MDOT
Michigan Department of Transportation

2009
Comprehensive Household Travel Data Collection Program

MI Travel Counts II

Comparison Report

July 30, 2010

Prepared by:

Abt SRBI

275 Seventh Avenue, Suite 2700
New York, NY 10001

Partners and Sub-consultant:

CAMBRIDGE SYSTEMATICS
Transportation leadership you can trust.
100 CambridgePark Drive, Suite 400
Cambridge, MA 02140

PlanTrans (Peter Stopher)
Institute of Transport Studies, C37
University of Sydney, NSW 2006, Australia

RSG INC.
RESOURCE SYSTEMS GROUP, INC.
55 Railroad Way
White River Junction, VT 05001

This Page Intentionally Left Blank

Table of Contents

List of Figures

List of Figures – Continued

Section 5:

List of Figures – Continued

List of Tables

List of Tables (Continued)

Section 6:

List of Appendices

Executive Summary

MI Travel Counts II (MTC II) collected travel data in 2009 from a subset of households which responded to MI Travel Counts I (MTC I) in 2005. MTC II data provides opportunities to gauge how household travel has changed in Michigan since the completion of MTC I.

This comparison report provided both unweighted and weighted analysis of MTC II data and featured comparisons between MTC surveys. Comparisons were also made to the 2009 National Household Travel Survey (NHTS) where applicable. In addition, a set of preliminary statistical analyses were conducted to test the validity of the MTC II sample and to investigate effects of changes in key socioeconomic characteristics of the households on the observed differences in household level trip production across the MTC surveys.

The objectives of the comparative analysis of the two datasets include the following:

- Understand the changes in household travel behavior characteristics between the two surveys,
- Identify if the surveys provide evidence to support the observed reduction in travel as reflected in changes in traffic volumes in the recent years, and
- Examine the changes in household socioeconomic characteristics and their impacts on observed travel behavior.

The MTC I and MTC II surveys were conducted five years apart and had important differences in scale. MTC II sampled about one eighth the households who responded to MTC I.

The sample design for both surveys divided the State of Michigan into seven geographic sample areas. The seven sample areas were the following:

1. SEMCOG (seven counties of Detroit Area)
2. Small Cities (Population of 5,000-50,000 outside small urban and Transportation Management Areas (TMA) areas)
3. Upper Peninsula Rural
4. Northern Lower Peninsula Rural
5. Southern Lower Peninsula Rural
6. Transportation Management Areas (TMAs) (Population over 200,000)
7. Small Urban Modeled Areas (SUMAs) (Population between 50,000-200,000)

MTC II used a sampling method adapted from the MTC I study. The sampling considered household size, number of vehicles available and number of workers in the household. The MTC II sampling plan was further revised based on a statistical review of MTC I data and additional expert reviews.

Expansion weights for MTC I data were revised using the 2000 Census (Census Transportation Planning Package) CTPP. A new set of weights was developed for the MTC

II survey using the 3-year 2006-2008 American Community Survey (ACS) data in conjunction with the Census Population Estimates and County Level Housing Unit Estimates datasets.

Socioeconomic Comparisons of Survey Data

Household socioeconomic characteristics estimated from MTC II were compared with MTC I and 2009 NHTS data and there were some modest levels of differences. In MTC II there was a slight increase in the shares of small households (one and two-member households) and the share of households with higher levels of vehicle ownership (two or more) compared to MTC I. There was also a slight reduction in three or more-worker households in MTC II. Finally, the MTC II and 2009 NHTS household profiles with respect to size, number of vehicles and workers were very similar.

The MTC II income distribution showed a higher share for the mid-to-high income group at the expense of the lowest and highest income groups when compared to the 2009 NHTS.

Distribution of age groups in MTC II showed higher shares for older age groups, while school age children and young adults were underrepresented when compared to MTC I.

The MTC II survey did not reflect the increase in unemployment that is currently experienced in Michigan. There was an increase of survey respondents reporting that they were not workers at the time of the survey. The percent of respondents working declined by about two percent and there was also an increase in non-workers looking for work.

Overall Trip Making

The household trip rate obtained in the MTC II survey was 8.63 trips per household compared to 9.17 trips per household reported in the MTC I survey. The 2009 NHTS estimate of 8.46 trips per household, was very close to the MTC II estimate. Both of the MTC surveys and the 2009 NHTS data showed a person trip rate of 3.65 trips/person.

The comparison of trip rates across the MTC surveys indicated that there had been a decrease of about six percent in household trip rates while person trip rates remained stable. The combined effect of these comparisons suggests that the decrease in household travel reflects a change in average household size of about five percent between the two studies.

Home-based work (HBW) and non-home based (NHB) trips declined at a higher rate than other trip purposes. This pattern can be linked to the oversampling of older respondents in the MTC II survey. Moreover, reduction in household size leads to fewer opportunities to link trips or activities to meet the needs of other members in the household resulting in the reduction of demand for NHB trips.

These results indicate that between the MTC surveys, person-trip making did not change while sizeable changes occurred in household structure. Based on the survey estimates, changes in traffic volumes are more likely to be related to changes in household size and structure rather than changes in trip making or changes in activities.

Trip Making by Segment

The analysis of trip rates segmented by trip purpose and key socioeconomic parameters such as household size, vehicle ownership, and number of workers revealed that at an aggregate level there were no major differences. However, as the level of segmentation increased, there were a few segments with different trip patterns across the MTC surveys.

There were no major changes in trip rates by purpose at the statewide level between the two MTC surveys. A similar pattern of differences also existed when the travel market was segmented by geography.

The analysis of travel times showed that for urbanized areas the travel time distributions remained stable while for small urban areas there was a shift to very short trips (one to five minutes) from medium range trips (five to 20 minutes). In rural areas there was a similar shift to shorter trips from the medium range and from longer trips (30-45 minutes).

The analysis by mode indicated that mode shares were stable across the two MTC surveys. The analysis of travel times by mode suggests a shift towards shorter trips. The shift to shorter trips was higher for shared ride modes compared to drive alone.

Vehicle Utilization

Vehicle utilization by trip purpose, sample area, and auto sufficiency levels was also analyzed. Auto sufficiency gauges the level of availability of an auto for every worker in the household.

The auto utilization differences by trip purpose can be explained by the nature of trip. For example, home-based work purpose had a higher share of drive alone trips while home-based school trips had a higher share of shared ride. Home-based other and non-home based trips had comparable shares of drive alone and shared rides. Moreover, segmentation by trip purpose did not show any substantial changes in the auto modal shares across the MTC surveys.

Segmentation by sample area also showed consistent shares.

Households with a surplus of vehicles showed very similar patterns of auto modal share distributions. For households with vehicles equal to or less than the number of workers, there was a shift from shared ride to the drive alone mode during the MTC II survey potentially reflecting the aging of the households in the sample. This could reflect a reduction in the household size or the growing up of younger household members who used to share a ride. Households with vehicles equal to or greater than the number of workers exhibited very similar modal choices across the two surveys. Non-motorized modes and transit were used by a substantial share of zero-vehicle households, while households with an insufficient supply of vehicles relied on non-motorized modes more than transit.

Time of Day and Activity Duration

The distributions of trips by time of day and trip purpose across MTC surveys were stable and had consistent patterns when compared with the 2009 NHTS.

Average time spent for various activities by the respondents of both MTC surveys were computed and contrasted to examine whether there were any changes in activities and activity durations. For most mandatory activities such as work or education, the MTC surveys provided consistent estimates of activity durations. Non-mandatory activities such as shopping or recreation were reduced substantially in MTC II. Most reductions came from non-commuters who are more likely to endure economic hardships at a higher level than commuters.

In order to examine whether trip patterns had changed over time, each person's travel diary was summarized into a sequence of trips by purpose. The frequency analysis of daily trip sequences across MTC surveys showed that simpler trip patterns made up the most common patterns for both surveys. Short and simple activity sequences with two to four trips as part of one or two tours accounted for nearly 37 and 41 percent of all activity sequences observed in the MTC I and MTC II data, respectively. There were no substantial changes in the daily activity compositions between the two surveys.

Long Distance Travel

The final descriptive analysis of MTC survey data was conducted for long-distance trips. The respondents were asked to report whether they have made a trip longer than 100 miles in the last three months and also to report how many such trips were made in the past three and 12 months. The analysis of the data summaries indicated that the rate of long distance trips per household in the MTC II survey was slightly higher than the MTC I survey but the difference in rates for total long-distance trips is not significant. The share of trips made within Michigan grew slightly at the expense of "Other States and International" trips.

Quarterly retrospective trip counts per household were consistent, while the annual rates decreased by about 15 percent for MTC II.

Detailed Comparisons of Trip Rates and Household Profiles

The set of statistical analysis presented in the final section of this report focused on the disaggregate characteristics of MTC II households. These analyses were conducted at three different levels of detail:

1. Comparison of trip rates. First, it is established that respondents in the MTC II survey represent the travel behavior of Michigan residents. To accomplish that, their trip rates during the MTC I survey were compared to the trip rates of the rest of the MTC I sample who were not interviewed during the MTC II survey.
2. Examination of key socioeconomic characteristics. Since the MTC II households have changed over time, the socioeconomics as reported in MTC I and MTC II surveys were compared to document key changes over time.

3. The presence of differences in household-specific trip rates over time was examined. Furthermore, the analysis examined whether differences in trip rates across the surveys can be explained by the changes in socioeconomic characteristics.

Based on the findings of the *first level* statistical tests, it was concluded that the MTC II sample respondents exhibited equivalent levels of total trip production rates, similar average travel distances, and equivalent distributions of trips by time of day and by trip purpose during MTC I survey. This confirmed the validity of the sample and pointed out that the travel data collected from MTC II participants would produce unbiased estimates for key travel characteristics.

The descriptive analysis of the key socioeconomic characteristics in the *second level* of analysis of MTC II participants indicated that the average household size was reduced by about 8.5 percent for the sample (MTC II households only) across the surveys. While one-third of the households had a change in vehicle ownership, there was no net gain or loss in the overall vehicle ownership of the sample. Moreover, the incidence of zero-worker households grew in 2009 substantially compared to 2005 in part reflecting the aging of the sample respondents and potentially reflecting a decrease in employment.

Based on these changes, it is reasonable to conclude that household trip rates may decrease due to the reduction in household size. On the other hand, the reduction of workers in a household may have mixed impacts on overall trip rates. Although home based work trips will be reduced, those trips may be replaced with additional home-based non-work trips and other non-home based trips.

To accomplish the *third level* of the analysis, the change in trip rates was examined. However, household structure had also changed over time. To isolate the effect of socioeconomic characteristics, the sample was divided into two groups.

The first group included households whose composition had changed between 2005 and 2009 because of a change in household size, number of vehicles or number of workers. The second group included only those households that had remained stable. These households had similar characteristics in 2005 and 2009 and belonged to the same sample cell in both surveys. By focusing on the trip rates of these households, the differences in the household composition over time were controlled.

The analysis indicated that 47 percent of the MTC II households changed their sampling cells across the surveys. These results showed a fairly dynamic sample with respect to socioeconomic characteristics.

The third level of statistical tests revealed the following:

- There were statistically significant differences in the unweighted trip rates for MTC II households between the two surveys. There was a reduction in trip rates from 9.17 trips per household in MTC I to 7.82 trips per household in MTC II.
- For households which remained in the same sampling cell in MTC II, the difference became much smaller at 0.5 trips per household.

- This implies that the households that had a change in socioeconomics and their sampling cell were responsible for most of the observed difference.
- For households that had moved to a different sampling cell, the change in household size was a significant contributor to the observed change in trip rates. The reduction in the number of workers was found to have only a marginal effect.
- Overall, changes in socioeconomics had statistically significant explanatory power to explain the observed changes in trip rates. However, more detailed study designs are needed to isolate the effects of the economic downturn on the trip rates more reliably.

The analysis of MTC II survey data along with MTC I survey and 2009 NHTS provided important insights about the change in travel behavior in Michigan. The experience gained throughout the study pointed out several recommendations for further analysis of the data and for future data collection efforts.

The response from zero-vehicle households with at least one worker or with two or more persons was very low in MTC II. For similar studies in the future, MDOT could consider a sampling approach that focuses on two dimensions such as household size and number of vehicles available. Moreover, incentives for participation may also help improve response from zero-vehicle or low-income households as was the case in MTC I.

It is proposed that MTC II weights be revised once a more comprehensive and reliable national data source such as Census 2010 or the five-year ACS become available. Current rates for MTC II data rely on the estimated number of households derived from the population estimates.

Based on the observed differences in age and income groups and the underrepresentation of unemployment, the addition of person-level adjustment factors is recommended. This adjustment would help account for these key socioeconomic parameters as they would be reflected in regional and statewide data.

The patterns observed for non-travel among participating households were somewhat higher in MTC II compared to MTC I. Although non-travel is a valid survey response, future studies should monitor and compare incidence of non-travel at the household level against other data sources such as NHTS to minimize any potential biases.

The effects of household characteristics on travel behavior are fairly complex and require an in-depth study to systematically gauge the effects of all possible parameters. Our descriptive analysis of MTC surveys in this report highlighted changes in specific types of trips and market segments. Similar analyses can be conducted for these segments to incorporate additional variables such as household and personal characteristics.

Moreover, a cohort study can also be designed for which certain household structure and life cycle groups can be treated as cohorts. In general terms, a cohort is a group of subjects who have shared a particular experience during a particular time span. In order to define a relevant set of cohorts, more disaggregate level comparisons are needed.

Based on these comparisons and through a literature review, a reliable cohort study can be designed to account for impacts of socioeconomic and demographic factors and to isolate the effects of changes in the economic climate on travel behavior.

Section 1: Purpose

In Brief: *Section 1 provides information about the contents and organization of this report.*

1a. Purpose of this Report

MI Travel Counts II (MTC II) collected travel data in 2009 from a subset of households which responded to MI Travel Counts I (MTC I) in 2005. MTC II data provides opportunities to gauge how household travel has changed in Michigan since the completion of MTC I. Comparative analysis of key parameters in these datasets may help achieve the following key objectives:

- Understand the changes in household travel behavior characteristics between the two surveys,
- Identify if the surveys provide evidence to support the observed reduction in travel as reflected in changes in traffic volumes in the recent years, and
- Examine the changes in household socioeconomic characteristics and their impacts on observed travel behavior.

To accomplish these objectives, data from MTC I and MTC II are analyzed and an extensive set of data summaries are created to examine the nature of the observed differences in Michigan.

This report is intended for the use of current and future MDOT modeling staff or those of other planning agencies. It supplements the Methodological Report by documenting the findings of the final quality assurance (QA) analysis, procedures used for updating expansion factors for MTC I data and developing new factors for MTC II data, and providing summary statistics and findings of the study.

1b. Organization of this Report

This report is organized in seven chapters and supported by a set of Appendices that contain data and technical details that can be useful for more analytically oriented users. Section 1 provides the purpose of the report and organization of the report.

The final data set has been re-examined to evaluate the responses from each sampling target cell and a subset of QA checks was performed to assess the overall quality of the data. The findings are presented in Section 2.

An update of the existing MTC I expansion factors was required as MDOT had removed a few households from the original MTC I data to improve overall quality. Furthermore, a new set of weights was developed for MTC II using more recent 3-year 2006-2008

American Community Survey (ACS) data. The procedures and results are discussed in Section 3.

A set of key data summaries for MTC II data is presented in Section 4. This includes descriptive statistics on key variables and comparison of travel on Fridays against travel from other weekdays.

Section 5 provides aggregate comparisons of MTC II data with MTC I survey, and 2009 National Household Travel Survey (NHTS) where appropriate. These include comparisons of frequency distributions of key socioeconomic variables, trip rates by purpose, trip length distributions, modal shares, diurnal distribution of trips, time use, and preliminary trip chaining patterns.

MTC II was conducted as a panel survey which makes it possible to perform more disaggregate paired comparisons. Section 6 provides such a comparison of the households who participated in both studies. This section focuses on the impact of changes in household structure on observed travel patterns.

Section 7 summarizes the key findings and recommendations for future efforts.

The final technical memo on findings of the QA/QC checks conducted on the final data set and additional tables and charts supporting the discussions presented in Sections 4, 5, and 6 are featured in the Appendices.

Section 2: Overview of Sampling and Data Quality

In Brief: *Section 2 provides an overview of sample framework, description of key parameters used in quality assurance, and key findings from the final quality assurance analysis.*

2a. Key Elements of Sampling Framework

The MTC II survey data collection was expected to obtain the same data as the MTC I effort. MTC II survey was conducted for a 24-hour diary period compared to the 48-hour diary period used in the first survey. The MTC I data provided more than 14,000 usable responses from households in 169 cells. There are seven geographic sample areas, and within each, the households are classified by household size, number of household workers, and number of available autos. In many cases, adjacent combinations of households are merged into a single survey cell while considering an additional factor, auto sufficiency, which gauges availability of an automobile for each worker in the household.

Under the MTC II sample plan, the MTC I sample cells were first compared in terms of several relevant travel behavior variables. The means and standard deviations of these travel measures were calculated for each cell. Statistical tests were used to compare the means and standard deviations for the travel behavior measures. Adjacent cells that had several measures that were statistically indistinguishable from each other were identified. These comparable cells were combined to form a new set of cells for the MTC II survey. The geographic sample areas were not combined, but adjacent cells for household sizes, workers, and autos were combined where warranted. Through this process, the 169 cells were reduced to 98 cells.

To estimate the necessary sample size for MTC II, potential ranges of averages and standard deviations for a set of travel behavior measures were investigated, and statistical simulations were performed at the statewide and geographic category levels. Based on these results it was estimated that a basic sample size of one-eighth of the initial survey should provide a reasonable probability of accurately detecting real changes in travel behavior. At this approximate sample size, real differences in statewide trip rates and travel times of five percent or more are likely to be correctly measured at least 90 percent of the time. Real differences in the sample area trip rates and travel times of 15 percent or more will be correctly measured 90 percent or more of the time. An overall minimum sample size of 1,960 households, 280 from each sampling area, was set for the MTC II study.

The sampling design was revised to ensure that aggregation of sample cells proposed by the plan would be in line with practice. The review process resulted in an increase in the number of cells from 98 to 106, while the sample area targets were preserved. More details about the sample design can be found in the Cambridge Systematics Inc. (CS) memo to Michigan DOT dated October 21, 2008 (revised October 31, 2008), and in the

August 25, 2009 technical memo from CS to Michigan DOT (Appendix P of the MTC II Methodological Report).

2b. Key Elements of Data Quality Checks

The project team developed a comprehensive set of Quality Control procedures to ensure accuracy and validity of the MTC II survey data. The complete set of these procedures and technical details can be found in the "Task 4, Quality Control, Geocoding Process, and Data Checking Manual for Implementation" memo dated October 08, 2009 (Appendices L and M of the Methodological Report). CS together with AbtSRBI designed a set of logic checks to be performed on the collected data, and implemented these checks periodically throughout the course of the study. These checks helped identify critical data quality issues and develop procedures for revising the collected data to improve their quality.

Travel survey data are fairly complex. The data are stored in multiple files at different levels (household, person, and trip) which are connected by common identifiers. The main sources of data include multiple instruments (retrieval interviews and trip diaries). Since individual and common household characteristics and travel attributes of each member of the responding household make up the dataset, the data also contain a number of logical connections between different components of the data. The QA/QC process focused on a specific set of these logical connections. These include but are not limited to:

- Consistency of counts of data elements in higher nests, such as total person counts in the person file for each household should be equal to the household size for that household in the household file.
- Completeness of travel diaries and data items.
- Presence of valid geocoding information for household, workplace, school and trip origins and destinations.
- Reasonableness of responses with the relationships within the household.
- Reasonableness of trip characteristics in terms of length, purpose, and travel mode.
- Incidences of unexpected responses from certain respondents or households, such as non-workers reporting work trips or drive alone trips from zero-vehicle households.
- Consistency between reported and modeled travel times.

After completion of the data collection, the QA/QC checks adopted for the study identified important violations of the quality standards set forth in the beginning of the study. This resulted in detailed reviews of over 400 household diaries. During the reviews additional geocoding was performed and updates on reported arrival and departure times were implemented. The corrections allowed the project team to build a high quality data set that met sample area targets. The following section provides a summary of the major findings from the QA/QC checks performed on the final data. The technical memo detailing results of the final set of checks is also provided in Appendix A.

2c. Overview of Data Quality for the Final Dataset

The Final MTC II dataset is composed of three files that are interrelated with common identifiers. The dataset is free of structural problems. All three files contain a consistent number of records for household, person and trip level data.

The dataset contains information from 1,975 households, 4,410 individuals, and 16,419 trips. Since 685 trip records indicated no actual trips were made, the total number of trips is reduced to 15,734 actual trips.

This set of figures corresponds to an average household size of 2.23 persons, and an average trip rate of 7.97 trips per household and 3.57 trips per person. The data from entire MTC I sample indicated an average household size of 2.5 persons and a trip rate of 9.1 trips per household which was higher than MTC II. For both datasets, the trip rate per person was very close to each other; 3.60 vs. 3.57 trips per person.

All of the household diaries had an acceptable level of missing geocoding information as set forth by the quality standards for the study.

During the previous rounds of QA/QC, incomplete travel diaries for respondents with more than nine trips per day were observed. A procedure to impute trip records for these respondents was developed which used the information from trips of individuals who were accompanying these respondents. On average, this process produced two additional trips. Therefore, for those who were traveling alone at the ninth trip, two artificial trip records were created. The overall process yielded an addition of 293 trips to the dataset.

The time-distance checks using SEMCOG and Michigan Statewide model networks indicated that there is substantial level of agreement between reported and modeled travel times. A small portion of the trips (about 2.2 percent) still shows significant differences and can be targeted with future efforts.

None of the checks performed in the final round produced critical errors to affect the overall data quality. However, due to reasons beyond the control of the project team, response from zero-vehicle households and households with lower levels of auto-sufficiency were found to be lower than expected. The next section provides a discussion on the level of response from different segments of the targeted population.

2d. Sample Targets and Response

As discussed in Section 2a the MTC II sample design of 106 cells considered seven sample areas, household size, number of workers, and vehicles available in the households. Each cell had targeted responses based on the size and response levels observed during the MTC I study. For potentially low response cells, a target value of 10 households was selected as a minimum response level. The survey recruitment process was designed to draw from the list of households from the original MTC survey who agreed to be recontacted for further studies. While this strategy was expected to improve response levels, it limited the size of the population to be contacted, particularly for zero-vehicle households which may have purchased a vehicle between the two studies and may have moved into another target cell. Section 6 provides more detailed

discussions on the participating households and how their socioeconomic status and travel behavior has changed. Moreover, further details about sampling target achievement and recommendations can be found in AbtSRBI's Methodology Report.

Table 2.1 shows the total number of households retrieved by each target cell. For about 44 percent of the cells, targets were reached or exceeded. More than 26 percent of the cells (28 cells) had minor deviations (a deficit of less than or equal to 30 percent of the cell target) from the target values. However, for 29 percent of the cells (31 cells), mostly among zero-vehicle households, the response was weaker (no response from more than 30 percent of the cell target).

There were two cells for which no response was observed. Cell 10, which included households with three or more members without an automobile in the SEMCOG sample area and Cell 66 which included households with two or more members without an auto in the Upper Peninsula sample area. The survey lacked responses from zero-vehicle households with three or more members, and considerably low levels of response were observed from households with zero vehicles, medium size households especially those with three members, and large households with a small number of workers. The low response issue is more prevalent in the more urbanized portion of the state where socioeconomic changes may take place at a higher pace.

Table 2.1. Survey Data Retrieval by Sample Cell

Cell	Sample Area	Cell Description	Survey Freq	Survey Target	Minor Deviation[1]	Low Response[1]	Target Reached[1]
1	SEMCOG	HH Size=1 Autos=0 Workers=0,1	10	15	0	1	0
2	SEMCOG	HH Size=1 Autos=1+ Workers=0	44	21	0	0	1
3	SEMCOG	HH Size=1 Autos=1+ Workers=1	40	34	0	0	1
4	SEMCOG	HH Size=2 Autos=0 Workers=0,1,2	3	10	0	1	0
5	SEMCOG	HH Size=2 Autos=1 Workers=1,2	8	14	0	1	0
6	SEMCOG	HH Size=2 Autos=1,2+ Workers=0	38	19	0	0	1
7	SEMCOG	HH Size=3 Autos=1,2,3+ Workers=0	6	10	0	1	0
8	SEMCOG	HH Size=2 Autos=2+ Workers=1	33	14	0	0	1
9	SEMCOG	HH Size=2 Autos=2+ Workers=2	22	24	1	0	0
10	SEMCOG	HH Size=3,4+ Autos=0 Workers=0,1,2,3+	0	10	0	1	0
11	SEMCOG	HH Size=3 Autos=1,2,3+ Workers=1	15	16	1	0	0
12	SEMCOG	HH Size=3 Autos=1,2 Workers=2,3	8	15	0	1	0
13	SEMCOG	HH Size=3 Autos=3+ Workers=2,3	15	10	0	0	1
14	SEMCOG	HH Size=4+ Autos=1,2,3+ Workers=0	1	10	0	1	0
15	SEMCOG	HH Size=4+ Autos=1,2 Workers=1	9	18	0	1	0
16	SEMCOG	HH Size=4+ Autos=1,2 Workers=2,3+	14	18	1	0	0
17	SEMCOG	HH Size=4+ Autos=3+ Workers=1,2	11	12	1	0	0
18	SEMCOG	HH Size=4+ Autos=3+ Workers=3+	3	10	0	1	0
SEMCOG SUBTOTALS			280	280	4	9	5

[1] Value of "1" indicates the presence of the condition for the sampling cell.

