical component in the trip distribution portion of the urban travel demand forecasting process. Census data based TLFDs for the journey to work (i.e., the commute trip) are available for San Antonio for both 1980 and 1990. The comparison of these distributions provides information not available from comparison of a single statistic (e.g., average trip length) (e.g., Pearson et al. 1974).

In the San Antonio case, the average trip lengths for journey-to-work trips in 1980 and 1990 were significantly different (15.6 minutes versus 16.8 minutes). An examination of the respective distribution of the TLFD confirms this change. The median trip lengths (the trip length with 50% higher and 50% lower) are also different (14.2 versus 15.6) reflecting differences between the distributions of trip lengths. With the two distributions plotted on the same scale (Figure 1) it is immediately obvious that the TLFD for 1980 is more peaked than the TLFD for 1990. The interpretation of this observation is that not only has the average work trip length increased in San Antonio between 1980 and 1990, but the relative frequency of trips around the peak has increased as well. In other words, whereas in 1980 the most frequent trip length was 10 minutes with longer trips occurring with decreasing frequency, in 1990 the most frequent trip length was 14 minutes. However, trips from 4 to 15 minutes occurred with virtually the same frequency (4.5 - 4.6).

Figure 1 can also be summarized numerically (see Table 27). Here we can clearly see the effect of the flattened distribution in 1990. The critical part of this curve is the peak that is the most frequent trip length. In addition to the peak, there are two inflection points. One occurs before the peak and represents the point of greatest increase in trip length. The other occurs after the peak and represents the point of most rapid decline in trip length.

The areas under the curve are also important. In 1980 trips equal to or less than the distance of the most frequently occurring trip length comprised almost 30% of all trips. In 1990 trips equal to or less than the distance of the most frequently occurring trip length comprised nearly one-half (42.9%) of all trips.

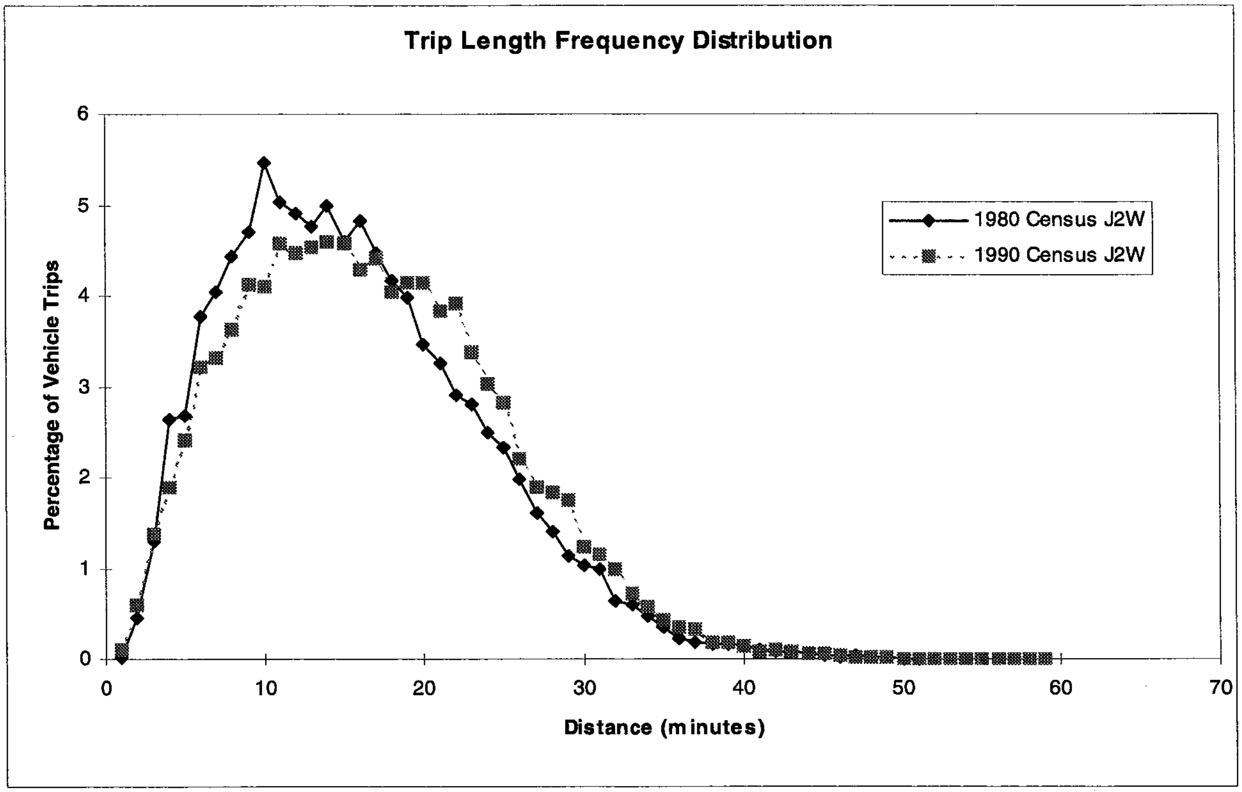


**FIGURE 1. Comparison of 1980 and 1990 Trip Length Frequency Distributions for San Antonio Vehicle Trips.**

**TABLE 27**
**Comparison of 1980 and 1990 Trip Length Frequency Distributions (San Antonio Vehicle Trips)**

| Year | Measurement | Flex 1 | Peak | Mean | Flex 2 | Max |
|---|---|---|---|---|---|---|
| 1980 | Trip Length (minutes) | 8 | 10 | 16 | 16 | 51 |
| | Frequency | 4.4% | 5.5% | 4.8% | 4.8% | 0.001% |
| | Cumulative Frequency | 19.3% | 29.5% | 58.6% | 58.6% | 100.0% |
| 1990 | Trip Length (minutes) | 6 | 14 | 17 | 22 | 59 |
| | Frequency | 3.2% | 4.6% | 4.4% | 3.9% | 0.001% |
| | Cumulative Frequency | 9.6% | 42.9% | 56.2% | 76.3% | 100.0% |

The interpretation of the changes in the shape of the San Antonio TLFD for work trips from 1980 to 1990 is analogous to the interpretation of the distribution of traffic volumes by time of day. The spreading of the peak and widening of the shoulders of the distribution is indicative of a more uniform commute in terms of the number of trips that are at or near the average trip length. It is also indicative of a longer commute as shown by the increase in the median value for 1990 trip lengths (15.6 minutes) as opposed to the median value for 1980 trips (14.2). The relative magnitude of the peaks (e.g., approximately 5.0% for the peak values) along with the shape of the distribution makes comparison of mean trip lengths a poor measure of change compared to the median. The increase in the maximum value between 1980 and 1990 (51 minutes versus 59 minutes) supports this interpretation. The San Antonio example illustrates how slight increases in average work trip length may be indicative of substantially more change than is implied by the magnitude of the change. It is reasonable to assume that a process similar to this is at work in other Texas urbanized areas experiencing even slight increases in average work trip travel time.

