

Transportation Data from the 1980 Census: A Retrospective Assessment

Philip N. Fulton

Transportation data are an integral part of the U.S. Census of Population and Housing. The bulk of these data are statistics pertaining to the journey to work of the labor force. During the planning phase of the 1980 census, four basic goals were identified for the journey-to-work statistics program: (a) include additional transportation questions in the census to meet program needs, (b) provide more journey-to-work data in standard census products, (c) improve the quality of small-area place-of-work coding, and (d) increase the utility of the Urban Transportation Planning Package (UTPP). This paper provides an assessment of how successful the Census Bureau was in achieving these goals.

TRANSPORTATION QUESTIONS IN THE CENSUS OF POPULATION AND HOUSING

The inclusion of transportation items is a fairly recent occurrence in the history of the decennial census. Although the first census was conducted in 1790, questions pertaining to transportation did not appear until 1960 when three such questions were asked on a 25-percent sample basis. The population items in 1960 included questions on each worker's place of work (city, county, and state) and means of transportation to work, whereas the housing items included a question on the number of automobiles available for use by the members of each household. The principal impetus for adding the question on place of work to the 1960 census was the need for data on commuting interchanges for use as an indicator of economic integration between large cities and their suburbs as part of the criteria for delineating metropolitan statistical areas. The commuting data from the census were certainly of interest to transportation planners, but urban transportation planning was still being done on the basis of origin-destination surveys.

By 1970, with the development of Address Coding Guides (ACGs) and Dual Independent Map Encoding (DIME) files, interest in the census as a source of transportation planning data had increased considerably. The ACGs and DIME files provided the capability of geographically coding addresses within the urbanized portion of metropolitan areas down to the level of the census block. The 1970 census again asked questions on place of work, means of transportation to work, and automobile availability, this time based on a 15-percent sample. However, the place-of-work question asked for the actual street address of the respondent's workplace, and these addresses were coded to census blocks within the areas covered by ACGs and DIME files.

Between 1970 and 1980, several developments resulted in a significant expansion in the number of transportation items included in the decennial census. The energy crisis of the early 1970s and the subsequent ongoing concern for the nation's supply of nonrenewable energy sources brought about a sharp increase in the need for statistics for transportation planning and policy formulation. From 1975 to 1977, under the sponsorship of the U.S. Department of Transportation, the Census Bureau conducted for the first time journey-to-work surveys in 60 metropolitan areas and a national survey in 1975, all as part of

the Annual Housing Survey. In recognition of the growing need for analysis of these data, a Journey-to-Work Statistics Branch was created within the bureau's Population Division to carry out the technical planning and developmental work pertaining to the collection, processing, tabulation, and analysis of journey-to-work data from the decennial census and periodic surveys. Also during the decade, the cost of conducting origin-destination surveys increased rapidly, and the U.S. Department of Transportation began to encourage local agencies to look to the decennial census as an alternative source for cost-effective transportation planning data.

Thus, due to the significant increase in the need for transportation data at all levels of government, the 1980 census included eight transportation items: six population questions and two housing questions. On the population side, in addition to questions on place of work and means of transportation to work, the 1980 census asked about carpooling arrangements, the number of riders in the carpool, travel time from home to work, and whether persons had a disability that limited or prevented their use of public transportation. On the housing side, the automobile availability question was supplemented with an additional question on the number of light trucks and vans available for use by members of each household.

JOURNEY-TO-WORK DATA IN STANDARD 1980 CENSUS PRODUCTS

Standard census data products include printed reports for states and Standard Metropolitan Statistical Areas (SMSAs) that contain information on all the various subjects collected in the census, special reports that focus on a particular subject, and data on computer tape. Important improvements were made in the journey-to-work data included in each of these products for 1980.

State and SMSA Reports

The series of state reports entitled General Social and Economic Characteristics (Series PC80-1-C) contains data for states, counties, places of 2,500 or more inhabitants, SMSAs, and towns or townships in selected states. For 1980 these reports include data on all the journey-to-work items (place of work, means of transportation, carpooling, persons per vehicle, travel time) for all geographic areas regardless of size. In 1970 not all the journey-to-work information collected was published for counties and small places. Furthermore, the place-of-work data in the 1980 reports show the number of persons who worked outside their area of residence instead of their county of residence as was the case in 1970. This means that if a particular table is for residents of the state, counties, places, or towns and townships, the 1980 data will show how many residents worked outside each specific state, county, place, or town and township rather than always referring to the county of residence.

