

The Journey-to-Work in the Context of Daily Travel
For the
Census Data for Transportation Planning Conference

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Executive Summary

The commute trip bears an importance to transportation planning far beyond simply its share of total travel. Commuting is regular in its frequency, time of departure and destination—and, for most communities, it is highly concentrated in time and space (some call this congestion). Commuting is still predominantly a weekday activity, tied to the morning and evening hours, and has historically defined peak travel demand, and in turn influenced the design of the transportation infrastructure. Work trips are also critical to transit planning, and help determine the corridors served and the levels of transit service available.

The characteristics of the commute for most Americans depend on the demographic characteristics of the worker, the supply and location of jobs and housing, and the availability, cost and convenience of various modes of commuting. The work trip is often the longest trip of the day, and the environs of the workplace provide a sphere of activity that anchors much of our travel, either in stops we make between home and work or in trips we make around work. The increasing time spent in travel to and from work influences the mode of travel and the propensity to make non-work related trips in the remaining time after working and commuting.

The commute trip is so important in understanding people's daily travel that information about the commute has been included in the U.S. decennial Census (in the long form) since 1960. This rich source of data over 40 years has been invaluable in understanding trends that impact commuting, such as:

- Growth of the single-person household and the advent of working women
- Sprawl of residence and workplaces in suburban areas
- Explosion of vehicle ownership
- Drastic increase in private vehicle use
- Significant increases in commute times in all large metro areas.

Going forward, as the Census long form transitions into the American Community Survey, transportation planners hope to continue to be able to use the data at very small geography, but far more importantly, given the recent trends in overall travel patterns, they are wondering if focusing exclusively on work travel will be sufficient to plan for future travel in America. This paper uses the long form data provided by the decennial Census in conjunction with the National Household Travel Survey (NHTS) data to look at the trends pertaining to the journey to work, and to try to address some key issues.

Findings:

The work trip is as important as it has ever been. The number of work trips has risen with the number of workers. Nearly 70 percent of the people aged 16 and older are in the workforce, which is 46 percent of the total U.S. population. (p. 6) Of the total population, the proportion of workers has increased from 37 percent in 1970, when the baby boom generation was just entering the workforce and many women did not work outside the home, to about 46 percent in the last decade of the century.

Workers travel about 12 miles more each day than non-workers, accounting for almost 2 billion more miles a year than non-workers. Work travel still is predominantly a weekday activity (p. 8) and more than 90 percent of work travel is on weekdays.

Commuting, whether direct trips to and from work or tours (which includes stops made on the way to or from work), contributes heavily to the peak period congestion experienced by many. More than half of the departures for work are between 5 am and 8 am. There is some evidence of peak spreading, perhaps as a response to congestion. (p.10)

However, work travel is a shrinking share of overall travel. Trips for non-work activities are increasing faster than work trips—there is more travel for family and personal errands, shopping, and social and recreational purposes. (p. 13) Work trips have gone from 25 percent of overall travel in 1969 to 16 percent in 2001.

Importantly, however, many non-work trips are planned around the work trip, such as dropping children at school or daycare. Real life examples show that the time, location, and frequency of these other trips can be dictated by the work trip as people respond to the pressures of work and home (p. 37). This paper shows that we need greater detail on the geography of stops made during commutes, and how these stops are affecting the work trip.

Other trips that are regular in frequency and location are linked to the workplace, such as trips out to lunch. Fifteen percent of all weekday workers make a trip to and from the workplace while at work, 43 percent of those trips are between 11 am and 1 pm, and another 35 percent between 1 pm and 6 pm.

The traditional enumeration of home-based work trips (often used in planning) counts only trips directly to and from work, without intervening stops. More than half (54

percent) of weekday commuters stop for a non-work purpose (such as to drop a passenger or shop) during their commute. Using Census journey to work flows as the only data for HBW trips may bias results (p. 21). However, the high sample size associated with the Census journey to work allows the analyst to get a more realistic picture of commuting patterns (p. 30).

Using the concept of a tour allows us to capture more travel that is linked into the commute, and better measure the time and distance that workers spend commuting. In an average weekday, workers spend about 100 minutes in travel of which 45 are in work tours. (p. 21)

The time spent at work and traveling to and from work pushes non-work activities and trips into the periods outside of work time, evidenced by the growth in pm peak traffic. However, workers with very long commutes spend less time in non-work travel on their workday. (p. 26)

As the baby-boomers move into retirement, planners expect work trips to decline precipitously. In fact, “retired” people are making more work trips than ever. “Retired” people ages 55-59 in 2001 made nearly half of the weekday work trips per person of non-retired people in the same age category. (p. 40)

Although the National Household Travel Survey (NHTS) series allows us to measure the impact of the growth in non-work travel and activities, it cannot be used at small geography. This is a particular limitation in understanding travel by local modes, such as walk and transit. The benefit of the Census long form, and in the future the American Community Survey (ACS) data is in the fine geography—analysts can link land-use and the local transportation system characteristics to the worker residence and workplace location.

The Census asks about the location of home and work, and about the usual travel to work—the location or usual travel for other purposes is not obtained. In addition, the frequency and details of the trip to work are unknown from the Census. However, building on the fine geography of the Census and using the data on travel characteristics from a traditional travel survey like the NHTS, can help inform a many-layered analysis.

The journey-to-work data are still relevant and needed for small-area reporting, and are widely used by transportation planners and analysts. There is a particular need for these data in areas that do not have a local, current household travel survey.

Introduction

This paper uses the decennial Census, which contains 6 questions related to the journey to work for a large sample of workers (about 1 in 6 households receive the long form), and the National Household Travel Survey (NHTS), which contains data on all trips for all purposes for a small sample (about 1 out of 1500 households are represented). The use of the two surveys together allows comparisons of travel to work, and within the NHTS, the relationship of the work trip to non-work travel for workers.

The main objective of this paper is to examine the work trip as part of daily travel for workers. Over time the proportion of travel directly to and from work has declined, and the nature and reason for this decline are presented. The work trip has also become more complex as non-work trips are linked into commutes, trips so common now that they are part of the fabric of most American's commutes--dropping children at school, returning videos, buying a cup of coffee, or stopping at the grocery store to pick up dinner.

Some of these trips are regular daily stops, some are scheduled and recurring but not daily, and some are infrequent. The Census asks about how workers 'Usually' traveled to work 'Last Week'. We do not know how respondents measure the 'Usual' travel to work—do they include regular daily trips that add time to the journey to work, or do they respond for a direct trip? Recommendations from this research include conducting some cognitive testing to parse out how respondents measure their 'usual' travel to work in replying to the Census questions.

On the other hand, the NHTS obtains individual travel for a single day, across all days of the year. Therefore the frequency or regularity of stops over a week or month is unknown due to the short time frame of the travel diary. Luckily, the NHTS obtains data comparable to the journey-to-work questions from the Census, which allows us to see the differences between what respondents report as the 'usual' mode and travel time to work and what that same worker does on a single day.

This analysis looks at the enumeration of the workforce from a number of sources, and discusses the probability of a worker to make a work trip on any given day. Not every day is a workday, and not every worker goes to work on each workday. The Census includes workers who worked even 1 hour "Last Week", while the single reporting day of the NHTS means that we do not know, especially for part-time workers, what the regularity of their work travel might be across the days of the week. Although analysis by day of the week is presented here from the NHTS, because the travel is obtained for a

single day each day is a different pool of workers (the NHTS data were weighted by day of week).

Further analysis compares the travel day data and the Census journey-to-work data, which asks about ‘usual travel last week’ for three major variables: the mode of travel for work, the departure time and the distance. Trends in mode are examined focusing on the multi-occupant vehicle trips and dividing these into carpool and ‘Fam-pool’ (where all members on a work trip are from the same family).

A number of trends in commuting are examined, using Census data from 1990 and 2000 in comparison with survey data from 1990, 1995, and 2001. First we look at the absolute number of trips (based on movement from one address to another), and the trends in the trip purpose most often compared to the Census journey-to-work (home-based work trips). Work tours—that is the total travel between home and work, including stops for non-work purposes along the way—are introduced and the trends in the time and distance in commuting is analyzed using trips and tours.

To illuminate the importance of geography in transportation planning, this paper includes a case study using a supplemented sample of the NHTS for Albany, NY. This case study compares the coverage and resulting work-trip flows in Albany from the NHTS and the CTPP, and uses a few of the sampled workers to illustrate the types of trips workers make during the commute and around the workplace.

Again, focusing on the importance of geography, the differences between the ACS and the Census long-form data is described to help illuminate future issues. The paper concludes with suggestions for further research.

Who is a Worker?

The enumeration of the workforce is not straightforward. The decennial Census asks whether the person did any work for pay or profit last week. The NHTS 2001 followed the same series of questions, but unlike the Census, which was conducted in April, 2000, the NHTS samples a single day for each household with the sample days spread over an entire calendar year.

The difficulty in determining who is a worker is illustrated by Table 2. The CTPP estimate and the Census 2000 fall at the low end, whereas the NHTS estimate is the highest.

All sources of employment data have shown an increase in the proportion of workers who are in the workforce over the last decades. For instance, the decennial Census shows an increase in the percentage of the population in the labor force (Statistical Abstract Table 587, p. 385), from 62.8 in 1990 to 64.4 percent in 2000. Likewise, the NHTS data series shows an increase from 64.7 percent in 1990 to nearly 70 percent in 2001. The increase in the proportion and number of workers in the U.S. will mean an increase in the number of work trips.

Table 2 – Number of Workers (thousands)

Source:	Employment in Thousands
CTPP	128.3
Census (Apr 2000)	129.7
CES (Apr 2000)	131.7
CPS (Apr 2000)	137.3
NHTS*	145.3

*The NPTS/NHTS was conducted 2001-2002

Research has shown that the 2001 NHTS has a consistently higher estimate of workers than the Census, both nationally and at the County Level (Nathan Erlbaum, “A Quality Assessment of the 2001 NY State Add-on Data”, 2004). Trying to explain the differences, Erlbaum stated:

“The concept of worker in the NHTS shows that many people do not have full time or part time jobs and do some other type of activity during the week, yet they would report that they work and are compensated. This type of questioning may explain some of the problems between the decennial Census and the Current Population Survey, as well as illustrating the effects of differences in question wording, survey instrument design and administration, the difference between

“job” and “worker” for the respondent, [and] the impact of effect variables that are not controlled for...”

The differences in estimates may also be due to sample error and coverage (especially in the NHTS), seasonality in the workforce, or other factors. However, if we look at only people who answered that their “Primary Activity Last Week” was work, the 2001 NHTS counts 126 million workers compared to the Census count of 128. Another 9.8 million NHTS respondents answered that they were not a worker, but did some work for pay or profit last week. The remainder of the NHTS worker sample said their primary activity was to be a student or homemaker, retired, or “doing something else”. The NHTS may obtain more temporary, seasonal or part-time workers, or people may describe themselves as workers or making a work trip when they are going to a regular volunteer or other unpaid activity.

On the other hand, the decennial Census reports as “workers” people who were 16 years or older and who were AT WORK during the reference week (including people in the Armed Forces, who are excluded from NHTS).

What is a Usual Day?

Just as difficult as comparing the number of workers in the Census and the NHTS is comparing the travel to work. The Census counts workers, not work trips, and provides flows between residence location and work locations. But not every worker makes a work trip on a ‘usual’ day, as shown by the NHTS.

Since the NHTS represents a calendar year, on any given day 53.2 percent of workers make a work trip, and 46.8 percent did not. Of the 365 days of the survey, 261 are weekdays (71.5 percent of all days), about 240 average workdays excluding holidays and vacation (about 66 percent of all days). If one adds a typical absentee rate of 15 percent on any given workday, altogether we would expect about 56 percent of workers to make a work trip on any given day of the year. So the 53 percent of workers making a work trip in the NHTS sample is still slightly low.

The annual work trips per worker look reasonable, but the daily work-trip rate is low, as shown in Table 3.