# CHAPTER 4. FACTORS IN COMMUTE PATTERN TRENDS

## NATIONAL TRENDS

Commuting during the period from the early 1950s to the early 1980s was characterized by dramatic increases in three factors directly related to commuting behavior and patterns. These are workers, suburban commuting, and private vehicle availability. These increases have been characterized as "booms" (Pisarski 1987) and are described in detail elsewhere in this report. These demographic and social trends have dominated commuting behavior since the 1950s. Taken together, the worker boom, suburban commuting boom, and automobile commuting boom have created an automobile dominated suburban oriented nationwide commute pattern. The mechanism (or at least the sequence of events) is one of population and worker pressure forcing the suburbanization of first the population, followed by employment. These changes in commuting patterns and flows reflect the suburbanization of workers and jobs. These trends have, of course, been influenced by other factors, including a generally strong and growing economy during critical portions of the period (e.g., post WWII).

These trends have changed somewhat in the past two decades (i.e., since 1980). The three booms (workers, suburban commuting, and private vehicles) have changed. Each is discussed separately. The increase in workers in the 1970s has been attributed to increases in jobs, increases in population (the baby boom), and increases in the number of women in the workforce. The baby boom is fully incorporated in the workforce. Similarly, women workers have been largely incorporated into the workforce (for purposes of analyzing commute patterns). Thus, the high growth rates characteristic of the 1970s and 1980s are over, though substantial growth in absolute numbers of workers will continue (Pisarski 1996).

During the 1980s, the increase in the number of single occupant vehicle commuters exceeded the increase in the number of commuters (Pisarski 1996). In other words, there was a mode share shift toward the single occupant automobile. Sometime during the 1980s however, the number of available vehicles exceeded the number of drivers. There appears to be virtual saturation of licensed drivers, with more than one vehicle per driver. It follows that the demand for single occupant commuting has also reached saturation. However, the factors that drove private automobile use to begin with are likely to continue (e.g., suburbanization of jobs, time sensitive life styles, and low vehicle operating cost). Thus, though the private vehicle boom is over, growth in single occupant commuting will continue, approximating the growth in the population of workers.

The growth in suburban commuting, itself a product of the previous two factors, has also changed. Suburban areas (the metropolitan areas outside of central cities) are the most frequent destination for work trips (Pisarski 1996). Suburban destinations for the work trip account for substantial portions of total journey-to-work travel. For example, the number of workers who work outside of their county of residence has almost tripled since 1960 (Pisarski 1996) and over 50% since 1980 (Census Bureau).

### Commute Patterns

Recent national trends in commute patterns (1980 to 1990) suggest a general decrease in the rate of growth from earlier periods of suburbanization, though growth in absolute numbers continues to be significant. (See Table 28.) As a matter of methodology, the proportion of a given commute pattern, minimizing the effect of changes in absolute numbers, is a good statistic for comparing aggregate flow patterns (e.g., national versus Texas). However, percent change from 1980 to 1990 for each type of flow pattern is a better measure of the comparison of trends in commuting patterns (e.g., national versus Texas).

Workers living in an MSA increased almost 35% (34.8%) from 1980 to 1990. Against this aggregate increase, between 1980 and 1990 three commute patterns increased greater than the population of workers. These are central city to suburb, central city to outside the MSA, and suburb to outside the MSA. The other three commute patterns (central city to central city, suburb to central city, and suburb to suburb) increased slightly less than the overall increase in workers between 1980 and 1990. (Recall that "central city" is defined by the legal city limits. Location within the central city is not specified.)

Regarding the increases that are greater than the increase in the general population of workers, there was a substantial increase (80.8%) from 1980 to 1990 in the numbers of workers commuting from the central city to outside the MSA (the so-called reverse commute). The other forms of reverse commute, suburb to outside the MSA and central city to suburb, also increased substantially (76.7% and 50.5%, respectively). In one case (suburb to outside the MSA), the increase was sufficient to also increase the proportion of this pattern from 1980 to 1990. Thus, nationally "reverse flow" commuting of every form grew from 1980 to 1990, reflecting the continued suburbanization of jobs and departure of residential population from the central city.

**TABLE 28**
**Summary of National Commuting Pattern Trends**
**(Workers Living in an MSA 1980 and 1990)**

| Year | Workers (000) | CC to CC | CC to Sub | CC to Out | Sub to CC | Sub to Sub | Sub to Out |
|---|---|---|---|---|---|---|---|
| 1980 | 67,903 | 20,900 | 4,200 | 1,200 | 12,700 | 25,300 | 3,700 |
| 1990 | 91,515 | 26,893 | 6,322 | 2,170 | 16,393 | 33,200 | 6,537 |
| Change | 34.8% | 28.7% | 50.5% | 80.8% | 29.1% | 31.2% | 76.7% |

Key: CC = central city
Sub = suburb
Out = outside MSA of residence

**Commute Length and Travel Time**

The changes in commute travel patterns summarized above are reflected in changes in the length of the commute. However, nationally the changes had relatively little impact. There were modest increases in travel distance and time for commuters. Several qualifications follow, however. First, trip length statistics are relatively poor representations of regional (e.g., small MSAs versus large MSAs) commute trips experience. Second, mode shifts to faster modes (e.g., carpool to SOV) mask increases in distance. Finally, residential location decisions (and to a lesser extent, employment location decisions) are influenced by a relatively stable "travel time budget" that causes locational decisions to compensate for slower commute speeds (e.g., due to congestion). (Pisarski 1996) Clearly the mode shift response is a one time tactic, whereas the residential / employment locational response is more or less ongoing.

This assessment is confirmed by the national aggregate statistics (Vincent et al. 1994) for work trip length and travel time from 1983 to 1990. As noted earlier, the average journey-to-work trip length across all modes increased from 1983 to 1990 by 26% (8.5 miles to 10.7 miles). During the same period, the average commute time increased only about 8% (18.2 minutes to 19.7 minutes), implying an increase in speed for the commute trip of over 18% (28.2 mph to 33.3 mph).

The national trend in commute patterns from 1980 to 1990 in general is improved commute times for commute trips going outside the MSA and originating outside the MSA. Commute times for commute trips originating in the central city and suburbs are getting longer. (See Table 29.)