The series of state reports entitled Detailed Population Characteristics (Series PC80-1-D) contains detailed cross-tabulations of characteristics for each state and each SMSA of 250,000 or more inhabitants. For 1980 an expanded table was added to this series that provides socioeconomic and demographic characteristics of interstate commuters. One of the most important characteristics shown is the earnings of workers who work in one state but live in another. Each commuter flow between contiguous states is identified uniquely.

The series of SMSA reports entitled Census Tracts (Series PHC80-2) provides data for each SMSA and its census tracts. Summaries for component counties and places of 10,000 or more inhabitants are also given. For 1980 these reports contain more detailed place-of-work destinations than in 1970. In addition to the central cities and counties that make up the SMSA, important suburbs and

destinations outside the SMSA are also included. For SMSAs in New England, the place-of-work destinations shown in the tract reports are individual towns or logical groupings of towns rather than county portions. This provides more useful town-to-town commuting data for areas where counties have little meaning.

Subject Reports

In contrast to 1970, when only one subject report on journey-to-work data was produced, three such reports were produced as part of the 1980 census.

The first, Journey to Work: Metropolitan Commuting Flows (PC80-2-6C), portrays the commuting patterns of workers in the 318 SMSAs recognized for the 1980 census (excluding Puerto Rico). Place of residence and place of work are also shown in summary tables for the United States and each of the four census regions and nine census divisions. Data are given on the workplaces of workers residing or working in each SMSA. They cover the component counties of each SMSA, their central cities, and other places with 25,000 or more residents. Commuter interchanges between SMSA components and areas outside the SMSA are shown when they amount to 100 or more workers.

The second subject report, Journey to Work: Characteristics of Workers in Metropolitan Areas (PC80-2-6D), provides comparative data on the characteristics of workers who reside in each geographic unit of each SMSA and who work in each unit, followed by information on the characteristics of workers commuting within and between each geographic unit. The geographic units recognized are each central city; each other place of 50,000 or more inhabitants; for workplace only, the central business district (CBD) of each central city and the remainder of the central city; the remainder of each county containing central cities or other qualifying places; and each additional county that does not contain either a central city or other qualifying place. Summary data on the workplace of workers classified by type of residence for the United States and regions are also provided.

The third subject report, Place of Work (PC80-2-6E), presents information on selected social and economic characteristics of workers by place of work. The total number of workers that worked in each area and the number of those workers living outside their area of work are given. Areas of work shown in the report include each state, county, and SMSA central city, each other place of 25,000 or more inhabitants, and each New England county subdivision.

Computer Tapes

The 1980 census computer files include Summary Tape Files (STFs), Public-Use Microdata Sample (PUMS) files, and other special-purpose files.

STF 3 provides characteristics summarized for geographic areas down to the level of block group or enumeration district. Because of this small-area geographic detail, the content detail of STF 3 had to be somewhat abbreviated. Instead of place-of-work data for specific workplace destinations, STF 3 contains four unique place-of-work recodes--state and county, minor civil division (MCD), place, and SMSA--that can be used to ascertain general commuting patterns. For example, on the Massachusetts STF 3, the place-of-work recodes on the data record for Chelsea city in the Suffolk County portion of the Boston SMSA could be used to find the number of Chelsea residents who worked in Chelsea, worked in Boston, worked elsewhere in Suffolk County, worked outside Suffolk County but within the Boston SMSA, worked outside the Boston SMSA but within Massachusetts, or worked outside Massachusetts.

STF 4 provides characteristics summarized for geographic areas down to the census-tract level. This file provides in complete detail the

transportation-item categories reported in the census as well as cross-tabulations of carpooling arrangements and sizes separately for workers using cars, trucks, and vans. STF 4 also includes the most detailed place-of-work tabulation contained in any standard 1980 census product, the so-called "20 places of work." This tabulation provides the number of workers commuting to 20 workplace destinations that are defined uniquely for each county (MCD in New England). The destinations may be cities, counties, towns or town groupings in New England, or other areas. For 1980 many more cities were included in these lists of workplace destinations to provide more subcounty detail.

PUMS are computerized files containing most population and housing characteristics as shown on a sample of individual census records. These files contain no names or addresses, and geographic identification is limited to counties or county groups with at least 100,000 or more inhabitants to protect confidentiality. Microdata files allow the user to prepare customized tabulations. Place-of-work information on the 1970 census microdata files was of limited utility because it was provided in terms of recodes (e.g., worked inside or outside county of residence or worked in central city or in the suburbs or outside the SMSA of residence). For 1980 the actual county or county group of work is included in the microdata files to allow users to develop their own customized county-to-county commuting tabulations.