Table 3 - Number of Work Trips, 1990 and 2001 NPTS/NHTS

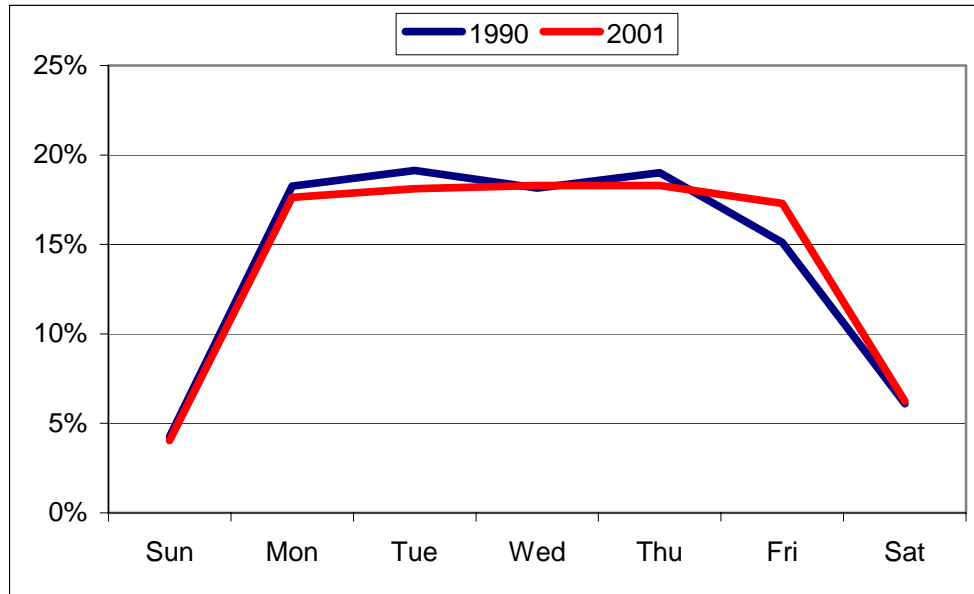
	1990 NPTS	2001 NHTS
Workers as % of pop 16+	64.7%	69.8%
Work Trips (millions)	50,314	60,690
Annual Work Trips/Worker	425.2	417.8
Daily Work Trips/Worker	1.16	1.14

One reason for the low percentage of workers making work trips could be related to the probability of the worker making a travel trip on the assigned travel day is almost always smaller than the probability of the worker making a travel trip on **any** weekday. The decennial census measures workers as anyone who goes to work for pay or profit (for even an hour) during the “usual” week. As mentioned earlier, 90 percent of the work trips are made on weekdays in the NHTS, but 29 percent of the sample days are weekends.

In 1990 the average number of *weekday* work trips per worker is 1.46 compared to 1.44 in 2001, using the coding for trips to and from work. Of the workers who made a work trip in the NHTS, around 90 percent of the person trips to work, vehicle trips, person miles, and vehicle miles were made on weekdays.

There may be a perception that the move toward a service economy is dramatically changing the amount of commuting to work during the average weekday or traditional peak periods. Looking at the distribution of commuting by day of week for 1990 and 2001 NHTS (Figure 1) shows a consistent high percent travel to work occurring Monday through Friday. The 2000 Census found that nearly 72 percent of workers departed for work between 5:00 and 9:00 am.

Figure 1 – Commuting to Work by Day of Week, NPTS/NHTS



Since the NHTS asks about the usual mode to work in a question similar to the Census, it is possible to construct a table of workers by the usual mode and the actual mode used on the travel day. This comparison between the usual and the actual allows us to see the mode loyalty, or variation in the mode to work between a ‘usual’ week and an actual sample day.

Table 4 shows the usual mode reported by the respondent for “Last Week” and the mode of travel to work for the work trip on the travel day from the 2001 NHTS. The diagonal shows the percentage of workers for whom the sample day matched what they reported as their usual mode to work.

For example, Table 4 shows that 8 to 10 percent of the workers who usually use non-carpool modes actually were in multi-occupant cars on the travel day, while for 75 percent of carpoolers the sample day matched the usual mode to work. On the other hand, 22 percent of workers who usually carpool drove alone on the sample day.

Table 4 – Percent of Workers by Usual and Actual Mode to Work on Travel Day, 2001 NHTS

Usual Mode is:	On Travel Day Took:				
	Single Occupant Vehicle	Drove with Others	Transit	Walked	Biked
Drove Alone	90.0%	9.3%	0.2%	0.3%	0.1%
Carpool	22.2%	74.8%	1.0%	1.4%	0.4%
Transit	7.8%	9.7%	69.4%	10.1%	0.5%
Walk	8.1%	9.2%	2.6%	79.5%	0.2%
Bike	6.7%	8.4%	1.7%	6.1%	77.1%

Source: “Journey to Work Trends in the United States and its Major Metropolitan Areas, 1960-2000” FHWA-EP-03-058, Nancy McGuckin and Nandu Srinivasan, 2003)

Departure times to work, using Census percentage of workers who report that they ‘usually’ leave for work at the stated time and NHTS work trips on the sample day (weekdays only) pretty closely match, as seen in Table 5. Unfortunately, the NHTS does not ask when the worker usually leaves for work, so comparisons between the usual and actual behavior are not possible. It would be very interesting to see if people usually leave at the same time as they report, or whether people who make complex tours on the sample day depart at times far from their ‘usual’ time.

Table 5 - Comparison of Census Departure Time and NHTS Departure Time

	Census	2001 NHTS
5:00 – 6:59am	26.2%	25.0%
7:00 – 7:59am	29.9%	28.4%
8:00 – 8:59am	15.5%	16.0%
9:00 – 9:59am	5.3%	5.6%
All Other Departure Times	19.8%	25.1%

According to the decennial Census, travel-time distributions show that the percentage of workers with long commutes is growing, adding to the travel time increase between 1990 and 2000. In 2000, 15 percent of workers usually traveled 45 minutes or more compared to 12 percent in 1990. Overall commutes are taking longer, in the Census data travel times to work in 2000 average 25 minutes and 30 seconds, increasing on aggregate over 2 minutes from 1990 (JTW Report reference).

Some of the growth in travel time may be because commutes are getting longer, and longer commutes can be more variable. Table 6 shows the usual and actual time to work for workers in the NHTS sample, and the diagonal boxes show the percentage of workers whose report of the usual travel time to work closely matched (in 10-minute bands) the actual travel time on the workday.

For example, Table 6 shows that the variation between the usual and actual travel times gets larger as the travel times grow longer—71 percent of the workers with commutes of less than 10 minutes actually spent less than 10 minutes commuting on the travel day. Almost the reverse occurs for people with commutes of 50 to 60 minutes—only 31 percent of those workers actually spent 50-60 minutes commuting on the travel day.

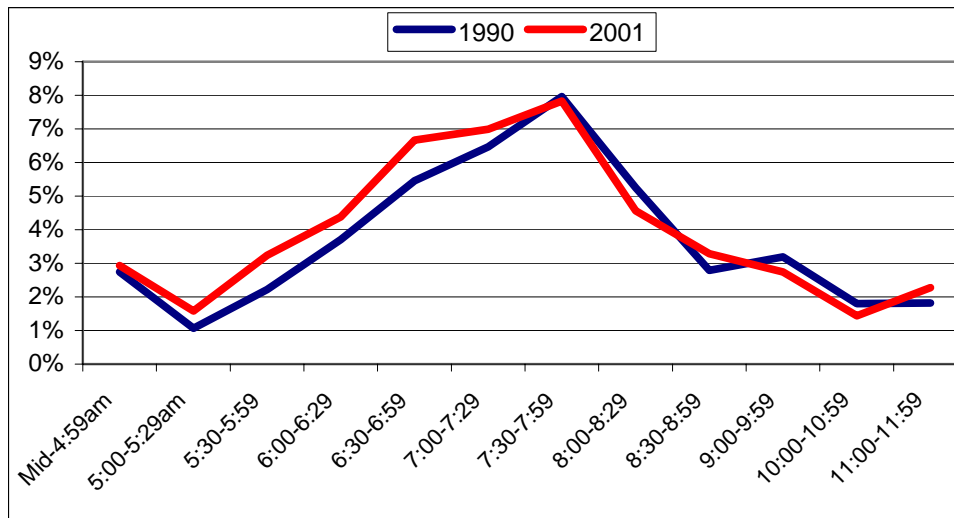
This shows that longer work trips can be more variable in terms of time of arrival, and therefore although departure times may be rather consistent, the amount of time the worker is on the road and the arrival time for these people with long commutes may be less predictable.

Table 6 – Percent of Workers by Usual and Actual Time to Work on Travel Day, 2001 NHTS

Usual Travel Time (mins) is:	Work Trip on Travel Day Took (Number of Minutes):						
	Less than 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60+
< 10 mins.	70.9 %	23.1%	2.8%	1.7%	0.5%	0.1%	1.0%
10 – 20	10.4%	71.3 %	12.5%	3.7%	0.9%	0.2%	1.1%
20 – 30	6.8%	17.0%	51.6 %	19.1%	2.9%	0.7%	1.9%
30 – 40	6.2%	10.8%	13.2%	53.0 %	12.1%	1.8%	3.0%
40 – 50	5.3%	8.4%	6.2%	16.7%	42.1 %	8.9%	12.4%
50 – 60	6.1%	10.0%	5.6%	5.8%	17.6%	31.0 %	24.1%
60 +	4.8%	8.5%	4.3%	4.8%	7.5%	6.2%	64.0 %

There are indications in the NHTS data and in the patterns discernible from the Census that, perhaps as a product of shifting work patterns or congestion, the proportion of early morning commutes is growing. Using the actual departure times for work from NHTS, Figure 2 shows that both the AM and PM peaking characteristics of commuting seem to be dispersing.

Figure 2 – Percent of Work Trips by Time of Day, NPTS/NHTS



This section looked at the variability of travel between a ‘usual’ week and a single sample day. The major factors related to work travel, such as mode, departure time to

work, and trip length were examined, and the decennial Census ‘usual’ work trip closely matches what respondents report on a diary day. The next section describes the proportion of work trips out of all trips, and the reason for that proportion’s decline.

What Proportion of Daily Travel is for Work?

Over the last 35 years the NHTS data series shows that travel has increased dramatically, but the increase in work trips has not kept pace with the increase in recreation, errands, and shopping (see Figure 4 on page 13). Work as a proportion of all person trips (movement from one location to another) has been steadily declining since 1969, when work trips were about 25 percent of all person trips and nearly a third of all vehicle miles. In 2001, work trips account for just over 16 percent of all person trips for the same population (ages 5 and over), and 27 percent of all vehicle miles. Figure 3 and Table 6 show the trends in work travel.