Table 2.1. Survey Data Retrieval by Sample Cell (Continued)

Cell	Sample Area	Cell Description	Survey Freq	Survey Target	Minor Deviation[1]	Low Response[1]	Target Reached[1]
19	TMAs	HH Size=1 Autos=0 Workers=0,1	4	10	0	1	0
20	TMAs	HH Size=1 Autos=1+ Workers=0	40	23	0	0	1
21	TMAs	HH Size=1 Autos=1+ Workers=1	33	34	1	0	0
22	TMAs	HH Size=2,3,4+ Autos=0 Workers=0,1,2,3+	5	10	0	1	0
23	TMAs	HH Size=2 Autos=1 Workers=0,1	22	19	0	0	1
24	TMAs	HH Size=2 Autos=1,2+ Workers=2	43	37	0	0	1
25	TMAs	HH Size=2 Autos=2+ Workers=0	25	14	0	0	1
26	TMAs	HH Size=2 Autos=2+ Workers=1	30	17	0	0	1
27	TMAs	HH Size=3 Autos=1,2,3+ Workers=0,1	13	19	0	1	0
28	TMAs	HH Size=3 Autos=2,3+ Workers=2	9	18	0	1	0
29	TMAs	HH Size=3 (Autos=1 Workers=2,3) and (Autos=2,3+ Workers=3)	3	10	0	1	0
30	TMAs	HH Size=4+ Autos=1,2,3+ Workers=0,1	19	24	1	0	0
31	TMAs	HH Size=4+ Autos=1,2 Workers=2,3+	19	23	1	0	0
32	TMAs	HH Size=4+ Autos=3+ Workers=2	9	10	1	0	0
33	TMAs	HH Size=4+ Autos=3+ Workers=3+	6	12	0	1	0
TMA SUBTOTAL			280	280	4	6	5
34	SUMA	HH Size=1 Autos=0 Workers=0,1	11	12	1	0	0
35	SUMA	HH Size=1 Autos=1+ Workers=0	52	26	0	0	1
36	SUMA	HH Size=1 Autos=1+ Workers=1	31	31	0	0	1
37	SUMA	HH Size=2,3,4+ Autos=0 Workers=0,1,2,3+	1	10	0	1	0
38	SUMA	HH Size=2 Autos=1 Workers=0,1	24	21	0	0	1
39	SUMA	HH Size=2 Autos=1,2+ Workers=2	36	36	0	0	1
40	SUMA	HH Size=2 Autos=2+ Workers=0	29	19	0	0	1
41	SUMA	HH Size=2 Autos=2+ Workers=1	21	19	0	0	1
42	SUMA	HH Size=3 Autos=1,2,3+ Workers=0,1	13	18	1	0	0
43	SUMA	HH Size=3 Autos=1,2 Workers=2,3	9	14	0	1	0
44	SUMA	HH Size=3 Autos=3+ Workers=2,3	13	12	0	0	1
45	SUMA	HH Size=4+ Autos=1,2,3+ Workers=0,1	18	21	1	0	0
46	SUMA	HH Size=4+ Autos=1,2 Workers=2+	9	21	0	1	0
47	SUMA	HH Size=4+ Autos=3+ Workers=2	9	10	1	0	0
48	SUMA	HH Size=4+ Autos=3+ Workers=3+	4	10	0	1	0
SUMA SUBTOTAL			280	280	4	4	7

Table 2.1. Survey Data Retrieval by Sample Cell (Continued)

Cell	Sample Area	Cell Description	Survey Freq	Survey Target	Minor Deviation[1]	Low Response[1]	Target Reached[1]
49	Small City	HH Size=1 Autos=0 Workers=0,1	14	14	0	0	1
50	Small City	HH Size=1 Autos=1+ Workers=0	44	24	0	0	1
51	Small City	HH Size=1 Autos=1+ Workers=1	34	29	0	0	1
52	Small City	HH Size=2,3,4+ Autos=0 Workers=0,1,2,3+	6	10	0	1	0
53	Small City	HH Size=2 Autos=1 Workers=0,1	17	20	1	0	0
54	Small City	HH Size=2 Autos=1,2+ Workers=2	36	31	0	0	1
55	Small City	HH Size=2 Autos=2+ Workers=0	22	18	0	0	1
56	Small City	HH Size=2 Autos=2+ Workers=1	23	18	0	0	1
57	Small City	HH Size=3 Autos=1,2,3+ Workers=0,1	15	19	1	0	0
58	Small City	HH Size=3 Autos=1,2 Workers=2,3	12	18	0	1	0
59	Small City	HH Size=3 Autos=3+ Workers=2,3	14	12	0	0	1
60	Small City	HH Size=4+ Autos=1,2,3+ Workers=0,1	16	24	0	1	0
61	Small City	HH Size=4+ Autos=1,2 Workers=2,3+	25	26	1	0	0
62	Small City	HH Size=4+ Autos=3+ Workers=2,3+	13	17	1	0	0
Small City SUBTOTAL			291	280	4	3	7
63	UP Rural	HH Size=1 Autos=0 Workers=0,1	12	14	1	0	0
64	UP Rural	HH Size=1 Autos=1,2,3+ Workers=0	39	32	0	0	1
65	UP Rural	HH Size=1 Autos=1,2,3+ Workers=1	32	30	0	0	1
66	UP Rural	HH Size=2,3,4+ Autos=0 Workers=0,1,2+	0	10	0	1	0
67	UP Rural	HH Size=2 Autos=1 Workers=0,1	23	21	0	0	1
68	UP Rural	HH Size=2 Autos=1,2,3+ Workers=2	33	30	0	0	1
69	UP Rural	HH Size=2 Autos=2,3+ Workers=0	26	21	0	0	1
70	UP Rural	HH Size=2 Autos=2,3+ Workers=1	32	19	0	0	1
71	UP Rural	HH Size=3 (Autos=1,2,3+ Workers=0) and (Autos 1,3+ Workers=1)	11	12	1	0	0
72	UP Rural	HH Size=3 Autos=2 Workers=1	6	10	0	1	0
73	UP Rural	HH Size=3 Autos=1,2 Workers=2,3	8	14	0	1	0
74	UP Rural	HH Size=3 Autos=3+ Workers=2,3	15	10	0	0	1
75	UP Rural	HH Size=4+ Autos=1,2,3+ Workers=0,1	13	16	1	0	0
76	UP Rural	HH Size=4+ Autos=1,2 Workers=2,3+	18	21	1	0	0
77	UP Rural	HH Size=4+ Autos=3+ Workers=2	8	10	1	0	0
78	UP Rural	HH Size=4+ Autos=3+ Workers=3+	4	10	0	1	0
UP Rural SUBTOTAL			280	280	5	4	7

Table 2.1. Survey Data Retrieval by Sample Cell (Continued)

Cell	Sample Area	Cell Description	Survey Freq	Survey Target	Minor Deviation[1]	Low Response[1]	Target Reached[1]
79	NLP Rural	HH Size=1 Autos=0 Workers=0,1	11	10	0	0	1
80	NLP Rural	HH Size=1 Autos=1+ Workers=0	42	32	0	0	1
81	NLP Rural	HH Size=1 Autos=1+ Workers=1	30	28	0	0	1
82	NLP Rural	(HH Size=2 Autos=1 Workers=0,1) and (HH Size=2,3,4+ Autos=0 Workers=0,1,2,3+)	31	28	0	0	1
83	NLP Rural	HH Size=2 Autos=1,2+ Workers=2	33	30	0	0	1
84	NLP Rural	HH Size=2 Autos=2+ Workers=0	31	26	0	0	1
85	NLP Rural	HH Size=2 Autos=2+ Workers=1	23	22	0	0	1
86	NLP Rural	HH Size=3 Autos=1,2,3+ Workers=0,1	21	18	0	0	1
87	NLP Rural	HH Size=3 Autos=1,2 Workers=2,3	8	12	0	1	0
88	NLP Rural	HH Size=3 Autos=3+ Workers=2,3	11	10	0	0	1
89	NLP Rural	HH Size=4+ Autos=1,2,3+ Workers=0,1	17	24	1	0	0
90	NLP Rural	HH Size=4+ Autos=1,2 Workers=2,3+	11	24	0	1	0
91	NLP Rural	HH Size=4+ Autos=3+ Workers=2,3+	11	16	0	1	0
NLP SUBTOTAL			280	280	1	3	9
92	SLP Rural	HH Size=1 Autos=0 Workers=0,1	8	10	1	0	0
93	SLP Rural	HH Size=1 Autos=1+ Workers=0	39	24	0	0	1
94	SLP Rural	HH Size=1 Autos=1+ Workers=1	30	31	1	0	0
95	SLP Rural	HH Size=2,3,4+ Autos=0 Workers=0,1,2,3+	1	10	0	1	0
96	SLP Rural	HH Size=2 Autos=1 Workers=0	13	10	0	0	1
97	SLP Rural	HH Size=2 Autos=1 Workers=1	7	10	1	0	0
98	SLP Rural	HH Size=2 Autos=1,2+ Workers=2	37	35	0	0	1
99	SLP Rural	HH Size=2 Autos=2+ Workers=0	27	20	0	0	1
100	SLP Rural	HH Size=2 Autos=2+ Workers=1	27	20	0	0	1
101	SLP Rural	HH Size=3 Autos=1,2,3+ Workers=0,1	16	18	1	0	0
102	SLP Rural	HH Size=3 Autos=1,2 Workers=2,3	11	15	1	0	0
103	SLP Rural	HH Size=3 Autos=3+ Workers=2,3	13	12	0	0	1
104	SLP Rural	HH Size=4+ Autos=1,2,3+ Workers=0,1	19	22	1	0	0
105	SLP Rural	HH Size=4+ Autos=1,2 Workers=2,3+	15	23	0	1	0
106	SLP Rural	HH Size=4+ Autos=3+ Workers=2,3+	21	20	0	0	1
SLP SUBTOTAL			284	280	6	2	7
TOTAL			1975	1960	28	31	47

Section 3: Data Weighting and Expansion

In Brief: *Section 3 provides the description of the procedures used for updating the expansion factors for MTC I data and creating expansion factors for MTC II data.*

The final step before analyzing travel survey data is to develop expansion factors to weight each observation to expand the data to represent the population. Weights are derived so that the weighted data would reflect the same distribution of selected key variables as observed in the population. These key variables are also generally used in developing sampling plans.

In both MTC studies, household size, the number of vehicles available, and the number of workers in the household were selected as target variables to segment the population into groups with distinct trip-making characteristics. In addition, the state was divided into seven distinct sample areas as described in Section 2. More details about the sampling framework for MTC I can be found in MTC I Final Report, and MTC II sample design is detailed in Appendix P of the MTC II Methodology Report.

Both weighting schemes were developed based on the sampling framework for each MTC survey. Occurrences of each unique sample cell characteristic are queried in a dataset which contains data for the population. The results are used to derive expansion weights for each sample cell.

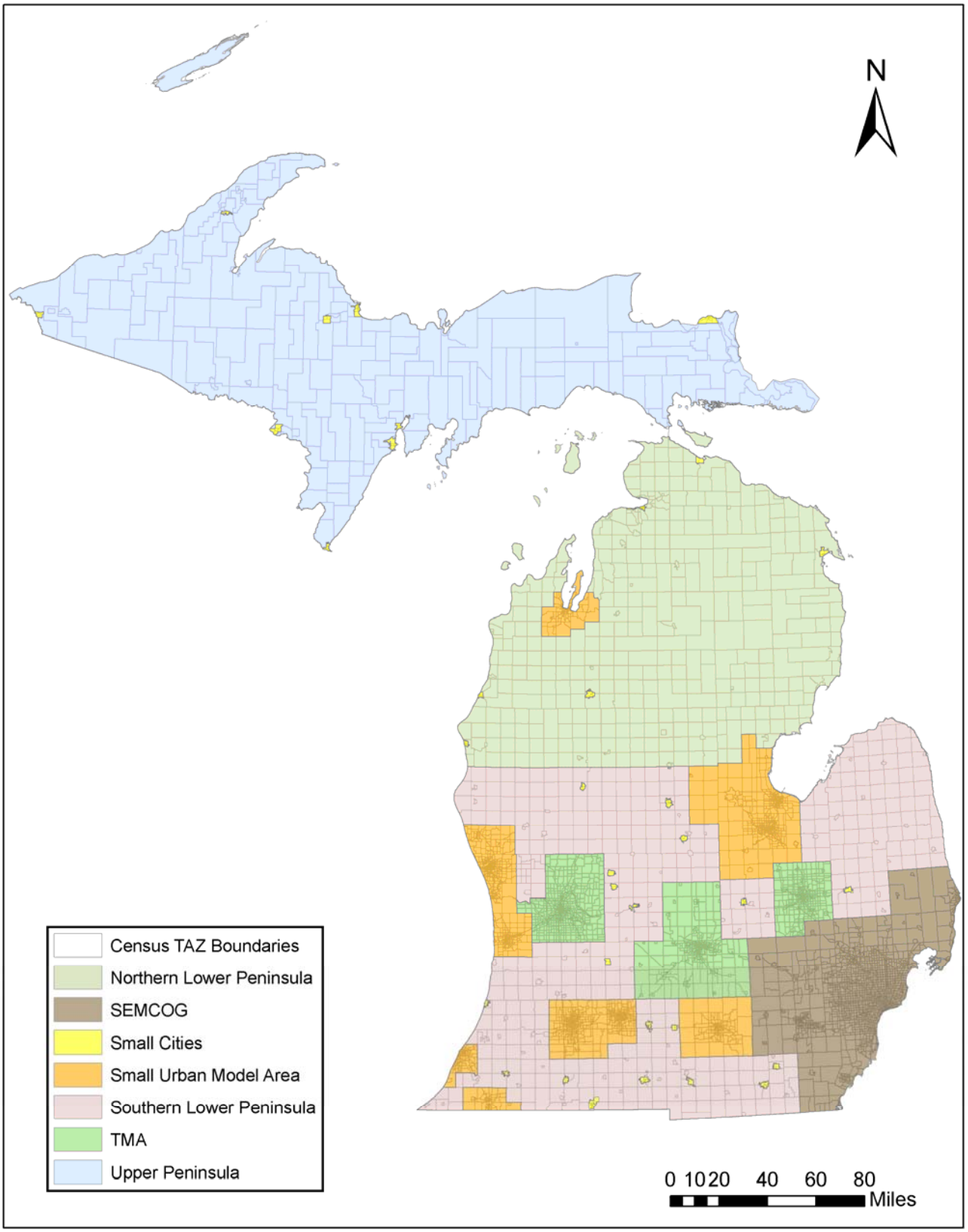
Census Transportation Planning Package (CTPP) 2000 Part I (Place of Residence) dataset is used for updating the MTC I weights, and 3-Year American Community Survey (ACS) 2006-2008 data is used for developing expansion factors for the MTC II data.

3a. Updating Expansion Factors for MTC I Data

Following completion of MTC I, the dataset was slightly reduced in size by MDOT staff in order to improve the overall quality of the data. Since this affected the counts for a portion of the sample cells in the data, the existing weights had to be updated.

The review of geographical boundaries of the sample areas revealed that sample areas were nested in the Traffic Analysis Zone (TAZ) level of detail adopted by the Census for Michigan. Figure 3.1 features a map showing the level of match between sample area and Census TAZ boundaries. Furthermore, CTPP 2000 Part I data also included three dimensional tables for household size (S), number of vehicles available (V), and number of workers in the household (W). CTPP 2000 data provided the highest level of compatibility in geographical boundaries and contained information at the desired level of segmentation. Moreover, the sampling plan for MTC I was also developed based on year 2000 Census data.

Figure 3.1 MTC Sample Areas and Census TAZ Geographical Boundaries



Sample area to TAZ correspondence was created in ArcGIS and SVW tables were aggregated over sample cell categories. Expansion factors were derived as the ratio of household counts from CTPP Part I to the sample frequencies for each cell. The weights for each cell are provided in Appendix B. These household-level weights were merged to the person and trip level files.

Table 3.1 shows the estimates for the total number of households, persons, and trips (Day 1) in each of the sample areas after expanding the data to the Michigan population. Based on these estimates, in 2004-2005 there were nearly 3.8 million households, with over 9.5 million people in Michigan producing 34.7 million daily trips. These figures correspond to 9.17 trips per household and 3.65 trips per person.

Table 3.1 Estimated Numbers of Households, Persons, and Trips by MTC I

Sample Areas	Households		Persons		Trip Records[2]		Trips[2]	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
SEMCOG	2,221	1,846,277	5,577	4,638,216	21,001	17,545,651	20,186	16,871,573
Small Cities	2,328	129,369	5,835	296,162	23,552	1,187,507	22,683	1,141,139
Upper Peninsula Rural	2,027	87,115	4,853	209,919	17,674	763,970	16,934	731,983
Northern Lower Peninsula	2,073	206,210	5,077	501,075	17,680	1,734,217	16,760	1,640,999
Southern Lower Peninsula	2,059	394,588	5,236	1,044,969	19,230	3,854,570	18,493	3,713,155
TMAs	2,065	579,415	5,284	1,465,017	20,608	5,689,767	19,994	5,519,561
Small Urban Modeled Areas	2,045	545,557	5,060	1,360,511	19,646	5,295,062	18,998	5,124,637
State Total	14,818	3,788,531	36,922	9,515,870	139,391	36,070,744	134,048	34,743,048

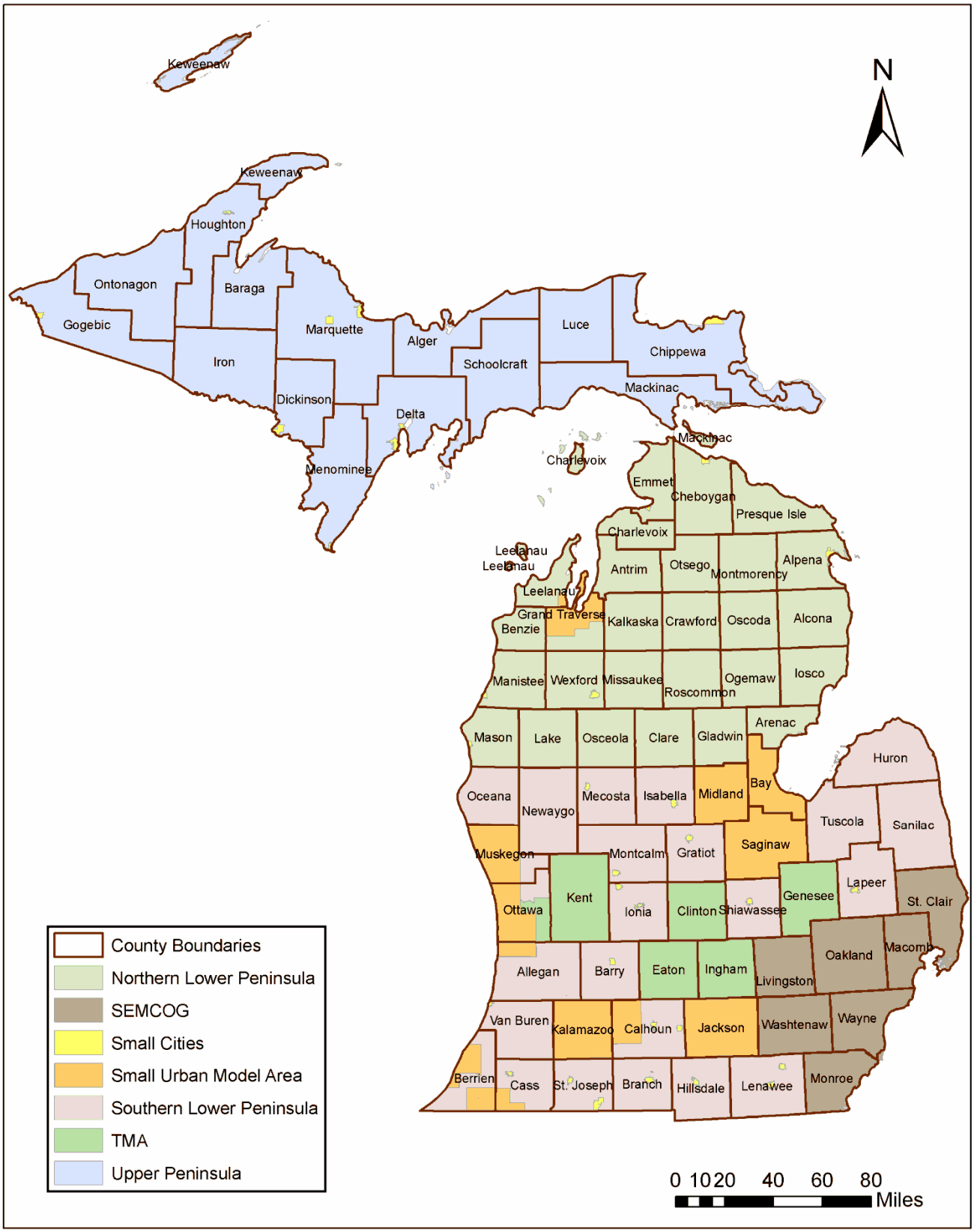
3b. Developing Expansion Factors for MTC II Data

MTC II data were collected during the Fall of 2009. One of the goals of the study is to gauge the differences in the travel behavior of residents of Michigan and to search for evidence for observed reductions in indicators of travel, such as vehicle miles traveled (VMT). Therefore, more current data than 2000 CTPP is needed for developing weights. However, at the time of this report, a new data source with the same levels of geographical coverage and data segmentation as 2000 CTPP was not available. The most current available data source was the "2006-2008 3-Year ACS" data which had limitations in geographical coverage and the level of tabulation detail. The 3-year ACS data exclude places with a population smaller than 20,000. Data summaries are available at the State, County, and Place level of detail. Ideally, the MTC sampling areas require a Census TAZ level of geographical detail and three dimensional tables for household size (S), number of vehicles available (V), and number of workers in the household (W).

The seven sample areas for the MTC surveys are not perfectly nested in county boundaries. Small Cities lie within county boundaries and Small Urban Model Areas (SUMA), and TMAs may cover parts of county boundaries as shown in Figure 3.2

[2] Besides actual trips, trip records include information for individuals who did not travel on the day of the survey. However, the "Trips" columns show the unweighted and weighted counts of the actual trips only.

Figure 3.2 MTC Sample Areas and County Boundaries



TMAs are almost nested in the County structure, with the exception of Grand Rapids area, while SUMAs are the combinations of city and township boundaries as defined in MTC I Final Report Appendix 1.

There are only three Small Cities (Adrian, Marquette, and Mt. Pleasant) covered by the place-level ACS data, while 64 counties out of 83 counties in Michigan were included in the county-level ACS data.

The US Census provides annual population estimates at the city and township level of detail in the "Incorporated Place and Minor Civil Division Population Dataset." The data was used to estimate population of the portions of SUMAs and TMAs that partially cover a county boundary. Moreover, for all counties in the US, annual estimates of the number of households are also provided by the "County-Level Housing Unit Estimates Dataset." However, estimates of the number of households at city and township levels are unavailable. Moreover, for rural areas including Upper Peninsula, and Northern Lower Peninsula sample areas, estimates of number of households were found to be unreliable. The analysis of the data indicated that numbers of households were overestimated. Based on this finding, use of “County-Level Housing Unit Estimates Dataset” was limited to the SEMCOG sample area. For the rest of the sample areas, population estimates were used to produce household level targets based on estimates of an average household size for each region. Targets were computed using the average values of population for the three-year duration between 2006 and 2008 to be consistent with the ACS time framework.

The level of data segmentation in the ACS tables is also limited to two dimensions, while the MTC II sampling framework uses three dimensions.