Another important computer tape is the user file developed from the base file that was the source of the three journey-to-work subject reports described earlier. This file contains a record for the number and characteristics of workers in each commuter flow that occurred between specified geographic areas in the United States. The geographic areas include counties, cities of 25,000 or more inhabitants, and New England county subdivisions. Much of the data contained in this file for cities of 25,000 to 50,000 persons, nonmetropolitan counties, and New England subdivisions is not available elsewhere in other census data products.

PLACE-OF-WORK CODING

The development of the ACGs as part of the 1970 census provided the capability for the first time of geographically coding place-of-work addresses down to the level of the census block; the 1960 census had asked only city, county, and state of work. About 63 percent of the eligible workers (those living in SMSAs who worked in the ACG-covered portion of their SMSA) were coded to block of work in 1970.

For the 1980 census place-of-work ACGs were prepared from computerized geographic base files (GBF/DIME files) that allowed more extensive block coding, and workers were assigned to the census tract of work if a block code could not be obtained. In addition several other noteworthy improvements were made in the 1980 place-of-work coding operation that resulted in more accurate small-area data: (a) a better coder-training program was developed that combined videotaped training modules with step-by-step workbooks of place-of-work coding exercises, (b) the place-of-work coding procedures themselves were more comprehensive and easier for the coders to use than those in 1970, and (c) place-of-work coding specialists from the Census Bureau's Journey-to-Work Statistics Branch were detailed to each of the three census processing centers as technical advisors for the duration of census processing. But the single most significant improvement in place-of-work coding for 1980 was the creation of Major Employer Lists (MELs) covering each SMSA.

Complete number-and-street place-of-work addresses are usually reported by about half of all respondents. The rest report the name of their employer, the name of the building or shopping center where their employer is located, or some

other description of where they work. In order to code these responses, the Census Bureau developed extensive precoded lists of major employers (companies, businesses, shopping centers, office buildings, colleges, military installations, etc.) for each SMSA. The bureau also contacted the local metropolitan planning organization (MPO) in each SMSA to request a list of its major traffic generators to check the coverage and accuracy of the Census Bureau's list. About half of the MPOs responded.

The estimated rates of small-area place-of-work coding in the 1980 census are as follows:

<u>Level of Coding</u>	<u>Percentage of Eligible Workers Coded by Year</u>		
	<u>1960</u>	<u>1970</u>	<u>1980</u>
Census tract	NA	NA	81
Block	NA	63	73

About 73 percent of all workers eligible for small-area coding were coded to the block level, a 10-percentage-point improvement over 1970. Further, about 81 percent of eligible workers were coded at least to the census tract of work.

URBAN TRANSPORTATION PLANNING PACKAGE

The availability of block-level data on commuting origins and destinations from the 1970 census made possible the development for the first time of the Urban Transportation Planning Package (UTPP). The 1970 UTPP was a special tabulation of census data for individual metropolitan areas tailored to the geographic areas that are used in transportation planning. Local transportation planning organizations prepared specifications for the blocks that made up their traffic analysis zones, and the Census Bureau then produced a standard set of tabulations for those zones on a cost-reimbursable basis. Specifications for the content of the UTPP were submitted to the bureau by FHWA. About 120 UTPPs were prepared after the 1970 census.

The Census Bureau again produced the UTPP after the 1980 census. This time specifications were developed and submitted to the bureau by an ad hoc committee of transportation planners under the auspices of the Transportation Research Board. Funding for development of the necessary computer programs and administration of the 1980 project was provided by the U.S. Department of Transportation.

1980 UTPP Highlights

Just as improvements in the quality of 1980 census place-of-work coding resulted from experience gained in coding to block for the first time in 1970, so too did improvements in the overall UTPP program derive from experience with the production and use of the 1970 version. The highlights of the 1980 UTPP program were in the general areas of product utility, user assistance, and governmental cooperation.

The 1980 UTPP was a much more useful and flexible product than the 1970 package. The 82 data tables included in the 1980 UTPP compared with 43 in the 1970 version gave users a more comprehensive transportation planning data base. Purchasers of the 1980 package had the option of having the small-area parts of their UTPP tabulated on the basis of traffic zones, census tracts, or block groups and the option of receiving the package on computer tape, printout, or microfiche; the 1970 UTPP was only produced on computer tape using traffic zones. The 1980 UTPP was not limited to SMSAs as the 1970 version had been,

because some transportation planning regions are not limited to one metropolitan area; in addition to single SMSAs, special 1980 UTPPs were produced that covered single SMSAs with commutersheds (significant commuter inflows from adjacent SMSAs), multiple SMSA planning regions, nonmetropolitan counties containing urbanized areas, and entire states. As part of the 1980 UTPP processing, place-of-work responses that were incomplete or not reported were allocated to the most detailed level of geography possible; no such allocation procedure was developed for the 1970 UTPP.