Figure 3 – Trends in Travel to Work as a Proportion of All Travel, NPTS/NHTS

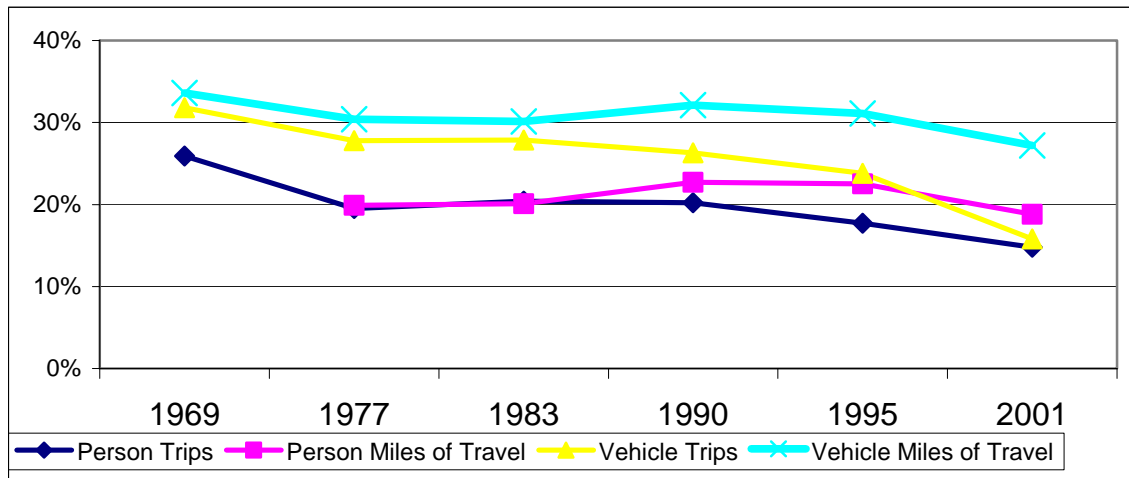


Table 6 – Trends in Work Travel as a Proportion of All Travel, NPTS/NHTS

	Person Trips	Person Miles of Travel	Vehicle Trips	Vehicle Miles of Travel
1969	25.9%	31.8%	31.8%	33.6%
1977	19.5%	19.9%	27.8%	30.4%
1983	20.4%	20.1%	27.9%	30.1%
1990	20.2%	22.7%	26.3%	32.1%
1995	17.7%	22.5%	23.8%	31.1%

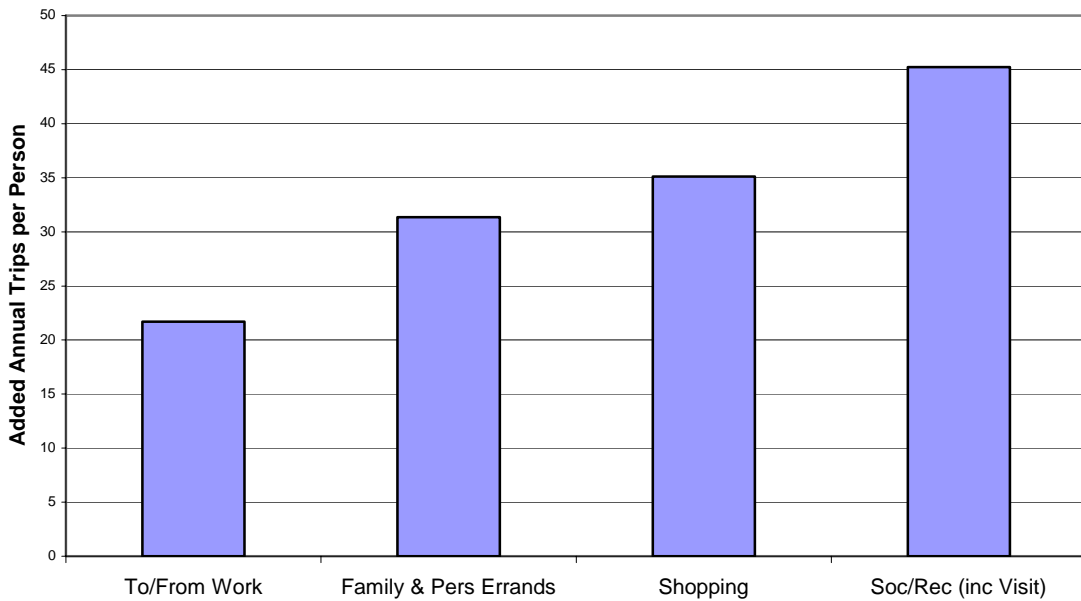
2001*	15.8%	21.3%	22.1%	27.0%
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* 2001 is for 5 and older to match previous sample populations

This decline is not the result of fewer workers—according to the NHTS data series more than 20 million workers were added in the decade. Neither is the decline a result of fewer work trips per worker—the average work trips per worker, that is trips to and from work per day over 365 days a year, is 1.14 in 2001, compared to 1.16 in 1990—virtually unchanged.

The reason for the decline in the share of travel that is for work is the added trips for other purposes that Americans are doing (Figure 4). In the space of one year, the average American adult (16 years and older) is taking 45 more trips for social and recreation, 35 more for shopping and 31 more for family and personal errands. (Plus 76 for other purposes). Of the total of 210 added trips per year, only 22 of the added annual trips are for commuting to and from work.

Figure 4 – Added Annual Trips per Person 16+ from 1990 to 2001 (NHTS)



Simply being a worker increases the probability of making more trips and traveling more miles—workers make an average of 1.7 more daily trips and spend more than 22 minutes

a day more in travel (for people 16 years and older) than non-workers. On average workers travel 12 miles more per day than non-workers, accounting for a total of 1.74 billion miles more per year.

Commuting trips, but not all travel, may decline as work at home and telecommuting become more common--the 2001 NHTS data show that weekday workers who took a work trip made an average of 4.9 total person trips on the travel day versus workers who did not take a work trip and averaged 4.7 person trips.

This section looked at the proportion of all travel that is to or from work using the NHTS, and showed that the proportion has declined in the last 30 years (in terms of the number of place-to-place trips). The next section looks specifically at trips that go directly from home to work and work to home.

What About Home-Based Work Trips?

The definition of what constitutes a work trip varies by the purpose of the analysis. Many transportation researchers, especially those creating travel-demand models, divide trip purposes into home-based work or HBW (generally to compare with the journey-to-work flows obtained from the Census), home-based other trips or HBO, and non-home based trips or NHB. All home-based trips have one end at home, so a home-based work trip is a direct trip from home to work or work to home without intervening stops, such as stops that are made during tours to work. Non-home-based trips have neither end of the trip at home.

For instance, Figure 5 shows a journey-to-work trip that would be coded as two home-based work trips.

Figure 5 - Two Home-Based Work Trips

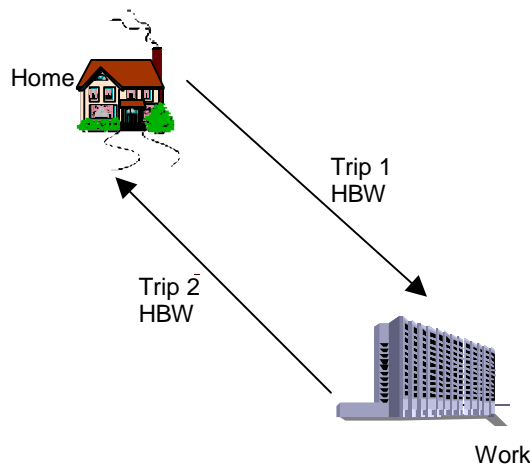
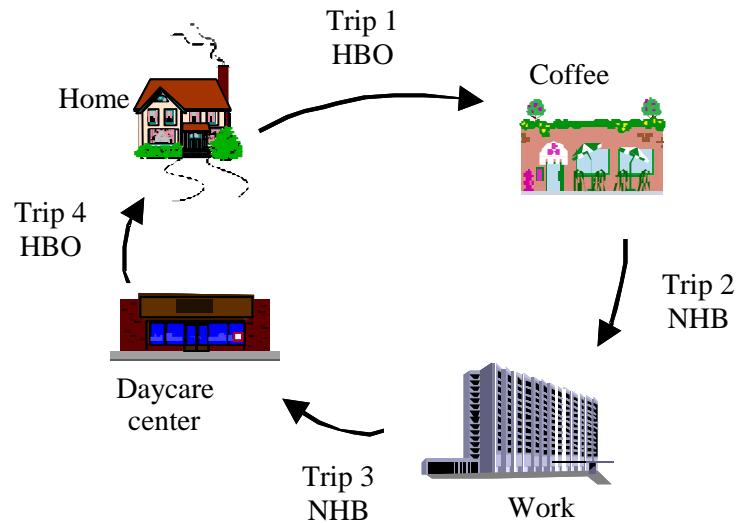


Figure 6 shows a journey-to-work trip that would be coded as 2 home-based other trips and 2 non-home based trips. However, in a tour-based analysis (which is introduced in the next section), Figure 5 would be characterized as a home-to-work tour with no stops, and Figure 6 would be characterized as a home-to-work tour with 2 intermediate stops, one before work and one after.

Figure 6 - Two Home-Based Other and Two Non-Home Based Trips



This simplified consolidation of purposes is useful in comparing trips by purpose and origin/destination, and allows us to see shifts in travel related to changes in purpose and in origin/destination. The general purposes used in this portion of the paper include:

- HBW (home-based work) is a trip with one end at home and one at work, or a trip directly between home and work
- HBShop (home-based shop) is a trip with one end at home and one at shop,
- HBSoc (home-based social and recreational) is a trip with one end at home and one at a social purpose, including visiting,
- HBO (home-based other) is a trip with one end at home and one at another purpose, and
- NHB (non-home-based) which is a trip with neither end at home.

The NHTS shows that the proportion of trips in these general purpose categories are very different on an average weekday or weekend day. The vast majority of home-based work trips occur during weekdays, and since 1990, there has been a large increase in home-based shopping and non-home based trips by the working age population that takes place on the weekdays.

Figure 7 shows the number and Table 7 shows the percentage of weekday and weekend trips by general purpose from the 1990 and 2001 NHTS for all persons 16 years and older.

Figure 7 – Number of Weekday and Weekend Trips by General Purpose for People 16+, 1990 and 2001 (NPTS/NHTS)

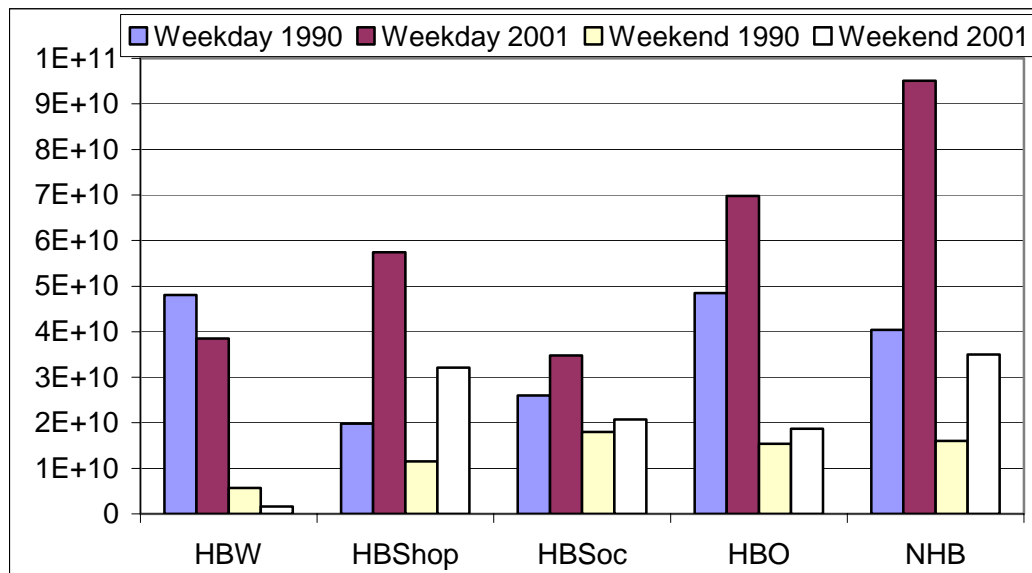


Table 7 - Percent of Weekday and Weekend Trips by General Purpose for People 16+, 1990 and 2001 NHTS

		HBW	HBShop	HBSoc	HBO	NHB
Weekday	1990	26.3%	10.8%	14.2%	26.5%	22.1%
	2001	13.0%	19.4%	11.8%	23.6%	32.2%
Weekend	1990	8.6%	17.3%	27.0%	23.1%	24.0%

2001 1.5% 29.7% 19.1% 17.3% 32.4%

As shown in Figure 7, non home-based trips accounted for 22 percent of all weekday trips in 1990 and 32 percent in 2001. Home-based shopping trips (HBShop) have also increased substantially, both on weekdays and on weekends.

Table 8 shows the trips per worker by general purpose for weekdays and weekend. The most obvious shift has been the decline in home-based work trips, both on weekdays and weekends. On the other hand, there has been a marked increase in non-home based trips on weekdays, from less than one trip per worker in 1990 to nearly two per worker in 2001 (0.93 and 1.73 respectively).

Table 8 – Trips per Worker on Weekdays and Weekends by General Purpose, 1990 and 2001

		HBW	HBO	NHB	Total
Weekday	1990	1.72	1.46	0.93	4.11
	2001	1.07	2.06	1.73	4.86
Weekend	1990	0.54	2.56	1.05	4.15
	2001	0.34	2.90	1.56	4.80

Just looking at home-based work trips, Figure 8 shows the rather drastic decline for each day of the week. Across all days the 2001 home-based work trips per worker are significantly lower than 1990.