**TABLE 29**
**Summary of National Commuting Travel Time (Minutes)**
**(1980 and 1990)**

| Year | From Central City | | | From Suburbs | | | From Outside MSA | | |
|---|---|---|---|---|---|---|---|---|---|
| | CC to CC | CC to Sub | CC to Out | Sub to CC | Sub to Sub | Sub to Out | Out to CC | Out to Sub | Out to Out |
| 1980 | 17.8 | 23.5 | 40.9 | 25.4 | 18.3 | 33.9 | 44.5 | 36.5 | 16.5 |
| 1990 | 19.1 | 24.8 | 37.9 | 29.0 | 20.8 | 31.8 | 40.7 | 35.8 | 16.5 |

Key: CC = central city
Sub = suburb
Out = outside MSA of residence

## TEXAS TRENDS

Texas has been subject to most of the same factors that have influenced the rest of the nation and significant changes have occurred in commuting patterns in Texas over the past several decades. Similar to national trends, the expansion and changing nature of the workforce has resulted in an increase in commute trips and vehicle ownership. The growth in suburban and exurban employment and residential development has further changed commuting patterns. In many urban areas, the traditional work trip from the suburbs to downtown has been replaced by suburb to suburb commutes. Many are choosing to live in smaller communities or rural areas and are driving longer distances to their places of employment. These trends, and the extent to which they continue, have major implications for traffic congestion, the environment, the quality of life, and transportation investments.

### Commute Patterns

Detailed Texas commute pattern data are available for 1980 and 1990. Throughout this period, suburban commuting as a proportion of the total commute pattern increases with MSA size. In addition, smaller MSAs have a greater proportion of workers commuting outside the MSA of residence than do medium or large MSAs. Both of these patterns are consistent for 1980 and 1990.

During this period, the number of workers in Texas living in an MSA increased by almost 23%. (See Table 30.) This growth was primarily in larger MSAs. The proportion of workers living in large MSAs increased from 64% to 73%. Commuting outside of the MSA declined across all MSAs and central city commuting in small MSAs increased dramatically. Internal commuting (i.e., central city to central city or suburb to suburb) increased slightly more than the worker population. However, central city to suburb and suburb to central city commuting increased substantially more than the general increase in workers (50.4% and 38.5% respectively). Finally, commuting outside the MSA of residence declined in general from 1980 to 1990. This decline was dramatic (-52.3%) in the case of central city to suburban commuting and less, though still substantial (-14.6%), in the case of suburb to outside the MSA flows.

Based on these data and related analysis researchers identified several trends in Texas commute patterns. (Note that these data apply to workers living in an MSA.) The Texas commute pattern trends are as follows:

- commuting outside the MSA of residence is declining for all sizes of MSAs, in some cases dramatically;
- suburban commuting has increased with MSA size for 1980 and 1990;
- small MSAs lost workers during the 1980 to 1990 period; and
- medium and large MSAs gained workers between 1980 and 1990.

Taken together, these trends indicate a pattern of vigorous suburbanization, but not outside the MSA. In fact, there appears to be a retreat from commuting activity outside the MSA.

**TABLE 30**
**Summary of Texas Commuting Pattern Trends**
**(Workers Living in an MSA 1980 and 1990)**

| Year | Workers (000) | CC to CC | CC to Sub | CC to Out | Sub to CC | Sub to Sub | Sub to Out |
|---|---|---|---|---|---|---|---|
| 1980 | 5,231 | 2,379 | 282 | 388 | 910 | 977 | 295 |
| 1990 | 6,413 | 3,012 | 424 | 185 | 1,260 | 1,281 | 252 |
| Change | 22.6% | 26.6% | 50.4% | -52.3% | 38.5% | 31.1% | -14.6% |

Key: CC = central city
Sub = suburb
Out = outside MSA of residence

## COMPARISON OF TEXAS AND NATIONAL COMMUTE TRENDS

Growth in workers living in an MSA between 1980 and 1990 is somewhat lower for Texas than for the nation (22.6% versus 34.8%). (See Table 31.) Texas commute trends for the period 1980 to 1990 are virtually identical with national trends for internal commuting (i.e., central city to central city and suburb to suburb) and central city to suburb commuting. Growth in the suburb to central city flow is somewhat greater for Texas than for the nation as a whole (38.5% versus 29.1%). The most striking difference between Texas commute patterns and those for the nation is in commuting to employment outside of the MSA of residence. Nationally, commuting to areas outside of the MSA from the central city and from the suburbs grew rapidly during the 1980 to 1990 period (80.8% and 76.7% respectively). During the same period for Texas, however, there was a decline in commuting outside the MSA, -52.3% in the case of the central city and -14.6% for the suburbs. Compared with aggregate nationwide commuting trends for the same period and distinguishing between relative proportion and growth, workers residing in an MSA in Texas differ as follows:

- central city commuting is more prevalent in Texas than in the nation as a whole;
- growth in central city commuting in Texas is slightly slower than nationally;

- suburb to suburb commuting is less prevalent in Texas than nationwide;
- growth in suburb to suburb commuting in Texas is the same as nationally; and
- commuting outside the MSA has grown rapidly nationally but has declined sharply in Texas.

These differences are summarized in the following table:

**TABLE 31**
**Comparison of Texas and National Commuting Patterns**

| Dimension | Area | Workers (000) | CC to CC | CC to Sub | CC to Out | Sub to CC | Sub to Sub | Sub to Out |
|---|---|---|---|---|---|---|---|---|
| Proportion 1990 | Texas | 100.0% | 47.0% | 6.0% | 3.0% | 20.0% | 20.0% | 4.0% |
| | US | 100.0% | 29.0% | 7.0% | 2.0% | 18.0% | 36.0% | 8.0% |
| Growth 1980-1990 | Texas | 22.6% | 26.6% | 50.4% | -52.3% | 38.5% | 31.1% | -14.6% |
| | US | 34.8% | 28.7% | 50.5% | 80.8% | 29.1% | 31.2% | 76.7% |

Key: CC = central city
Sub = suburb
Out = outside MSA of residence

## FACTORS INFLUENCING FUTURE COMMUTE PATTERNS

Until the period of the worker, suburban, and private vehicle "booms" documented by Pisarski, population growth was a reliable indicator of likely growth in travel and traffic. Once workers began to grow faster than the population (the baby boom and women entering the workforce), and automobile availability outpaced growth in workers, population growth ceased to be a reliable indicator. (Pisarski 1987 and Ford and Lomax 1989) With the saturation of these two factors, (workforce growth greater than population growth and automobile availability greater than one for every worker) population growth is becoming again a more reliable predictor of growth in travel. However, travel patterns are now more complicated. Consequently, while population growth may be restored as a credible predictor of increases in travel, it is not adequate by itself. Furthermore, with the loss of worker and automobile availability as important factors, the remaining factors (workers, household size, and household income) are even more important.

