Supplementing Census Data for Transportation Planning

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ABSTRACT

Based on experience at the Washington Metropolitan Area Council of Governments, census journey-to-work data supplemented with small-scale automobile use or telephone home interview surveys and with roadside interviews to obtain data on travel into and through the area can serve as a relatively low-cost basis for verifying and updating travel models and for modifying forecasts. Before-and-after studies of changes caused by the opening of major transportation facilities are valuable supplements to such a data effort. Recommendations are given with regard to supplementing census data in large urban areas.

In this paper an attempt is made to place the Urban Transportation Planning Package (UTPP) in the context of a total transportation forecasting process for an urban area. Although the package is extensive, it must be recognized that it is but one source of data and by its limited nature cannot address all of the issues surrounding transportation planning in the 1980s. The recommendations made 12 years ago for large urban areas (more than 500,000 inhabitants) are that rather than continue to collect across-the-board uniform sample home interview data (1),

1. 1970 census data together with data on transportation network characteristics be used to describe areas where differing socioeconomic and transportation service levels exist;
2. Small-scale detailed surveys be conducted in these areas in which a variety of data collection techniques would be used, including
   a. In-depth interviews in the home,
   b. On-board transit surveys,
   c. Telephone interviews,
   d. Mail-out mail-back questionnaires, and
   e. Surveys conducted at major travel generators, such as industrial parks, shopping centers, and the like;
3. The data collection be tailored to the specific requirements of the forecasting models to be used and not vice versa;
4. The home-to-work travel data obtained by the 1970 census be updated annually as opposed to conducting a large-scale survey once every 5 or 10 years; these data can largely replace the conventional home interview survey; labor force and employment data should be kept current by small area; this information can serve as the basis for applying the models and developing the home-to-work travel pattern, which can then be checked against traffic-count data;
5. Conventional truck and taxi surveys be discontinued and replaced by goods-movement and visitor (or tourist) surveys;
6. Roadside surveys be conducted in one direction on a small-sample, continuing basis and that these interviews include weekend travel; in addition, mail-back questionnaires handed or mailed to the driver can pick up socioeconomic data required for forecasting purposes; and
7. Every available opportunity be taken to collect data both before and after the implementation of new urban transportation facilities and that the models developed attempt to replicate the behavior observed.

These recommendations called for the use of 1970 census journey-to-work data supplemented with special surveys. A review of the recommendations is made in the light of experience over the last decade.

The National Capital Region Transportation Planning Board (TPB) of the Metropolitan Washington Council of Governments (COG) has planned its future program around the availability of the census package and has been involved in supplemental data collection and analysis efforts for the last few years. Experience with these supplemental efforts is now available.

1977 ANNUAL HOUSING SURVEY

Based on poor experience nationally with the 1970 UTPP, the accuracy and usefulness of the data were suspect. (It should be noted that COG/TPB did not order the 1970 package because an extensive home interview survey had been conducted in the Washington, D.C., area in 1968.) Would the 1980 data be of similar poor quality? The 1977 Annual Housing Survey (AHS) conducted by the Census Bureau contained a journey-to-work sample, and therefore there was an opportunity to find out whether the data in the 1980 package had in fact improved over those in the 1970 UTPP. In addition, census-collected work-trip data are not obtained in the same form as the conventional home interview data and would need to be adjusted so as to be compatible with the models and forecasting process used for the last decade in the region. The AHS work-trip data were derived from a sample of 15,000 households, approximately two-thirds of the number of households surveyed in the 1968 home interview survey. This is an approximately 1.5 percent sample of households compared with a 3 percent sample of 1968 households and an approximately 8 percent sample for the 1980 journey-to-work package.

The 1977 AHS work trip data were adjusted as follows:

1. Factors by mode to account for cases in which there was no fixed place of work or place of work was not reported;
2. Factors to account for absenteeism from work on the average day;
3. Factors by mode to convert the usual-day census trip data to home-based work-trip production and attraction formed (in the census the question is asked, "How do you usually travel to work?" whereas in home interview surveys it is "How did you travel to work yesterday?");
4. Factors by mode to account for occasional shifts to other modes; for example, only 85 percent of all transit riders are regular riders (based on survey data from the Washington Metropolitan Area Transit Authority for those who ride four or more days a week).