These issues required some assumptions regarding the consistency of socioeconomic patterns within each sample area. These include the following:

A. Three-dimensional tables were created by an Iterative Proportional Fitting (IPF) technique for the portions of each sample area included in the 2006-2008 ACS data.

B. Socioeconomic patterns (SVW) observed in the ACS data are also valid for all the remaining parts of the sample area geography outside the ACS sampling framework.

   For example, a small city which is a part of the “Small Cities” sample area but is excluded in the ACS framework is assumed to have the same SVW distribution as the Cities of Adrian, Marquette, and Mount Pleasant.

C. For cities and townships that define Small Cities, SUMA and TMA sample areas, the “Incorporated Place and Minor Civil Division Population Dataset" population estimates were used. The numbers of households for these areas were estimated by an average household size obtained for the portion of the sample area included in the ACS or by using the 2000 CTPP data when anomalies were suspected in the ACS estimates.

The following subsections describe the steps followed for each sample area to expand the patterns derived in step A.

1. SEMCOG

The SEMCOG sample area is composed of Wayne, Monroe, Washtenaw, Macomb, Oakland, Livingston and St. Clair counties. All of these seven counties were covered by the ACS data. The SVW patterns observed in the aggregated ACS data from these counties were used to derive weights. However, since an underestimation of population was observed in earlier iterations, total number of households was expanded to match the estimate from the County-Level Housing Unit Estimates Dataset, while SVW patterns from ACS were maintained.

2. Small Cities

There are 35 small cities that make up the "Small Cities" sample area. Only three cities (Adrian, Marquette, and Mount Pleasant) in this sample area were included in the place-level ACS data. Patterns of SVW were established by using the aggregated data from these three cities. Based on Assumption B, these patterns are transferred to the remaining population of the sample area. An estimate of average household size from these three cities was created using 2000 CTPP data and population figures for the remaining 32 small cities were converted to the number of households. The SVW patterns were applied to the total number households in the sample area to define weighting targets.

3. TMAs

The TMAs sample area covers five counties entirely (Kent, Clinton, Eaton, Ingham, and Genesee) and a portion of Ottawa County. The SVW patterns were established by using the ACS data for these five counties. Using average household size derived from 2000 CTTP for the sample area, a population estimate for the entire sample region was converted to estimate the number of households, and the SVW patterns were applied.

4. SUMA

The SUMA sample area covers the entirety of five counties (Midland, Bay, Saginaw, Kalamazoo, and Jackson) and portions of Muskegon, Ottawa, Allegan, Grand Traverse, Leelanau, Berrien, Cass and Calhoun counties. The SVW patterns were established by using the ACS data for the five counties above and an estimate of population living in the sample area was obtained from the "Incorporated Place and Minor Civil Division Population Dataset." Using an average household size estimate from 2000 CTPP and ACS data, a population estimate for the entire sample area was converted to the number of households. The SVW patterns were applied to the total number of households for the entire sample area.

5. Southern Lower Peninsula

There are 24 counties included in this sample area. All counties were included in the ACS data. Most of these counties share a portion of their land with another sample area (Small Cities, TMA or SUMA). Counties were grouped and their data were aggregated based on the type of overlapping sample area. For each group, the SVW table from the

overlapping area was subtracted from the ACS tables. The resultant tables were aggregated to establish SVW patterns for the sample area. The total number of households as reflected in the ACS data was expanded about 12 percent to better match the population estimates for the sample area.

6. Northern Lower Peninsula

There are 27 counties included in the sample area. However, only 17 counties were included in the ACS data. Seven of these 17 counties share a portion of their land with another sample area (Small Cities or TMA). For these counties the same procedure described in the previous section was applied. The resultant table was aggregated with the tables for the other 10 ACS counties and SVW patterns were established. For the remaining 10 non-ACS counties, a household estimate was produced by using an average household size derived from ACS data and the population estimate as reflected in Census population estimates. The SVW patterns above were applied to the number of households estimate for these counties. The resultant tables from both ACS and non-ACS counties were aggregated to establish sample area weighting targets.

7. Upper Peninsula Rural

There are 15 counties in the sample area and seven of those contain at least one small city. Only six counties were included in the ACS data. These six counties shared a portion of their land with the Small Cities sample area. The only county which had a small city within its boundaries and not included in ACS framework was Gogebic County. First, the SVW pattern obtained from the six counties in the ACS data was applied to Gogebic County and tables were aggregated. In the next step, tables from the Small Cities sample area in the Upper Peninsula were subtracted from the aggregated table. The resultant values were used to define the SVW pattern for the sample area. For counties outside the ACS sampling framework, an average household size estimate from ACS data and population estimates for non-ACS counties were used to compute an estimate of number of households in these counties. The SVW pattern was applied to this estimate. Finally, the resultant tables from both ACS and non-ACS counties were aggregated to establish sample area weighting targets.

For each sample cell, the detailed patterns obtained in each sample area were aggregated into the SVW categories that defined each sample target cell for the MTC II study. The ratio of the target cell totals to the observed frequencies from the survey yielded the expansion weights for each target cell. Based on the review of the initial results, the project team decided to merge certain cells such that each revised cell would contain at least 10 respondent households. As a result, the total number of cells was reduced to 86 from 106. The reduction process considered merging cells that have the same or adjacent household vehicle sufficiency level categories to meet or exceed the minimum responses level of 10 households. For a few cells, the response level remained as nine households since further merging would complicate the composition of the cells. Moreover, most of the zero-vehicle households were merged into a single cell within a sample area due to the low responses from this segment. The original cell identifiers in the data were preserved and another data field for the revised cell identifiers was created.

The set of new sample cell definitions and the weights for each cell are provided in Appendix B. These household-level weights were merged to the person and trip files. Table 3.2 shows the estimates for the total number of households, persons, and trips in each of the sample areas after expanding the data to the Michigan population.

Table 3.2 Estimated Numbers of Households, Persons, and Trips by MTC II

Sample Areas	Households		Persons		Trip Records[2]		Trips[2]	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
SEMCOG	280	2,071,786	591	4,820,277	2,250	18,492,758	2,165	17,819,527
Small Cities	291	147,121	669	315,640	2,730	1,242,035	2,648	1,197,877
Upper Peninsula Rural	280	90,553	622	212,970	2,157	731,242	2,040	692,071
Northern Lower Peninsula	280	218,238	622	520,125	2,163	1,819,251	2,050	1,730,304
Southern Lower Peninsula	284	412,944	668	1,078,905	2,405	3,939,950	2,293	3,776,454
TMAs	280	622,928	639	1,519,419	2,422	5,705,436	2,334	5,500,979
Small Urban Modeled Areas	280	593,556	599	1,399,086	2,292	5,369,730	2,204	5,174,502
State Total	1,975	4,157,125	4,410	9,866,421	16,419	37,300,403	15,734	35,891,714

Based on these estimates, there are over 4.15 million households, with nearly 9.9 million people in Michigan producing 35.9 million daily trips. Comparisons of these statistics with those for MTC I indicate that number of households increased about 10 percent, and population and number of trips grew 3.7 and 3.1 percent, respectively. However, the Census estimates for the year 2000 and for the 2006-2008 period indicate that the growth in population is slightly over only one percent (9,938,444 vs. 10,045,216).

When population estimates from MTC I were compared to Census population estimates for the year 2000, it was seen that CTPP driven estimates were about 4 percent lower than Census estimates. Moreover, MTC II underestimates population about 1.8 percent. Weights developed for MTC I survey relied on CTPP data and households in the sample were expanded to the levels as reflected by the CTPP estimates. Due to problems in the number of household estimates in the "County-Level Housing Unit Estimates Dataset," MTC II weights were based on estimates of number of households derived by using Census population estimates and average household sizes from ACS and/or CTPP.

While the resultant weights for both data sets expanded the sample to the population with the use of best available data for socioeconomic patterns, their estimates cannot be reliably contrasted to evaluate changes in population.

Differences in the computation of household targets, simplifying assumptions to incorporate differences in geographical level of detail of sample areas and county boundaries, and potential differences in household size distributions for larger households (with four or more individuals) between the Census and survey data are

[2] Besides actual trips, trip records include information for individuals who did not travel on the day of the survey. However, the "Trips" columns show the unweighted and weighted counts of the actual trips only.

mainly responsible for this conclusion. However, weights produced for both data sets can be reliably used to estimate rates and relative sizes of travel markets.

According to the MTC II data there were 8.63 trips per household and 3.64 trips per person. This indicates a very stable average household and person trip rates across the surveys. The upcoming 3-year and 5-year ACS data would provide more reliable data. Particularly, the 5-year data could be more useful since they will include a finer level of geographical detail and extensive geographical coverage. The next 3-year ACS data product will include more accurate socioeconomic information reflecting the effects of the economic crisis of 2008. Finally, a reliable data source for number of households at county level of detail is necessary to control sample area totals. A revised set of weights derived from a more detailed source is likely to improve the accuracy of the results of the study.

Section 4: Descriptive Analysis of MTC II Data

In Brief: *Section 4 provides descriptive statistics from the MTC II data. Most of the summaries presented in this section use unweighted data to describe the observed patterns.*

As noted in the previous sections, the MTC II survey collected travel data from 1,975 households across seven sample areas in Michigan. In this section, the distributions of key data elements across sample areas and multivariate classifications that are known to influence travel behavior were emphasized. The data summaries shown in tables and charts are unweighted and they reflect the characteristics of the MTC II sample. This helps explain potential sources of uncertainty in the data which may have been confounded by the weights. For example, an underrepresented population group may have not been noticed with weighted data analysis.

A key source of bias in travel surveys is non-travel. While respondents can provide other data, they may not have travel to report for the survey day they were assigned. The presence of higher levels of non-travel would bias trip rates and increase uncertainty in the data. While it is expected that not all households would make a trip during a given a day of the week, it is important to confirm that there are no systematic reasons for such observations. Figure 4.1 shows the percentage of households which did not produce a trip on the survey day. Overall, nearly 11 percent of the households did not report a trip. The distribution of no-trip households across the sample areas showed a slightly higher rate for rural sections of the state.

Figure 4.1 Distribution of Non-Traveling Households by Sample Area (Unweighted)

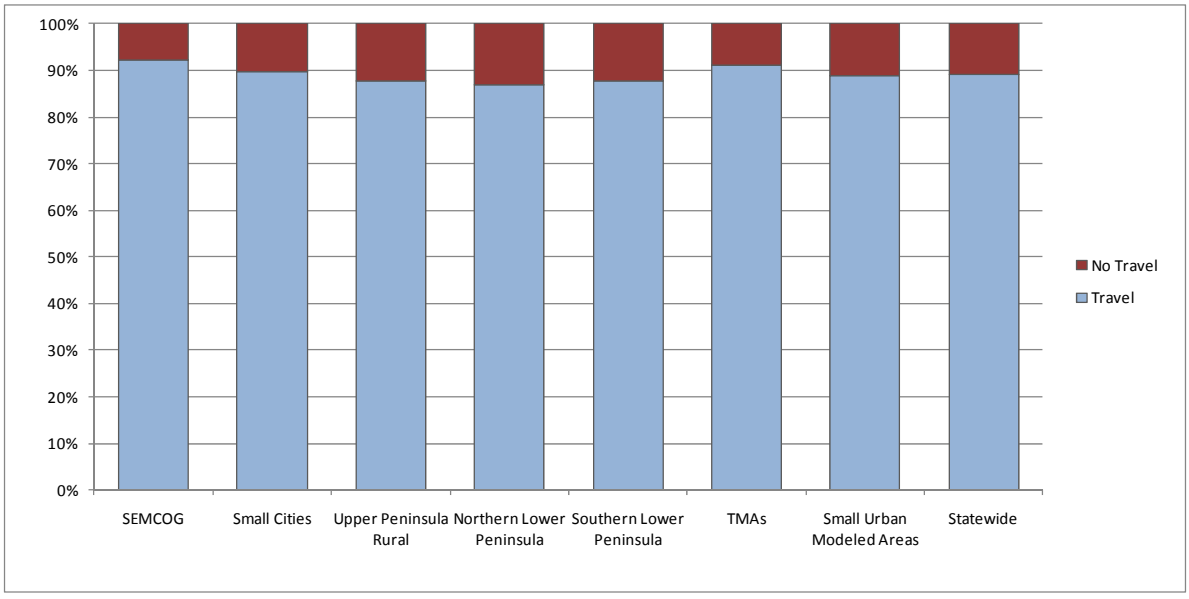


Table 4.1 features the breakdown of non-traveling households and respondents across the sample areas. At the person level, more than 15 percent of the respondents did not report a trip. The distribution of non-traveling respondents across the sample areas is very similar to the patterns observed in Figure 4.1. In rural sample areas, the portion of non-traveling respondents could be as high as 19 percent.

Table 4.1 Distribution of Non-Traveling Households and Persons by Sample Area (Unweighted – MTC II Data)

	Households by Travel Status					Persons by Travel Status				
	Travel	No Travel	Total	Percent Travel	Percent No Travel	Travel	No Travel	Total	Percent Travel	Percent No Travel
SEMCOG	258	22	280	92.1%	7.9%	506	85	591	85.6%	14.4%
Small Cities	261	30	291	89.7%	10.3%	587	82	669	87.7%	12.3%
Upper Peninsula Rural	246	34	280	87.9%	12.1%	505	117	622	81.2%	18.8%
Northern Lower Peninsula	243	37	280	86.8%	13.2%	509	113	622	81.8%	18.2%
Southern Lower Peninsula	249	35	284	87.7%	12.3%	556	112	668	83.2%	16.8%
TMAs	255	25	280	91.1%	8.9%	551	88	639	86.2%	13.8%
Small Urban Modeled Areas	249	31	280	88.9%	11.1%	511	88	599	85.3%	14.7%
Statewide	1761	214	1975	89.2%	10.8%	3725	685	4410	84.5%	15.5%

Table 4.2 provides a summary of non-traveling households and persons from MTC I data which showed slightly lower rates, about two percentage points at the household level, and about a percentage point at the person level.

Table 4.2 Distribution of Non-Traveling Households and Persons by Sample Area (Unweighted – MTC I Day-One Data)

	Households by Travel Status					Persons by Travel Status				
	Travel	No Travel	Total	Percent Travel	Percent No Travel	Travel	No Travel	Total	Percent Travel	Percent No Travel
SEMCOG	2,042	179	2,221	91.9%	8.1%	4,762	815	5,577	85.4%	14.6%
Small Cities	2,116	212	2,328	90.9%	9.1%	4,966	869	5,835	85.1%	14.9%
Upper Peninsula Rural	1,821	206	2,027	89.8%	10.2%	4,113	740	4,853	84.8%	15.2%
Northern Lower Peninsula	1,837	236	2,073	88.6%	11.4%	4,157	920	5,077	81.9%	18.1%
Southern Lower Peninsula	1,893	166	2,059	91.9%	8.1%	4,499	737	5,236	85.9%	14.1%
TMAs	1,933	132	2,065	93.6%	6.4%	4,670	614	5,284	88.4%	11.6%
Small Urban Modeled Areas	1,893	152	2,045	92.6%	7.4%	4,412	648	5,060	87.2%	12.8%
Statewide	13,535	1,283	14,818	91.3%	8.7%	31,579	5,343	36,922	85.5%	14.5%

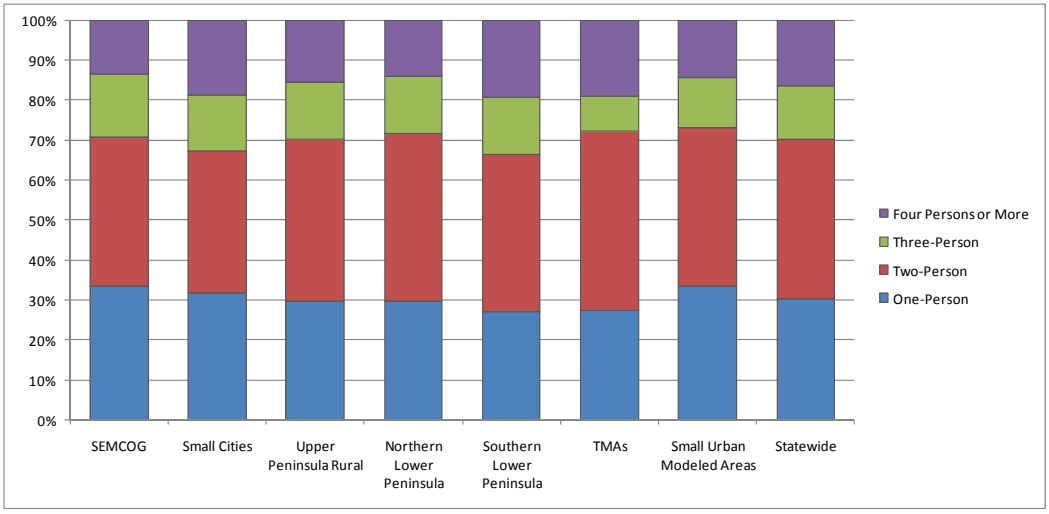
The SEMCOG sample area had almost the same rates for non-trip making while households from rural and less urbanized portions of the state had higher levels of non-trip making in MTC II.

At the person level, TMAs and SUMAs had higher rates of non-travel in MTC II, while Small Cities had a lower rate. Northern Peninsula had a stable but high rate while other rural sample areas had higher rates in MTC II. In general, the rates for non-trip making at the household level showed a slight increase for MTC II. However, the changes at the person level were not systematic, and the size of difference in overall rates is too small to conclude that non-trip making would cause any substantial bias between the two MTC surveys.

4a. Key Socioeconomic Patterns

The sampling plans for both MTC surveys considered household size, vehicles available, and workers in the household as socioeconomic control variables. Figures 4.2 through 4.6 feature the observed distributions of households by household size, number vehicles, and workers in the household.

Figure 4.2 Distribution of Households by Size and Sample Area (Unweighted)

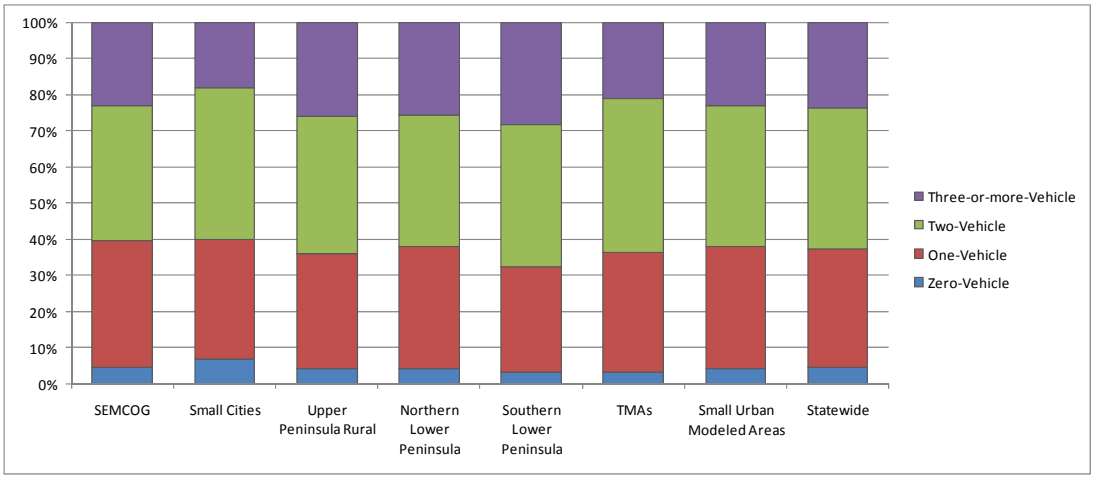


The observed shares of household size in the MTC II sample are dominated by small households (one- or two-member); approximately 70 percent of all households. During the MTC I survey, a larger share, nearly 40 percent, of larger households was observed (MTC I Final Report). Particularly, response from three-member households was consistently low for all sample areas in MTC II data.

Figure 4.3 shows the distribution of households by vehicle ownership. As discussed in Section 2, the response from zero-vehicle households was lower than expected (4.4 percent). However, the share of households with two or more vehicles remained almost the same (62 vs. 63 percent). The total of zero and one-vehicle households made up about 38 percent of the overall sample in MTC I (MTC I Final Report), compared to 37 percent in MTC II. Therefore, it is quite possible that some of the zero-vehicle

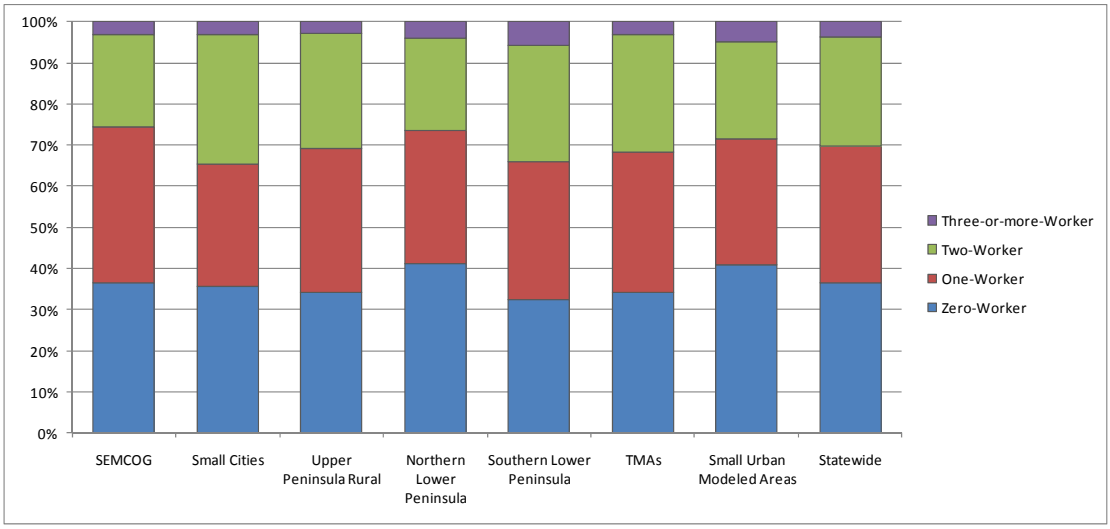
households may have moved into the one-vehicle household category over the past few years. Comparisons in Section 6 provide more details about the changes in household structure and socioeconomics between the two surveys. In general, patterns across the sample areas were found to be consistent with the statewide patterns.

Figure 4.3 Distribution of Households by Vehicles Available and Sample Area (Unweighted)



The distribution of households by workers in the household indicates that about 36 percent of the households in the sample do not have a worker. This share increased about eight percent from the previous survey. When examining the other categories, the observed reduction in shares was found to be uniform. In other words, while zero-worker household frequencies increased eight percent, the other categories were reduced by almost equal percentage points. For Northern Lower Peninsula and Small Urban Areas, shares of zero-worker households were at a slightly higher level of approximately 40 percent.

Figure 4.4 Distribution of Households by Number of Workers in the Household and Sample Area (Unweighted)



Households in the MTC II sample are segmented by household size, vehicle availability, and sample area in Figure 4.5. The analysis of plots by sample area indicated that, in general, observed patterns are similar to each other. As expected, one-person households had the highest levels of zero-vehicle auto ownership level. However, for SEMCOG, Small Cities, and TMAs, zero-vehicle ownership was noticeable in two-person households as well.

For all sample areas in Michigan, the majority of two-person households own two vehicles. Moreover, the vehicle ownership level of three or more vehicles is also quite common in two-person households.

All of the households with three and four or more persons had at least one vehicle.

One notable finding is that, for almost all sample areas, the shares of three-person households with three or more vehicles are quite large and mostly the highest. This can be explained by the large share (67 percent) of all adult three-person households.

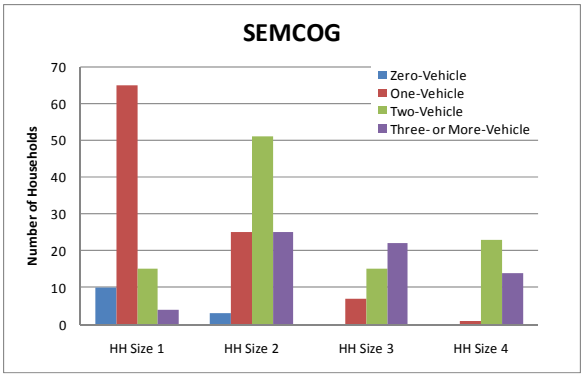
In general, for households with four or more members, shares of three or more vehicles are not as high as three-person households, except for Southern Lower Peninsula and SUMA sample areas.