The linkage between household income and travel is well known and documented. Household income and travel are closely related. As income increases, travel increases. Both trips and miles of travel are positively associated with income. Person trips and person miles traveled (PMT) generally increase as household income increases. So does trip length. Vehicle trips and vehicle miles traveled (VMT) also increase as household income increases. This is true for all trip purposes in the aggregate, as well as for work related trips. While the cause of this relationship is beyond the scope of this research, household income reflects vehicle availability as well as some of the lifestyle sensitivities to travel time believed to be important in recent changes in commuting travel behavior. (Ross and Dunning 1997:20)

Individuals in lower income households are much less likely to have a vehicle than those in households with higher household income. This is often because a greater portion of household income is spent on food and shelter. In 1995, low-income households averaged less than one automobile per adult. (0.7). At the household level, low-income households averaged 1.16 vehicles per household, while other households averaged 1.89. About 26% of low-income households had no automobile at all (as opposed to about 4% of other households). When these lower income households do have an automobile, it is often older (almost 11 years versus 8 years) and less reliable. Despite having fewer vehicles available, individuals in lower income households still make most of their trips by private automobile. These vehicles are owned by someone else (e.g., friend, relative, etc.). (Murakami and Young 1997:6-7)

Aggregate annual travel (all purposes) for low income households in 1995 averaged 7,112 VMT and 1,012 trips versus 20,895 VMT and 2,321 trips for all households. Work related trips averaged 1,454 VMT and 165 trips for low income households versus 7,885 VMT and 633 trips for all households. (Murakami and Young 1997, Ross and Dunning 1997, and 1995 NPTS data) Low-income households also had shorter average trip lengths than those for all households (8.8 versus 12.5 miles for work and 7.0 versus 8.0 miles for all purposes).

## DEMOGRAPHIC TRENDS IN TEXAS

### Population

The Texas population has historically grown more rapidly than the rest of the nation. This growth was especially rapid during the 1970s and 1980s and into the 1990s when growth rates were nearly double those for the rest of the nation. Immigration from other states and immigration from other nations (primarily Mexico) has been an important element in recent growth. In addition to this rapid growth, the Texas population has been aging, becoming increasingly diverse ethnically, and increasingly diverse in household structure. (Murdock et al. 1995: 2-1 - 2-2)

Projections indicate that the Texas population will continue to grow and will be increasingly diverse. The projected growth will involve substantial levels of net immigration. This suggests, among other things, that the future growth of Texas is likely to be impacted by events outside the state. (Murdock 1995:2-6) Texas population growth will be increasingly dependent upon minority population with Hispanics playing a particularly important role in the growth of minority populations in Texas. (Murdock 1995: 2-7) Though they may vary between regions, these changes are expected to be pervasive across the entire state. (Murdock 1995: 2-22)

Currently, the Texas population is relatively young (median age of 30.8 in 1990) and is the third youngest population of any state (following Alaska and Utah). However, over the next 30 years the Texas population is expected to age substantially (projected median age of 37.9 in 2030). This aging is due to the impact of the aging of the baby boom generation (born 1946 - 1964) and is more pronounced in the latter part of the projection period than in the earlier part. (Murdock 1995: 2-9)

### Households

Texas households generally follow the same patterns as Texas population, but in recent decades (e.g., 1970 - 1990) Texas households have increased faster than the state's population. An important element in this rapid growth has been a shift toward smaller and more diverse household forms. For example, the average household size in Texas has decreased from 3.74 persons in 1940 to 2.73 in 1990 (Murdock 1995: 3-1). Among family households, single parent households have increased faster than married couple households and the proportion of all households involving a married couple has declined (Murdock 1995: 3-2).

Thus, Texas households in the early part of the next century will likely be characterized by faster growth than the general population of the state, increased diversity and increased aging. The role of immigration and immigration in the growth of households is expected to be significant. Texas households will become increasingly diverse in ethnic makeup. They will also become older. Texas households will become more diverse in form as well. Family households will increase more rapidly than non-family households (reversing the current trend). Households without children will grow most rapidly. (Murdock 1995: 3-22 - 3-23)

In short, the number of Texas households can be expected to increase substantially. They will become smaller and more diverse, more likely to be headed by a middle aged or older adult, and more likely to be composed of a married couple with no children. (Murdock 1995: 3-22)

**Workers**

As would be expected from other trends associated with the baby boom generation, the Texas labor force has historically (1970 - 1990) increased much faster than population. Texas workers are disproportionately employed in service industries and consequently have lower average wages than the rest of the nation. (Murdock 1995: 4-1)

The Texas labor force is projected to grow rapidly over the next several decades (i.e., to 2030). Labor force growth is expected to exceed population growth, though growth in the labor force will be more similar to growth in the general population than it was earlier (i.e., 1970 - 1990). Immigration and immigration are important factors in this growth, a substantial portion being dependent on actual migration rates. (Murdock 1995: 4-6) In addition, the labor force in Texas will age substantially over the projection period and the proportion of the labor force in older age groups will be less for most minority groups than for Anglos. (Murdock 1995: 4-8)

The implications of these changes in the labor force involve three parameters that are indicative of competitiveness and returns on labor. These are educational levels, occupational categories, and income. Education is directly related to the types of employment a person can obtain. Occupational category (i.e., the type of job) in turn has a direct impact on income. Income itself, of course, impacts commuting behavior through mode choice, automobile availability, automobile occupancy, etc. (Murdock 1995: 4-18)

One of the predominant dynamics involved in these projections is the differential growth in the various ethnic groups, combined with observed relationships between ethnicity and educational attainment. Current projections indicate a less well-educated labor force in Texas in the decades ahead (i.e., 2030). More importantly, this would occur at a time when most analyses indicate that greater levels of education will be needed. In other words, the changing composition of the Texas population may have a substantial impact on the types of jobs available to Texas workers (Murdock 1995: 4-22). The occupational structure could shift toward less skilled occupational groups. Leading to a labor force that is increasingly concentrated in lower status and lower paying occupations, with the concomitant decline in income. (Murdock 1995: 4-24) While these are complex behavioral and demographic parameters that are inherently difficult to predict with accuracy, these projections do provide a picture of how the state would look if certain trends and relationships continue into the future. (Murdock 1995: 4-19)

Thus, the future growth of the Texas workforce appears likely to lead to a workforce that is less well educated, more concentrated in lower status occupations, and earning lower salaries then the labor force of the state in 1990. (Murdock 1995: 4-25)

**Household Income**

Historically, the socioeconomic resources of Texas residents have been below those of the nation as a whole. Gains in the 1970s were lost to the economic problems in Texas in the 1980s. Overall, the socioeconomic resources of Texans have remained relatively stable, making only modest gains in recent decades. (Murdock 1995: 8-1 - 8-2)

There are several patterns in household income projections for Texas. There is a substantial income difference between races and ethnic groups. (Murdock 1995: 8-5) With the disproportionate increase in minority groups, the overall impact is to lower household income for Texas households. The composition of the population will result in less rapid increases in aggregate household income than in the number of households as a whole. Similarly, the projected population change is expected to lead to less than proportional growth in household expenditures. The average household in Texas will be poorer in 2030 than in 1990. (Murdock 1995: 8-6) In one moderate migration scenario, average household income is expected to decline from $35,667 in 1990 to $32,299 in 2030. (Murdock 1995: 8-9)

**Summary of Demographic Trends in Texas**

Projected demographic changes imply a reduction in the relative rate of growth in the labor force, lower educational attainment and skill level of the labor force, and reduced wage and salary levels. These trends imply a relative reduction in household income (i.e., less than proportional growth in household expenditures), and an absolute reduction in average household income. (Murdock 1995:9-3)

# CHAPTER 5. FUTURE SCENARIOS

Projected changes in the demography of Texas are expected to produce an increase in population, an increase in the number of workers, an increase in the number of households (along with reductions in household size), and reductions in household income. The linkages and interrelationships between these parameters are multiple and complex. While exploration of these linkages is beyond the scope of this study, it is important to separate those parameters that directly impact commuting behavior from those which are secondary or tertiary in their influence on commuting behavior.

