

Using 1990 Census Data in National Policy Analysis

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Decennial census data on the journey to work from 1960 onward have been of critical importance in transportation planning at all levels of government. Census data on mobility and the journey to work are used in transportation planning, development and project impact analyses, and in supporting policy decisions at the federal, state, regional, and local/site level. The focus of this paper is on the use at the federal level, specifically, use by the U.S. Department of Transportation (USDOT) in developing, monitoring, and assessing transportation policies and service delivery programs, and on use by other federal agencies for a wide range of applications.

The paper begins with a short description of census products available for transportation policy at the federal level, summarizes the broad dimensions of federal use of decennial census data for policy assessment and development, and concludes with a summary of census data at the national level.

CENSUS PRODUCTS USED IN TRANSPORTATION PLANNING

Census Transportation Planning Package

USDOT has sponsored the preparation of special journey-to-work tabulations from the decennial census in 1970, 1980, and 1990. Of the more than 70 similar efforts conducted by the Census Bureau across a wide variety of program and topic areas, the Census Transportation Planning Package (CTPP) is the largest project. Through the American Association of State Highway and Transportation Officials, states and metropolitan planning organizations (MPOs) coordinated their needs to sponsor this special tabulation, resulting in the \$2 million budget for the Census Bureau to prepare the tabulations. Even more will be spent in analyzing the data. This sponsorship reflects the level of demand for transportation and mobility data and the reliance on the census to provide this information.

Summary Tape Files 1 and 3

Summary Tape Files 1 and 3, which are standard data files reporting information for residence geography, are widely used. The Census Bureau, through the state data center program, was able to deliver tape copies and CD-ROMs relatively quickly to many levels of government

analysts. The STF3 files, which include data from the "long" (sample) form, include tables on household vehicle availability, journey-to-work mode, trip length in minutes and departure time, and household income and housing unit tenure characteristics. Whereas tables in STF3 do not have the detailed cross-tabulations available in CTPP, the early release of these data gives analysts an early reading of what the detailed tables are likely to exhibit.

TIGER Files

Topologically Integrated Geographic Encoding and Referencing (TIGER) files are the geographic reference files, built in conjunction with the USGS. The TIGER files form a national coverage of roads, waterways, and political boundaries. Whereas their primary purpose was to assist the Census Bureau in collecting the census data, there have been many uses in the rapidly developing geographic information systems for transportation arena. These files, along with additional materials on employer addresses, were used in the workplace address coding portion of the CTPP.

Public Use Microdata Sample Files

The Public Use Microdata Sample (PUMS) files provide a sample of individual responses from the census questionnaire. Instead of tables where answers are grouped into ranges, the PUMS files have individual answers, such as the travel time to work in minutes or household income. To avoid disclosing information that can be traced to a specific person, the geographic detail is limited to large geographic areas called PUMAs, which have a minimum population of 100,000. These sample files are also available from the Census Bureau on CD-ROM, which much improves their use and access from the 1980 census.

FEDERAL USE OF CENSUS DATA

Decennial census data are used by USDOT in four general ways:

1. As a comprehensive demographic and mobility data base supporting development of new policies and programs,
2. As a statistical basis for setting program requirements and funding apportionment,
3. As a resource of "benchmark" data with which to evaluate the impacts and effectiveness of federal programs, and
4. As a travel behavior data base to support model development.

The journey-to-work data are used as an information resource by other federal agencies. In particular, employment location analyses are used by the Department of Labor and the Department of Justice.

Policy and Program Development

Census data constitute the primary data resource for establishing a profile of key population demographic and employment patterns as well as definable market segments. The profile provides a context and framework for identifying performance indicators with which to assess community livability and societal quality-of-life attributes and formulate effective policy actions.

Journey-to-work data assist in federal-level transportation policy and program development because they are consistent both longitudinally and cross-sectionally. That is, using standard census geography and geographic definitions and having the ability to report data for small

geographic units allows the results to be compared over time. In addition, since all the data are collected in a consistent manner and at the same point in time, comparisons between areas can be made easily.