Figure 8 - Mean Number of Home-Based Work Trips per Worker, 1990 and 2001

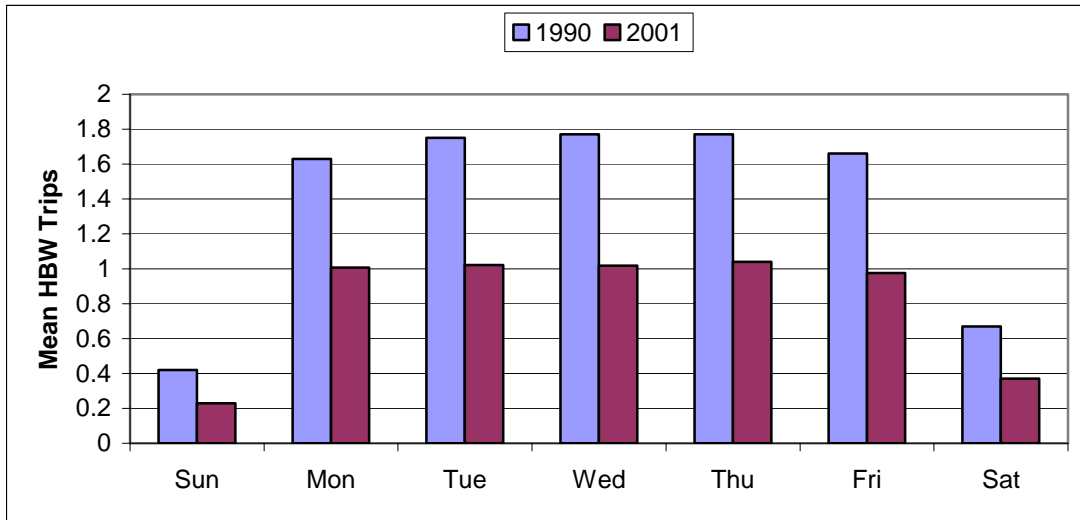
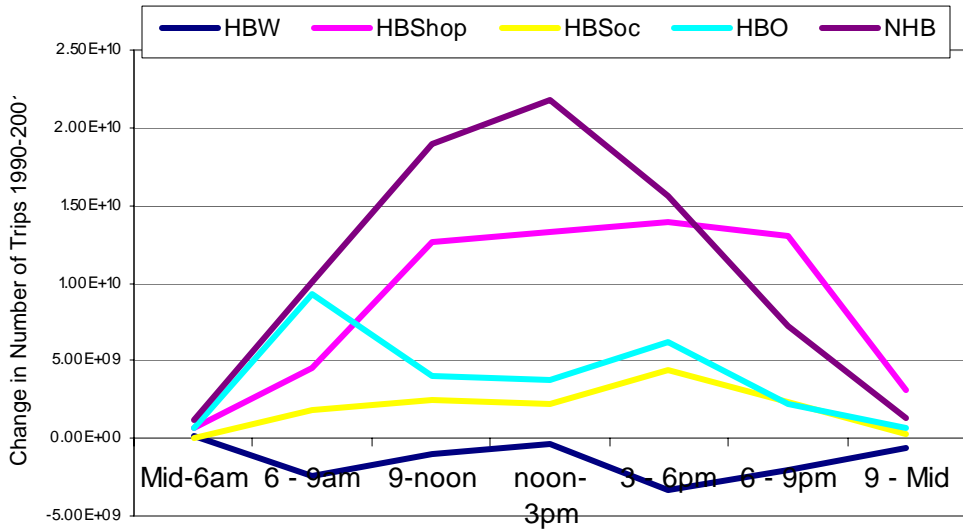


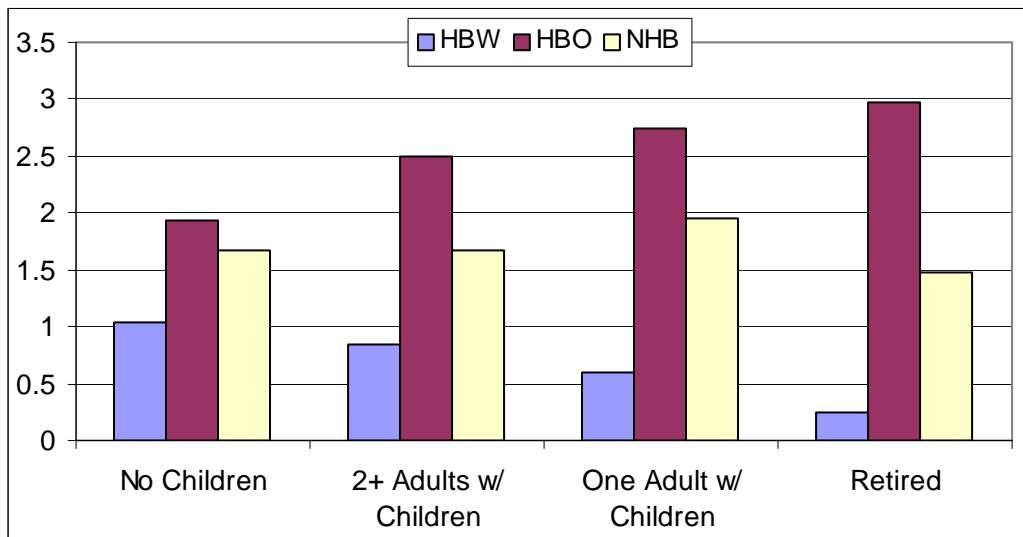
Figure 9 shows the difference in the annual number of trips by general purposes by broad time periods. In 2001, there were fewer home-based work trips in each time period than in 1990—showing the decline in the non-stop or direct trip to work and the advent of trip chaining as an integral part of American commuting. Remember that stops from home on the way to work would be coded as home-based other, and the next segment, from the stop to work would be coded as non-home based. The non-home-based trips that are added since 1990 dwarf the other purposes, especially in the midday period.

Figure 9 – Difference between 1990 and 2001 in the Number of Trips by General Purpose by Time of Day, 1990-2001 NPTS/NHTS



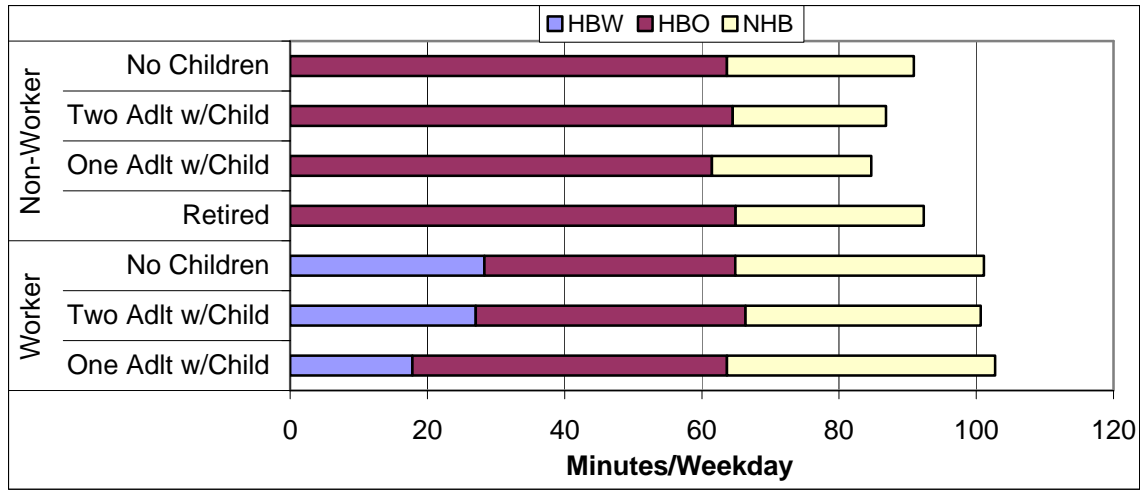
Not surprisingly, the number and type of trips vary with the lifecycle (or stage in the life course) of the traveler. Figure 10 shows the per capita trips for people 16 and older by general purpose (home-based shop, home-based social/recreational, and home-based other have been combined) and the life stage or life cycle of the household.

Figure 10 – Trips per Capita (16+) by General Purpose and Lifecycle, Weekdays Only, 2001 NHTS



The amount of time spent in travel by workers on weekdays hovers around one hundred minutes for all trips and all modes. The proportion of time spent in home-based work, home-based other, and non-home-based travel is rather different based on the life cycle of one's household as shown in Figure 11. Single people and couples without children spend the most amount of weekday travel time in their commutes, and single parent households with children spend more time in non-home-based travel.

Figure 11 – Number of Minutes/Weekday Spent in Travel by Purpose and Life Cycle



The increase in non-home-based travel, including the intermediate stops on the way to work, undermines the ability of the home-based work trip to represent commute behavior, since it is by definition a non-stop trip. About half of weekday commuters stop for some purpose on the way to or from work. That is one of the reasons many travel-forecasting models are turning toward using tours, which incorporate a series of trips, as the unit of analysis.

The commute pattern of workers continues to determine the location and time of other activities—the location of work anchors some trips and the location of home anchors others. The timing of these trips, location of the stops, and even the need (for instance, dropping children at daycare), is determined by the time and location of the work trip.

In our analysis, non-home-based trips are the only type of general purpose trip that are correlated with home-based work trips (Pearson’s correlation significant at the 95 percent significance level). Non-home based trips, with neither end at home, can be trips made on the way to or from the work place, and trips (such as lunch trips) that begin and end at the workplace. The next section looks at work tours as the unit of analysis.

What About Work Tours?

The pressure of time is a major factor in the travel choices people make today, perhaps more than the pressure of the rising fuel costs in the late 1970s. Consolidating trips has been called “trip chaining” and the entire course of travel, regardless of the number of links in a chain between two anchor points such as home to work, is often called a tour. Travel forecasters are well aware that the commute is becoming more complex and interspersed with trips for other purposes, such as to drop children at school or to stop at the grocery store on the way home from work.

In this section the term work tours include direct home-based work trips and trips that are from home to work or work to home but have stops along the way. Previously published research has used the definition of a tour as incorporating stops of 30 minutes or less, however for this research no dwell-time rule was incorporated.

Any travel between home and work, regardless of the number and/or length of the intervening stops, was included in this analysis. The weakness of using this approach is that trend data are not available, since work tours without dwell-time rules were not created for previous data sets of the NHTS.

The majority (54 percent) of weekday workers stop during their commute when all tours, without regard to the amount of time spent at intervening destinations, are included. Table 9 shows the miles and minutes of travel for all workers who reported a weekday work trip that was spent in work and non-work travel. Non-work tours are the series of trips that begin at home, have one or more trips that are not to work, and return home.

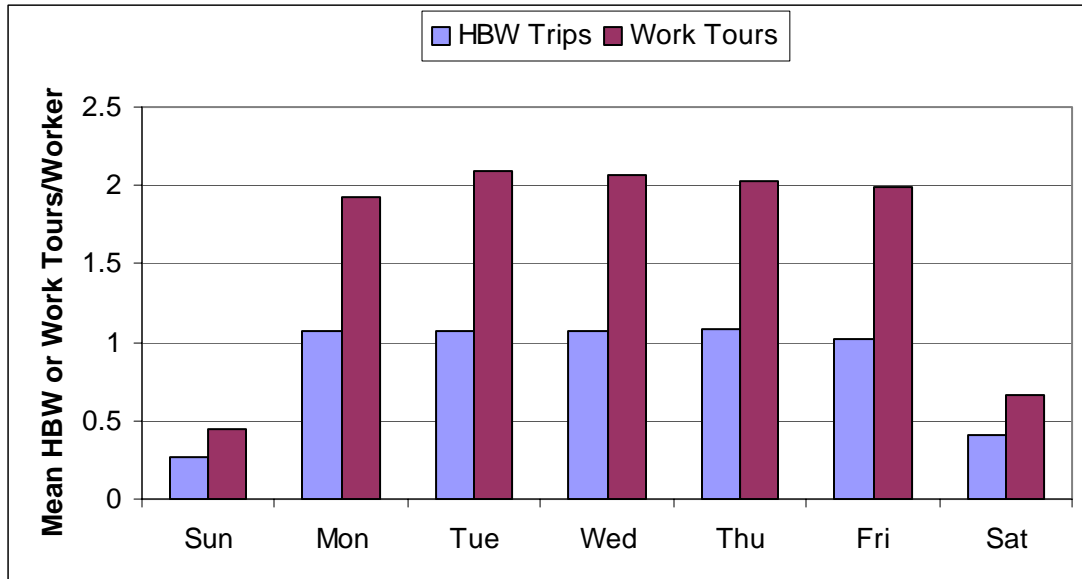
Table 9 –Weekday Workers in Work- and Non-Work Tours, 2001 NHTS

Made Non-Stop Home-Work and Work-Home Tours	46%
Made Work Tours with a Stop of any Duration	54%
Number of Weekday Work Tours	2
Weekday Miles in Work Tours	22

Weekday Miles in Non-Work Tours	31
Total Miles per Worker on a Weekday	53
Weekday Minutes in Work Tours	44
Weekday Minutes in Non-Work Tours	56
Total Travel Time per Worker on a Weekday	100

The mean number of home-based work trips and work tours per worker by day of the week are compared for 2001 in Figure 12. The HBW trips for 2001 shown here are the same as those shown in Figure 9 in the previous section (which compares HBW trips from 1990 and 2001), but here the comparison is with 2001 work tours. The work tours shown here have intervening stops of any length and for any purpose except home. Using the construct of a work tour allows us to better capture the travel of workers, with an intuitively satisfying average of about two work tours per weekday.