Population composition and growth is the fundamental parameter, though by itself population does not necessarily impact commuting. Workers and households are another matter. The number and composition of the workforce has a direct impact on commuting, as does the number of households and their composition. (Household size is more of a corollary of number of households than a separate parameter.) The relationship between household income and travel behavior is well documented, as noted above, though its effect in the case of commuting is less than in travel in general. (Work trips are much less discretionary than other types of trips, though income is certainly a consideration in mode choice and distance, both of which are related to cost.)

Regarding commuting, these changes imply continued growth in the absolute number of workers in the labor force. They also imply a reduction in the relative rate of growth due to the aging of the population, as well as lower educational attainment and skill levels of the labor force. This is due to the existing relationships between low socioeconomic status and minority population status. As a result of these trends, a relative reduction in aggregate household income (i.e., less than proportional growth in household expenditures), an absolute reduction in average household income, and increased poverty levels are expected. (Murdock 1995:9-3)

Extrapolating expected changes in the critical commuting pattern factors identified above (i.e., workers, and household income) and applying these extrapolations to the Texas commuting trends previously identified (i.e., vigorous suburbanization, but not outside the MSA) produces a set of scenarios (one for each trend).

- Commuting outside the MSA of residence is declining for all sizes of MSA, in some cases dramatically.
- Suburban commuting has increased with MSA size for 1980 and 1990.
- Small MSAs lost workers during the 1980 to 1990 period.
- Medium and large MSAs gained workers between 1980 and 1990.

These trends are summarized in Table 32.

**TABLE 32**
**Summary of Commuting Pattern Futures**

| Trends (observed) | Commute Factors (projections) | | Combined Impact |
|---|---|---|---|
| | Workers (increase) | HH Income (decrease) | |
| Commuting outside MSA (decrease) | counter | enhance | mixed (1) |
| Commuting in suburbs (increase) | enhance | enhance | enhance / reinforce (2) |
| Workers in small MSAs (decrease) | counter | enhance | mixed (3) |
| Workers in large MSAs (increase) | enhance | enhance | enhance / reinforce (4) |

Notes:

1. Trend continues but rates of decrease slows and trend moves toward equilibrium/limit. Overall slowing of trend to limit of decrease.

2. Lower income jobs tend to warrant less commute. Growth in suburbs is concomitant with higher growth in larger areas. Overall enhancement of trend.

3. Absolute increase in workers partially offsets loss of workers trend. Pressure for better jobs drives workers toward larger MSAs. Trend toward larger MSAs may be offset by desire for lower cost of living, however, smaller household size minimizes cost of living differential. Overall slowing of trend to limit of decrease.

4. Increase in workers concentrated in larger MSAs. Pressure for better jobs attracts workers to larger MSAs. Overall enhancement and reinforcement of trend. Note that the changes in workers for the small and large MSAs should not be thought of as a shift between these two geographic categories, though some individuals may in fact be going from small to large MSAs. The data support no such conclusion and the two trends may actually be independent (e.g., reductions in workers in smaller MSAs due to the aging of the population and increases in workers in larger MSAs due to population growth).

While these trends are important, the complete picture of future commuting in Texas includes all the commute patterns (i.e., central city, suburb to central city, central city to suburb, central city to outside the MSA, and suburb to outside the MSA). Each is influenced by the trends and forecasts discussed above. Each is discussed separately below.

## CENTRAL CITY TO CENTRAL CITY

The central city to central city commute pattern has consistently been more important in Texas than in the rest of the nation. This situation is expected to continue between now and 2030. The proportion of commuters making this type of commute will increase slightly (from 47% in 1990 to 50% by 2030) with the actual number of commuters increasing slightly faster than the growth of the worker population in general. (See Table 33.) Thus, in Texas the central city to central city commute may be expected to remain the predominant commute pattern for the near future. This is contrary to the national trend.

**CENTRAL CITY TO SUBURB**

The central city to suburb commute pattern (the so-called reverse commute) is expected to continue to grow slightly as a proportion of all commute trips. (See Table 33.) This growth is expected to be greater than the growth in the worker population, but less than experienced between 1980 and 1990. (See Tables 34, 35, and 36.) Increases in reverse commuting can be seen as related to the relative dominance of central city to central city commuting discussed above.

**CENTRAL CITY TO OUTSIDE THE MSA**

Commuting from the central city to outside the MSA declined dramatically between 1980 and 1990. This decline is expected to continue, though at a much lower rate. Both the absolute number of commuters going from the central city to outside the MSA and the relative proportion of commuters making this type of commute will continue to decline (Table 33).

**SUBURB TO CENTRAL CITY**

The suburb to central city commute is the traditional commute pattern. Nationally this pattern has increased to dominate commuting. In Texas, however, suburb to central city commuting increased from 1980 to 1990 but was never the dominant commute pattern (Table 33). This increase is expected to cease and the relative proportion of commute trips that are suburb to central city is expected to remain constant after 1990. This is expected although the absolute numbers of trips is expected to increase approximately equal to (or slightly greater than) growth in the worker population (Tables 35 and 36).

**SUBURB TO SUBURB**

The suburb to suburb commute pattern has increased dramatically nationally. In Texas, suburb to suburb commuting has also increased, but less than national. Suburb to suburb commuting has never dominated Texas commuting, though it did increase between 1980 and 1990 as a proportion of all commute trips. This increase is expected to cease and the relative proportions of commute trips that are suburb to suburb are expected to remain constant after 1990. The absolute number of suburb to suburb commute trips is expected to grow approximately equal to the growth of the worker population (Tables 35 and 36).

**SUBURB TO OUTSIDE THE MSA**

Nationally, from 1980 to 1990, suburb to outside the MSA commuting increased dramatically. In Texas, during the same period, suburb to outside the MSA commuting declined in both absolute numbers and as a proportion of all commute trips (Table 33). This decline is expected to continue, though the rate of decline is expected to decrease. Absolute numbers of commuters making this type of commute will decline as well, regardless of worker population growth (Tables 35 and 36).