With the exception of item 4, data from the census and prior home interview data can be used to calculate adjustment factors. A full discussion of these factors may be found elsewhere (2).

COMPARISONS WITH MODEL ESTIMATES

How well do census data compare with model forecasts of work travel or vice versa? Planners were anxious to utilize the census information and compare it with their 1977 model-based forecasts. These models were built in the early 1970s using the 1968 home interview data base and had been used as the basis for transportation planning in the Washington, D.C., area ever since. More and more, politicians, citizens, and planners were questioning the continued use of these models because the data base on which they had been developed was more than a decade old. The perception was that habits had changed and that the smaller household size, two-worker households, and greatly increased car ownership had modified travel behavior. Could models constructed with 1968 data be valid in the 1980s and be used as a basis for forecasting travel in the next century?

Census journey-to-work data could only provide a partial response to these concerns. Because nonwork travel and external or through travel are not included, only work-travel forecasts could be compared. This comparison was made for total trips and trips by mode and for automobile occupancy. Where census data and model-derived data agreed, confidence could be placed in both census data and the models. Where they disagreed, judgments as to the usefulness or accuracy of the new data or the validity of the models could be made.

Total Person Work-Trip Comparison

In Table 1 total person work trips from the 1977 AHS are compared with the COG/TPB 1977 simulation. On a regional basis, total person work trips matched within 4.3 percent, transit mode-split percentage by 5.2 percent, and total transit work trips by 9.8 percent. (Total employment reported by the census was lower than that used in the simulations. Part-time workers and two-job holders are not included in census information. Preliminary comparisons of COG's 1980 employment census with 1980 census data on total employment show much closer agreement, however.) Most of the differences could be traced to lower total work-trip generation from within the District of Columbia reported by the census, which could well be caused by smaller family size (and labor force) per household. Although COG/TPB trip generation relationships do reflect lower work-trip rates for the city, an even lower rate is indicated by census data. Total person work trips from the District showed an 18.6 percent difference. If this one rate were corrected, simulation and census data would compare in all categories within 1 percent on a regional basis as follows:

Category	Rate (%)
Total person work trips	+0.6
Percent transit work trips	+0.9
Total transit work trips	+0.8

More detailed comparisons of trip generation, modal split, and trip distribution can be made with the data as well, and other corrections or adjustments to the existing simulation models can be made. Distribution by city or county of workplace is shown in Table 2. Again, extremely close correlation can be noted between the AHS data and the basic employment data used as input to the travel simulation.

Automobile Occupancy Comparison

Census data also provide the means to compare model- (or rate-) based estimates of automobile occupancy with that reported. As shown in Table 1, overall automobile occupancy simulated for 1977 compared closely with census information with the exception of travel to the core area of the Washington region. In particular, it was found that long trips to the core from outlying suburban counties had much higher car occupancies than had previously been observed or estimated. The recent emphasis on car- and vanpooling plus the existence of high-occupancy-vehicle (HOV) facilities have changed the prior relationships, even after accounting for higher core-area employment densities and parking charges. Automobile travel to the core could be overestimated if such behavioral changes are not taken into account in the planning process.

SUPPLEMENTAL TRAVEL SURVEYS

Automobile Use Study

With transit-vehicle travel data being obtained on a continuing basis by the transit authority, the con-

TABLE 1 Selected Comparisons: 1977 Simulations Versus 1977 AHS

Category	Simulation	AHS	Difference	Percentage of Difference
Total person work trips (no. of trips)				
From D.C.	447.1	376.9	+70.2	+18.6
From suburbs	1,540.2	1,529.3	+10.9	+0.1
All	1,987.3	1,906.2	+81.1	+4.3
Transit work trips (%)				
From D.C.	42.5	44.0	-1.5	-3.4
From suburbs	11.2	10.7	+0.5	+4.7
All	18.2	17.3	+0.9	+5.2
Total transit work trips (no. of trips)				
From D.C.	190.0	165.9	+24.1	+14.5
From suburbs	172.1	163.9	+8.2	+5.0
All	362.1	329.8	+32.3	+9.8
Automobile occupancy (no. of persons)				
To D.C.	1.5	1.64	-0.14	-8.5
To rest of D.C.	1.3	1.25	+0.05	+0.4
To suburbs	1.2	1.2	-	-
All	1.3	1.3	-	-

Note: Total employed workers reported by the AHS was significantly lower than that used in the 1977 simulation. Census data do not include part-time employment or second jobs.