Although the trip to work (and the "usual" one at that) is only one part of everyday travel, the sample size of the census and the ability to compare socioeconomic characteristics of persons and households with this one trip provide a benchmark. Many large and medium-sized MPOs collect household travel survey data to get information on all trips, but there is no standard method or sampling design to permit results to be easily compared. These regional data collection efforts are conducted infrequently, and the time between data collection points may range from 7 to 15 years. Thus, the likelihood of all or even many metropolitan areas conducting a survey within the same time period is almost zero, and census data provide the only nationally consistent source for these areas.

The Nationwide Personal Transportation Study (NPTS) includes reporting for all trips. However, the small sample size ($n = 20,000$ households) prohibits its use for specific geographic areas and allows only comparisons such as by metropolitan area size or by census geographic region.

The CTPP is the only decennial census product that includes two geographies: residence and workplace. Whereas there may be other resources available to identify worker populations, these resources do not include characteristics of persons or households. Only census data allow analyses at the workplace location that include such variables as gender, industry, occupation, earnings, and hours worked, in addition to the journey-to-work mode and travel time variables.

Metropolitan Development and Access to Jobs

A current policy area being emphasized at the federal level is the relationship between emerging metropolitan development patterns and the social, economic, and intellectual well-being of the various population segments, including the inner-city poor. Census data provide both evidence and statistics on the sizable and growing employment base in suburban areas. The data can be further used to indicate the level of highway and transit access provided to these suburban centers from other suburbs and the central city. CTPP journey-to-work data have small-area data at both the place of residence and the place of work, as well as detailed information on commuter travel between the two.

There has been continuing debate on whether high unemployment rates among urban poor are due to a "spatial mismatch" between workers and jobs. Census data permit analysis of some of these characteristics with varying degrees of geographic detail. One study by Johnston-Anumonwo (1) analyzed PUMS data from the 1980 and 1990 censuses. She found that in Buffalo, New York, black women in service occupations had an average travel time to work of 20 min, compared with 15 min for white women. The difference was even more pronounced for women who commute to jobs outside the central city. Her study found little difference in travel time between black and white men, controlling for occupation, work location in or outside the central city, and income.

Both PUMS and CTPP provide detailed data on personal characteristics, such as race, Hispanic origin, gender, and occupation; household characteristics, such as household income; and travel characteristics to work that can be used to explore these issues and to measure trends over time. These analyses are possible for large geographic areas, such as counties, as well as small transportation analysis zones (TAZs) in metropolitan areas.

National Highway System and National Transportation System

At the federal level, TIGER files have been used to prepare nationwide geographic files to include state, county, place, and urbanized area boundaries, in addition to the very detailed census geography such as tracts and blocks. The boundaries have been incorporated into technical work for the National Highway System (NHS) and will likely be used in the development of the multimodal National Transportation System.

To some extent, the TIGER line files were used for mapping and analysis of candidate routes by states and local governments in developing NHS recommendations for submittal to the

Federal Highway Administration (FHWA). In turn, use of geographic information system-based mapping and analysis methods will enable FHWA to develop important accessibility and service measures to use in the upcoming congressional review and approval period.

Program Requirements and Fund Apportionment

As set forth in the Intermodal Surface Transportation Efficiency Act (ISTEA), USDOT uses population counts and basic socioeconomic data from the decennial census to support apportionment of funding for several grant programs among states. These include population counts for allocating funding from the Surface Transportation Program of ISTEA and urban planning grants under the Federal Transit Act Amendments of 1991.

Under the State Planning and Research Program, 50 percent of the program funds is made available to the Transit Cooperative Research Program. The remainder is apportioned to the states for grants and contracts consistent with the purposes of Sections 6, 8, 10, 11, and 20 of the act. Amounts are apportioned to the states in the ratio that the population in urbanized areas in each state bears to the total population in urbanized areas in all the states, as shown by the latest available decennial census, except that no state shall receive less than $\frac{1}{2}$ of 1 percent of the amount apportioned.

In addition, census data are used as the basis for apportioning funds for the Airport Improvement Program, State Highway Safety Grants, Alcohol Program Incentive Grants, and the Congestion Mitigation and Air Quality Improvement grant program.