**SUMMARY**

Taken together these trends imply a future for commuting in Texas that is very different from the rest of the nation. This is not unexpected since Texas commuting has historically been unique and has not followed national trends for sometime. This is especially true regarding commuting within the central city and outside the MSA of residence. In addition, the proportion of suburb to suburb commuting in Texas is about half that of the rest of the nation. In fact, the only commute pattern where Texas is approximately the same as national patterns is between the suburbs and the central city.

These differences are expected to continue for the near future, though the extreme trends are expected to moderate somewhat. In the aggregate, Texas will continue to be characterized by a high proportion of central city to central city commuting and a very low proportion of commuting outside the MSA of residence.

Specific recommendations following from the unique commuting patterns and trends in Texas are provided in the following section, however, based on the preceding analysis and discussion, the researchers conclude that:

- commuting from outside the MSA, which is of such concern at the national level, is not a critical problem in Texas (isolated local situations notwithstanding);
- data relating to national trends are likely to be of only limited value in developing commuting policy and strategies in Texas; and
- commuting and congestion relief policies formulated at the national level are likely to be of limited application in Texas.

**TABLE 33**
**Summary of Texas Commuting Patterns**
**(Workers Living in an MSA)**
**(Migration = 50% 1980 - 1990)**

| Year | Workers (000) | CC to CC | CC to Sub | CC to Out | Sub to CC | Sub to Sub | Sub to Out |
|---|---|---|---|---|---|---|---|
| 1980 | 5,231 | 2,379 | 282 | 388 | 910 | 977 | 295 |
| | 100% | 45% | 5% | 8% | 17% | 19% | 6% |
| 1990 | 6,413 | 3,012 | 424 | 185 | 1,260 | 1,281 | 252 |
| | 100% | 47% | 6% | 3% | 20% | 20% | 4% |
| 2010 | 8,460 | 4,150 | 590 | 165 | 1,690 | 1,690 | 175 |
| | 100% | 49% | 7% | 2% | 20% | 20% | 2% |
| 2030 | 9,350 | 4,675 | 750 | 90 | 1,870 | 1,870 | 95 |
| | 100% | 50% | 8% | 1% | 20% | 20% | 1% |

Key: CC = central city
Sub = suburb
Out = outside MSA of residence

**TABLE 34**
**Summary of Texas Commuting Pattern Trends**
**(Workers Living in an MSA 1980 and 1990)**

| Year | Workers (000) | CC to CC | CC to Sub | CC to Out | Sub to CC | Sub to Sub | Sub to Out |
|---|---|---|---|---|---|---|---|
| 1980 | 5,231 | 2,379 | 282 | 388 | 910 | 977 | 295 |
| 1990 | 6,413 | 3,012 | 424 | 185 | 1,260 | 1,281 | 252 |
| Change | 22.6% | 26.6% | 50.4% | -52.3% | 38.5% | 31.1% | -14.6% |
| Net | 0.0% | 4.0% | 27.8% | -74.9% | 15.9% | 8.5% | -37.2% |

Key: CC = central city
Sub = suburb
Out = outside MSA of residence

**TABLE 35**
**Summary of Texas Commuting Pattern Trends**
**(Workers Living in an MSA 1990 and 2010)**

| Year | Workers (000) | CC to CC | CC to Sub | CC to Out | Sub to CC | Sub to Sub | Sub to Out |
|---|---|---|---|---|---|---|---|
| 1990 | 6,413 | 3,012 | 424 | 185 | 1,260 | 1,281 | 252 |
| 2010 | 8,460 | 4,150 | 590 | 165 | 1,690 | 1,690 | 175 |
| Change | 31.9% | 37.8% | 39.2% | -10.8% | 34.1% | 31.9% | -30.6% |
| Net | 0.0% | 5.9% | 7.2% | -42.7% | 2.2% | 0.0% | -62.5% |

Key: CC = central city
Sub = suburb
Out = outside MSA of residence

**TABLE 36**
**Summary of Texas Commuting Pattern Trends**
**(Workers Living in an MSA 2010 and 2030)**

| Year | Workers (000) | CC to CC | CC to Sub | CC to Out | Sub to CC | Sub to Sub | Sub to Out |
|---|---|---|---|---|---|---|---|
| 2010 | 8,460 | 4,150 | 590 | 165 | 1,690 | 1,690 | 175 |
| 2030 | 9,350 | 4,675 | 750 | 90 | 1,870 | 1,870 | 95 |
| Change | 10.5% | 12.7% | 27.1% | -45.5% | 10.7% | 10.7% | -45.7% |
| Net | 0.0% | 2.1% | 16.6% | -56.0% | 0.1% | 0.1% | -56.2% |

Key: CC = central city
Sub = suburb
Out = outside MSA of residence

# CHAPTER 6. RECOMMENDATIONS

The preceding analysis clearly demonstrates that Texas commuting patterns and trends do not mirror the rest of the nation. More specifically, Texas commute patterns and trends are unique compared to national patterns in that:

- the central city is currently a significant element in the commute patterns of Texas cities, and is likely to remain so for sometime;
- growth in commuting is most likely to be concentrated in and around existing central cities;
- congestion is most likely to occur along more or less traditional commuting patterns (i.e., within the central city and between the central city and the suburbs); and
- consequently, demand for improvements is likely to be greatest on central city links and central city to suburban links, contrary to national trends. Improvements contrary to this trend (i.e., development of external links to facilitate commuting outside the MSA of residence) would tend to encourage longer commutes and would have less impact on overall congestion.

In interpreting these results it is important to keep in mind the nature of Census geography, particularly the central city. Census geography is based on jurisdictional boundaries, the city limits in the case of the distinction between the central city and the suburbs. As noted earlier, city limits are a function of annexation policy, which is in turn influenced by the availability of open real estate. Thus, while it is true that all central cities are defined by the same standards in the Census data and central city commuting in Texas as defined by these criteria appears different from the nation, it is also true that the physical commute as defined by criteria other than jurisdictional boundaries (e.g., traffic volume, delay, or trip length) may be less different. However, to the extent that jurisdiction makes a difference in transportation decisions, the differences identified in this research are meaningful. (A simple example would be the relative ease of coordination of transportation planning and improvements contained in a single large jurisdiction compared to the same planning and improvements spread across several smaller jurisdictions. Regional allocation of planning and improvement funds is another example. Interpretation of federal policy relating to suburban growth and/or travel patterns would be yet another example.)

General recommendations regarding congestion relief strategies and roadway improvements to relieve congestion follow directly from these findings. The preceding analysis indicates that these broad recommendations, when applied to regional planning decisions, will help guide congestion relief and roadway improvement strategies and planning toward the most effective use of the limited resources devoted to these activities. The recommendations are:

- recognize that Texas commute patterns and trends are contrary to national commute patterns and trends;
- give links and corridors serving the central city priority in developing congestion relief strategies; and
- focus roadway improvements and capacity increases first on links and corridors serving the central city.