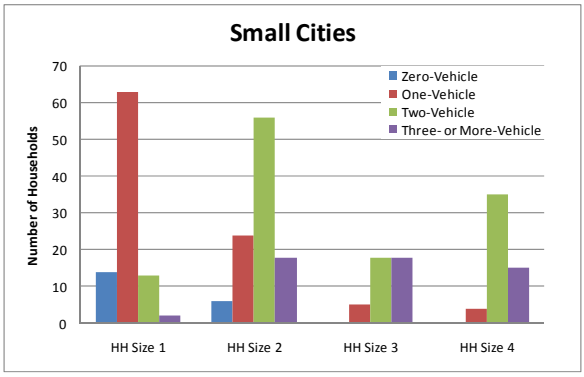
The series of charts in Figure 4.6 show the distributions of households by vehicle ownership and number of workers in the household. For almost all sample areas, a household would own at least one vehicle, if one of its members was a paid worker. Almost all zero-vehicle households were not part of the labor force.

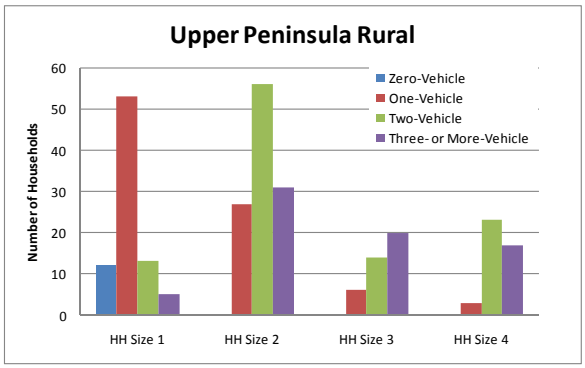
The number of workers also seems to be closely related to household vehicle ownership levels as expected. In households with two or more workers, there are very few households that have fewer vehicles than workers. In other words, auto sufficiency is satisfied for almost all households with a worker.

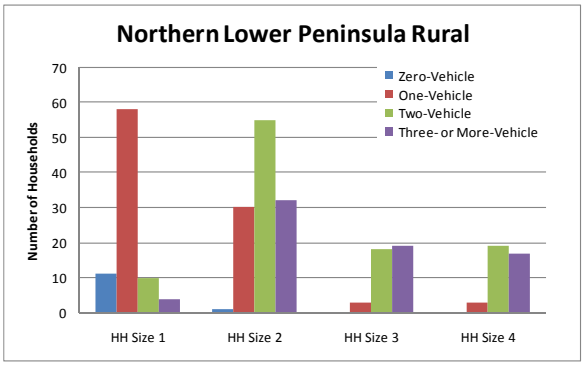
These findings can be used to revise the number of target cells for future data collection efforts. Household size and number of workers seem to provide sufficient levels of variance. Special attention needs to be paid to zero-vehicle households during sample design and recruitment.

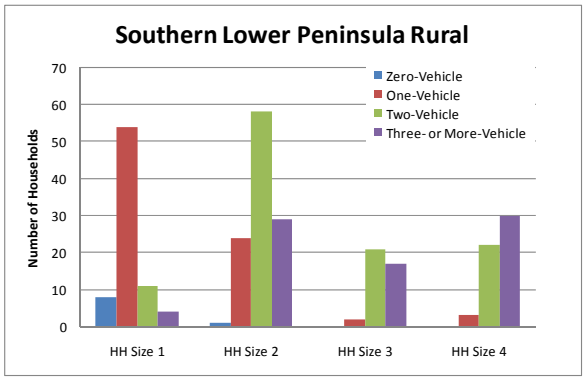
Figure 4.5 Distribution of Households by Size, Vehicles Available, and Sample Area (Unweighted)

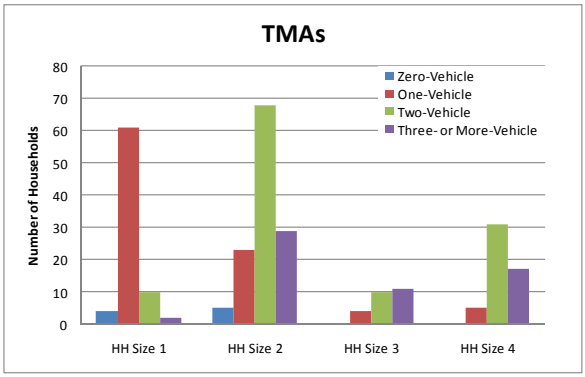


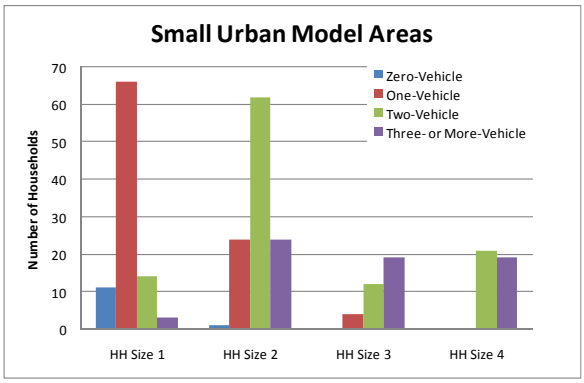












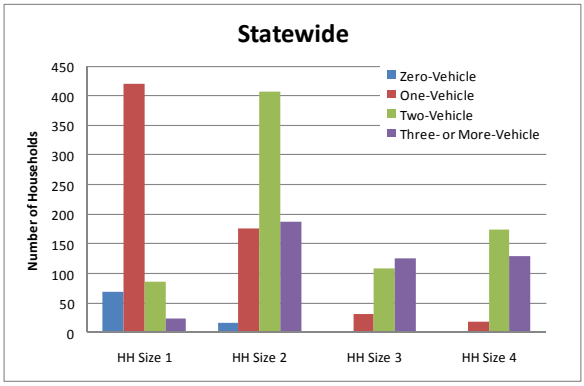
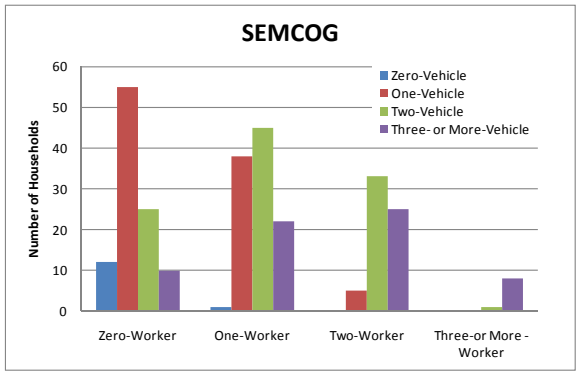
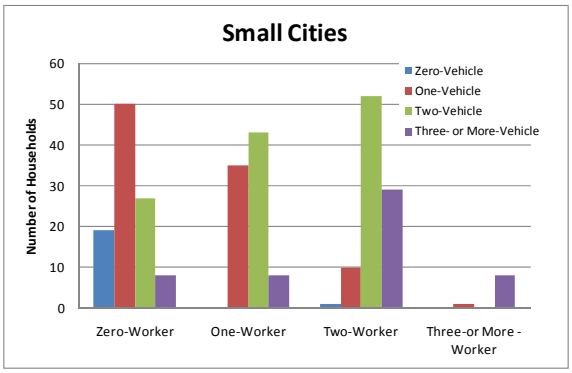
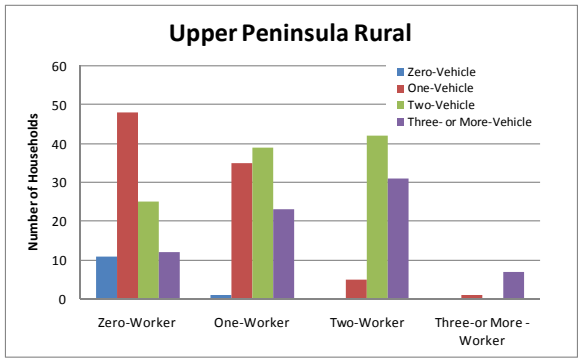
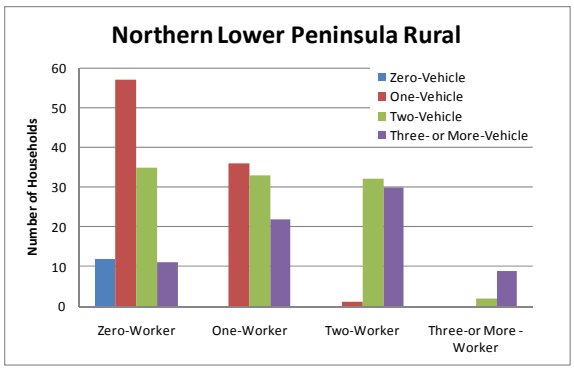


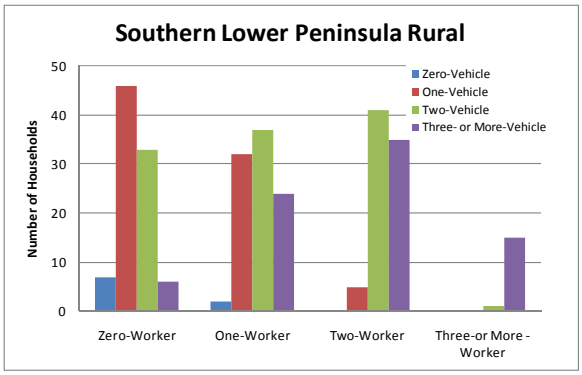
Figure 4.6 Distribution of Households by Number of Workers, Vehicles Available, and Sample Area (Unweighted)

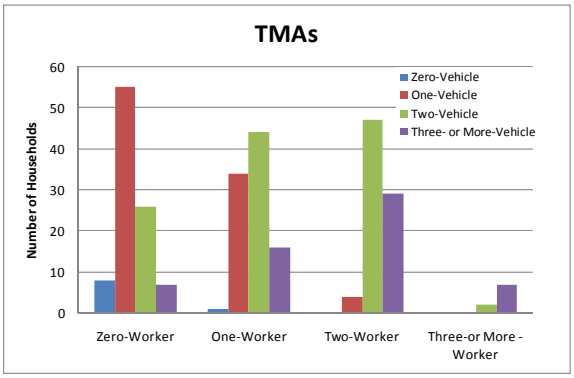


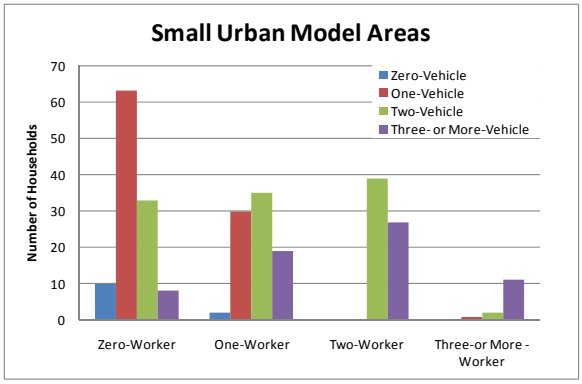


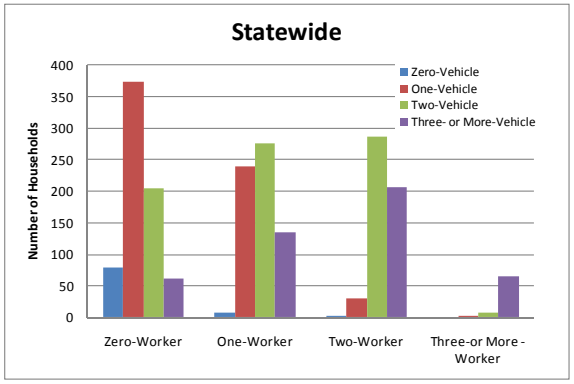






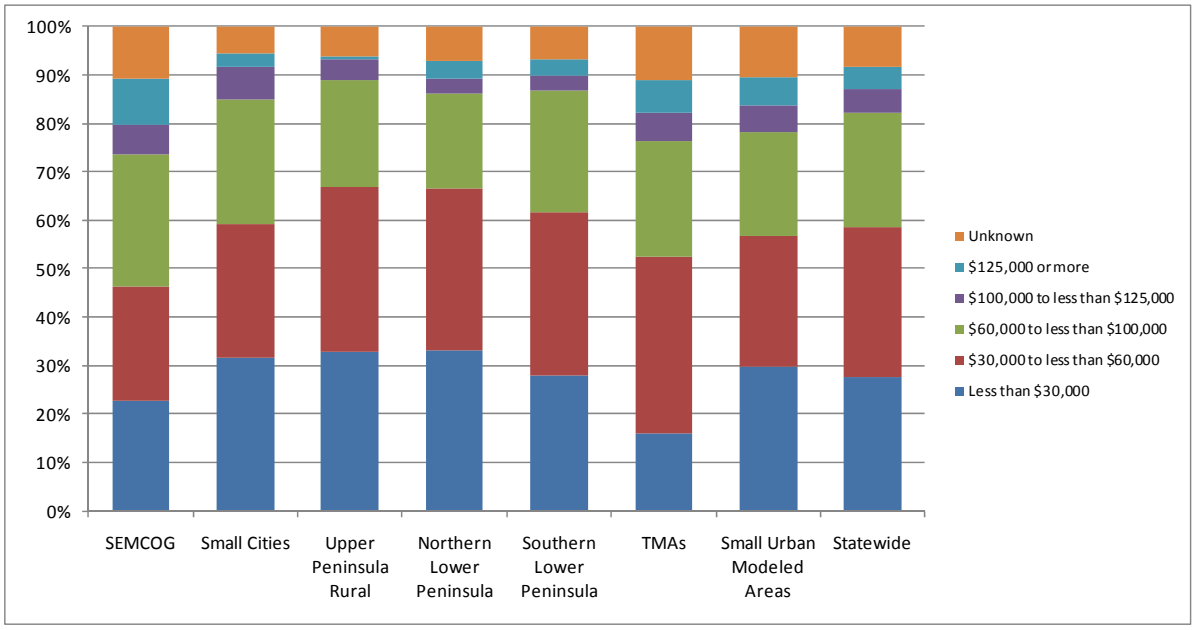






Household income is another key socioeconomic variable that influences travel behavior. Figure 4.7 shows the distribution of households by income and sample area. About eight percent of the households did not report income at the desired level of detail and non-response was slightly higher in the SEMCOG, TMA and SUMA sample areas.

Figure 4.7 Distribution of Households by Income Groups and Sample Area (Unweighted)



More than 80 percent of the households in the sample have an income lower than $100,000. For the rural portion of the state, the size of this segment approaches 90 percent. Among the lower income levels, a higher variability was observed in the lowest income category. In the SEMCOG and TMA sample areas, there were fewer respondents in the "Less than $30,000" category compared to other sample areas. The SEMCOG sample area also had the smallest share of the "$30,000 to less than $60,000" category and the largest share in the high income categories. Small Cities, TMAs, and SUMA sample areas also had modest but noticeable levels of high income. The rural portion of the state had slightly higher levels of low income groups when compared to other sample areas.

Figure 4.8 presents the distribution of respondents in the sample by employment status. Nearly 45 percent of the respondents were paid workers, with 32 percent working full-time and 12 percent working part-time. About 36 percent did not work at the time of the study. In order to confirm whether these findings were consistent with the previous survey, MTC I figures are presented in Table 4.3. The MTC I figures indicate that relative size of the working respondents is similar to that for MTC II. However, there are sizeable differences between the "Not Working" and "Not Applicable" groups where MTC II data had a higher share of non-workers and a smaller share of young respondents who cannot work legally.

Figure 4.8 Distribution of Respondents by Employment Status (Unweighted)

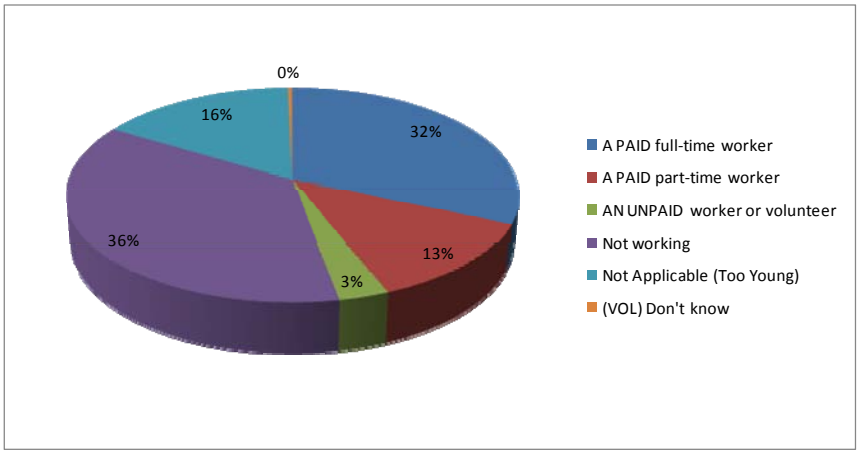
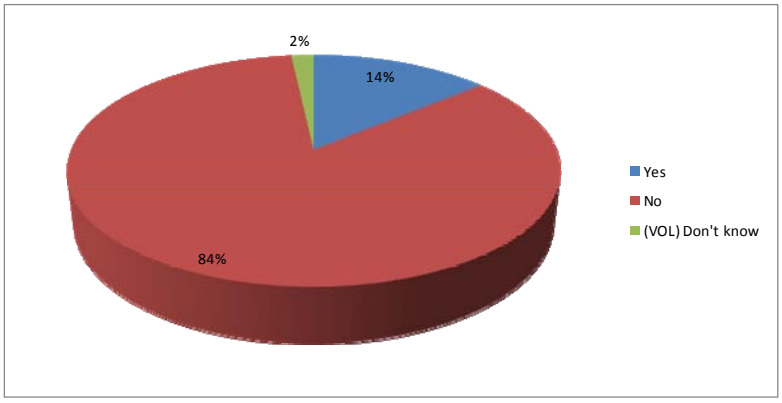


Table 4.3 Distribution of Respondents by Employment Status (Unweighted)

Persons by Employment Status				
	MTC I		MTC II	
	Persons	Percent	Persons	Percent
Paid full-time	13,036	35.3%	1,387	31.5%
Paid part-time	4,160	11.3%	552	12.5%
Unpaid worker or volunteer	902	2.4%	138	3.1%
Not working	10,387	28.1%	1,606	36.4%
Not Applicable (Too Young)	8,422	22.8%	712	16.1%
Unknown	15	0.0%	15	0.3%
Total	36,922	100.0%	4,410	100.0%

The composition of the non-worker group has three major categories: retirees, homemakers, and unemployed individuals who are still in the labor force. The survey includes a question whether a non-worker at the time of the survey was seeking a job. Figure 4.9 show the distribution of responses to this question.

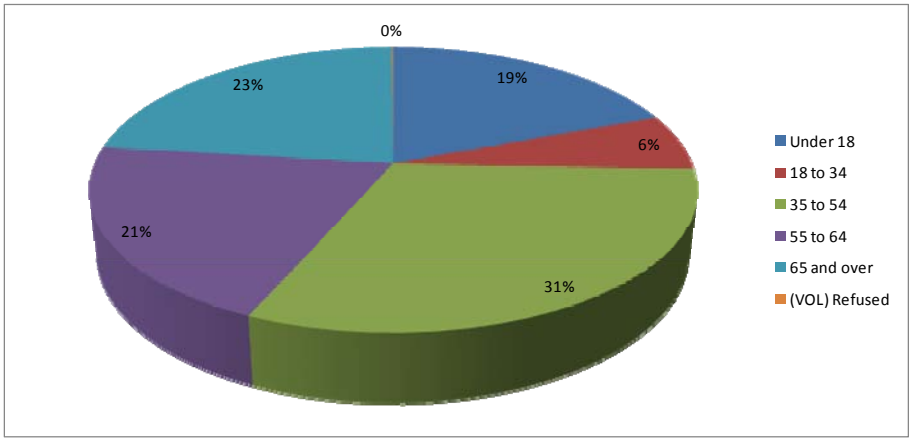
Figure 4.9 Distribution of Non-Workers by Job Seeking Status (Unweighted)



According to Figure 4.9, only 14 percent of the non-worker respondents in the MTC II sample were pursuing other job opportunities (in MTC I this figure was 13 percent). This indicates that the relative size of non-worker respondents who were still in the labor force was equivalent across the MTC surveys. This finding and the difference between "Not Applicable" groups imply that the sample for MTC II may include more respondents from older age groups and homemakers. Moreover, although the relative size of job-seeking non-worker respondents remained stable, this result may also point out that the number of non-workers who are seeking a job may have increased since there was an increase in the share of non-workers.

Figure 4.10 features the distribution of respondents by age groups. The smallest segment is the youngest adult age group (18-34 year olds) with a six percent share. The other age groups had comparable sizes, and the 35-54 year old group had the highest share.

Figure 4.10 Distribution of Respondents by Age Group (Unweighted)



Although Section 5 provides detailed comparison on age groups, the unweighted age group distribution from MTC I and MTC II are presented together in Table 4.4 to assess the differences between the two surveys. The relative sizes of age groups across the MTC surveys clearly indicate that MTC II data drew more respondents from older age categories.

Table 4.4 Distribution of Respondents by Age Group (Unweighted)

Respondents by Age Groups				
	MTC I		MTC II	
Age Groups	**Persons**	**Percent**	**Persons**	**Percent**
Under 18	9,508	25.8%	852	19.3%
18 to 34	5,132	13.9%	279	6.3%
35 to 54	11,750	31.8%	1,362	30.9%
55 to 64	5,047	13.7%	897	20.3%
65 and over	5,472	14.8%	1,016	23.0%
Refused	13	0.0%	4	0.1%
Total	36,922	100.0%	4,410	100.0%

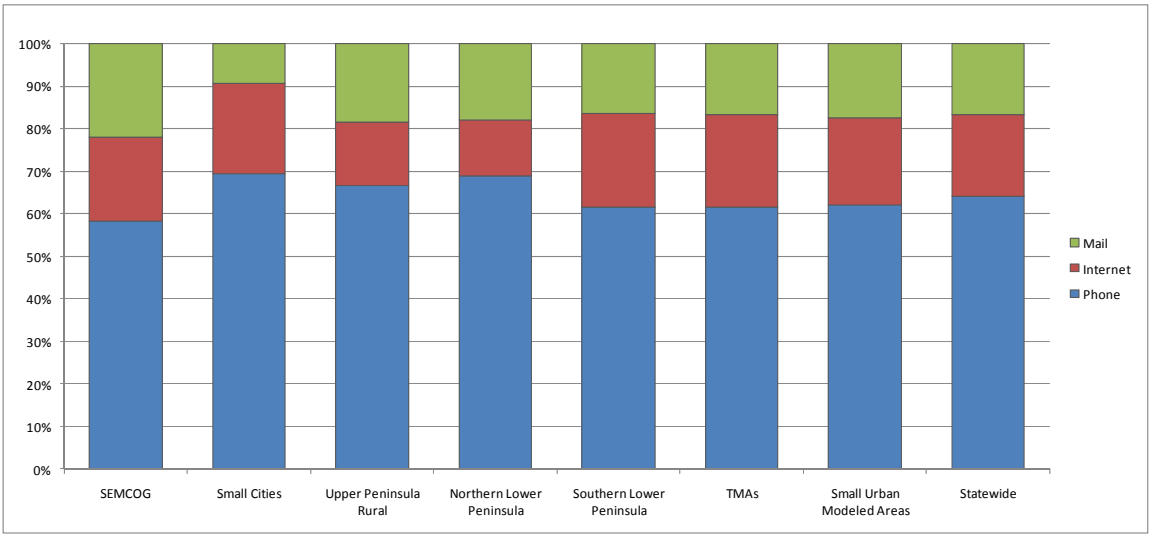
Young adult households and households with kids did not respond to the MTC II study at the same rate as they had responded to MTC I. This can be partly explained by common findings in surveys that young households were found to be more mobile, therefore more likely to change their residence or switch from landlines to cell phones. Moreover, the recruitment strategy may have played a role in this result, since some portion of the young households may have moved to the next cohort after 5 years vacating the pool from which these households can be drawn. In addition, households of older respondents may have agreed to participate in further studies at a higher rate. Section 6 contains tabulations from MTC I data to confirm this preliminary conclusion. Finally, the introduction of adjustments to expansion weights at the person level to correct for age differences can be considered for future analysis of the data.

4b. Respondents by Data Collection Method

Different methods of data retrieval were implemented in this study. Figure 4.11 shows the relative sizes of by method and sample area. Nearly 65 percent of the respondents were interviewed by phone. Mail and the Internet were other alternatives which had comparable sizes. About 19 percent of the respondents reported their travel via Internet and 17 percent chose to reply by mail. The distribution of respondents by data retrieval method across sample areas shows fairly consistent patterns similar to the statewide distribution. The SEMCOG sample area had the lowest level of responses by phone.