ISTEA recognizes the special challenges faced by large metropolitan areas in meeting the mobility needs of their population while improving environmental quality. The act established the concept of transportation management areas (TMAs), which are metropolitan areas having a population of 200,000 or more. Special program and funding provisions are contained in the law for TMAs, and the decennial census is the recognized source of this population information.

Nationally, the definition of metropolitan statistical areas is based, in part, on commuting patterns at the county level. Furthermore, urbanized area boundaries are used by FHWA and the Federal Transit Administration to allocate Surface Transportation Program and planning funds. MPOs are designated in urbanized areas of more than 50,000 population. By definition, the boundaries of the metropolitan area must include at least the existing urbanized areas and the contiguous area expected to become urbanized within the 20-year forecast period, and they may encompass the entire metropolitan statistical area or consolidated metropolitan statistical area.

Program Evaluation

Modal administrations of the USDOT use the household demographics and journey-to-work data from the decennial census to assess the impact of previously implemented policies. This is an important step in the refinement of policies or the development of new policies.

In addition, USDOT works in partnership with states and local governments to assess project/corridor-level effects of implemented plans, programs, and specific projects. In supporting ISTEA and the Clean Air Act Amendments of 1990 (CAAA), as well as other federal legislation such as the National Environmental Protection Act (NEPA), Title VI of the Civil Rights Act of 1964, the Uniform Relocation Assistance Act, and the Highway Safety Act, decennial census data facilitate a consistent level of responsible federal oversight and review of state and local plans and programs.

Furthermore, a consistent, reliable decennial census permits establishment and use of secondary sources for demographic and travel trends during the intercensal period. Maintaining the 10-year census survey cycle, however, is critical to providing periodic benchmarks of these indicators.

Information from the decennial census is used to evaluate the use, performance, and effects of implementation of the transportation program. Perhaps the most notable example is the

environmental review process required under NEPA. Small-area demographic data are required to assess the potential effects of projects yet to be implemented. Detailed information is required on the age, race, and income characteristics of individuals likely to be affected, either directly or indirectly, by program initiatives. Both residential- and nonresidential-based information are obtained from census data to support this effort.

Beyond this, census-reported means of commuting travel, stratified by place of residence and work as well as by demographic level, provide an important barometer of the equity and cost-effectiveness of transportation programs. In consideration of CAAA, USDOT will need to rely on the 2000 census to continue the broad level of program assessment from past decennial efforts. With much of the nation actively promoting alternatives to the single-occupant vehicle throughout the 1990s, reported mode of travel from the 2000 census will provide important feedback on the overall effectiveness of today's national air quality agenda.

Nonmotorized Rates by Area

Bicycle and pedestrian access is a new focus expressed in ISTEA. Some transportation improvement programs (TIPs) around the country are making significant investments in bicycle paths and exploring pedestrian-oriented land use development. Whereas bicycling remains largely a recreational activity in the United States, bicycling is a major means of commuting to work not only in China but also in the Netherlands, Sweden, Denmark, and Germany.

With the CTPP, we can examine trip length and trip time by mode and by location. Bicycling represented less than 1/2 percent of all work trips in 1990, and walking represented about 4 percent. There was significant variation by area. The largest shares for bicycle commuting were in Sacramento, Phoenix, and San Francisco. For walking, the highest shares were in New York, Boston, Philadelphia, and Pittsburgh. As with other transportation investments, investments in nonmotorized travel modes will need to be evaluated with use over time.

Trends in Mode Use Across Metropolitan Areas

Reliable, comparable data for different metropolitan areas, even if limited to the journey to work, give policy analysts at the federal level the ability to evaluate how different areas reflect similar or differing travel patterns and trends. Repeating this data collection over time further enriches the effort by enabling these local area trends to be compared over time.

A dominant mobility theme to be addressed over the next decade will be whether the decline in transit and high-occupancy vehicle (HOV) shares of work trips will continue or be reversed.

Transit Share of the Work Trip

The CTPP shows that transit times often range from 50 to 100 percent longer than travel times by private vehicle for the same origin-destination pairs. With multiple-worker households, efficient use of time appears to be more valuable than (potential) cost savings from riding the bus or the social goal of reducing air pollution. Thus, the proportion of workers driving alone to work has continued to increase. Since most working Americans do not pay for parking, parking costs have not been a disincentive to private vehicle travel.