# REFERENCES

Cervero, Robert.
1988 *America's Suburban Centers: A Study of the Land Use - Transportation Link.* DOT-T-88-14. Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration.

Cervero, Robert.
1986 *Suburban Gridlock.* New Brunswick, NJ: Center for Urban Policy Research, Rutgers.

Cooper, Harris and Larry V. Hedges (editors).
1994 *The Handbook of Research Synthesis.* New York: Russell Sage Foundation.

Dresser, George B. and Mark Luszcz.
1994 *Comparison of Trip Length Frequency Distributions as Observed in the Household Surveys vs. Theoretical Estimates.* Technical Memorandum, Study 0-1235. College Station, TX: Texas Transportation Institute, The Texas A&M University System.

Ford, Patrice B. and Timothy J. Lomax.
1989a *An Analysis of Commuting Patterns in Texas Urban Areas - Volume 1.* Research Report 1193-1F. College Station, TX: Texas Transportation Institute, The Texas A&M University System.

Ford, Patrice B. and Timothy J. Lomax.
1989b *An Analysis of Commuting Patterns in Texas Urban Areas - Volume 2.* Research Report 1193-1F. College Station, TX: Texas Transportation Institute, The Texas A&M University System.

Garreau, Joel.
1991 *Edge City: Life on the New Frontier.* New York: Doubleday.

Gordon, Peter and Harry W. Richardson.
1994 "Geographic Factors Explaining Worktrip Length Changes." In Walcoff & Associates. *1990 Nationwide Personal Transportation Survey: Implications of Emerging Travel Trends.* Conference Proceedings (FHWA-PL-94-027). Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration.

Hu, Patricia S. and Jennifer Young.
1992 *1990 Nationwide Personal Transportation Survey: Summary of Travel Trends.* (FHWA-PL-92-027. Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration.

Hu, Patricia S. and Jennifer Young.
1993a *1990 Nationwide Personal Transportation Survey: 1990 NPTS Databook Volume I.* FHWA-PL-94-010A. Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration.

Hu, Patricia S. and Jennifer Young.
1993b *1990 Nationwide Personal Transportation Survey: 1990 NPTS Databook Volume II.* FHWA-PL-94–010B. Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration.

Hunt, Morton.
1997 *How Science Takes Stock - The Story of Meta-Analysis.* New York: Russell Sage Foundation.

Jou, Rong-Chang and Hani S. Mahmassani.
1994 *Comparability and Transferability of Commuter Behavior Characteristics Between Cities: Departure Time and Switching Decision.* Washington, D.C.: Transportation Research Board, 73rd Annual Meeting, January 1994.

Lattu, Lisa K.
1994 *Actual and Perceptual: A Comparison of Dallas - Fort Worth Travel Times.* 1994 Undergraduate Transportation Engineering Fellows Program. College Station, TX: Texas Transportation Institute, The Texas A&M University System.

Law, Wing-Kwong.
1975 *Comparative Travel Patterns From Four Work Trip Data Sources.* Joint Highway Research Project. Lafayette, IN: School of Civil Engineering. Purdue University.

Long, Larry and Diana DeAre.
1983 "The Slowing of Urbanization in the U.S." *Scientific American.* July 1983. (33-41)

Long, Larry and Diana DeAre.
1988 "US Population Redistribution: A Perspective on the Nonmetropolitan Turnaround." *Population and Development Review.* September 1988. (433-450)

Luszcz, Mark, David Pearson, and George B. Dresser.
1992 *Comparison of Trip Length Frequency Distributions as Observed in the Household Surveys vs. Theoretical Estimates.* Research Report 1235-TN. College Station, TX: Texas Transportation Institute, The Texas A&M University System.

Morrison, Peter A. and Allan Abrahamse.
1982 *Is Population Decentralization Lengthening Commuting Distances?.* Santa Monica, CA: The Rand Corporation (N-1934-NICHD).

Murakami, Elaine and Jennifer Young.
1997 *Daily Travel by Persons with Low Income.* NPTS Symposium, Bethesda, MD. October 29-31, 1997.

Murdock, Steve H., Nazrul Hoque, Martha Michael, Steve White, and Beverly Pecotte.
1995 *Texas Challenged: Implications of Population Change for Public Service Demand in Texas, Volume I, II, and III.* Report 95-3. College Station, TX: The Center for Demographic and Socioeconomic Research and Education, Department of Rural Sociology, Texas A&M University.

O'Hare, William and Milton Morris.
1985a *Demographic Change and Recent Worktrip Travel Trends Volume I.* UMTA-DC-09-7009. Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration.

O'Hare, William and Milton Morris.
1985b *Demographic Change and Recent Worktrip Travel Trends Volume II.* UMTA-DC-09-7009. Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration.

Parsons Brinckerhoff Quade & Douglas, Inc.
1991a *San Antonio - Bexar County Travel Study, Home Travel Survey Report.* San Antonio - Bexar County Metropolitan Planning Organization, February 1991.

Parsons Brinckerhoff Quade & Douglas, Inc.
1991b *Amarillo Area Travel Study, Home Travel Survey Report.* Amarillo Metropolitan Planning Organization, August 1991.

Parsons Brinckerhoff Quade & Douglas, Inc.
1991c *Brownsville Urban Area Travel Study, Home Travel Survey Report.* Brownsville Metropolitan Planning Organization, October 1991.

Pearson, David F.
1993 *Urban Travel in Texas - An Overview of Travel Surveys.* College Station, TX: Texas Transportation Institute, The Texas A&M University System.

Pearson, David F. and George B. Dresser.
1994 *Evaluation of Urban Travel Survey Methodologies.* Research Report 1235-10. College Station, TX: Texas Transportation Institute, The Texas A&M University System.

Pearson, David F., Arthur F. Gamble, and Mansour Salami.
1996 *Urban Travel in Texas: An Evaluation of Travel Surveys.* Research Report 1099-F. College Station, TX: Texas Transportation Institute. The Texas A&M University System.

Pearson, David F., Vergil G. Stover, and J. D. Benson.
1974 *A Procedure for Estimation of Trip Length Frequency Distributions.* Research Report 17-1. College Station, TX: Texas Transportation Institute, The Texas A&M University System.

Pisarski, Alan E.
1987 *Commuting in America: A National Report on Commuting Patterns and Trends.* Westport, CT: Eno Foundation for Transportation, Inc.

Pisarski, Alan E.
1992 *1990 Nationwide Personal Transportation Survey: Travel Behavior Issues in the 90's.* FHWA-PL-93-012. Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration.