Figure 12 - Comparison of Home-Based Work Trips and Work Tours per Worker, 2001 NHTS



Including workers who don't stop and workers with multiple stops, weekday workers average .31 stops on the way to work and .57 stops from work to home (Table 10). The average number of stops does not vary by the size of the area the worker lives in (MSA size) as shown.

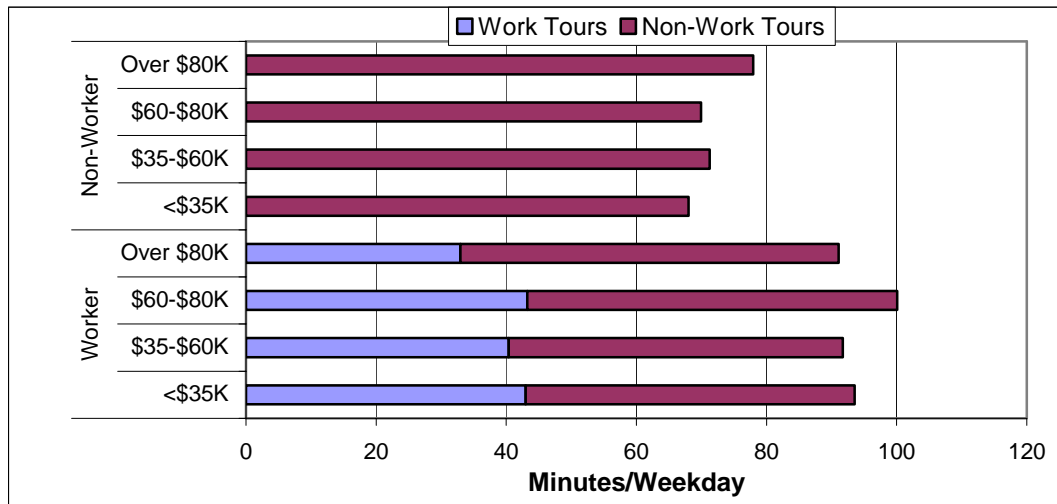
Table 10 - Average Number of Stops by MSA Size in Work Tours

	Home to Work Tours	Work to Home Tours
United States	0.31	0.57
MSA < 250K	0.31	0.53
MSA 250k - 499k	0.30	0.53
MSA 500K - 999k	0.34	0.60
MSA 1 million - 3 million	0.26	0.59
MSA > 3 million	0.31	0.52
Not in MSA	0.33	0.64

Minutes Spent in Work Tours

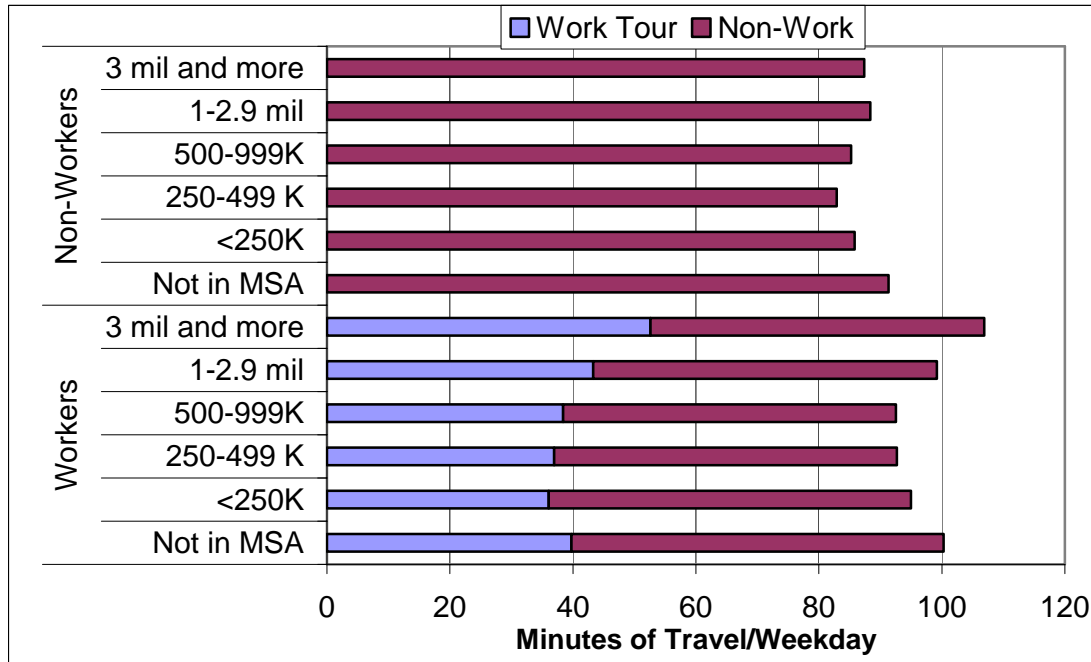
Looking at work travel as composed of tours allows us to measure the amount of time spent in work- and non-work tours by key variables, such as the size of the area the resident lives in or income (Figure 13). Higher income people spend more time in travel, whether they are a worker or not, but workers in each income group spend more time in travel than their non-working counterparts.

Figure 13 - Minutes Spent in Travel for Work and Non-Work Tours by Income, 2001 NHTS



As shown in Figure 14, workers in the largest metro areas spend the most time in work tours and the overall more total time in travel than workers in smaller metropolitan areas.

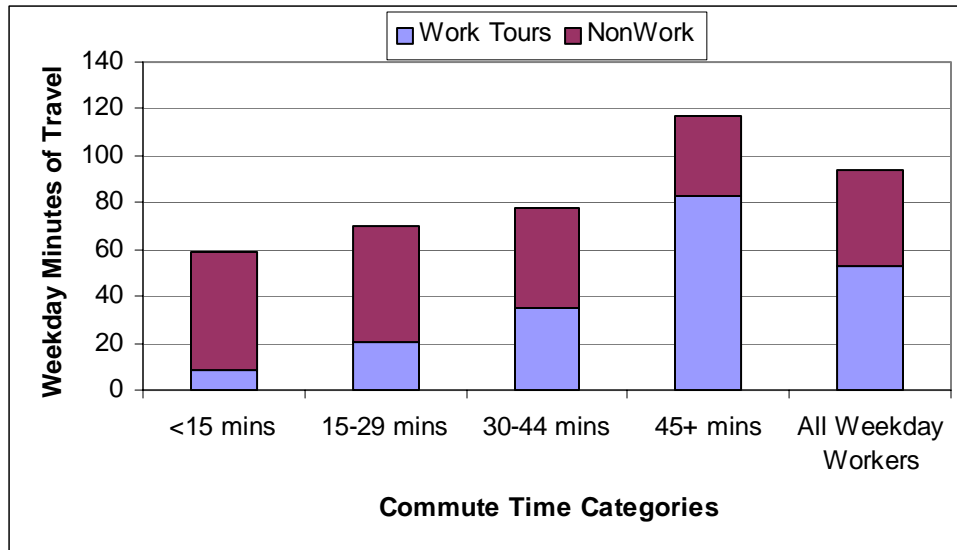
Figure 14 - Minutes Spent in Work and Non-Work Travel by Metro Area Size



There seems to be a relationship between the amount of time spent in commuting and the time spent in travel not related to the work tour. Figure 15 shows the average number of minutes per day for time in travel to work (excluding the dwell time at any stops) on work tours and the average number of minutes for travel unrelated to the commute, for workers with different commute lengths.

As shown in Figure 15, workers with short commutes (<15 minutes, for which the average is 9 minutes for the journey to and from work) average an additional 50 minutes in non-work related tours. On the other hand, weekday workers who have long work tours (45 minutes or more for the commute to and from work) average only 34 minutes a day in travel not related to the work tour.

Figure 15 - Minutes per Day in Travel in Work- and Non-work Tours by Commute Time, 2001 NHTS



This section has examined the work tour, which includes direct trips to work and commutes that have non-work stops along the way. Data was presented showing that using the concept of a work tour allows us to better understand the work trip, which often includes stops to drop or pick up a passenger, to stop at a store or coffee shop, or to run personal errands. Using work tours as the unit of analysis captures miles and minutes in commuting better than the traditional use of home-based work trips. Of the total travel by workers on weekdays, 45 percent of the minutes and 42 percent of the miles are in work tours.

The next section briefly examines the mode to work, showing the difference in estimates using work tours and direct trips to work (which are comparable to the Census journey-to-work), with an emphasis on the second most common mode--carpooling.

How Do Workers Travel to Work (or What's Happened to Carpooling?)

The private vehicle, especially driven alone to work, is the mode of choice for most Americans and, according to the Census, workers who drove increased in numbers and in share of work travel dramatically over the last decades—70 percent of workers used a private vehicle in 1960 while 88 percent did in 2000.

However, to understand worker’s choice of travel mode requires understanding a number of factors related to the individual traveler. Unfortunately, the two data sources used for this paper, the NHTS and Census, have little or none of the needed information. For instance, a worker’s decision on how to get to work obviously depends on availability, cost and convenience of the various choices. To use transit the worker must have transit service available at both the home and work end of the trip. Even walking and bicycling depend on the availability of sidewalks and bikeways. Neither the Census nor the NHTS collects information on those factors.

NHTS does not contain any information about locally available transit service, the ‘walkability’ of the respondent’s environment, or the cost of travel options. The Census has excellent information on the location of jobs and housing, and local planners can use local land-use and infrastructure data to enrich their understanding of travel modes for the work trip at the local level.

On the other hand, the NHTS has data on household characteristics and interactions among household members on the travel day. These include who the main driver of each household vehicle is, which household member drove for any particular trip, and whether other household or non-household occupants were in the vehicle. These data can enlighten us about the dynamics of vehicle use, and be especially interesting in studying carpools.

Table 11 shows the trends from NHTS in the means of travel to work. In 1990, 75 percent of the home-based work trips were in single-occupant vehicles, a share that rose to 80 percent in 2001. The work tour, however, shows only 73 percent in the drive alone category, and a robust 20 percent in multi-occupant vehicles. This makes sense since one of the largest categories for stops in home-to-work tours is to pick-up or drop-off a passenger.

Table 11 - Mode of Travel to Work, 1990 and 2001

	1990 HBW	2001 HBW	2001 Work Tours
Drove Alone	74.9	79.7	72.6
Carpool	16.3	12.3	20.1
Transit (inc. Taxi)	4.1	4.6	3.5
Walked	4.0	2.7	3.2

One of the ongoing questions about carpools is whether they are ‘formal’, such as rideshares arranged through local programs and consisting of workers from different households traveling to a central location, or consist of people from the same household or family (this latter category is sometimes called ‘fam-pools’). Table 12 shows the trends since 1990 for carpools to work that consist of one or more other family members.

In 1990, 75 percent of carpools consisted of people from the same household, which rose to 83 percent in 2001, and the vast majority (97 percent) had *only* household members on the trip. On the other hand, when we look at the 2001 work tours, including the non-stop or direct trips and those that have stops, 26 percent of the carpools to work have a non-household member on the trip.