With census data, investments in fixed-rail systems and their effect on the journey to work can be reviewed. For example, San Francisco, Atlanta, and Washington, D.C., have built large fixed-rail systems with major funding through the Urban Mass Transit Administration (now the Federal Transit Administration). In San Francisco, the number of workers traveling by rail has increased from 13,000 in 1960 to 90,000 in 1990. In Washington, D.C., the number of workers traveling by rail has increased from 1,500 in 1960 to 148,000 in 1990 (2).

Still, New York remains the leader in workers using alternatives to a private vehicle for the journey to work. Washington, D.C., now has the third-largest percentage of workers using transit to work, following only New York and Chicago. In San Francisco and Atlanta, even with large increases in the number of workers using rail, the percentage of workers using rail remains less than 3 percent. (See the following table, where "total transit" includes bus, streetcar, rail, subway, ferry, and taxi.)

<i>Metropolitan Area</i>	<i>1990 Rail (percent)</i>	<i>1990 Bus (percent)</i>	<i>1990 Total Transit (percent)</i>
New York	18.8	8.0	27.8
Chicago	6.6	6.8	13.7
Washington, D.C.	6.7	6.7	13.6
San Francisco	2.8	6.3	9.3
Atlanta	1.0	3.5	4.7

The census data show the loss in the share of jobs in central counties and a corresponding increase in the proportion of jobs in suburban counties. For example, in Atlanta, there was a 9 percent decline in the share of jobs in the central counties. In Washington, D.C., there was a 5 percent decline. The continuing suburbanization of jobs is an essential issue in studying the transit ridership in any given metropolitan area. Since the census data provide mode of travel and location of both residence and workplace, they can be used to analyze trends in transit use for specific geographic areas.

More recent investments in transit have been in light rail systems, such as those in Sacramento, Miami, Baltimore, Portland, and Buffalo. There will also be significant progress in fixed-rail systems in the Los Angeles area. How these systems fare will be reflected in the next census results.

Carpooling Rates

Perhaps even more significant than changes in transit use for the journey to work has been the decline of carpooling over the last 30 years. Nationally, vehicle availability has increased tremendously, from 0.85 vehicles per worker in 1960 to 1.32 vehicles per worker in 1990. Vehicle occupancy rates have declined from 1.17 in 1970 (3, Table 6-3) to 1.09 in 1990 (2, Table 5-3A).

Vehicle occupancy rates showed more variation across metropolitan areas in 1980 than in 1990. By 1990, there is little variation, with nearly all metropolitan areas with POV occupancy rates between 1.07 and 1.13 (2, Table 5-3A). Even more dramatic is the lack of variation in occupancy rates between central county and suburban county residents. New York was the prime exception, where central county occupancy (1.25) was much higher than occupancy for suburban counties (1.10).

NPTS data for 1990 indicate that carpooling is most likely to be with other household members. The census data support this, since most carpools have only two members. Formal carpools and vanpools with more than four members are a very small proportion of vehicle pool trips. Nationwide, 12.1 million workers reported going to work in a two-person carpool, compared with only 1.3 million in a carpool of four or more persons.

As regional air quality improvement programs are implemented, many agencies are hoping that employer-based travel demand management programs will increase vehicle occupancy for the journey to work. Still, it is unclear how changing vehicle occupancies to work will affect daily and weekly travel behavior. Will there be fewer total trips, will trips be moved from peak to off-peak, or will people return home from their carpool trip from work, jump into their car, and run errands as they did before, effectively causing no change in the number of cold starts per vehicle per day?

Spatial Analysis

The CTPP data in combination with the TIGER files form a powerful tool for spatial analysis of travel patterns. Flows between both large geographic areas like counties as well as for small TAZs can be depicted easily for spatial analysis. This technology enables analysts to combine any number of other data sources, such as land use, transit routes, and assessed value of property with population, employment, and journey-to-work data from the census.

At the federal level, specialized software was developed to provide user-friendly data extraction of CTPP data. With this software, the user can select small amounts of data from

very large files by pointing to areas on a map. Easy access to detailed journey-to-work data with a geographic component enhances the ability of federal analysts to compare areas on their desk-top computers. This data access capability was unheard of before this release of census data.