Pisarski, Alan E.
1996 *Commuting in America II: The Second National Report on Commuting Patterns and Trends.* Lansdowne, VA: Eno Foundation for Transportation, Inc.

Robertson, Sydney R.
1971 "Journey-to-Work Statistics." In *Use of Census Data in Urban Transportation Planning.* Special Report 121 (39-42). Washington, D.C.: Highway Research Board.

Ross, Catherine L. and Anne E. Dunning.
1997 *Land Use Transportation Interaction: An Examination of the 1995 NPTS Data.* Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration.

Rossetti, Michael and Barbara S. Eversole.
1993 *Journey to Work Trends in the United States and Its Major Metropolitan Areas, 1960 - 1990.* FHWA-PL-94-012. Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration.

Schrank, David and Tim Lomax.
1997a *Roadway Urban Congestion - 1982 to 1994 Volume 1: Annual Report.* College Station, TX: Texas Transportation Institute, The Texas A&M University System.

Schrank, David and Tim Lomax.
1997b *Roadway Urban Congestion - 1982 to 1994 Volume 2: Methodology and Urbanized Area Data.* College Station, TX: Texas Transportation Institute, The Texas A&M University System.

Shunk, Gordon A.
1971 "An Approach Using Work-Trip Data." In *Use of Census Data in Urban Transportation Planning.* Special Report 121 (68-71). Washington, D.C.: Highway Research Board.

Strathman, James G. and Kenneth J. Dueker.
1995 "Understanding Trip Chaining." *1990 Nationwide Personal Transportation Survey: Special Reports on Trip and Vehicle Attributes.* 1990 NPTS Report Series (FHWA-PL-95-033). Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration.

Taaffe, Edward J., Howard L. Gauthier, and Morton E. O'Kelly.
1996 *Geography of Transportation.* Second edition. Upper Saddle River, NJ: Prentice Hall.

Texas Highway Department.
1964 *Amarillo Urban Transportation Plan, 1964 Origin - Destination Survey, Volume 1.* Austin, TX: Texas Highway Department.

Texas Highway Department.
1969 *San Antonio - Bexar County Urban Transportation Study, Report No. 6A, Origin - Destination Survey.* Austin, TX: Texas Highway Department.

Texas Highway Department.
1970 *Brownsville Urban Transportation Study, 1970 Origin - Destination Survey, Volume 1.* Austin, TX: Texas Highway Department.

Vincent, Mary Jayne, Mary Ann Keyes, and Marshall Reed.
1994 *1990 Nationwide Personal Transportation Survey: Urban Travel Patterns.* FHWA-PL-94-018. Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration.

Wang, Morgan C. and Brad J. Bushman.
1999 *Integrating Results Through Meta-Analytic Review Using SAS Software.* Cary, NC. The SAS Institute.

# APPENDIX A

**TABLE A-1**
**Texas MSA Commuting Patterns for 1990**
**(US Census Data C90STF3 and C90STF3C1)**

| Commute Pattern | Workers (000) | Pct |
|---|---|---|
| **LIVING IN CENTRAL CITY** | 3,629 | 56.4% |
| Commuting within central city | 3,020 | 47.0% |
| Commuting to suburbs | 424 | 5.6% |
| Commuting outside MSA | 185 | 2.9% |
| **LIVING IN SUBURBS** | 2,800 | 43.6% |
| Commuting to central city | 1,263 | 19.6% |
| Commuting within suburbs | 1,284 | 20.0% |
| Commuting outside MSA | 253 | 3.9% |
| **TOTAL WORKERS LIVING IN AN MSA** | 6,429 | 100.0% |

**TABLE A-2**
**Texas MSA Commuting Patterns for 1990**
**Austin MSA**
**(US Census Data C90STF3 and C90STF3C1)**

| Commute Pattern | Workers | Pct |
|---|---|---|
| **LIVING IN CENTRAL CITY** | 244,258 | 60.5% |
| Commuting within central city | 224,148 | 55.5% |
| Commuting to suburbs | 15,422 | 3.8% |
| Commuting outside MSA | 4,688 | 1.2% |
| **LIVING IN SUBURBS** | 159,758 | 39.5% |
| Commuting to central city | 90,946 | 22.5% |
| Commuting within suburbs | 60,283 | 14.9% |
| Commuting outside MSA | 8,529 | 2.1% |
| **TOTAL WORKERS LIVING IN MSA** | 404,016 | 100.0% |

**TABLE A-3**
**Texas MSA Commuting Patterns for 1990**
**Dallas/Fort Worth CMSA**
**(US Census Data C90STF3 and C90STF3C1)**

| Commute Pattern | Workers | Pct |
|---|---|---|
| **LIVING IN CENTRAL CITY** | 705,412 | 35.7% |
| Commuting within central city | 539,596 | 27.3% |
| Commuting to suburbs | 125,897 | 6.4% |
| Commuting outside MSA | 39,919 | 2.0% |
| **LIVING IN SUBURBS** | 1,271,194 | 64.3% |
| Commuting to central city | 576,335 | 29.2% |
| Commuting within suburbs | 528,286 | 26.7% |
| Commuting outside MSA | 166,573 | 8.4% |
| **TOTAL WORKERS LIVING IN CMSA** | 1,976,606 | 100.0% |

**TABLE A-4**
**Texas MSA Commuting Patterns for 1990**
**Houston - Galveston - Brazoria CMSA**
**(US Census Data C90STF3 and C90STF3C1)**

| Commute Pattern | Workers | Pct |
|---|---|---|
| **LIVING IN CENTRAL CITY** | 799,596 | 45.4% |
| Commuting within central city | 692,058 | 39.3% |
| Commuting to suburbs | 90,125 | 5.1% |
| Commuting outside MSA | 17,413 | 1.0% |
| **LIVING IN SUBURBS** | 960,200 | 54.6% |
| Commuting to central city | 459,136 | 26.1% |
| Commuting within suburbs | 418,042 | 23.8% |
| Commuting outside MSA | 83,022 | 4.7% |
| **TOTAL WORKERS LIVING IN CMSA** | 1,759,796 | 100.0% |

**TABLE A-5**
**Texas MSA Commuting Patterns for 1990**
**San Antonio MSA**
**(US Census Data C90STF3 and C90STF3C1)**

| Commute Pattern | Workers | Pct |
|---|---|---|
| **LIVING IN CENTRAL CITY** | 395,551 | 69.5% |
| Commuting within central city | 358,865 | 63.1% |
| Commuting to suburbs | 29,228 | 5.1% |
| Commuting outside MSA | 7,458 | 1.3% |
| **LIVING IN SUBURBS** | 173,598 | 30.5% |
| Commuting to central city | 96,402 | 16.9% |
| Commuting within suburbs | 68,664 | 12.1% |
| Commuting outside MSA | 8,532 | 1.5% |
| **TOTAL WORKERS LIVING IN MSA** | 569,149 | 100.0% |