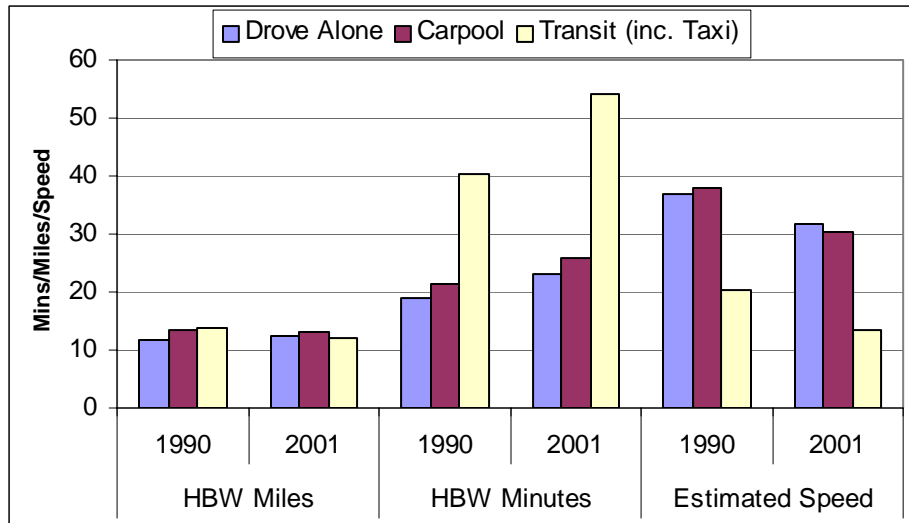
Table 12 – Percent of Carpools by Whether a Household Member was On the Trip, NPTS/NHTS

	Carpool	Fam-pool	All Multi-Occupant Vehicle Trips
1990 HBW	24.5%	75.5%	100%
2001 HBW	17.0%	83.0%	100%
2001 Work Tours	26.3%	73.7%	100%

The trends in the miles and minutes of travel to work by mode are shown in Figure 16. The data presented in this chart are home-based work trips to keep the interaction of mode and trip chaining separate (people who trip-chain are less likely to take transit, for instance).

Figure 16 shows that the time and distance for non-stop or direct work trips (home-based work trips) by private vehicle have increased a little since 1990. However, the minutes of travel for transit trips have increased from 40 to 54 minutes on average, bringing the estimated speed of the average transit trip to work to about 13 miles per hour compared with just around 30 mph for drive alone and carpool trips.

Figure 16 - Minutes, Miles and Est. Speed for Home-Based Work Trips, 1990 and 2001 NHTS



For home-based work trips the mode of travel is very different for households without vehicles, as shown in Table 13. Nearly half of the trips to work by people in households without vehicles were by transit in 2001, an increase since 1990. The number of work trips by workers in zero-vehicle households that were in carpools or by walking declined, while there was an increase in drive alone trips.

Table 13 - Percent of Home-Based Work Trips by Workers in Zero-Vehicle Households

	1990 HBW	2001 HBW
Drove Alone	6.4	10.9
Carpool	20.2	16.7
Transit	42.5	47.8
Walked	28.1	16.4

This section has briefly touched on the mode of travel for work. The NHTS is not sufficient to parse the data deeply because of the scarcity of transit and non-motorized travel modes. However, the NHTS shows that for carpools to work about three-quarters are fam-pools, with occupants from the same household.

In the next section, data from the supplemented NHTS sample in Albany, NY is examined. New York State DOT purchased additional samples of the 2001 NHTS for local and State-level analysis. Not only are there a greater number of samples at small-area geography, but the origin and destination of each trip is geocoded to latitude and

longitude. This allows anecdotal examination of the details of some example work tours with embedded trips.

Case Study – Albany, NY

The overwhelming benefit to transportation planning from the decennial Census long-form data or the ACS is that a large sample is tied to small-area geography. Although a household travel survey can illuminate the actual travel behavior of workers, including the propensity to work on any given day, stops workers may make on the way to and from work, and the impact of non-work travel and activities, the sample size is generally too small to be informative at small-area geography.

As stated previously, this is a particular limitation in understanding travel by local modes, such as walking and transit. More importantly, a small sample household travel survey counts many fewer workers' home and work locations. Because of the comprehensive geographic coverage of the Census and the flows provided through the CTPP (Census Transportation Planning Package), these data give a more realistic picture of commuting.

To illustrate the point, this section of the paper focuses on Albany, NY as a case study. Albany County had nearly 300,000 residents in 2000 in 523 square miles (562 persons per square mile). Figure 17 shows the location of Albany, NY within New York State.

The New York State supplemental sample obtained 13,423 NHTS households in the state in 2001. The mode of travel for work tours for the national sample, the State of New York, and the Albany subset trip files are compared in Table 14. The State of New York (including New York City) has a high share of transit trips, and even Albany County has a higher share than the nation as a whole.

Table 14 - Comparison of Mode of Travel for National, New York and Albany, NY

	U.S.	New York State	Albany County
Drive Alone	74.3	56.1	75.6
Carpool	18.8	13.4	14.3
Transit	3.5	19.1	6.4
Other	3.4	11.4	3.8

According to the Census, 218,715 workers work in Albany County. These workers come from areas within and outside of the state of New York. The NHTS shows 106,038

workers who reside in New York State (workers from outside the State were not available for this analysis) who made a travel day work trip into Albany, slightly less than half of the count by the Census. Figure 18 shows the employment density for Albany County from the Census. Figure 19 shows the NHTS sample of workers who work in Albany County. Each shaded tract has one or two workers sampled in the NHTS.

The NHTS 106,058 weighted workers were based on 541 sampled workers in 445 unique residence-workplace tract pairs (shown in Figure 20). In the decennial Census the high sampling rate allowed for 8,953 unique combinations of residence-workplace tracts shown in Figure 21.

The result is that when work flows are derived from the small-sample NHTS, the total number of tracts with flows are severely understated. This means that any one set of sampled flows may be overstated. This effect results from the small sample of NHTS workers who are weighted to represent many, many others—the small sample misses many residence-work location pairs, and the weighting magnifies the sampled workers' trips. The derived workflows showing the large-width bars of the overstated pairs from the NHTS are shown in Figure 22.

When the CTPP workflows are graphed the difference in the scale of the samples becomes clear. Figure 23 shows the major CTPP workflows for Albany County. In this graphic flows of fewer than 40 workers are not represented to preserve some clarity, and still the graph shows a great density of potential work flows. Nearly every possible combination of tracts with residence and work place locations are represented.

The point of this series of graphics is simply to show visually that the power of the decennial Census is that the resulting CTPP tables allow planners to evaluate workflows for small-area geographies. This attribute cannot be replaced by a small-sample household travel survey.