More detailed analysis can be conducted to evaluate whether there exist any differences in data quality and age composition between retrieval methods to make decisions for future data collection efforts in Michigan or any of the sample areas defined for the study.

Figure 4.11 Distribution of Respondents by Data Collection Method and Sample Area (Unweighted)



4c. Trip Rates and Characteristics

Trip rates and the spatial distribution of travel are the most important items that impact travel behavior and are critical inputs to demand models. Trip generation and distribution components of traditional four-step models rely heavily on trip rates derived from travel surveys. Figure 4.12 shows the average number of daily trips per household by sample area. The rates presented also include households who did not travel. Due to the effects of expansion weights, the rates reported in this section may slightly differ from the rates reported in Section 5.

The average household trip rate for Michigan was 7.97 trips/day. The Small Cities sample area has the highest trip rate (9.10 trips/day) in the sample. Both Upper Peninsula and Northern Lower Peninsula sample areas had lower trip rates (about 7.3 trips/day), as expected, Southern Lower Peninsula had an above average trip rate of 8.07 daily trips. The trip rate of 8.34 trips per day from TMAs sample area was also above average.

Figure 4.12 Distribution of Average Household Trip Rates by Sample Area (Unweighted)

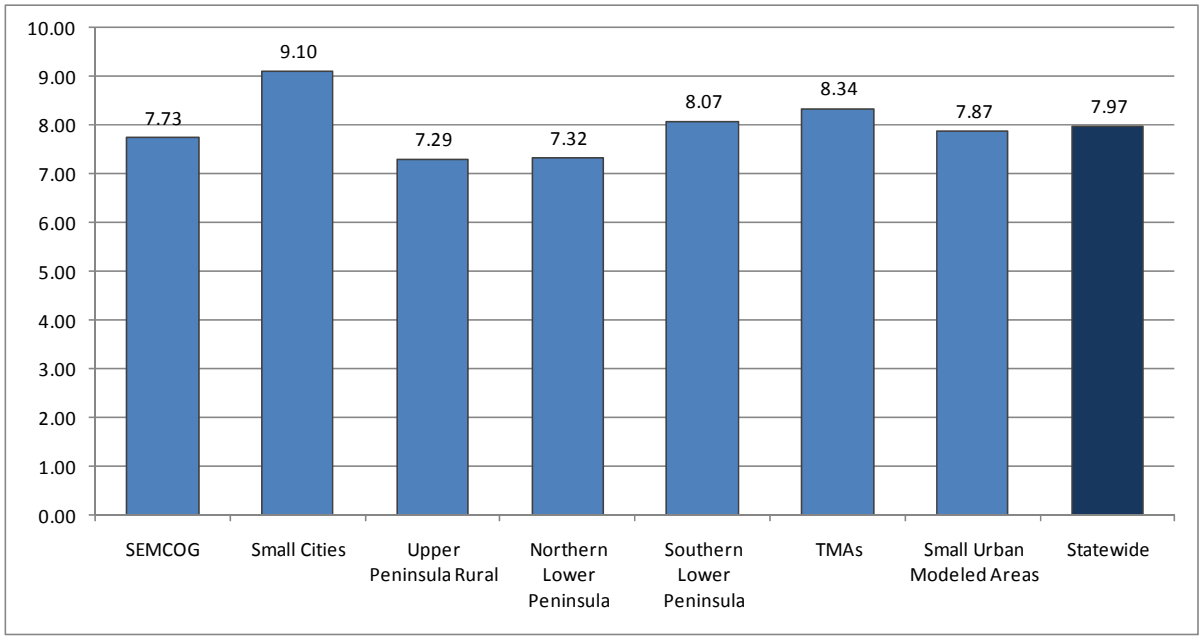
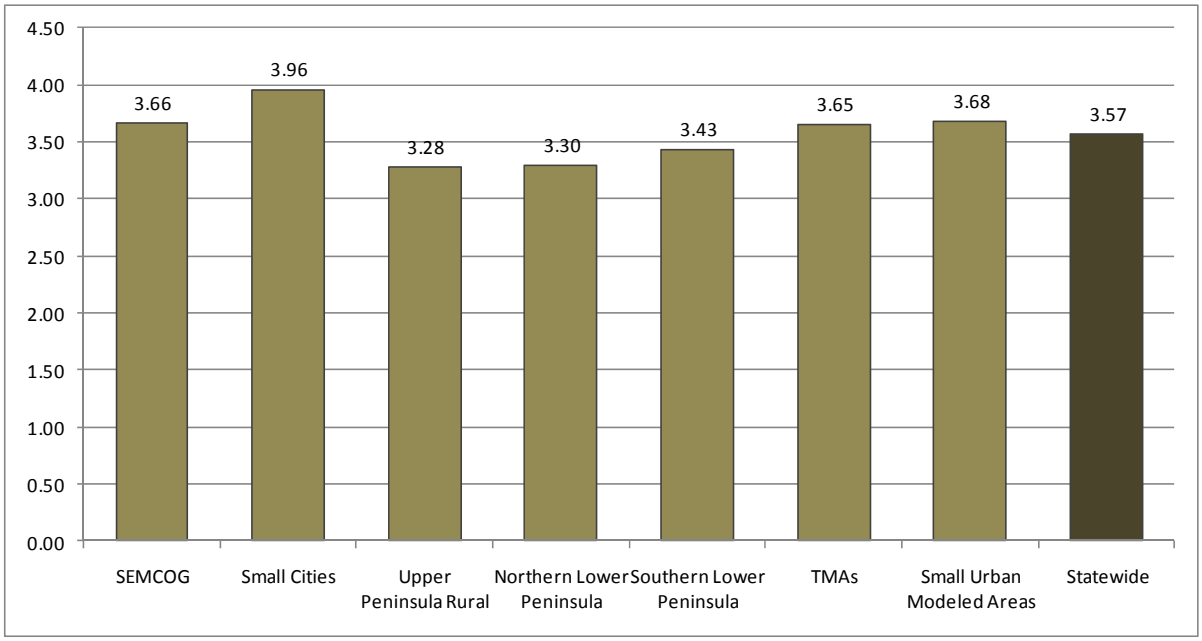


Figure 4.13 shows the distribution of person trip rates across the sample areas. The overall person trip rate for Michigan was 3.57 trips per day. All rural sample areas had a lower rate than average and all urbanized sample areas had a higher than average trip rate as expected. The Small Cities sample area still had the highest person trip rate (3.96 trips/day) and Upper Peninsula had the lowest person trip rate of 3.28 trips/day.

Figure 4.13 Distribution of Average Person Trip Rates by Sample Area (Unweighted)



Another important travel attribute for travel demand models is the trip purpose since trips with different purposes are modeled separately. The survey included detailed categories for activity types attended at the destination for each trip. Table 4.5 features average trip rates per household for each sample area. It should be noted that the sum of trip rates by purpose does not exactly match the total trip rates due to missing values on trip purpose for imputed trips and non-response to activity type questions.

Among trips beyond home locations, work trips had the highest frequency followed by personal business trips, everyday shopping trips and trips for picking up or dropping off passengers. School trips and trips to restaurants also had modest but noticeable frequencies. These patterns are consistent with the patterns observed in MTC I data (MTC I Final Report).

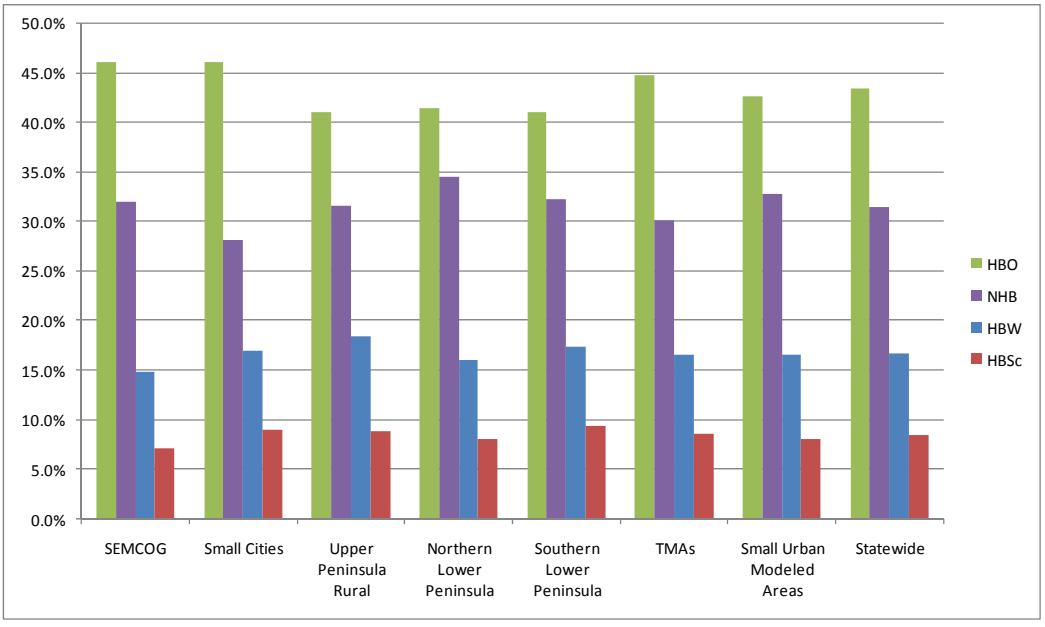
The highest rate for work trips was observed for the Small Cities sample area, while the lowest rate was produced in the SEMCOG sample area where personal trips had a higher frequency. The results for SEMCOG sample area is not consistent with MTC I survey findings, while it can be partly explained by economic downturn, oversampling of older age groups may also contribute to such results. It could be worth updating the expansion weights by age and possibly by gender for further analysis.

Table 4.5 Distribution of Trip Rates by Purpose and Sample Area (Unweighted)

	SEMCOG	Small Cities	Upper Peninsula Rural	Northern Lower Peninsula	Southern Lower Peninsula	TMAs	SUMA	Statewide
All	7.73	9.10	7.29	7.32	8.07	8.34	7.87	7.97
Home - Paid Work	0.03	0.03	0.04	0.01	0.05	0.04	0.03	0.03
Home - Other	2.53	3.13	2.39	2.28	2.61	2.80	2.54	2.61
Work	0.94	1.30	1.19	1.12	1.27	1.24	1.11	1.17
Attend Childcare	0.01	0.04	0.01	0.03	0.04	0.02	0.03	0.02
Attend School	0.33	0.47	0.35	0.39	0.45	0.42	0.39	0.40
Attend College	0.05	0.03	0.03	0.02	0.02	0.02	0.03	0.03
Eat Out	0.39	0.40	0.38	0.40	0.32	0.44	0.48	0.40
Personal Business	0.99	0.88	0.78	0.89	0.91	0.77	0.89	0.87
Everyday Shopping	0.80	0.68	0.78	0.68	0.78	0.86	0.84	0.77
Major Shopping	0.05	0.05	0.08	0.06	0.04	0.08	0.11	0.07
Religious/Community	0.13	0.14	0.11	0.15	0.11	0.15	0.12	0.13
Social	0.36	0.35	0.30	0.26	0.34	0.26	0.24	0.30
Recreation - Participate	0.26	0.35	0.13	0.20	0.19	0.23	0.25	0.23
Recreation - Watch	0.08	0.07	0.05	0.08	0.06	0.11	0.04	0.07
Accompany Someone	0.09	0.14	0.09	0.13	0.10	0.13	0.15	0.12
Pick-Up/Drop-Off Pass.	0.55	0.75	0.46	0.45	0.61	0.63	0.44	0.55
Turn Around	0.03	0.05	0.05	0.02	0.03	0.02	0.05	0.04

Trip purposes are grouped into broader categories for modeling purposes. Most common purposes include Home-Based Work (HBW), Home-Based School (HBSch), Home-Based Other (HBO) and Non-Home-Based (NHB) trips. Figure 4.14 plots the relative size of each of these segments by sampling sample area.

Figure 4.14 Distribution of Trips by Purpose and Sample Area (Unweighted)



For all sample areas HBO travel has the highest share with an average of 43 percent. The next largest segment is NHB trips with an average share of 31 percent. HBW trips made up 17 percent of the total travel market and HBSch trips had a share of about eight percent. These patterns were consistent across the sample areas with minor fluctuations around their respective mean values. The relative sizes for each trip purpose observed in MTC II are consistent with other travel surveys. The changes in the relative size of trip purposes between MTC surveys are detailed in Section 5.

Travel behavior changes by age, and sometimes oversampling in certain age groups may cause biases in estimates of trip rates. In order to confirm whether trip data in the MTC II sample differ from MTC I due to differences in response from different age groups, additional summaries were created using age as a classification variable.

Figure 4.15 features the portions of trips made by adult respondents from different age groups. The pattern for the entire sample indicated that the highest percentage of trips was generated by respondents between 35 and 54 years old. Young adults (ages 18 to 34) produced about eight percent and the rest of the trips were shared almost equally between the age groups of 55 to 64 years and 65 and over. These patterns were fairly consistent across the sample areas.

In the Northern Lower Peninsula and SEMCOG sample areas, there were more trips produced by the 65 and over age group compared to 55 to 64 year olds. The differences between age groups older than 35 years were found to be the smallest in Small Urban Model Areas and Northern Lower Peninsula sample areas.

Figure 4.15 Distribution of Person Trips by Adult Age Groups and Sample Area (Unweighted)

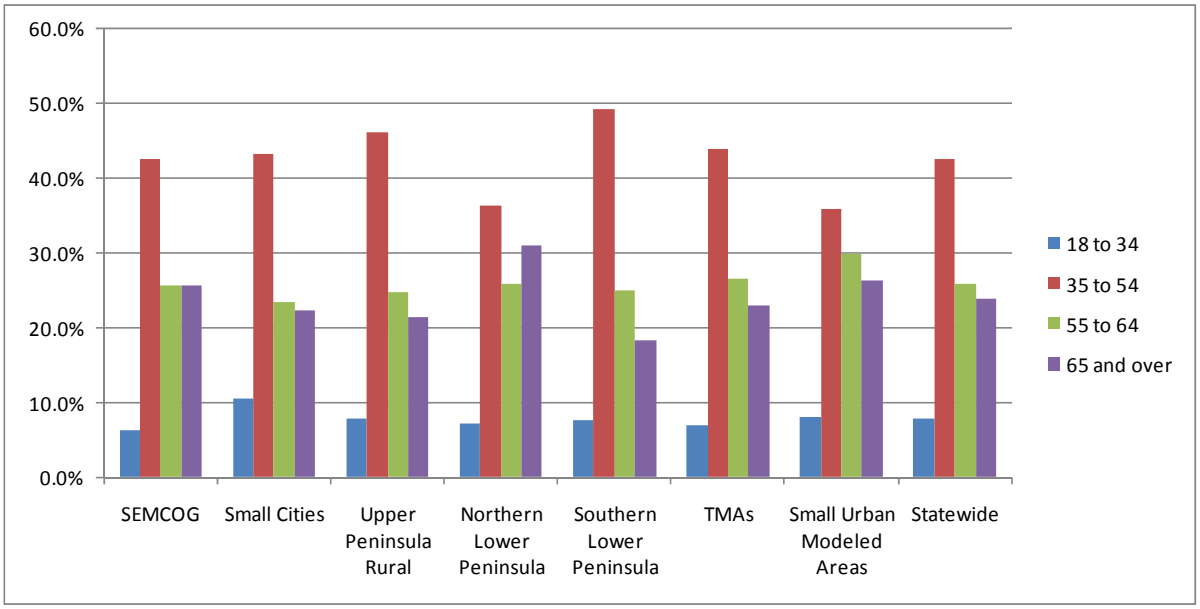
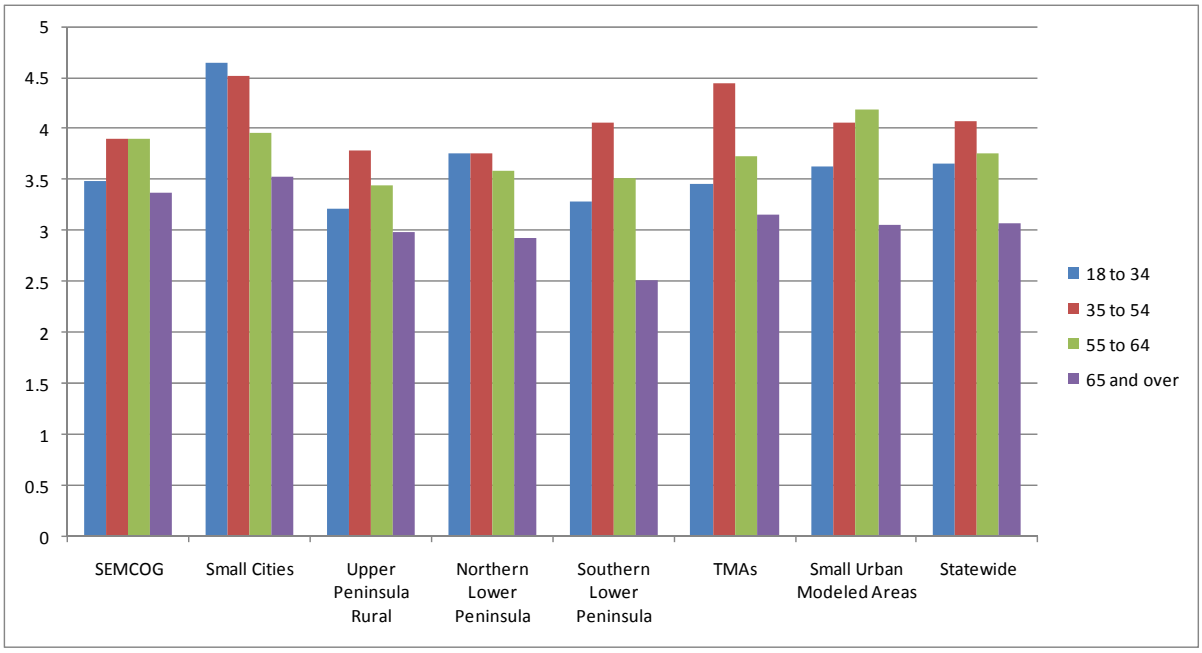


Figure 4.16 shows the distribution of person-level trip rates of adult respondents by age groups across sample areas. The review of statewide rates indicated that age groups between 18 and 64 year old respondents had minor differences, while the 65 and over group had a significantly lower trip rate. The age group of 35 to 54 year olds had the highest trip rate with 4.07 trips/day. This pattern is valid for all sample areas.

The Small Cities sample area had consistently higher trips rates for all age groups with the exception of 55 to 64 years old group, which had more trips per day in the Small Urban Model Areas sample area. The young adult age group in the Small Cities sample area also had the highest trip rate among all groups (4.65 trips/day). The lowest trip rate was observed for the 65 and older age group in the Southern Lower Peninsula sample area with 2.51 trips/day. While the SEMCOG sample area age groups showed lowest variance in trip rates across age groups, the highest variance was observed for the Southern Lower Peninsula sample area.

Figure 4.16 Distribution of Person Trip Rates by Adult Age Group and Sample Area (Unweighted)



Gender is another variable that influences travel behavior. The expectations include differences in trip rates between men and women particularly for different trip purposes such as shopping and drop-off/pick-up trips. Figure 4.17 shows the relative sizes of total trips made by males and females across the sample areas. For all sample areas, the majority of the trips were made by females representing about 55 percent of the trips in the sample.

The smallest difference was seen in the Upper Peninsula, while the largest difference was observed for the TMAs and the SEMCOG sample area.

Figure 4.17 Distribution of Adult Person Trips by Gender and Sample Area (Unweighted)

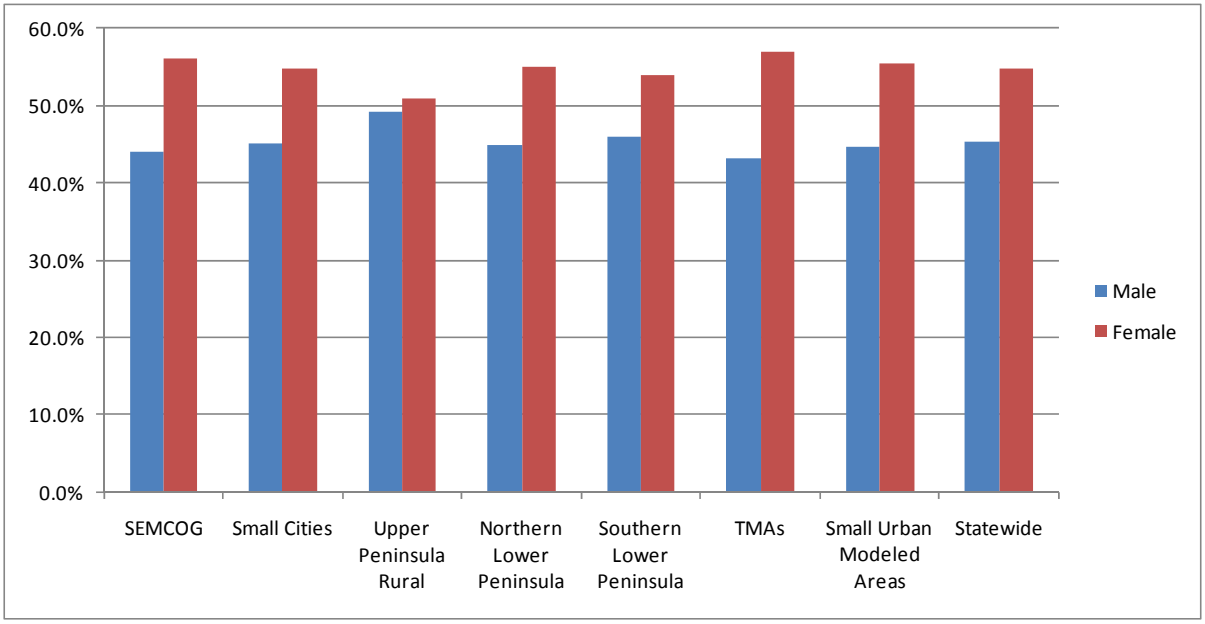
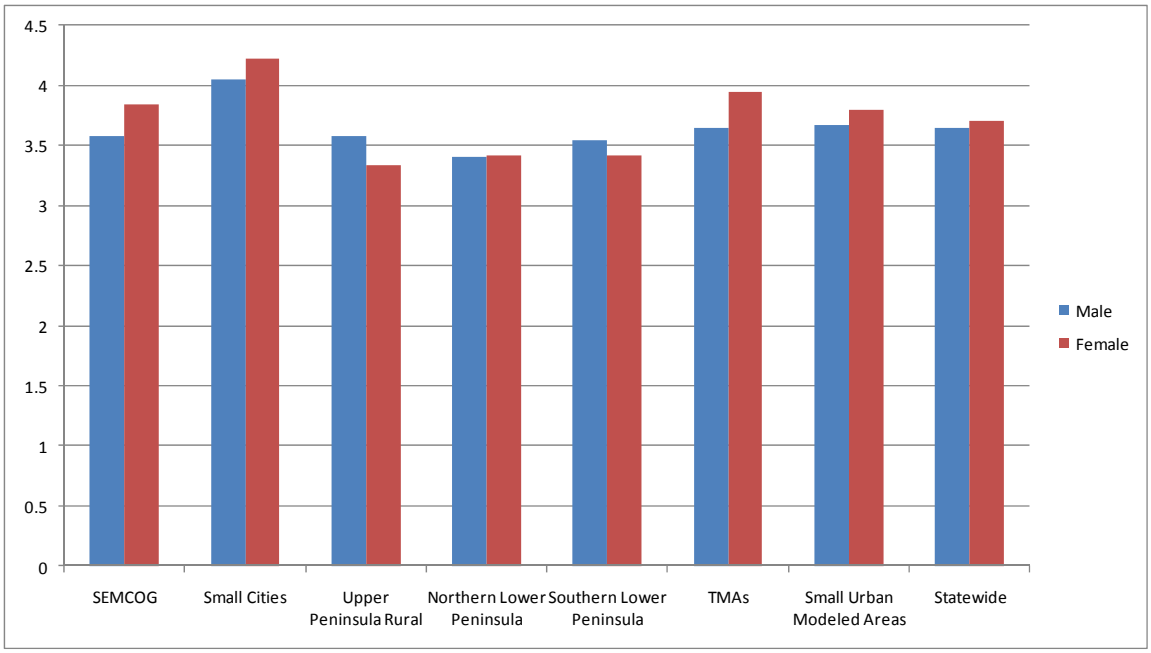


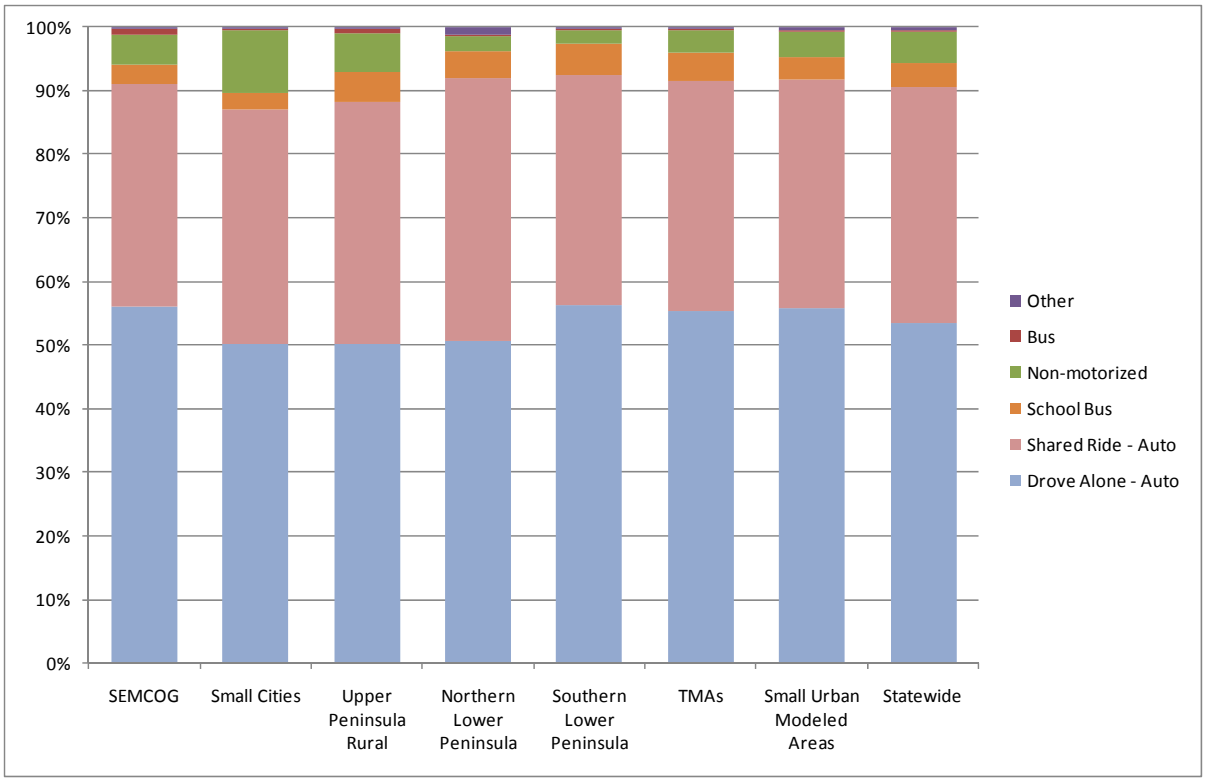
Figure 4.18 features person trip rates by gender. The statewide distribution indicates that trip rates do not differ significantly between males and females (3.64 vs. 3.70 daily trips). However, trip rates by males were slightly higher for the rural portion of the state, while in urbanized areas, females generated slightly more trips than males. The equivalence of trip rates by gender can be explained by the presence of more females in the sample; 54 percent of the adult respondents (16 or older) were female.