User assistance as part of the 1980 UTPP program was provided by the Census Bureau in a variety of ways. UTPPs produced on computer tape included in addition to the data files a machine-readable data dictionary containing the boxheads, stubs, and titles of all tables; a geographic name reference file for the geographic codes associated with the data; and a program to print out the tables. Extensive documentation was also provided with the tapes. From 1981 to 1984 staff of the Census Bureau and the U.S. Department of Transportation conducted more than 20 one-day user workshops on the UTPP throughout the United States. These workshops provided an orientation to the technical specifications of the UTPP and its application to transportation planning for more than 1,000 state and local planners. The Census Bureau also developed procedures for correcting place-of-work coding problems that occurred during census processing. UTPP purchasers who found such problems and notified the bureau within a reasonable time received corrected files without additional charge.

Another highlight of the 1980 UTPP program was the degree of intra- and intergovernmental cooperation achieved. Within the federal government, the already strong tradition of cooperation between the Census Bureau and the U.S. Department of Transportation was strengthened further in carrying out this successful project. Further, a solid working relationship was established between the Census Bureau and many local MPOs and states that will be the basis for mutual assistance in future censuses.

1980 UTPP Problems

Although the 1980 UTPP program was much improved over 1970, a few problems did occur. There were place-of-work coding errors in some areas that made the data less usable than they could have been. The computer program included on the UTPP tapes did not work for some areas because it could not accommodate all the geographic components in large metropolitan regions (the program has been corrected and will be sent to those UTPP purchasers that were affected). Despite the user workshops conducted as part of the UTPP program, some planners had trouble using the UTPP because of a lack of familiarity with census concepts, processing techniques, and the limitations of the data. Some planners also made mistakes in their census geography-to-traffic-zone equivalency files, which resulted in erroneous UTPP data. Such errors necessitated the correction of the equivalency files and reruns of the UTPPs.

Selected Results of the UTPP Program

Some overall results of the 1980 UTPP program as of December 1, 1984, are presented here. The information is not final because the program has not been closed and a few more UTPPs remain to be done. The various types of UTPPs that were produced in 1980 are summarized as follows:

<u>Type</u>	<u>No.</u>
Single SMSA	118
SMSA with commutershed	10
Regional (multiple SMSA)	9
Regional (Massachusetts)	9
Statewide	2
Statewide with commutershed	1
Nonmetropolitan county	3
Total	152

The SMSA-with-commutershed packages (a single-SMSA package that includes special inflow data from an adjacent SMSA) covered the following areas: Ann Arbor, Michigan; Baltimore, Maryland; Chicago, Illinois; Detroit, Michigan; Ft. Lauderdale-Hollywood, Florida; Gary-Hammond-East Chicago, Indiana; Miami, Florida; Newport News-Hampton, Virginia; Norfolk-Virginia Beach-Portsmouth, Virginia-North Carolina; Washington, D.C.,-Maryland-Virginia. Multiple-SMSA UTPPs were produced for the following regions: San Francisco Bay area (four SMSAs); Southern California (four SMSAs); Puget Sound region (three SMSAs); Cleveland, Ohio (two SMSAs); Columbus, Ohio (two SMSAs); Cincinnati, Ohio (two SMSAs); Houston, Texas (two SMSAs); Philadelphia, Pennsylvania (two SMSAs); and Bradenton-Sarasota, Florida (two SMSAs). Special UTPPs were done for each regional planning area in Massachusetts, areas that are usually made up of one or more core SMSAs and surrounding nonmetropolitan towns with commuting linkages to the SMSAs. UTPPs covering the entire state were prepared for Connecticut and Rhode Island. A statewide UTPP was also produced for New Jersey that included inflow data for commuters from counties adjacent to New Jersey in New York, Pennsylvania, and Delaware. Finally, three UTPPs were produced that covered nonmetropolitan urbanized areas: Grand Junction, Colorado; Houma, Louisiana; and Jackson, Tennessee. In all, 152 packages were produced from the 1980 census compared with 120 from the 1970 census.

A greater proportion of large metropolitan areas took part in the UTPP program than did smaller areas (Table 1). All but three of the SMSAs of 1,000,000 or more (Milwaukee, Wisconsin; Pittsburgh, Pennsylvania; Sacramento, California) purchased UTPPs in 1980, whereas fewer than half of the SMSAs under 250,000 participated in the program. Among all SMSAs, 55 percent purchased the UTPP.