Figure 17 - Albany County, New York

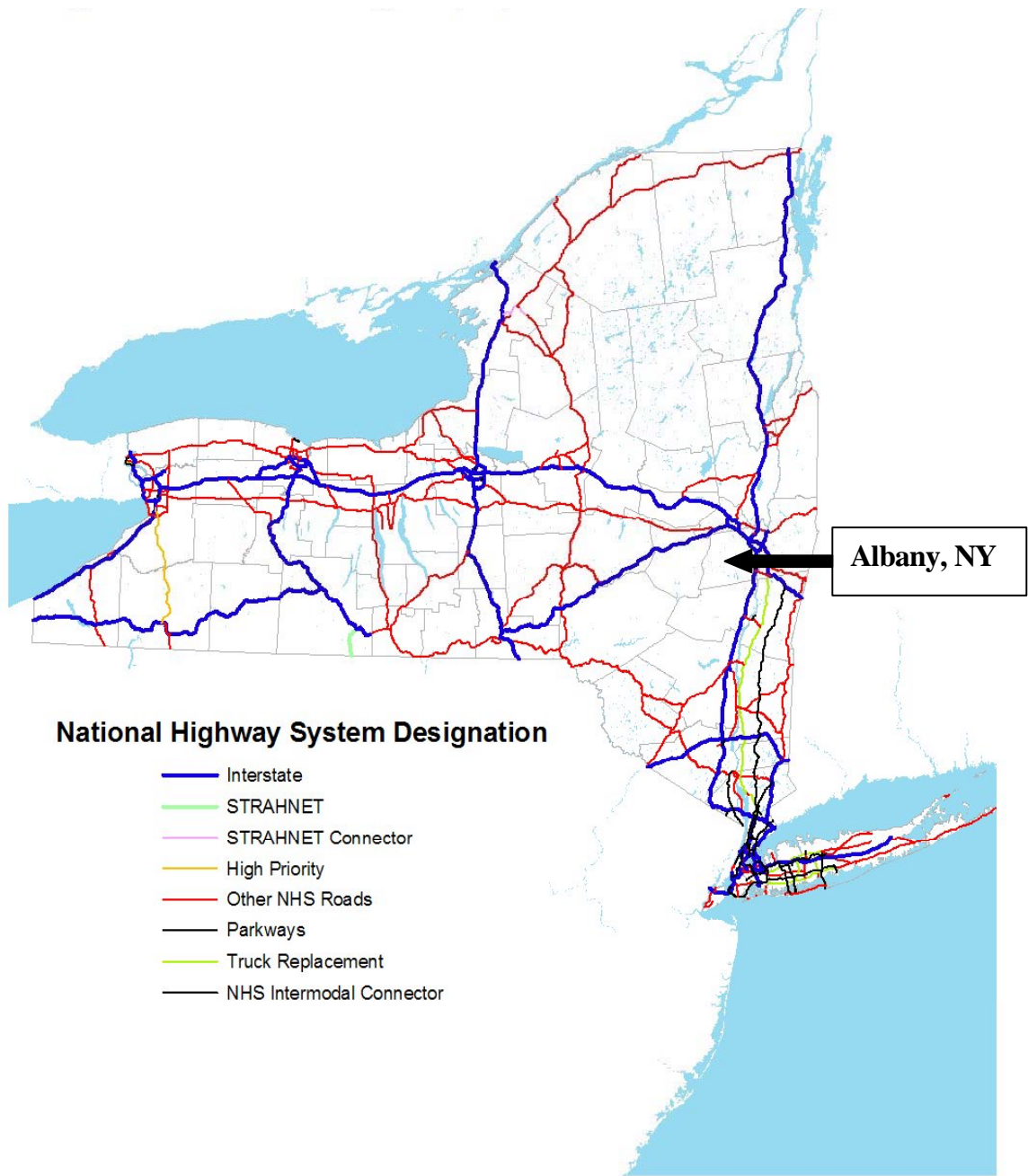


Figure 18 - Worker Density in Albany County – 2000 Census

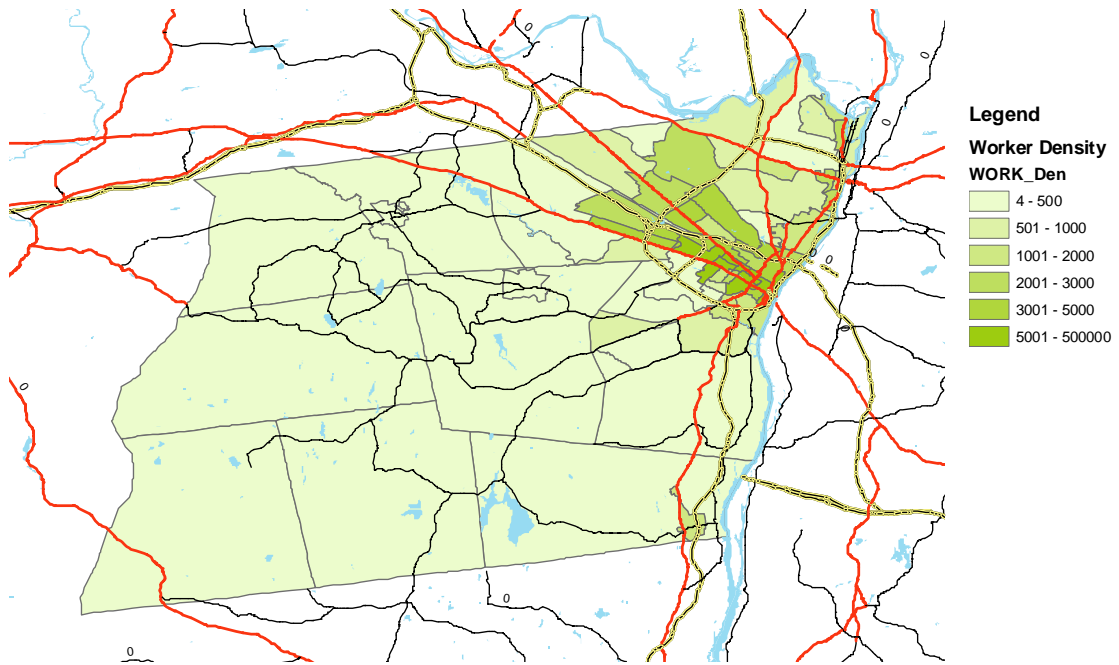


Figure 19 - Workers Working in Albany County, NHTS Sample

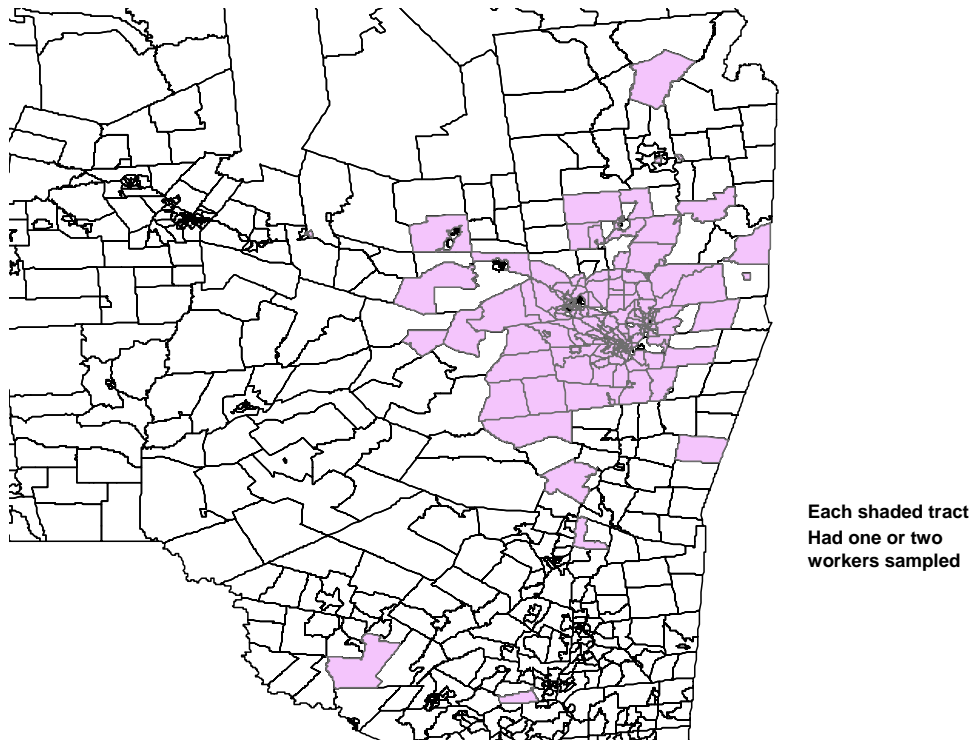


Figure 20 - NHTS Unique pairs of Worker Residence and Work Location Tracts

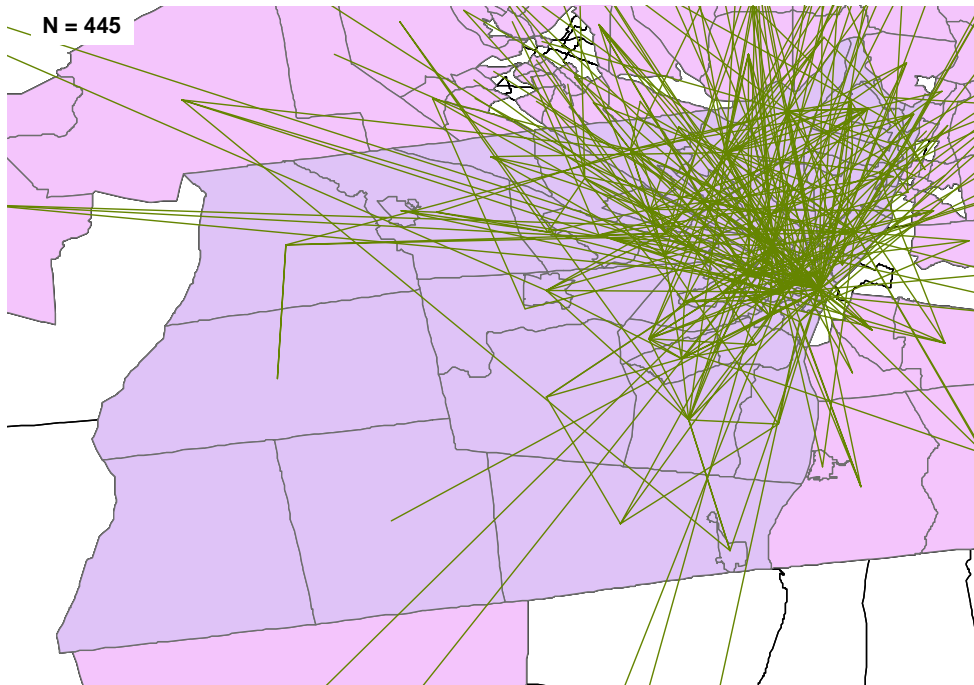


Figure 21 - CTPP Flow Pairs (Unique pairs of worker residence and workplace locations)

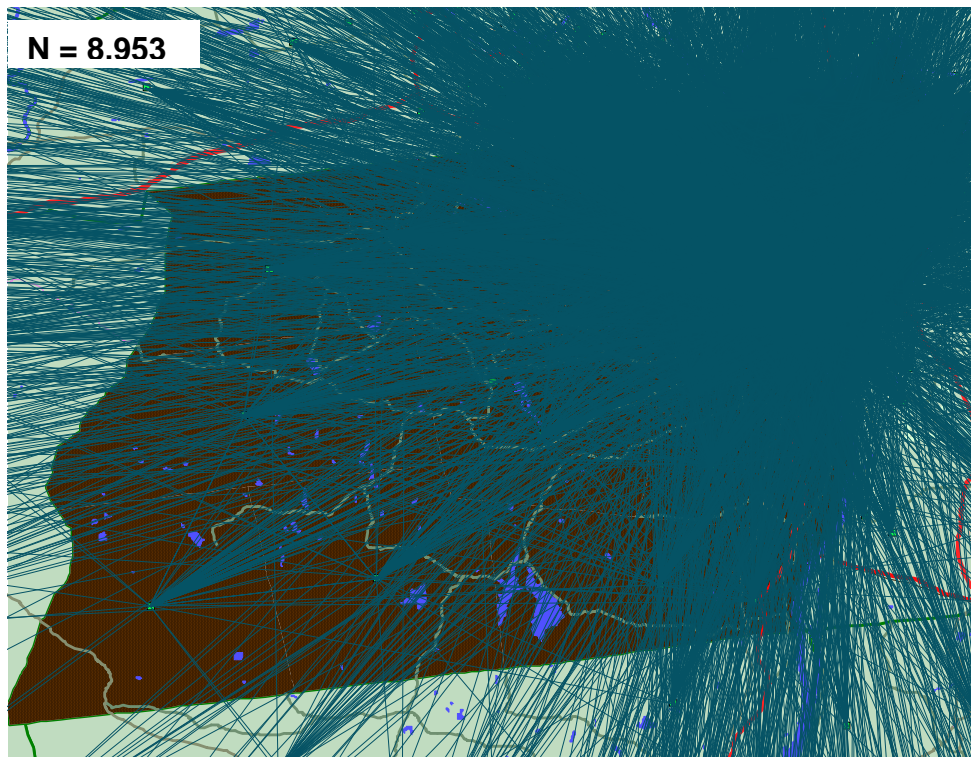


Figure 22 - Derived Home to Worker Flows from NHTS (Total Workers Trips into Albany=106,058)

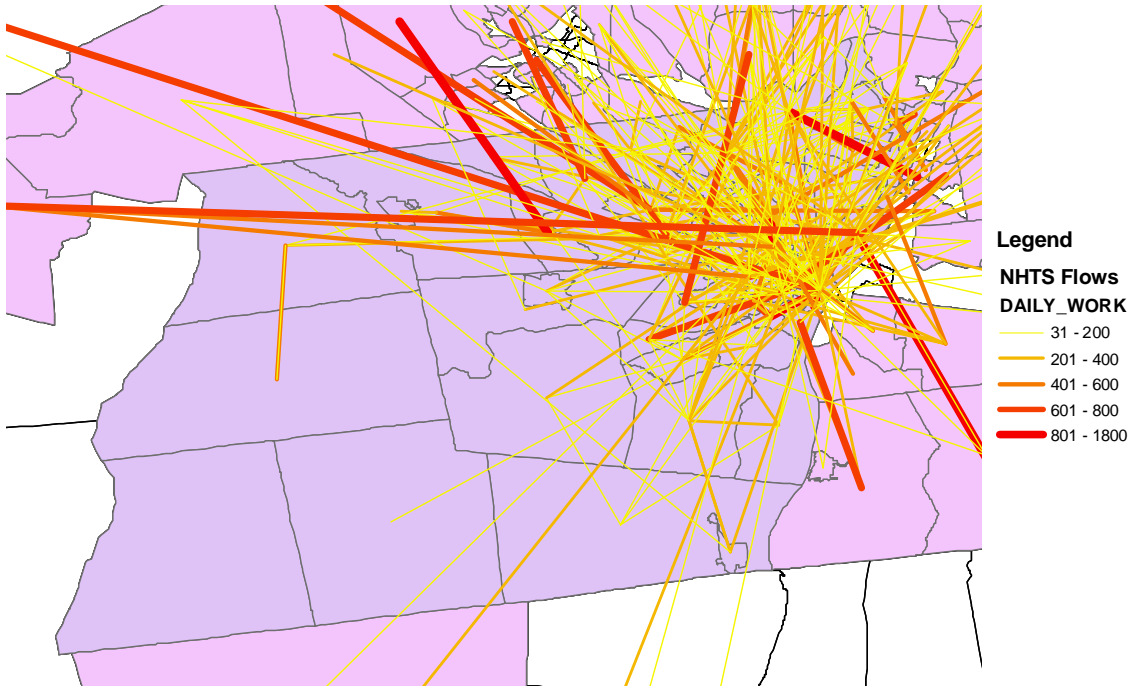
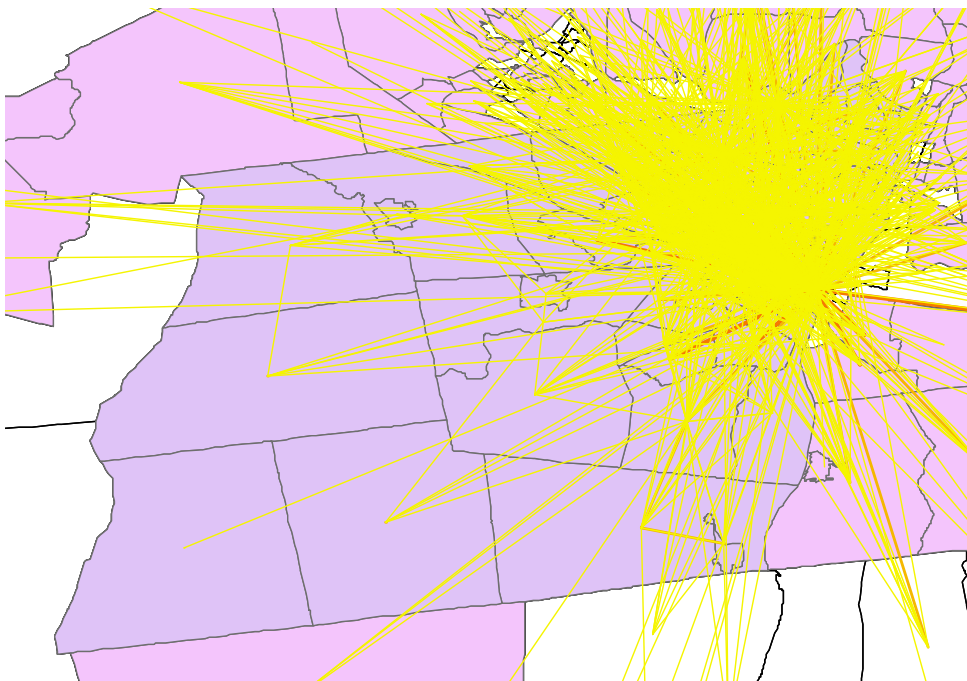


Figure 23 - Major CTPP Journey to Work Flows (Total Work Flows into Albany=218,715)

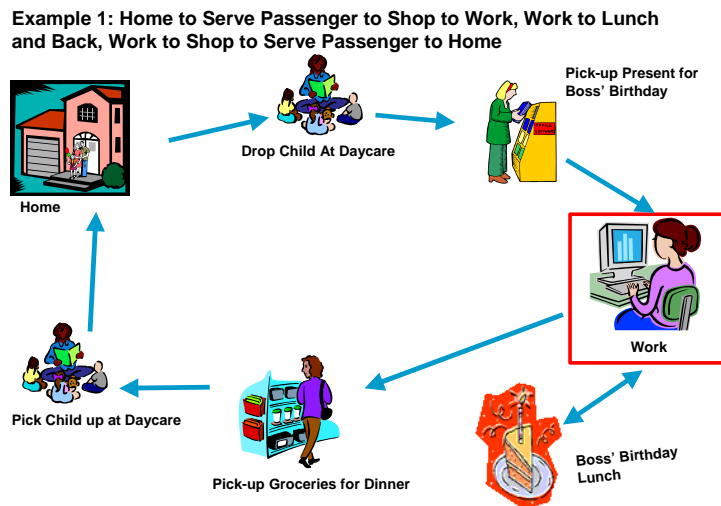


This section has illuminated the value of the small-area and comprehensive geographic coverage of the decennial Census data. The potential work-flow pairs in Albany County showed quite different patterns when the very dense sample of the CTPP was compared to the small sample of the NHTS. Clearly the value of the Census data is in the scope of the sample and the fine geographic detail.