Figure 4.18 Distribution of Adult Person Trip Rates by Gender and Sample Area (Unweighted)



Modal shares of the reported trips in the MTC II sample are featured in Figure 4.19. The statewide patterns indicated that the 53.5 percent of trips were made by auto while driving alone and 37 percent of trips were made by a shared ride. The remaining 9.5 percent were made by buses and non-motorized modes. These patterns were consistent across the sample areas.

Figure 4.19 Modal Distribution of Trips by Sample Area (Unweighted)



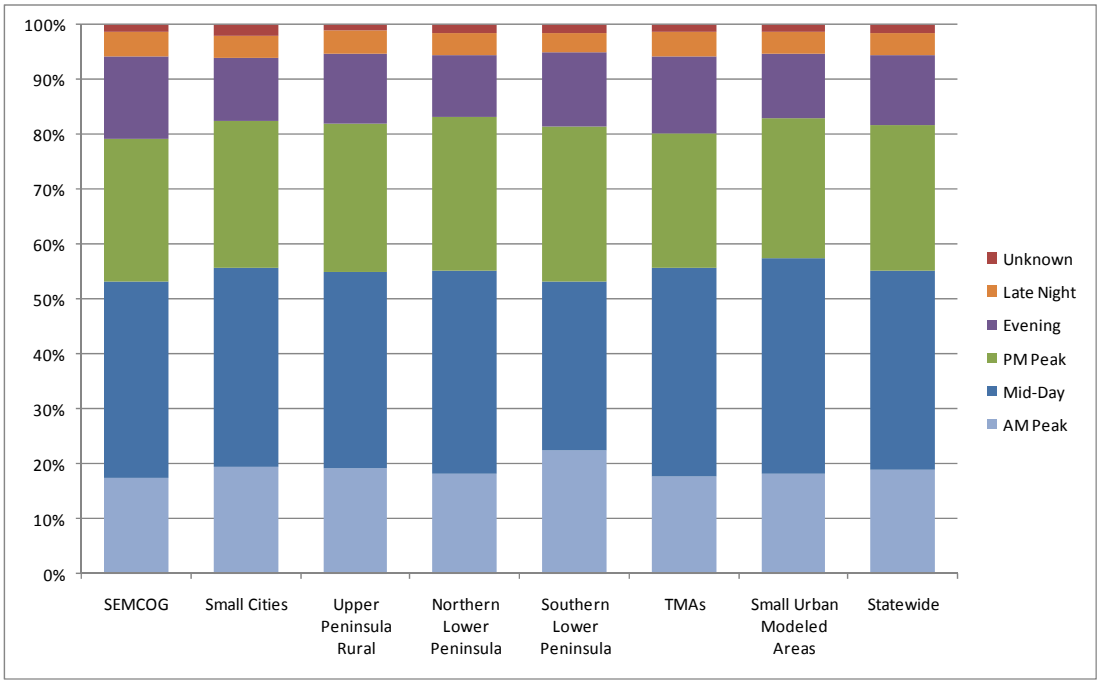
Distribution of trips by time of day periods across sample areas is plotted in Figure 4.20. The following break points were used to define the time periods used throughout the report.

AM Peak: 6:00 AM – 8:59 AM
Mid-Day: 9:00 AM – 2:59 PM
PM Peak: 3:00 PM – 5:59 PM
Evening: 6:00 PM – 8:59 PM
Late Night: 9:00 PM – 5:59 AM

The “Unknown” category for time of day is used for trip records with missing departure time values and for artificial trip records that were created during the imputation process.

Based on the statewide distribution, nearly 20 percent of the trips started in the AM Peak period, just over 35 percent in Mid-Day period, 27 percent in the PM Peak, and 13 percent during the evening period. Only four percent of the reported trips were observed during the late night period. This pattern is almost identical across sample areas.

Figure 4.20 Diurnal Distribution of Trips by Sample Area (Unweighted)

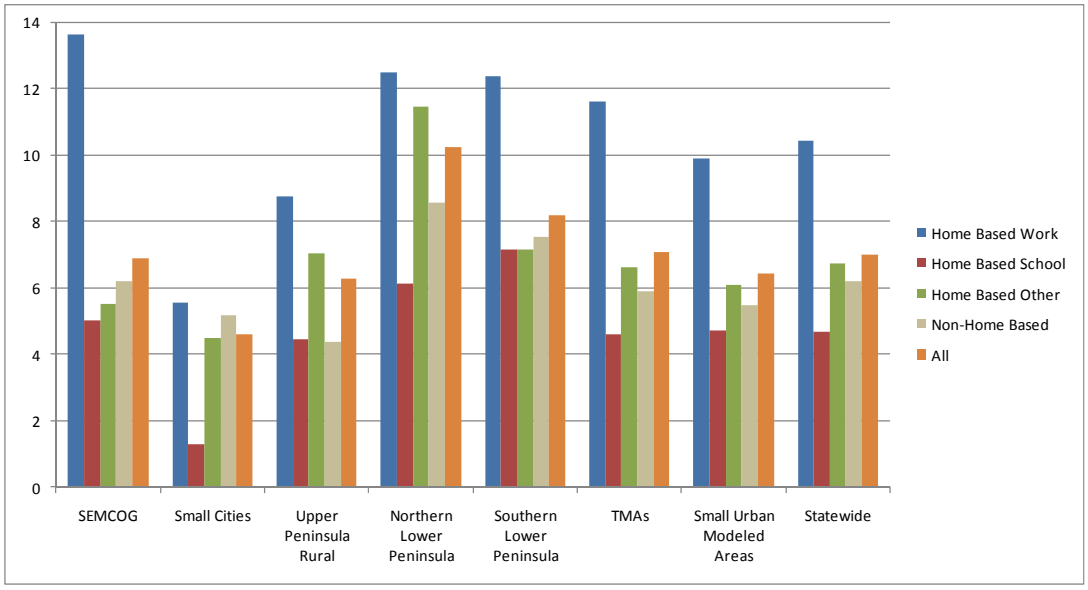


The MTC II survey also queried the respondents' travel times rather than distance since travel time can be remembered more easily and reported more reliably. In order to evaluate distribution of trip lengths, model skims are used as a proxy for actual trip lengths. Using geocoding information of trip ends, model networks were skimmed to estimate trip lengths and derive travel times. Figure 4.21 shows the average trip lengths for different trip purposes across sample areas. Trip lengths were derived from model skims and trip records failing the time-distance checks were excluded.

The statewide distribution indicates that the longest trips were made for work with an average distance of 10.4 miles. Home-based school trips had an average length of 4.7 miles, while home-based other and non-home based trips had comparable average trip lengths of 6.7 and 6.2 miles respectively. These statewide patterns were reasonable. Work trips are commonly the longest, while most school trips take place within the school district boundaries. While home-based other and non-home based trip lengths averaged close to the overall average trip length, trip lengths for these trips vary substantially with a mixture of very short and very long trips.

The SEMCOG sample area had the highest average trip length for work trips, while other purposes were close to statewide averages.

Figure 4.21 Distribution of Average Trip Lengths (Network Distances in Miles) by Trip Purpose and Sample Area (Unweighted)



Both the Northern and Southern Peninsula sample areas had average trip lengths higher than statewide averages for all purposes. This can be expected since in rural settings densities are low and trip ends are separated by larger distances. The other urbanized sample areas displayed similar patterns to the statewide patterns; however, the Small Cities sample area's trip lengths averages were consistently lower than statewide averages for all purposes. This can be explained by the relatively compact and self-sufficient development around the selected cities.

The highest variance of average trip lengths across trip purposes was found for the SEMCOG sample area due to the high frequency of long work trips. The most uniform distribution was in the Small Cities sample area.

The only sample area which had unexpected results was the Upper Peninsula sample area where relatively short trip lengths were observed. Since the sample area has the lowest density in the state, similar trip lengths to other rural sample areas were expected. Analysis of trip lengths in MTC I Final Report showed comparable trip lengths with other rural sample areas.

Since network density in the travel model is sparse in the Upper Peninsula sample area, it could be possible that trip ends may have been associated with network nodes that are relatively close to each other while links between trip ends and their assigned nodes may have been unusually large.

The lengths of the connector links (aerial distance between the trip end and its assigned network node) were analyzed and no major differences in mean link lengths between sample areas were found. However, the highest amount of variance was observed for the Upper Peninsula sample area. While this implies that network density is causing longer links, the mean link length indicates that there is a good mixture of long and short trips. Table 4.6 features a set of summaries produced after an analysis of link

lengths in the statewide travel demand model network (because the analysis was completed using the statewide travel demand model, the SEMCOG sample area is not included).

The “Reported Travel Times” indicate that the UP Rural sample area also had a relatively short average reported travel time when compared with other rural sample areas.

Table 4.6 Key Descriptive Statistics of Link Lengths by Sample Area

Sample Areas	Travel Time (min)			Link Length (miles)		Long Links		Same Node as OD	
	Reported	Modeled	Difference	Mean	Std	Counts	Percent	Counts	Percent
Small Cities	12.33	6.51	6.54	0.59	0.63	429	17.6%	254	10.4%
UP Rural	14.88	9.19	6.90	0.98	1.20	371	19.3%	261	13.5%
NLP Rural	18.97	13.12	7.39	1.01	0.85	304	15.8%	232	12.1%
SLP Rural	16.70	10.59	7.11	0.96	0.89	274	12.7%	185	8.6%
TMAs	16.14	9.03	7.83	0.60	0.44	182	8.3%	153	7.0%
SUMA	15.31	8.46	7.34	0.68	0.55	185	9.0%	122	5.9%

Other indicators of network representation for trip ends confirmed that UP Rural did not have a very distinct difference when compared to other rural sample areas. For rural areas, link lengths are longer and contain larger variation when compared to more urbanized sample areas.

The total link length for a trip is computed and compared to the trip length between network nodes. If the total link length was greater than the network distance between origin and destination nodes, that trip is labeled as a “long link” trip. Similar patterns existed in the percentage of such trips across the sample areas, while the Small Cities sample area also had a comparable amount of long link trips to rural sample areas.

The process that assigns nearest nodes to the trip ends, may sometimes assign the same node to both origin and destination of a trip, when the reported trip is very short or the road network in the model is sparse. The occurrence of such events was counted and relative sizes are computed. The patterns across sample areas in “Percent Same Nodes as OD” column confirmed the previous findings. While the UP Rural sample area had the highest percentage of the same node assignment, it was comparable to Northern Lower Peninsula figures.

These data summaries indicated that residents of the UP Rural sample area reported shorter trips in distance than expected. However, future analysis efforts may consider modifying the modeled trip lengths by incorporating link lengths. Another potential explanation is associated with the differences in geographical distribution of the households. If most of the respondent households were located just outside the Small Cities sample area (near but not in Escanaba, Marquette, etc) or in a smaller city that didn't make the Small Cities cut, they may exhibit shorter trips for the same reasons the Small Cities sample area does.

The distribution of average travel times obtained from the model by sample area was also created. However, since the patterns of travel times are almost identical to those for travel lengths, the plot of average travel times by trip purpose and sample area is presented in Appendix C, Figure C.2.

4d. Friday vs. Other Weekday Travel

The MTC II data retrieval process assigned Fridays as a survey day and travel information was collected. In the final dataset there were 345 (17.5 percent) households that reported 2,957 (18 percent) trips on Fridays. Since traditionally Fridays are not included in travel surveys, it was decided to create additional data summaries that help assess whether observed travel during Fridays was different than other days of the week. These summaries focus on the overall trip rates at the household level, distribution of trips by purpose, trip rates for different trip purposes, modal shares, diurnal distribution of trips, and trip length and travel time distributions. All of these summaries were created by using weighted data.

Table 4.7 presents the overall trip rates for households reporting travel on Fridays versus other weekdays. The initial counts of trips and trip rates showed that Friday trip rates are higher than those for the other weekdays. This can be explained by considering the additional trips for eating out and recreational activities later during the day or potential for replacing afternoon work activities with another activity which may require an additional trip.

For unweighted data, differences in total trip rates were small and the impact of Friday travel on the statewide rate was minimal. However, the analysis of weighted data showed that the impact of Friday travel is larger than unweighted data. This indicated that higher levels of uncertainty were associated with Friday travel due to larger weights, however, size of the weights is independent of the day of the week.

Table 4.7 Comparisons of Overall Household Trip Rates for Friday Travel

Day of Travel	Number of Households	Number of Trips	Unweighted Trip Rate	Weighted Trip Rate
Mon – Thurs	1,630	12,902	7.92	8.34
Friday	345	2,832	8.21	9.99
All	1,975	15,734	7.97	8.63

Based on initial findings, inclusion of Fridays as a day of observation seems to increase the overall trip rates by 3.5 percent. Moreover, the change reflected by unweighted data is at negligible levels. More detailed analysis can be conducted to account for changes in key characteristics of households surveyed on Fridays.

While Friday travel had a slightly higher number of daily trips, it was decided to review a few cross-sections of the data to examine whether general trip characteristics of Friday trips were consistent with those for other days of the week. Figure 4.22 shows the relative sizes of trips made for different purposes for each sample area.

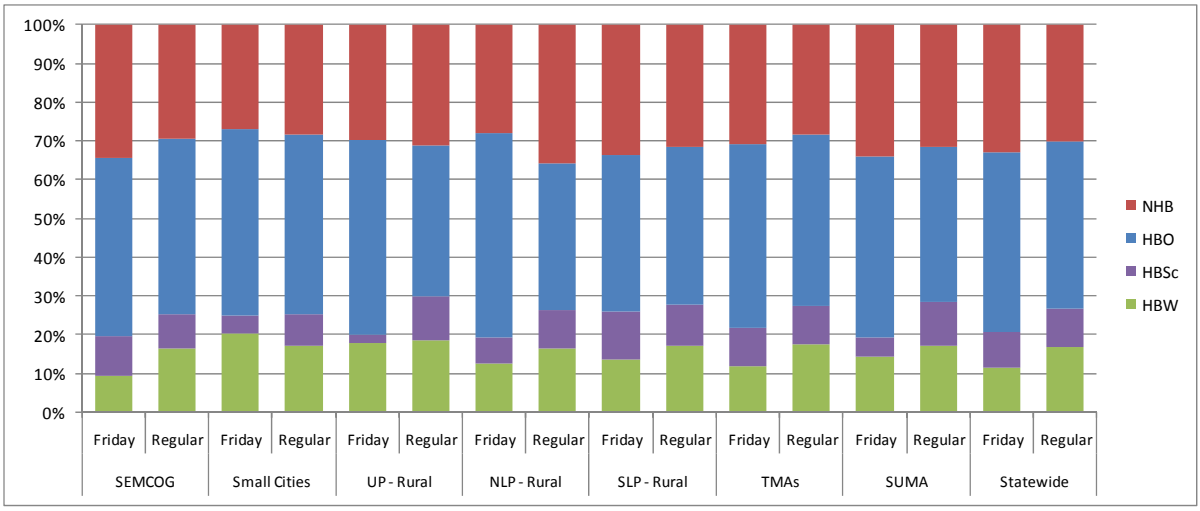
Each sample area has two bars that contain the distribution of relative size of trips by purpose for Fridays and the rest of the week, respectively.

Based on the statewide distributions, the frequency of home based work trips decreases by about 30 percent (16.7 percent versus 11.5 percent). The school trips were quite stable, while each of the home-based other and non-home based trips grew by three percent points. This finding implies that for about one third of the home based work activities, the following may be valid:

- Part of the work activity is replaced by other non-home based activities,
- Other activities are added to the return to home trip, or
- Work activity is replaced by other activities on Fridays.

Future modeling efforts may consider adjusting weights by purpose and day of the week to account for differences in trip making on Fridays.

Figure 4.22 Distribution of Trips by Purpose and Sample Area on Fridays and Other Days of the Week – (Weighted)



The rural portions of the state showed a smaller amount of differences between Fridays and other week days. The Small Cities sample area exhibited a pattern in the reverse direction with a slight increase in home-based work trips on Fridays.

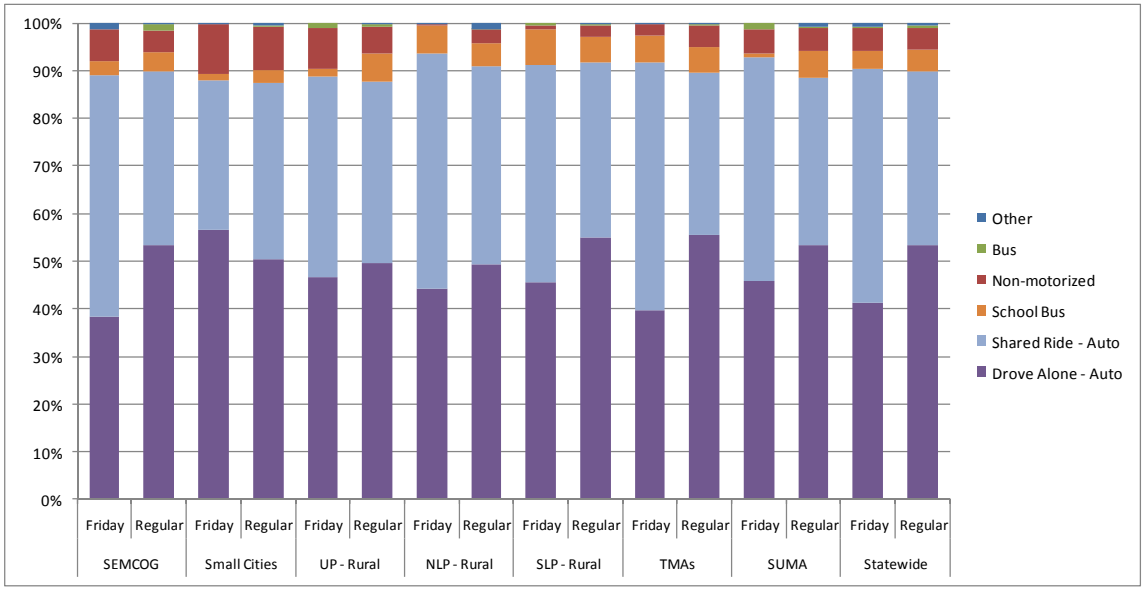
A chart that detailed distributions of household trip rates by trip purpose and sample area was created to examine the changes in trip rates. Since the observed patterns were almost identical to those in Figure 4.22, it is presented in the Appendix C, Figure C.3.

Modal shares by sample area for Fridays and other days of the week are plotted in Figure 4.23. In general, the total share for auto is stable, while there is a higher incidence of shared rides (about a 20 percent increase) on Fridays.

The distribution of trips by time of day is plotted in Figure 4.24. The patterns in Figure 4.24 indicate that AM and PM Peak trips were generally stable between Fridays and other weekdays. For Fridays, there were more trips reported during Evening and Late

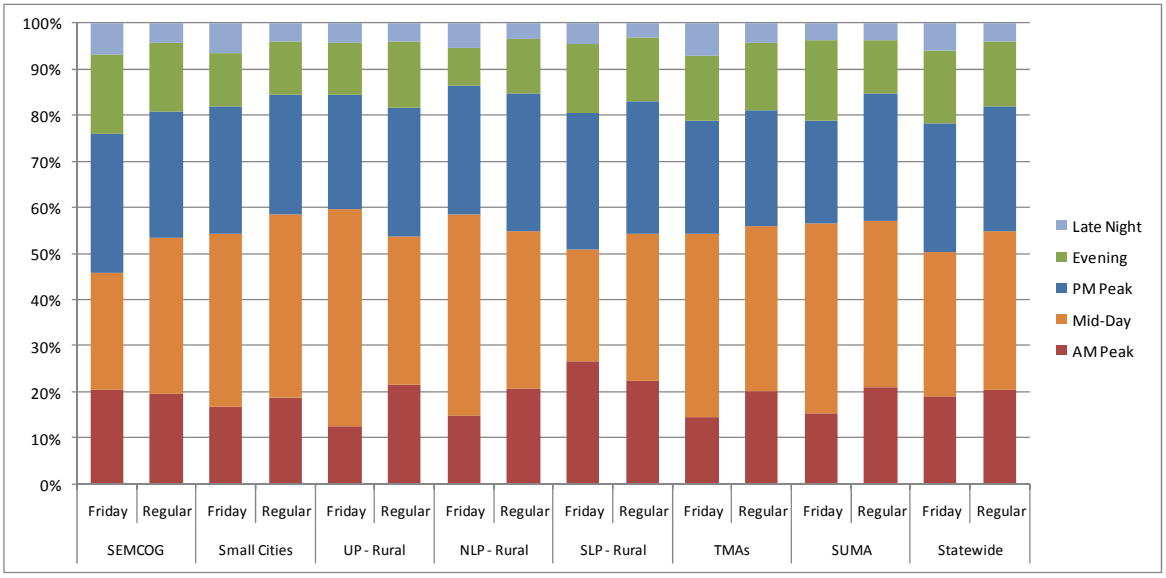
Night, while there were fewer trips (10 percent) during the Mid-Day period. These patterns can be potentially explained by participating in recreational or social activities for longer durations during later hours on Fridays. These patterns are more visible for the SEMCOG sample area.