TABLE 2 Comparison of 1977 AHS with 1977 Employment

City or County of Workplace	1977 Simulation	1977 AHS	Absolute Difference[a]
District of Columbia	41	42	-1
Arlington County	9	9	0
Alexandria City	3.5	4	-0.5
Montgomery County	16	16	0
Prince George's County	13.5	13	+0.5
Fairfax County	13	13	0
Loudoun County	1	1	0
Prince William County	3	2	+1

Source: COG employment census data (at place of work) used in traffic simulation and 1977 AHS journey-to-work data.

[a]Simulation data minus AHS data.

cept of a telephone survey of automobile users to complement these data with data on nonwork travel appeared attractive. This was especially true because home interview costs have risen to $100 per interview or more.

COG/TPB conducted a pilot study that obtained household and travel data from a sample of automobile-owning households in the Washington metropolitan area (3). Household data were obtained by phone and included information on family size, number and type of automobiles owned, number of licensed drivers, number of workers, household income, kind of dwelling unit, and other demographic variables. From this initial telephone contact, the percentage distribution of households cross-classified by the number of automobiles owned and number of persons in the household was used to obtain a quota sample for each category within each jurisdiction. These samples were mailed automobile logs. The survey data obtained were then expanded (after these variables had been adjusted for zero-car households) to the total number of households by county. The travel data obtained included the number of persons who normally use public transportation to work and a record of each automobile trip made by the household for each of two consecutive days. Trip information collected included the beginning and ending odometer reading, beginning and ending time, the number of persons in the car, the trip purpose, and the city or county of destination. More than 8,500 households were contacted, and more than 5,000 automobile logs were distributed to 2,800 households; 2,000 completed logs were received from 1,200 households.

Major conclusions from the study were that automobile ownership is a major determinant of trip production, vehicle miles of travel (VMT), and automobile occupancy. Household size, income, structure type, and the use of transit also influence automobile use but not to as great an extent. (It was found, for example, that the average miles driven per car within the region on a weekday was the same in 1980 as it was in 1968, approximately 20 miles.)

The information gathered in this type of survey can be used to obtain regional and subregional estimates of automobile ownership characteristics, average vehicle trip-generation rates, average vehicle trip lengths, and average automobile occupancies. As a result, total VMT can also be obtained and monitored. Survey-derived automobile ownership data and regional VMT were comparable with similar data obtained from other independent estimates.

This pilot study demonstrated the usefulness of the method as a relatively inexpensive way to collect relevant automobile travel information on a continuing basis. Based on the experience gained with this pilot study, the cost for an automobile use survey was estimated at approximately $20 per household or less on a continuing basis, making it feasible to conduct such smaller-scale surveys on a periodic basis to detect changes in automobile travel within an urban area.

There were two major hypotheses tested as part of the evaluation of the Automobile Use Study. The first was that a random-sample telephone-interview procedure could produce a reasonable distribution of non-car-owning and car-owning households from which a quota sample could be drawn. The second major hypothesis was that once that sample had been drawn and responses had been obtained, the expanded results would approximate the total vehicular travel by residents in the area. Both of these hypotheses have been confirmed, making such a sample survey a feasible method for updating travel data in a metropolitan area.

Telephone Interviews

The Automobile Use Survey, by design, did not attempt to obtain origin and destination addresses at less than a city or county level for the logs. It was felt that asking for an address more detailed than city or county would result in lowered response rates and fewer trips reported. In one portion of the region, COG did conduct a telephone home interview survey where detailed trip addresses were obtained directly from the respondent. This was accomplished by using a computer terminal to assist the telephone interviewer. Input statements were programmed to make the questions user friendly, automatically reference the questions to be asked, and properly sequence the question categories. For example, if the respondent said that no transit trips were made, the program would skip the transit section and branch to the next appropriate category of questions. The responses were keyed in as the questions were answered, and running totals of trips per household, and so on, were available immediately. This eliminated the need for subsequent coding of the data as well.

Based on preliminary analysis, it was concluded that this type of interactive computer-assisted telephone interviewing is entirely feasible and could reduce costs of home interviewing to acceptable levels for either periodic or small-scale continuing interviewing. Data obtained from this study are now being analyzed.