Americans with Disabilities Act

To respond to the requirements of the Americans with Disabilities Act (ADA) for transportation fully accessible to all segments of the population, the demographic and mobility measures traditionally included in decennial censuses provide an opportunity for USDOT to do a nationwide comprehensive assessment.

In summary, the decennial census provides for sufficient consistency nationwide in field data collection to permit consistent evaluation on a programwide basis.

Travel Model Development

Extensive research is being sponsored by USDOT to develop improved tools and methods of analyzing travel impacts and to project future trends. One of the significant uses of census data at the national level is in establishing and maintaining a robust data base for forecasting. The CTPP provides an empirical base of work trip data to support calibration and validation of travel demand models. In addition, the basic worker and employment characteristics, including trip length to work, can be used in developing land use allocation models.

Short-Term Improvements

At the federal level, short-term improvements through the Transportation Modeling Improvement Program are likely to include better estimates of transit ridership, improved procedures for estimating and forecasting participation in ridesharing programs, and support for the development of models to determine automobile ownership. Especially as HOV lanes and bicycle paths are added to TIPs, operational models must account for these choices in daily travel. Another short-term model improvement may be to use 1980 and 1990 PUMS files for improving forecasting of vehicle availability by such characteristics as immigration, household size, housing type, education, or other proxies for income and length of residence.

Long-Term Improvements in 1980s

The journey-to-work question in the 1990 census allowed workers to select only one mode for their journey to work. The question requested the mode for the longest portion of the trip. Whereas this is sufficient for the many people driving alone to work, transit trips often combine multiple modes: for example, drive to park/ride and rail trip for remainder, or drop off at kiss/ride and bus trip for remainder. We also do not have sufficient information on walk access for transit trips. Since intermodal transportation has been of increasing interest, the interfaces between these multiple modes are likely to be included in new travel demand models.

In the 1980s there was discussion but little formal encouragement of flexible work times to spread peak travel. The data indicate little evidence of spreading peak. Current models generally limit their time-of-day component to two cases: a total daily travel and a peak travel period (defined as period of 2 to 4 hr). Census data on departure time for work remains a large, nationally consistent data base on time-of-day of travel for at least one trip.

Nontransportation Uses

Federal agencies other than USDOT use the journey-to-work and mobility questions from decennial censuses. The Department of Labor used mode to work to analyze socioeconomic

and demographic characteristics of the work-at-home population. Tabulations of work force characteristics by tract or zone of work are key inputs for emergency response planning, public health studies, and other purposes. Tabulations by place of work provide key inputs to analyze residential opportunities by race and income relative to work locations (equal housing opportunities) and job market access (equal employment opportunities).

NATIONAL COMMUTING TRENDS

Data from the 1990 census indicate that between 1980 and 1990, nationally, driving alone to work gained 13.7 percent, and the proportion of workers using carpooling or transit declined. Overall, average vehicle occupancy declined from 1.15 to 1.09. Vehicle availability increased dramatically, with the number of vehicles available to households increasing faster than the number of workers or population. Nationally, these figures are used to direct policy decisions to enhance all modes of transportation. At the local and regional levels, these trends are used to develop transportation control measures and travel demand management programs in efforts to reduce congestion and improve air quality.

Commuting-Related Changes from the 1970s

- **Rapid growth in vehicular travel:** The number of households grew 26 percent between 1970 and 1980, whereas the number of household vehicles grew 64 percent. The number of vehicles per household increased from 1.25 to 1.61 between 1970 and 1980; at the same time, average household size was declining.
- **Growth in population and workers:** By 1980, the baby boom generation was fully of working age, with both men and women participating in the labor force. Labor force participation rates for women of all ages increased from 43 percent in 1970 to 51 percent in 1980, an increase of 14 million women. In the same period, labor force participation rates for men of all ages declined from 80 to 77 percent but increased in number by 10 million (4). Thus, the increase in the absolute number of workers was as critical as the labor force participation rate and the change in mode choice for the journey to work.
- **Suburb-to-suburb/intercounty commuting:** Between 1970 and 1980, employment in suburban areas and suburb-to-suburb commuting were increasing rapidly, portending changes for the next decade.
- **Decline in use of transit:** Given the rapid increase in vehicle availability, declining household size, and suburban residential development, perhaps the decline in the use of transit for the journey to work was not unexpected. Not only did transit use decline as a proportion of work trips, it declined in absolute number as well. In 1970, 6.5 million workers used public transit for the journey to work; this figure declined to 6.1 million in 1980.