Figure 4.23 Distribution of Modal Shares by Sample Area on Fridays and Other Days of the Week – (Weighted)



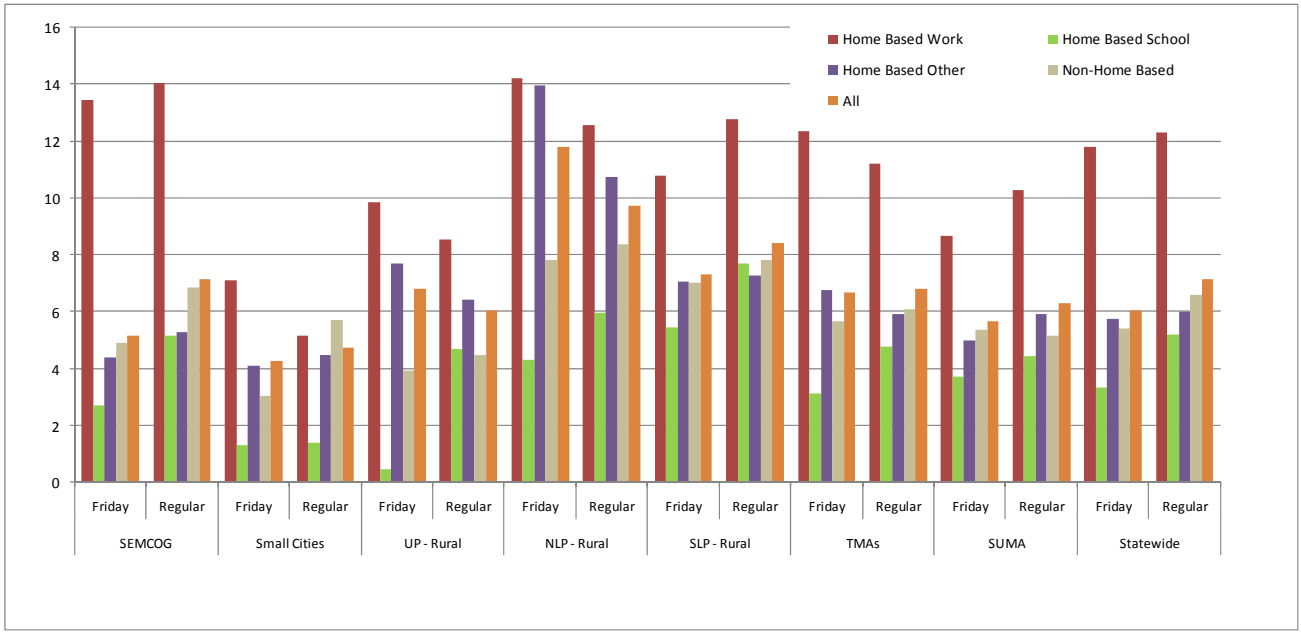
For most sample areas where modeling applications distinguish only between peak versus off-peak periods, trip frequencies may not need any adjustment. For a more detailed treatment of time of day periods, an adjustment can be considered.

Figure 4.24 Diurnal Distribution of Trips by Sample Area on Fridays and Other Days of the Week – (Weighted)



The distribution of average trip lengths for Fridays and other weekdays may help identify differences in trips taken on different days of the week. Figure 4.25 provides a plot detailing average trip length distributions by trip purpose, travel day, and sample area. In general, trip distances on Fridays and the other days of the week do not differ significantly. On Fridays, school trips were shorter which may be explained by the possibility that higher education institutions have fewer classes on Fridays and the remaining school trips represent trips for K-12 or lower level education purposes. Moreover, non-home based trips also got slightly shorter. The SEMCOG and SUMA sample areas have a similar pattern with the statewide distribution.

Figure 4.25 Distribution of Average Trip Lengths (Network Distances) by Trip Purpose and Sample Area on Fridays and Other Days of the Week – (Weighted)



The distribution of average travel times by trip purpose and sample area for Fridays and other weekdays was also produced. Since preliminary review of patterns of change in travel distances resembled those of travel times, the plot is presented in Appendix C, Figure C.4.

Section 5: Comparative Analysis of MTC II Data

In Brief: *Section 5 features a comparative analysis of the 2009 MTC II results with the 2004-05 MTC I. Trip diaries from the first day of MTC I data were used in this section. All data summaries use weighted data. Detailed descriptions of weighting procedures are provided in Section 3.*

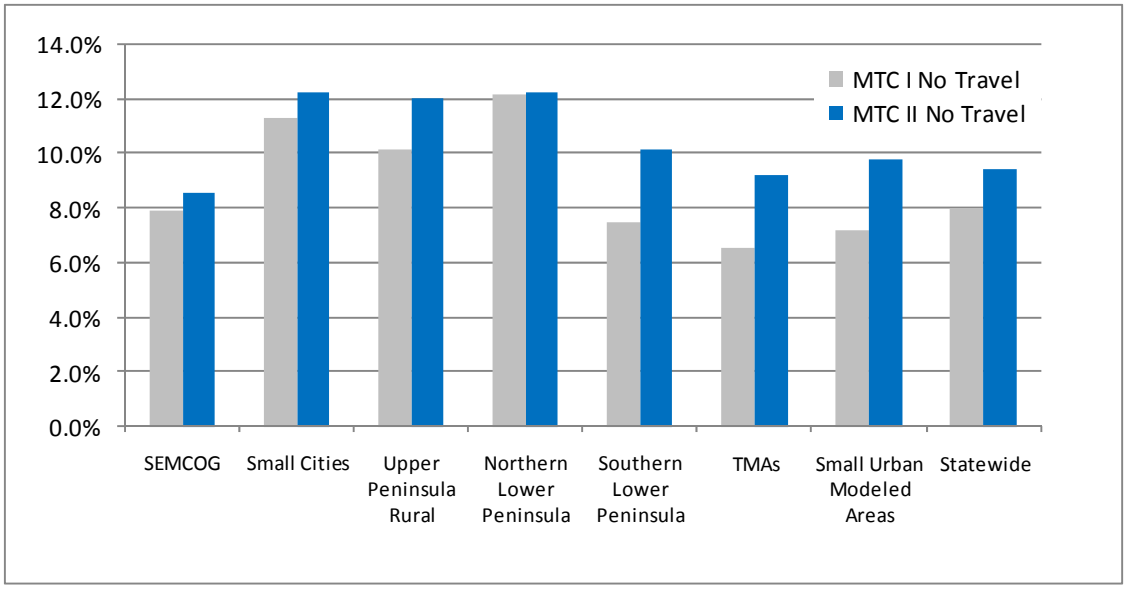
The observed changes between MTC surveys in the distributions of key data elements that are known to influence travel behavior and have particular importance for travel demand models were presented in this section. Most of the comparisons include a classification by sample area to examine changes across the state.

The MTC I data used for this comparison reflect the first day trip diaries from the MTC I dataset. Data are reweighted to reflect the changes to the dataset made by MDOT staff and to account for all households in Michigan. All data summarized in tables and charts in this section were weighted. The weights for both datasets were produced at the household level of detail, and the totals reflect an estimate of total households, persons, and trips derived as a result of application of the expansion weights.

Moreover, some of the discussion is supported by findings of the descriptive analysis of the first version of the 2009 NHTS data. As of the date of this report, the weighting process for 2009 NHTS data has been undergoing a through revision. Due to the potential that the revised data would produce differences in the estimates of a few key items, incorporation of 2009 NHTS Version 1 data were limited to comparisons conducted at more aggregate levels.

As discussed in Section 4, non-travel is a potential source of bias. Figure 5.1 shows the relative size of the non-traveling households in the population across the sample areas for each MTC survey.

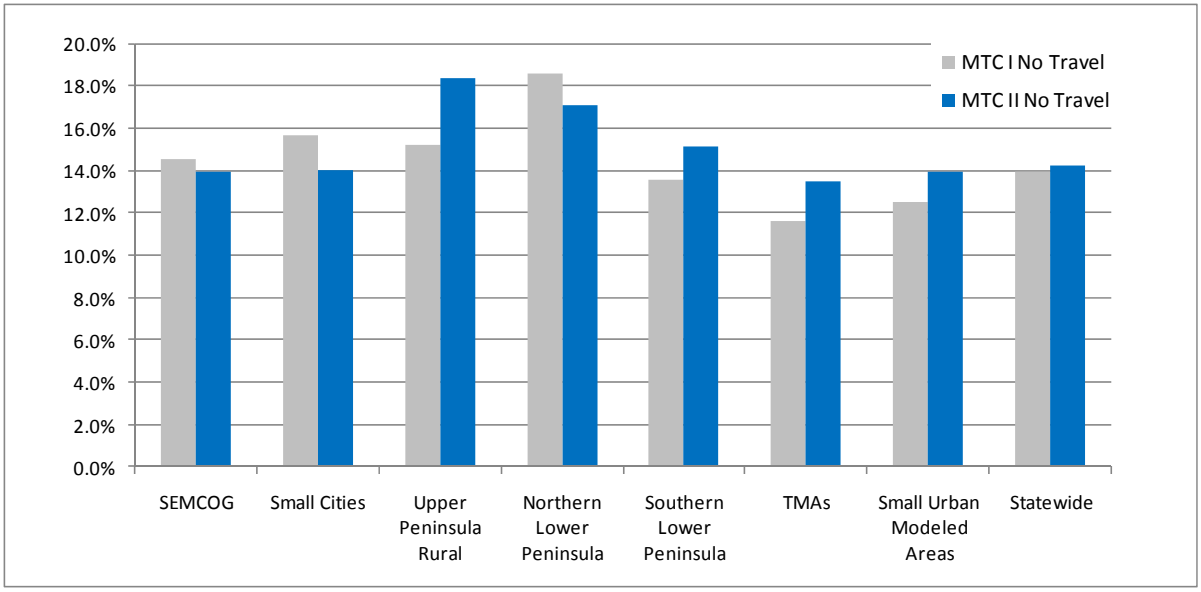
Figure 5.1 Percentage of Non-Traveling Households by Sample Area across MTC Surveys



Overall, MTC II had a higher level of non-traveling households with a 1.4 percentage point difference. While there were more non-traveling households across the sample areas, patterns in each survey were very similar. It was concluded that there were no major differences in no-trip making between the surveys that would cause a substantial bias.

Figure 5.2 features the relative sizes of individuals who did not report a trip during the survey. Overall, non-trip person levels are at 14 percent level for both surveys with almost equivalent patterns. The Upper Peninsula sample area had the highest share of no-trip individuals (more than 18 percent) in MTC II. For Small Cities and Northern Lower Peninsula there were fewer no-trip individuals in MTC II. In general, it can be concluded that there is no major reason for concern due to no-trip respondents in MTC II.

Figure 5.2 Percentage of Non-Traveling Respondents by Sample Area across MTC Surveys



The 2009 NHTS data indicated a share of 7.4 percent for households that did not report a trip on the day of survey, while at personal level this share was found as 16.9 percent. While MTC II data showed slightly higher levels of household level non-travel, both surveys provided a higher level trip reporting at personal level.

5a. Key Socioeconomic Patterns

Household size, number of vehicles, and number of workers are the parameters that defined sampling schemes for both MTC surveys. Figures 5.3-5.5 show the relative sizes of each segment within the sample area. Each segment (defined by a category of the variable of interest) is shown with the same color across the sample areas, while the same segment's data from MTC I and MTC II were plotted side by side for easier comparison. The first observation belongs to MTC I and the second bar in the same

color represents the relative share of that segment in the MTC II data. This setting was used to plot the fairly complex data presented in this section.

The patterns observed for household size, number of vehicles available, and number of workers in the household are closely related to the patterns found in the 2000 Census and in the three year 2006-2008 ACS data since these three variables were instrumental in the creation of expansion weights. However, due to aggregation of several combinations of selected category levels from these three variables into sample cells, the patterns obtained from the MTC surveys for these variables are still considered as estimates, rather than actual representation of 2000 Census and in the three year 2006-2008 ACS data.

Based on the patterns observed in Figure 5.3, it can be concluded that weighted data from both surveys provided comparable household size distributions. MTC II data showed fewer large households but the differences were small to impact the validity of MTC II survey. Moreover, differences in household sizes in MTC I and MTC II samples were examined in greater detail in Section 6 of this report.

Figure 5.3 Distribution of Households by Size and Sample Area across MTC Surveys

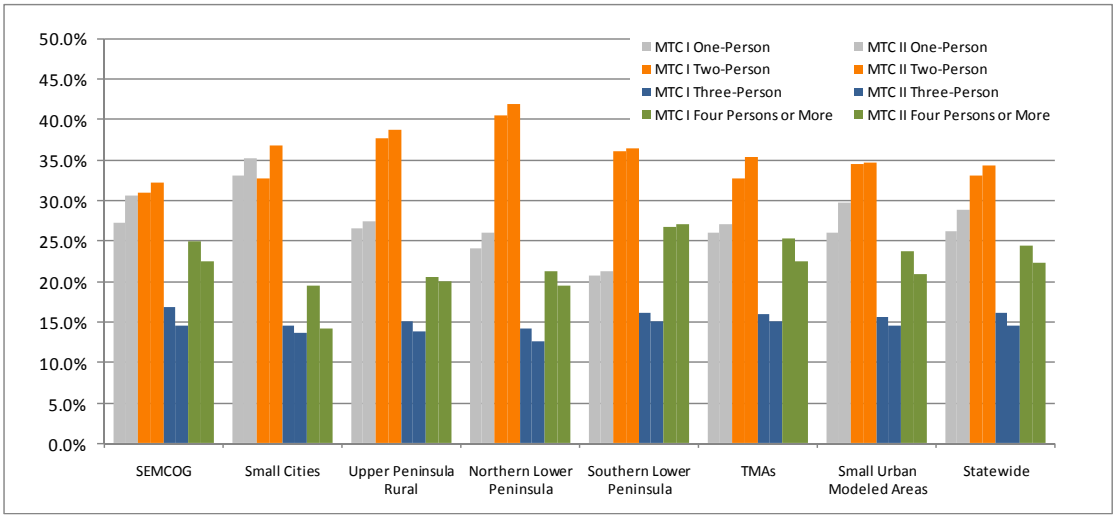


Table 5.1 shows percentage of households by size as reflected in 2009 NHTS data along with the shares from the MTC surveys. 2009 NHTS data indicated slightly higher shares for two-person households at the expense of one-person households compared to MTC surveys. However, statewide distributions of households by size from MTC surveys were found comparable to 2009 NHTS.

Table 5.1 Shares of Households by Size in MTC Surveys and 2009 NHTS

Data Source	One-Person	Two-Person	Three-Person	Four-or-More-Person
MTC I	26.2%	33.0%	16.2%	24.5%
MTC II	28.9%	34.3%	14.6%	22.2%
NHTS 2009	24.5%	36.9%	15.5%	23.2%

The patterns in Figure 5.4 indicate that the relative sizes of households with three or more vehicles were slightly higher for all sample areas for MTC II. Statewide shares of zero-vehicle households indicated a modest size of reduction while, for Small Cities and Small Model Urban Areas sample areas zero-vehicle household shares increased slightly. Shares of one-vehicle households declined slightly for most of the sample areas while for Northern Lower Peninsula there was a slight growth and TMA shares were consistent. Two-vehicle household shares were quite stable across the MTC surveys, while a small growth was observed for SEMCOG and a slight decline was seen for Northern Lower Peninsula.

Figure 5.4 Distribution of Households by Vehicle Ownership and Sample Area across MTC Surveys

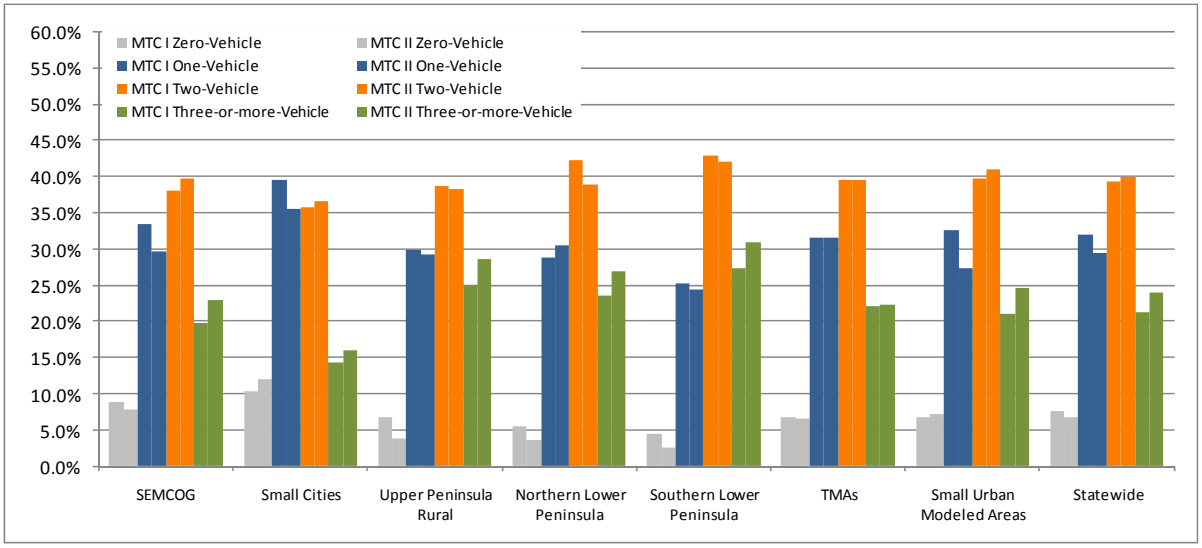


Table 5.2 shows the shares of households by vehicle ownership levels as reflected by the 2009 NHTS which were found to be generally consistent with the statewide pattern observed in MTC II survey. This confirms the validity of the changes in vehicle ownership levels as reflected by the MTC surveys.

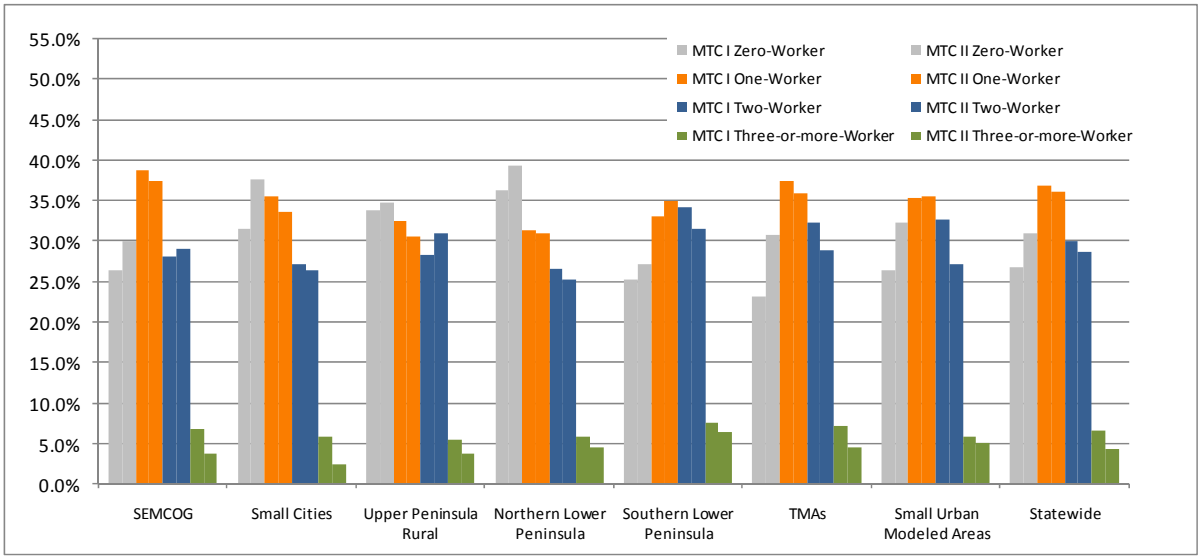
Table 5.2 Shares of Households by Vehicle Ownership in MTC Surveys and 2009 NHTS

Data Source	Zero-Vehicle	One-Vehicle	Two-Vehicle	Three-or-more-Vehicle
MTC I	7.6%	32.1%	39.2%	21.2%
MTC II	6.8%	29.4%	39.9%	23.9%
NHTS 2009	8.8%	29.4%	37.5%	24.3%

Similar to the patterns observed for household size distributions, the distribution of households by number of workers across MTC surveys as shown in Figure 5.5 points to comparable characteristics. MTC II data showed a slightly higher level of zero-worker households without any major degree of separation between the surveys. All segments

had comparable sizes across the MTC surveys for all sample areas. It can be concluded that the observed differences in the number of workers between MTC surveys is not likely to impact travel behavior.

Figure 5.5 Distribution of Households by Workers and Sample Area across MTC Surveys



Shares of households by number of workers in NHTS 2009 data along with those for MTC surveys are presented in Table 5.3. All distributions seem comparable to each other with slight deviations. NHTS data shows a share of nearly 41 percent for one-worker households while MTC surveys indicated a lower level around 36-37 percent and showed slightly higher shares of two-worker households.

Table 5.3 Shares of Households by Number of Workers in MTC Surveys and 2009 NHTS

Data Source	Zero-Worker	One-Worker	Two-Worker	Three-or-more-Worker
MTC I	26.7%	36.8%	29.9%	6.7%
MTC II	31.0%	36.0%	28.7%	4.3%
NHTS 2009	28.8%	40.8%	26.1%	4.3%

The statewide distributions of household income (Figure 5.6) indicated that the MTC II data had higher shares of mid-to-high and high income households, while lower income households were slightly lower by four percentage points. The observed difference at the state level can be considered comparable considering the potential effects of inflation on the observed income distribution for MTC II. For three of the sample areas, (SEMCOG, Small Cities, and Northern Lower Peninsula) the degree of separation between surveys

was slightly higher. Further analysis for these sample areas may consider testing household income distribution using ACS or other data from an extensive survey.

Figure 5.6 Distribution of Households by Annual Household Income and Sample Area across MTC Surveys

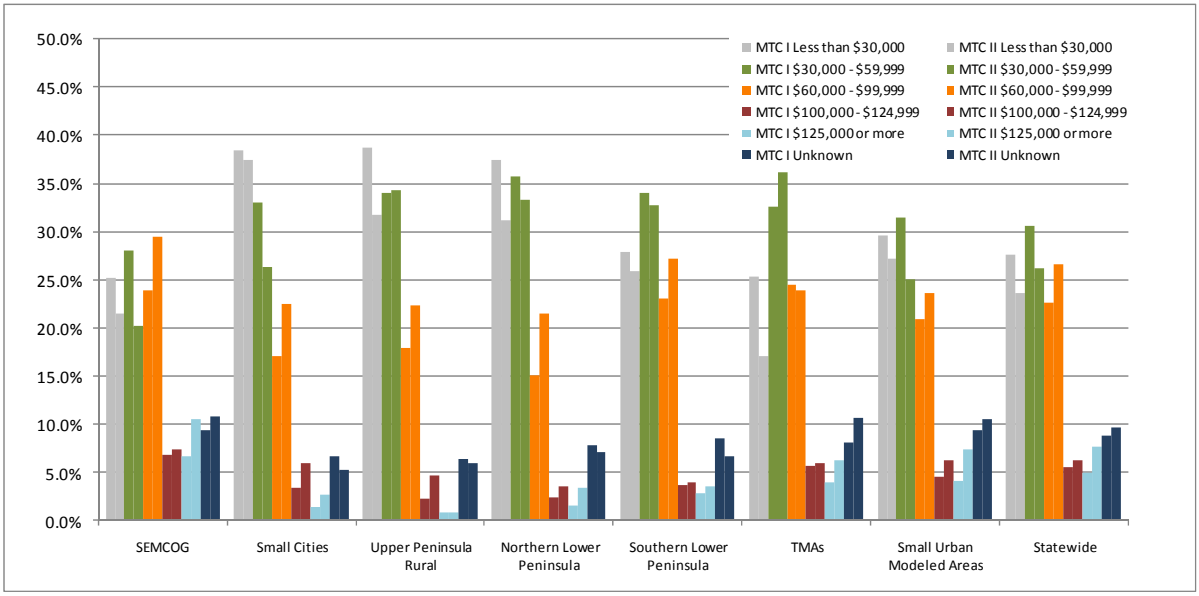


Table 5.4 features the percentage of households by income from 2009 NHTS and MTC Surveys. The highest two income categories in MTC survey data were merged to match 2009 NHTS categories. Comparison of MTC II and 2009 NHTS distributions indicates that lowest and highest income levels were slightly underrepresented in MTC II, while shares for high-to-medium level ($60,000 – $99,000) in MTC II was higher. Furthermore, statewide estimates from ACS data were also found very similar to those from 2009 NHTS shares, confirming the underrepresentation of low and high income groups. However, some portion of the observed differences in these groups may be offset by the higher percentage of the "Unknown" group in MTC II than the 2009 NHTS.