External-Travel Data

Because external and through travel can have a disproportionately larger impact than their proportion of total trips because of longer trip lengths, it is also desirable that new external-trip data be obtained to supplement census data. Although census journey-to-work data can be extended to commutersheds outside the region and external data obtained, such data are not specific to route of entry (or exit). Through trips or truck travel are not available from census data.

Alternative Methods for External Data Collection

Although external-travel data can be obtained inexpensively (on a cost-per-interview basis) through conventional roadside interviewing, traffic volumes at some locations are so high that any stoppage of traffic could cause severe delay. At other locations, such as high-speed limited-access highways, it may be judged dangerous to stop traffic for interviewing purposes.

The Maryland Department of Transportation experimented with different methods of collecting ex-

ternal-travel survey data as part of a regional update to supplement the census journey-to-work data. This survey was conducted in 1980 with the aid of the University of Maryland. Depending on the survey location, one or more of three survey methods were used. Roadside interviews were conducted at five sites, a combination of roadside interviews and return-postcard handouts was conducted at five additional stations, and a license-plate survey (with subsequent mailing of a return postcard to the address where the vehicle was registered) and a combination of roadside interviews and license-plate survey were conducted at another location. On high-speed facilities (Interstates) the license-plate technique was used, whereas on high-volume arterials (or during heavy peak-hour flows) the handout mail-back survey method was used.

It is important to classify traffic by state of origin when the license-plate technique is used so that response bias can be minimized when the survey data are factored. In addition, not all states will be surveyed. It was found that a useful technique was to record automobile occupancy both in the field and as a question on the survey form and to use this variable to check the factoring or as a basis for expanding sample data. This is especially important if any consideration is to be given to special HOV treatments, such as separate HOV lanes on these facilities. It should be noted that in all of the foregoing survey work, only inbound travel was surveyed.

Use of the New External-Travel Data

It is planned that the new external-travel data obtained be used as a basis for recalibration of the external-to-internal gravity trip distribution model (F-factors). In this regard, early data tabulations have indicated that high-speed Interstate facilities may need different F-factors than parallel arterial facilities. Because several of these facilities did not exist at the time of the last external survey in 1968, these data have the potential for improving existing forecasts. (No differential in the gravity models by type of route is currently made.) In addition, the through travel data obtained will serve as the basis for a new Fratar forecast.

Truck and Taxi Travel Data

In the 1971 paper cited previously (1), it was recommended that conventional truck and taxi surveys be discontinued and replaced by goods movement and visitor (or tourist) surveys. One-half of that recommendation has been adopted. No truck or taxi survey data have been collected since 1968 in the Washington area. Many former taxi riders, especially in the downtown area, have switched to Metrorail. Because Washington has a much smaller proportion of truck travel than most major areas, these data are not critical to transportation decision making. It is therefore unlikely that any large-scale effort to collect either truck or taxi data could be justified. Other urban areas should review their need for such data and act accordingly.

Before-and-After Studies

In addition to this basic data collection effort, supplemental before-and-after studies of the impacts of introducing new major facilities such as Metrorail and HOV lanes on Shirley Highway (I-95) and I-66 provide additional insights into travel behavior at a more detailed level. The impacts of changes in travel mode, mode of access, and automobile occupancy in affected corridors also provide new information and serve as a new data base by which models and forecasts can be compared to real-world behavior.

TRAFFIC-COUNT AND CORDON DATA

A continuing traffic-counting program to detect change and to provide the data needed to compare with that from simulations is also essential. COG/TPB experience is that such counts are invaluable, especially counts of all person trips entering the central area by mode of travel. This is done yearly through a cooperative program with the state transportation agencies and the transit authority. This program has been expanded to include travel across the Capital Beltway (I-495) on a periodic basis as well. Additional cut lines are desirable, especially in a nonradial direction.

SUMMARY AND CONCLUSIONS

Based on COG experience, census journey-to-work data supplemented with small-scale automobile use or telephone home interview surveys and with roadside interviews to obtain data on travel into and through the area can serve as a relatively low-cost basis for verifying and updating travel models and for modifying forecasts. Before-and-after studies of changes caused by the opening of major transportation facilities are valuable supplements to such a data effort. The recommendations listed at the beginning of this paper still appear valid for application to supplementing census data in large urban areas.

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