A larger proportion of SMSAs purchased the UTPP in the Northeast than in the other regions (Table 2). About 67 percent of the SMSAs in the Northeast purchased a package, 60 percent in the West, and 56 percent in the Midwest. Only 46 percent of the SMSAs in the South participated in the UTPP program. Within regions, the highest rate of purchase occurred in New England (Maine, Vermont, New Hampshire, Rhode Island, Massachusetts, and Connecticut) where nearly 80 percent of the SMSAs were covered by a UTPP. The lowest rate of purchase was in the West South Central states (Arkansas, Louisiana, Oklahoma, and Texas) where only 39 percent of the SMSAs were covered. The low rate in these states is primarily attributable to Texas, where only 5 of 26 SMSAs were covered by UTPPs.

Table 3 presents a comparison of UTPP cost data for 1970 and 1980. The data substantiate the cost-effectiveness of the 1980 census UTPP program. In constant 1983 dollars, the average cost of purchasing a UTPP was about the same in 1980 as it was in 1970, and the cost actually dropped significantly between 1970 and 1980 on a per-capita basis. The average cost was about \$11,000 in both 1970 and 1980, and the cost per 1,000 population was \$11.81 in 1980 compared with \$16.14 in 1970.

TABLE 1 1980 SMSAs Covered by UTPPs by Size of SMSA

SMSA Population	No. of SMSAs	No. of SMSAs Covered by UTPPs	Percentage of UTPP Coverage
1,000,000+	38	35	92
500,000-999,999	41	32	78
250,000-499,999	71	40	56
100,000-249,999	140	56	40
<100,000	<u>28</u>	<u>12</u>	43
Total	318	175	55

TABLE 2 1980 SMSAs Covered by UTPPs by Census Region and Division

Region and Division	No. of SMSAs	No. of SMSAs Covered by UTPPs	Percentage of UTPP Coverage
Northeast			
New England	29	23	79
Middle Atlantic	<u>34</u>	<u>19</u>	56
Total	63	42	67
Midwest			
East North Central	58	33	57
West North Central	<u>26</u>	<u>14</u>	54
Total	84	47	56
South			
South Atlantic	58	30	52
East South Central	20	9	45
West South Central	<u>41</u>	<u>16</u>	39
Total	119	55	46
West			
Mountain	17	9	53
Pacific	<u>35</u>	<u>22</u>	63
Total	52	31	60
Total United States	318	175	55

TABLE 3 Summary of UTPP Cost Data

Item	1970	1980
Number of UTPPs produced	121	152
Total population in areas covered	81,796,344	142,068,485
Percentage of U.S. total population	40	63
Total cost (unadjusted) (\$)	534,200	1,678,348
Total cost (\$1983)	1,320,100	1,678,348
Average cost (unadjusted) (\$)	4,415	11,042
Average cost (\$1983)	10,910	11,042
Cost per 1,000 population (unadjusted) (\$)	6.53	11.81
Cost per 1,000 population (\$1983)	16.14	11.81

SUMMARY

The four basic goals for the 1980 census journey-to-work statistics program were to include additional transportation questions in the census to meet program needs, provide more journey-to-work data in standard census products, improve the quality of small-area place-of-work coding, and increase the utility of the UTPP. An assessment of the results of the 1980 census shows that the Census Bureau was quite successful in meeting these goals.

The number of transportation-related items included in the decennial census increased from three questions in 1960 and 1970 to eight questions in 1980. More journey-to-work data were published in standard census reports for all geographic areas. Three special subject reports on the journey to work were published in 1980 compared with one in 1970. More journey-to-work data were made available on computer tape in 1980 than ever before. About 73 percent of eligible workers were coded to block of work in 1980 compared with 63 percent in 1970. About 81 percent of eligible workers were coded at least to their census tract of work in 1980.

The 1980 census UTPPs were improved significantly over 1970. The 1980 package provided more data, greater geographic and product flexibility, and more user aids. The few 1980 UTPP problems included place-of-work coding errors in some areas, problems with the data display program, errors in the zone equivalency files, and a lack of user knowledge. In all, 152 UTPPs covering 175 SMSAs and other areas were produced from the 1980 census. A greater proportion of larger SMSAs and SMSAs in the Northeast were covered by UTPPs. A lesser proportion of smaller SMSAs and SMSAs in the South were covered. In constant 1983 dollars, the average cost of purchasing a UTPP was about the same in 1980 as in 1970 (\$11,000). On a per-capita basis, the cost in constant dollars declined significantly from \$16.14 per 1,000 persons in 1970 to \$11.81 per 1,000 persons in 1980.