In this case study, the data were also available to examine the types of non-work trips associated with work trips with tract-level coded trip ends. New York State DOT kindly shared the trip end data from the sample in Albany County. The geographic dataset was used to examine the characteristics of work tours with imbedded non-work trips. In this way a picture can be drawn with real-life examples. Two types of work tours were selected—the first illustrating the types and locations of stops a worker made during the commute, and second the types and locations of trips made from the workplace.

Trip chaining has been called a rational response to the burden of time and duties, such as household sustaining activities involving childcare, home-care, and vehicle-care. Figure 24 shows an example of what many planners conceptualize as a complex trip chain. Figure 25, on the other hand, diagrams the actual trips from a complex tour selected from the Albany area. The map of the daily travel of this respondent is shown in Figure 26.

Figures 24 and 25 - Conceptualized and Real-Life Complex Work Tours



**Example 2: Home to Work, Work to Serve Passenger to Shop to Work,
Work to Shop to Shop to Home, Home to Serve Passenger to Home**

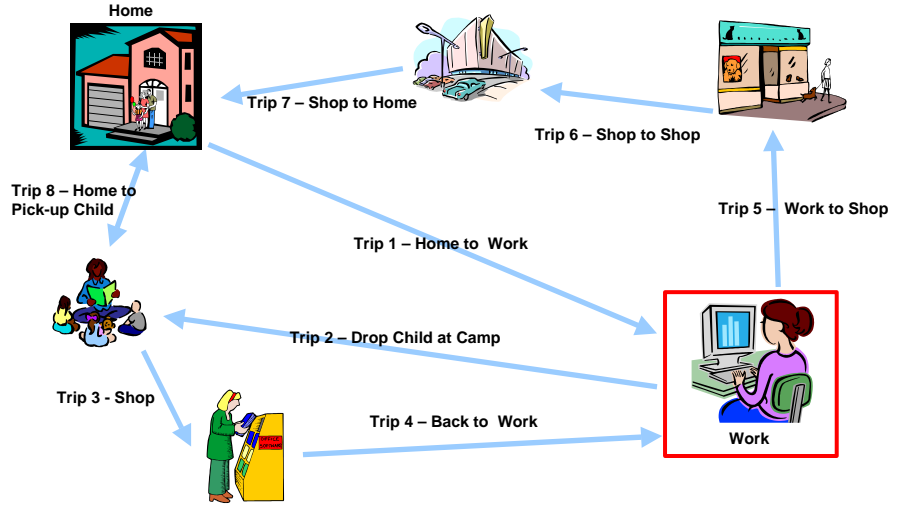
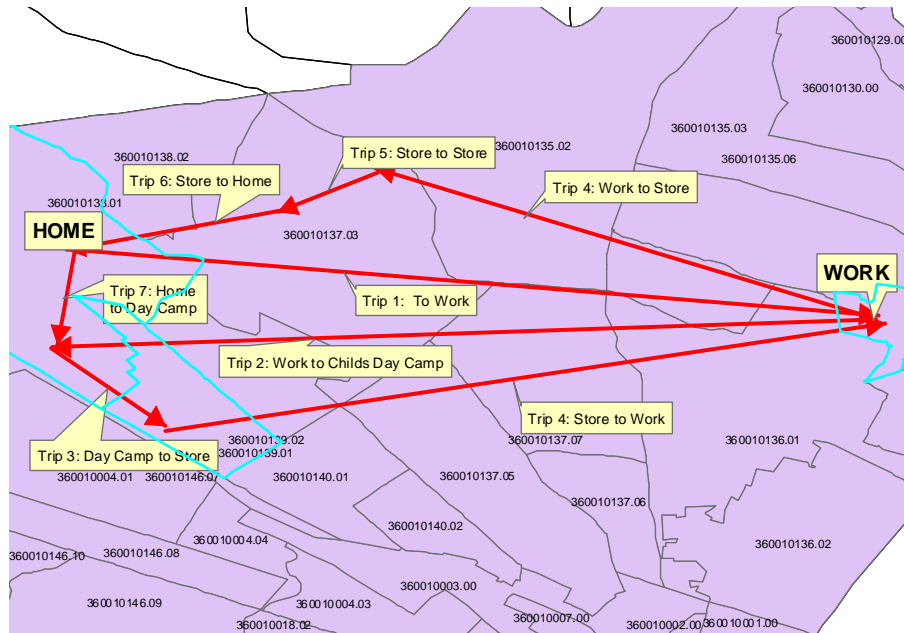


Figure 26 – Respondent #1 Complex Work Tour



A second example illustrates trips to and from the workplace by another respondent (Figure 27). This respondent makes a non-stop or direct trip from home to work, left work for a work-related trip and returned to work, went out to lunch and returned to work, then returned home. In the first example, the respondent had most of her trip destinations close to her home, whereas the second respondent had most of his trips close to his work.

Figure 27 – Respondent #2 Work-Based Trips



In this section we examined the ideal conceptualization of complex work tours compared to a couple of real-life examples. In the first example, most of the destinations were close to home, and in the second example most were close to work. More research is needed to quantify the power of the home as an anchor of travel activity compared to the workplace, by demographic factors and perhaps distance to work. With the advances in GPS tracking research will probably be forthcoming to help determine the attributes on non-work destinations in relation to residence and workplace location.

A travel survey like the NHTS, which obtains all trips for all purposes, can provide a rich description of the complexity of actual travel behavior. When used in conjunction with a robust sample of worker's residences (as an important loci of travel activity) and worker's workplaces (another important loci of travel activity) a household travel survey allows local planners to benefit from the geographic coverage of the Census and the descriptive power of a smaller-sample survey that obtains all trips for all purposes.

However, the forthcoming American Community Survey will not be as comprehensive in coverage as the decennial Census, and there are two reasons why: differences in sampling and weighting, and differences in geo-coding of workers.

Because the sample size of the ACS (about 2.5 % annually for large areas, or about 12.5% over 5 years) is smaller than that of the Census 2000 long form sample (sample size is about 17 %), the ACS is expected to capture fewer O-D pairs.

More importantly, since the ACS sample is smaller the Census Bureau disclosure rules may further limit the data available to planners. The Census threshold rules are based on the number of un-weighted observations, and with smaller ACS samples more O-D pairs will be impacted by these rules¹.

The differences in processing the reported work locations may also impact the coverage of the data. The Census is moving toward an automated (extended) allocation process for assigning Block Group and TAZ for work locations that do not match during the first phase of geocoding,

The extended allocation system is not currently being used for ACS (because of cost and the insufficient number of donor records). It is expected that when five years worth of ACS data are collected, the extended allocation process will be implemented.

¹ For a thorough discussion of confidentiality rules, and their effect of commute data, please see Ed Christopher and Nanda Srinivasan, "Disclosure and Utility of Census Journey-to-Work Flow Data from the American Community Survey - Is There a Right Balance?" Poster presented at the *TRB Conference on Census Data for Transportation Planning: Preparing for the Future*, May 11-13, Irvine, California.

Currently, the number of origin-destination pairs in ACS is about 75 percent of the O-D pairs shown in the Census 2000. Once the above improvements are made, a better match between ACS and Census 2000 is expected. If these issues of geographic coverage can be resolved, the ACS will continue to fulfill the role of providing origin-destination pairs for work flows at small geography.

The details of this small geography can be used in conjunction with a travel survey, such as the NHTS, to provide rich descriptions of the complexity of actual travel behavior. At the simplest level, a robust sample of worker's residence (which is one loci of activity) and worker's workplaces (which provides another loci of activity) allows local planners to benefit from good geographic coverage (from the Census) combined with descriptive data from a smaller sample (from a household travel survey like the NHTS).

More complex linkages may be useful. For instance, research projects are underway to develop transferred trip generation rates based on Census tract characteristics related to travel and NHTS samples.

Conclusion

In the context of daily travel the work trip remains as important as it has ever been. Work trips continue to increase as workers are added to the population, but the proportion and number of trips directly from home-to-work continue to decline. Direct, or non-stop trips to work are the minority of work travel--over half of all workers make non-work trips as part of their travel to work.

Workers are an important and growing segment of the traveling public. Workers spend a large portion of weekdays in travel to and from work--this paper has presented analysis showing that work tours can account for as much as 45 percent of the time in travel on weekdays and 42 percent of the miles traveled for workers. However workers, just like non-workers, are adding more trips for a variety of purposes into their day--trips for shopping, errands, and social and recreational purposes.

Therefore, local analysis based on an estimation of home-based-work trips as the only source of travel data may contain bias, since women stop during the work trip more often than men, and trends show that growth in stops made during the work tour varies by race, sex, and ethnicity. Using an estimation of home-based work trips as the only source of travel data also misses travel for other purposes, such as shopping and recreation, that adds miles to the roadways and may grow in importance in the future.

Stops made during the commute can result from recurring and non-recurring events. An example of a recurring stop could be dropping children at school, and a non-recurring example might be visiting the doctor's office. The NHTS has no information on whether the stop made on the travel day was a recurring or non-recurring stop. The Census wording does not differentiate the usual travel time to work incorporating usual stops and it is unknown how respondents answer—do they calculate the usual travel time with their usual stops included or not? This suggests that there is a need for cognitive testing to ascertain what people are reporting on the Census forms, and whether they calculate the travel time to work including usual stops or not.

Quantitative analysis on the geography of the work tours and the location of stops, whether closer to home or closer to work, is required. Our conceptualization of a rational work tour with stops for dropping children, shopping, or other errands may not match what typical respondents do when faced with pressures from work, home-life, or congestion. Typical travel surveys provide a rich description, but no data to help us understand the 'why' of people's behavior. The new moves toward process data are in response to that lack, and are sorely needed.

The planning community has the best local information on small-area geography and the longest comparable trend data on the work trip, which helps inform our understanding of all personal travel. It is not just that the Census or the ACS collects the journey to work data that makes it invaluable to local transportation planning--it is that it collects the work trip data in conjunction with the residence and workplace locations with such precise geographic detail. This detail allows the transportation planner to evaluate potential work travel in terms of small-area geography while using other data sources to expand their understanding of the work trip to the whole of daily travel.

Research on the actual sample yield of the American Community Survey is on going and instructive. The ACS may not provide as complete a sample as the decennial Census long-form sample did, for a number of reasons. Correctly combining the five-yearly samples into a robust dataset with rolling averages is a challenge for many transportation planners. On the other hand, the ACS provides the promise of revealing trends in a timely manner.