Driving alone became more and more dominant, taking shares away not only from transit but from carpooling as well. In the major metropolitan areas, average automobile occupancy declined from 1.17 in 1970 to 1.14 in 1980.

Commuting-Related Changes from the 1980s

- **Dramatic growth in drive alone:** Continuing the trend from the previous decade, driving alone was even more dominant. In 1980, 64 percent of workers reported driving to work alone. By 1990, the figure increased to 73 percent, representing more than 84 million workers in the United States.
- **Decline in carpooling and transit:** Nationally, 13 percent of workers reported carpooling to work, representing about 15 million workers. This was a significant decline from 1980,

when the share was 19.7 percent. In 1990, the share of carpooling was relatively stable across metropolitan areas, ranging from 10 to 15 percent in each area with a population of 1 million or more.

Whereas the share of workers using transit to work declined from 6.4 percent in 1980 to 5.3 percent in 1990, the number using transit remained about the same (6.17 million in 1980 and 6.07 million in 1990) (5).

Only in the New York metropolitan area does rail/subway make up a large proportion of commuters (20.9 percent in 1980 and 18.8 percent in 1990). Despite the drop in share between 1980 and 1990, the number of rail/subway commuters increased from 1.4 million in 1980 to 1.5 million in 1990.

- No change in commute time: Average travel time to work showed little change between 1980 and 1990, averaging 21.7 min in 1980 and 22.4 min in 1990. Increases in "reverse" commuting, increases in suburb-to-suburb commuting, shifts away from travel modes like bus (which tend to have long travel time over short distances), and increases in driving alone (the most "convenient" mode) are considered to be directly related to the stability of travel times.

Using the 1980 UTPP and the 1990 CTPP Urban Element, we will be able to compare travel times by mode for small area TAZ pairs between 1980 and 1990. This work is in progress at the Texas Transportation Institute. Each TAZ is assigned to one of five land use types, resulting in 25 possible combinations. Preliminary work using data from Houston shows that, overall, travel times remained the same, with small but significant increases in travel speed for five combinations.

- Less intracounty commuting: Historically, planners have assumed the development of the radial city, where employment was concentrated in major centers. Now, modern technologies permit expansion to vast areas. New concepts of metropolitan areas as a "string of varying-size beads," information superhighways, and telecommuting technologies allow people to communicate more quickly across wide distances, perhaps without face-to-face interaction. These changes affect location decisions of both businesses and households.

Suburban "bedroom" communities have developed into major regional employment centers. By 1990, for large metropolitan areas, 57 percent of the workers lived in suburban counties. About 60 percent worked in the same suburban county, and another 15 percent worked in another suburban county. These changes are reflected in the changing mix of commuting patterns between central cities, suburbs, and exurbs.

SUMMARY

Policy analysis applications of census data at the federal level have expanded with the completion of each decennial census. With the completion of the 1990 census and preparation of the CTPP, policy analysts can track trends in metropolitan growth and development over the past 40 years while assessing how this growth has been translated into access and mobility needs. With the 1980 and 1990 transportation planning packages (UTPP and CTPP), the subject and data reporting content was expanded to include indicators not only of the use of the transportation system but also of the performance of the system in meeting the demand.

The broad scope and topic content of census data, as well as their consistency over time and across regions, define an extensive range of applications in national policy analysis. Whereas many of these applications involve federal program investment decisions, the most extensive uses involve identifying and interpreting national trends, both in the aggregate and on a disaggregate level.

With completion of each decennial census effort, policy analysts are better able to distinguish between short-term issues and trends of a longer-term nature. Furthermore, the census data give us the ability to associate development trends with emerging patterns of transportation system usage. For these reasons, future censuses will prove useful in providing even greater opportunity to leverage past efforts in further enriching the national profile of demographics, development, travel demand, and system performance.

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