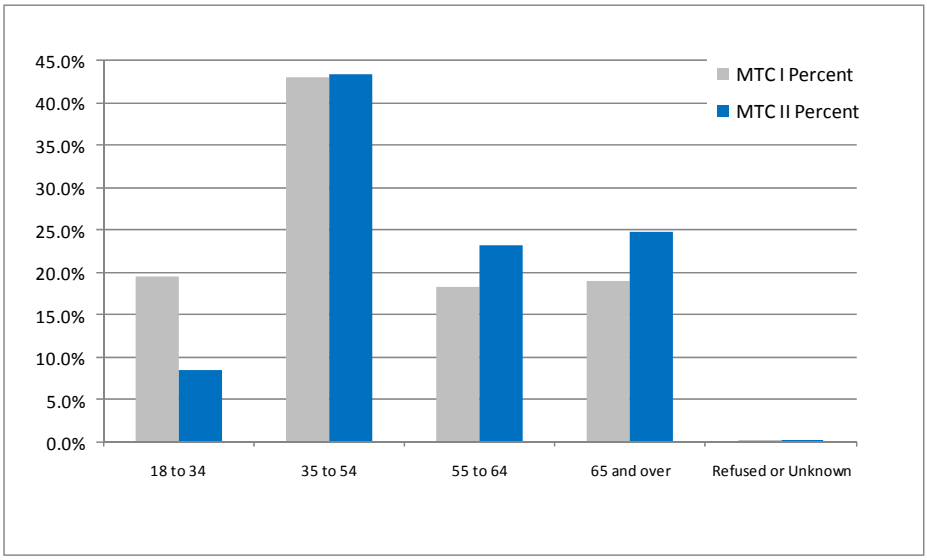
Table 5.4 Shares of Households by Income in MTC Surveys and 2009 NHTS

	MTC I	MTC II	NHTS 2009
Less than $30,000	27.6%	23.6%	30.2%
$30,000 - $59,999	30.6%	26.2%	25.1%
$60,000 - $99,999	22.6%	26.5%	20.7%
$100,000 or more	10.4%	13.9%	17.2%
Unknown	8.8%	9.7%	6.9%

Figure 5.7 summarizes the age distribution of respondents between the MTC surveys. As discussed earlier in Section 4, MTC II data had a higher frequency of older respondents. The patterns reflected by the weighted data also confirmed that MTC II data are different than MTC I with respect to age distribution mainly due to differences in

younger and older portions of the population. Statewide ACS estimates showed that 18-34 year olds make up about 29 percent of the population in Michigan, while the share of 55-64 year olds and 65 and over groups were 15 percent and 17 percent, respectively. These figures confirm that the MTC surveys, particularly MTC II, over-represented older age groups at the expense of younger age groups.

Figure 5.7 Distribution of Respondents by Age Groups across MTC Surveys



As mentioned in section 4, difficulties in reaching younger populations via traditional survey techniques and potential changes in cohort by younger respondents in MTC I can be responsible for such an outcome. It can be expected that the current patterns in age groups may lead to lower level estimates of work and school (for higher education) trips and an increase in personal trips.

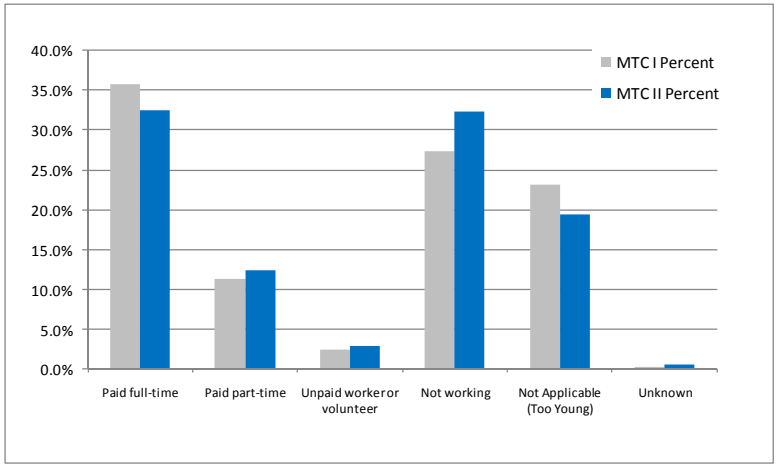
Further analysis and application of the MTC II data may consider adjusting expansion weights at the person level with respect to age.

Figure 5.8 plots the distribution of employment status of respondents across MTC surveys. The MTC II data contain fewer respondents who are too young to work and fewer full-time workers by about four and three percent, respectively. The data also showed higher proportions of non-working respondents. However, the data does not distinguish between unemployed and retired respondents. Moreover, the amount of change in the share of workers across MTC surveys may indicate that MTC II survey did not adequately measure the changes in employment in Michigan. The total reduction in worker shares was about two percent including part-time workers. Adjustment of expansion with respect to age may provide more intuitive results. An additional level of adjustment can be implemented by using detailed employment data.

The NHTS data showed that 37 percent of the nation was employed full-time, 11 percent part-time, 32 percent was not working, and about 21 percent were too young to be employed. These patterns showed that MTC II full-time worker share was five percent lower and shares for part-time workers was one percent higher. The non-worker share

was consistent for both surveys and the MTC II share for individuals who were too young to be employed was lower by two percent points.

Figure 5.8 Distribution of Respondents by Employment Status across MTC Surveys



The MTC surveys asked whether a non-working respondent was seeking employment. The responses to this question are particularly important since they may point out whether there had been changes in non-workers who were still in the labor force. Figure 5.9 features the non-working respondents who were seeking or not seeking employment. There were no substantial differences in the shares of non-workers who were seeking jobs between the MTC surveys. However, due to an increase in the size of the non-working portion of the population, it can be concluded that the number of non-workers seeking employment grew by the same rate of about five percent.

Figure 5.9 Distribution of Non-Working Respondents Seeking Employment across MTC Surveys

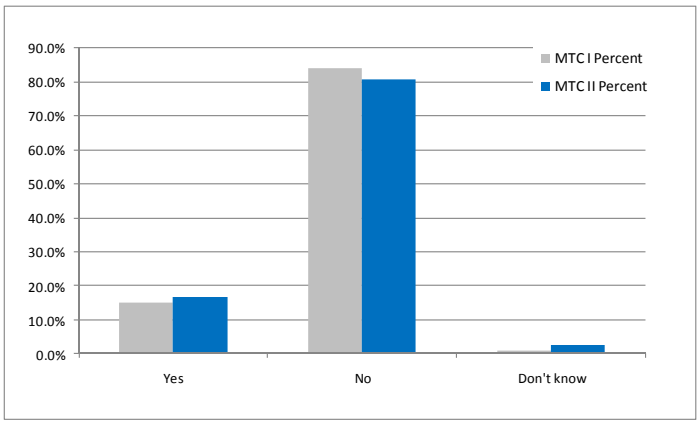
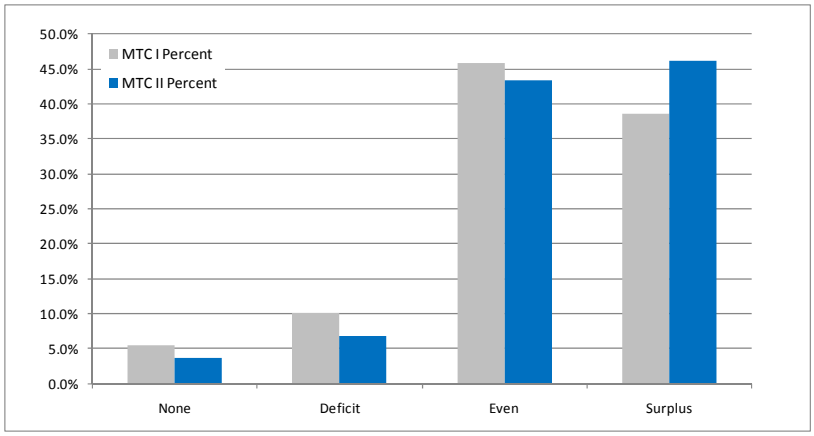


Figure 5.10 shows the distributions of households into categories of “Auto Sufficiency” or “Vehicle Budget” for both MTC surveys. This variable gauges the level of availability of an auto for every worker in the household. For zero-worker households, the availability of an auto is considered for licensed drivers in the household. The category label “None” denotes zero-vehicle households. The “Deficit” category identifies households which had

fewer vehicles than the number of workers. Although zero-vehicle households can be viewed as they belong to the "Deficit" category, due to the fact that presence of a vehicle has a major impact on the household travel behavior, it was decided to separate the zero-vehicle households under a distinct category. For a perfect match between the number of vehicles and workers, the category label "Even" is used. When the number of vehicles exceeds the number of workers the "Surplus" category is assigned.

The patterns shown in Figure 5.10 indicate that more MTC II households had a surplus of vehicles while there were fewer households in the "None" and "Deficit" categories. This was consistent with the findings for vehicle ownership patterns which reflected a higher frequency of households with three or more vehicles.

Figure 5.10 Distribution of Households by Auto Sufficiency across MTC Surveys



The comparative analysis between the MTC surveys on key household and person-level socioeconomic characteristics can be summarized as follows:

- No major differences were found in the relative sizes of no-trip households and non-traveling respondents, and number of workers in the household.
- Minor differences were observed for household size, household income, vehicle ownership, auto sufficiency, employment status, and number of non-workers seeking work.
- Change in employment across MTC surveys does not seem to be reflected accurately.
- Noticeable differences were observed for the relative sizes of age groups between the two MTC surveys.
- Revision of expansion weights with respect to age and/or employment may improve the value of the MTC II data.
- Comparisons of MTC II data with 2009 NHTS data also provided similar differences observed to those against MTC I Survey.
- The income distributions reflected by the MTC Surveys were different from 2009 NHTS and statewide ACS data.

5b. Trip Rates

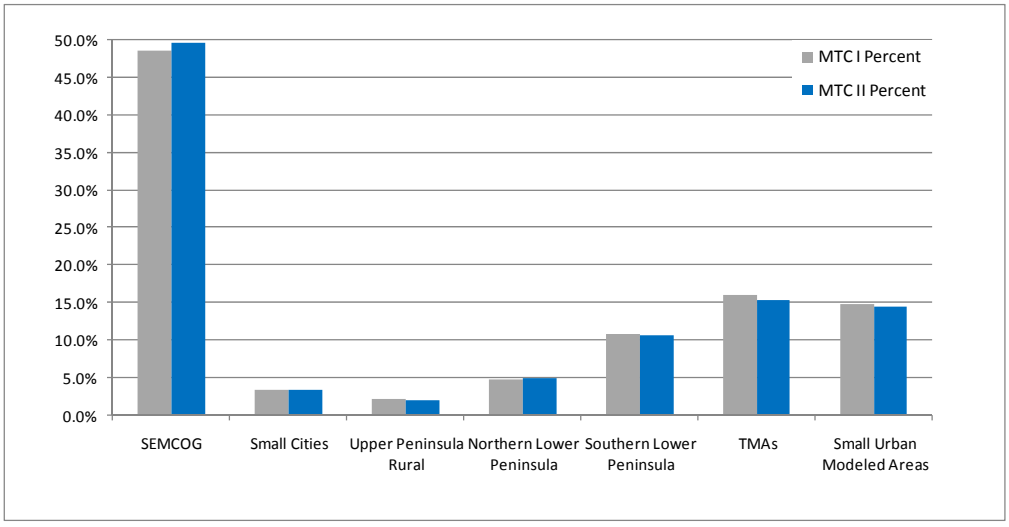
One of major objectives of the MTC II project is to determine whether the amount of travel and trip rates had changed between the two surveys. Table 5.5 features the total trips produced in each sample area and Figure 5.11 shows the relative size of each sample area's travel market. The term travel market refers to the total number of daily trips produced in a geographical area. It can be segmented by purpose, time of day, and characteristics of persons and their households.

Table 5.5 Number of Trips Produced by Sample Area and MTC Surveys

	MTC I		MTC II		Change	
	Trips	Percent	Trips	Percent	Trips	Percent
SEMCOG	16,871,573	48.6%	17,819,527	49.6%	947,954	5.6%
Small Cities	1,141,139	3.3%	1,197,877	3.3%	56,737	5.0%
Upper Peninsula Rural	731,983	2.1%	692,071	1.9%	(39,912)	-5.5%
Northern Lower Peninsula	1,640,999	4.7%	1,730,304	4.8%	89,304	5.4%
Southern Lower Peninsula	3,713,155	10.7%	3,776,454	10.5%	63,298	1.7%
TMAs	5,519,561	15.9%	5,500,979	15.3%	(18,582)	-0.3%
Small Urban Modeled Areas	5,124,637	14.8%	5,174,502	14.4%	49,865	1.0%
All	34,743,048	100.0%	35,891,714	100.0%	1,148,666	3.3%

The figures in Table 5.5 indicate that there has been no major change in the statewide travel market. The total number of estimated trips grew by more than one million trips which correspond to a growth rate of 3.3 percent in the size of the total travel market. The change across sample areas was not uniform. The SEMCOG, Small Cities and Northern Lower Peninsula sample areas grew more than five percent. The growth in the Southern Lower Peninsula was about 1.7 percent and Small Urban Model Area grew one percent. While TMA sample area had no sizeable change, Upper Peninsula Rural sample area had a reduction in the number of trips produced by more than five percent.

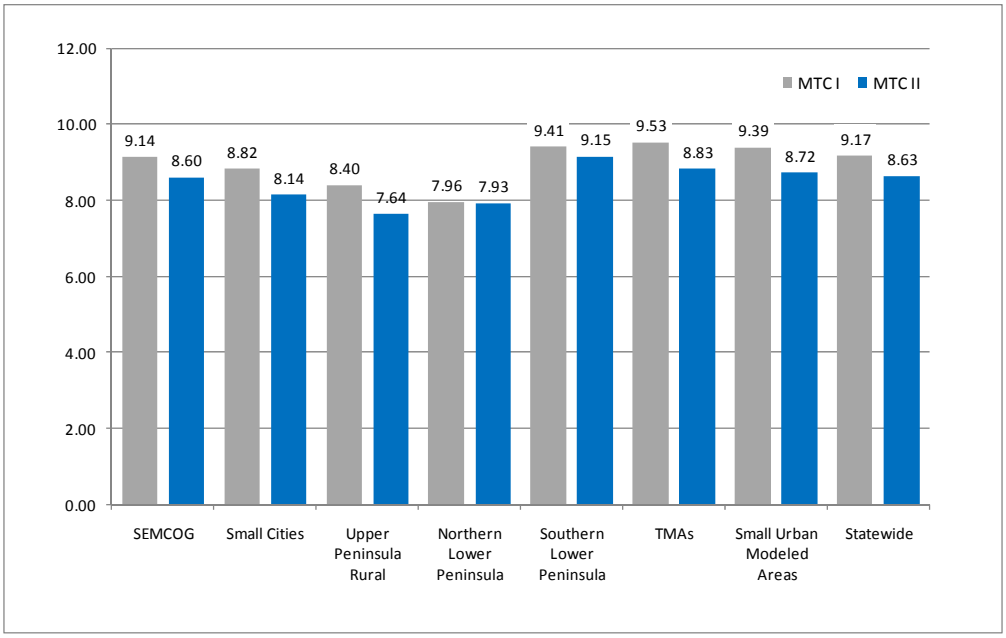
Figure 5.11 Relative Sizes of Travel Markets by Sample Area and MTC Surveys



It should be noted that these estimates are closely related to the estimates of population and the number of households in the 2000 Census, the 3-year 2006-2008 ACS dataset, and the Census estimates datasets. As detailed in Section 3, the weights developed for MTC II survey rely on a set of estimated number of households for each sample area derived from Census population estimates. Once a more reliable data source at the county level of detail becomes available, an update to expansion weights based on the number of households was suggested.

Figure 5.12 shows the total trip rates by sample area and MTC survey. The statewide rates reflected a reduction in trip rates from 9.17 to 8.63 trips per household at a rate of about six percent.

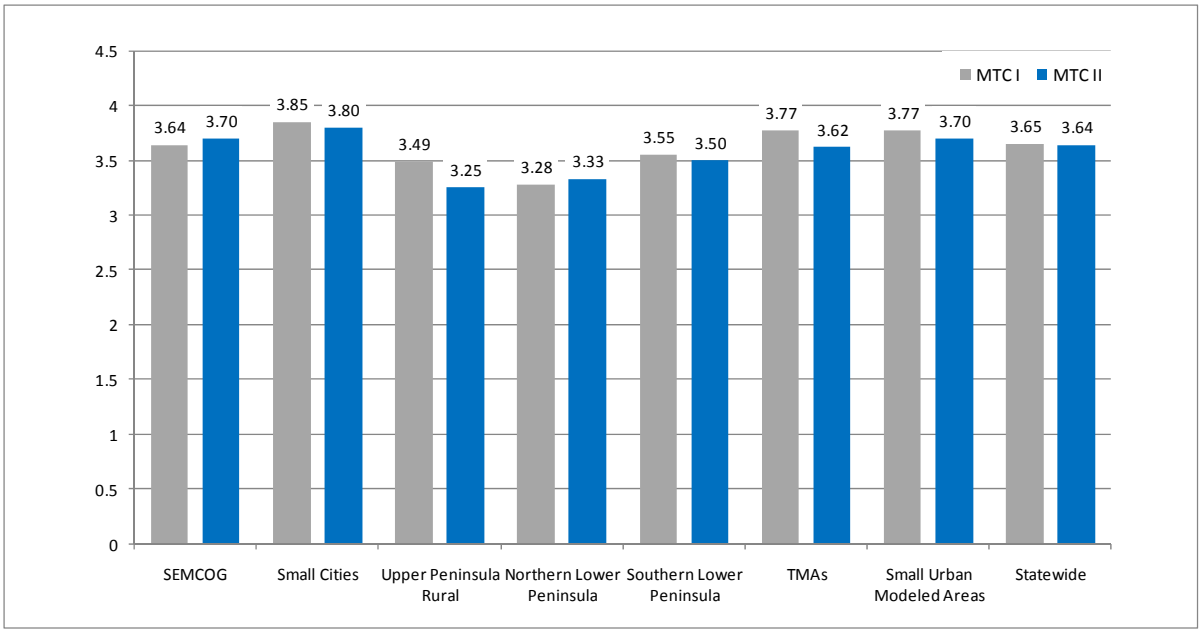
Figure 5.12 Household Level Total Trip Rates by Sample Area and MTC Surveys



The 2009 NHTS data indicated a trip rate of 8.46 trips per household. This rate is much closer to MTC II estimates. When rates by sample area were compared, each sample area showed a reduction in trip rates ranging between 9.0 (Upper Peninsula Rural) and 0.4 (Northern Lower Peninsula) percent. While there are various factors that can influence trip rates, change in household sizes is usually the greatest contributor. Figure 5.13 shows the changes in person-level trip rates for each sample area between the two MTC surveys. The statewide person trip rates were almost identical across the MTC surveys. The person trip rate obtained from 2009 NHTS data was 3.65 trips per person. The MTC respondents in both surveys had identical personal trip rates with the national average. There were minor changes in person-level rates in each sample area.

For the SEMCOG and Northern Lower Peninsula sample areas, there was a slight increase in person trip rates while the Upper Peninsula and TMAs sample area showed a small decline in person trip rates. However, these changes can be considered as insignificant.

Figure 5.13 Person Level Total Trip Rates by Sample Area and MTC Surveys



The changes in size of travel markets and total trip rates across the MTC surveys were marginal and can be considered as non-significant. The following data summaries present more detailed comparisons of travel markets segmented by different variables to identify substantially different travel markets across the MTC surveys and examine whether any of the observed changes were systematic.

The plots were designed to reflect the relative size of the travel markets or trip rates on the y-axis (height of the bars), and segmentation categories were reflected on the x-axis. The MTC surveys were represented by a bundle of two same colored bars, the first bar for MTC I and the second for MTC II. For zero-vehicle households with three or more members in MTC II data, no responses were observed which resulted in gaps in the plots.

Figure 5.14 presents the relative sizes of travel markets by household size, vehicle ownership, and trip purpose.

For most of the market segments, the HBO purpose had the largest share, followed by the NHB trips.

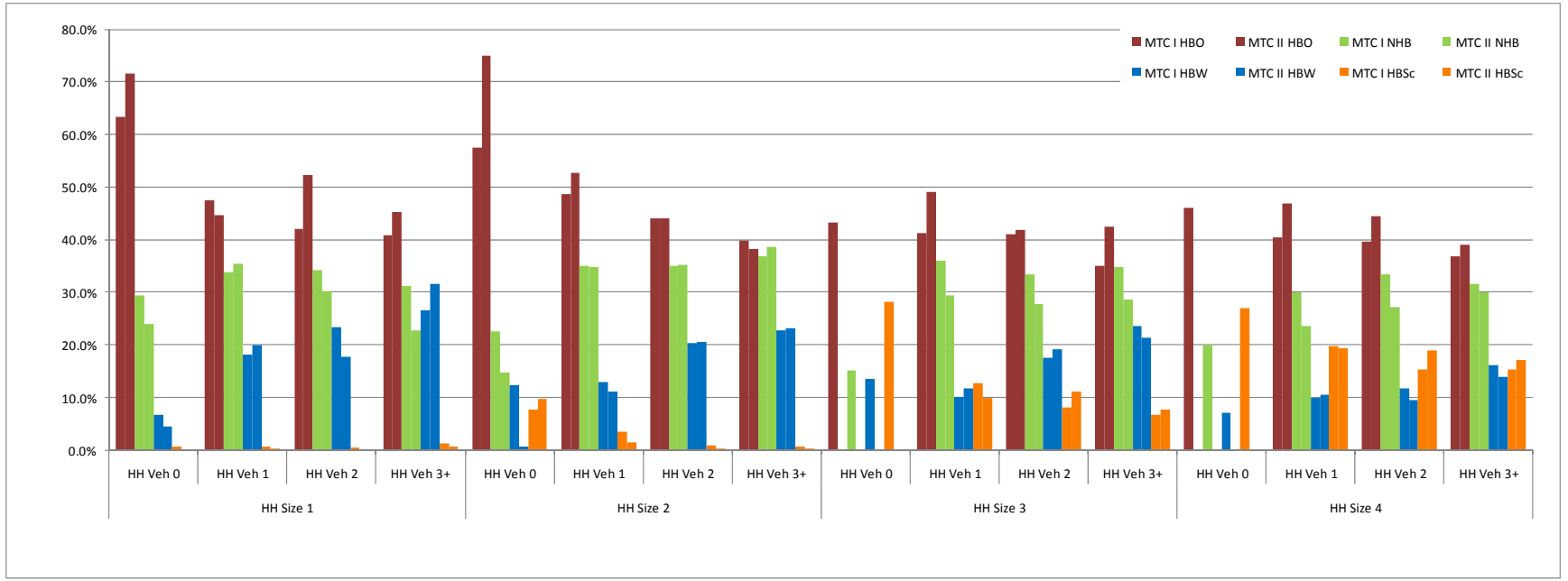
For one-person households with three or more vehicles, HBW purpose was second to HBO trips. However, this finding can be considered as inconclusive due the small sample size for this segment as shown in Figure 4.5.

School trips appear prominent for zero-vehicle households with two or more members in MTC I. Zero-vehicle households with two members show similar shares for school purpose, while work trips seemed replaced by home based other purposes in MTC II. However, the sample size for two-member households with zero vehicles was also too small (17 households) to draw concrete conclusions.

Table 5.6 Percentages of Trips by Household Size, Vehicle Availability, and Trip Purpose by MTC Surveys

		HH Size 1				HH Size 2				HH Size 3				HH Size 4			
		Veh 0	Veh 1	Veh 2	Veh 3+	Veh 0	Veh 1	Veh 2	Veh 3+	Veh 0	Veh 1	Veh 2	Veh 3+	Veh 0	Veh 1	Veh 2	Veh 3+
MTC I	HBW	6.7%	18.1%	23.3%	26.6%	12.4%	12.8%	20.2%	22.7%	13.5%	10.1%	17.6%	23.5%	7.1%	9.9%	11.7%	16.2%
	HBSch	0.6%	0.7%	0.4%	1.2%	7.7%	3.5%	0.8%	0.6%	28.2%	12.8%	8.0%	6.7%	27.0%	19.7%	15.2%	15.4%
	HBO	63.4%	47.4%	42.1%	40.9%	57.4%	48.7%	44.0%	39.8%	43.2%	41.3%	41.0%	35.0%	46.0%	40.5%	39.6%	36.9%
	NHB	29.3%	33.8%	34.3%	31.3%	22.5%	35.0%	35.0%	36.8%	15.0%	35.9%	33.4%	34.8%	19.9%	29.9%	33.5%	31.6%
	All	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
MTC II	HBW	4.4%	19.9%	17.6%	31.5%	0.6%	11.0%	20.5%	23.1%	0.0%	11.6%	19.2%	21.3%	0.0%	10.5%	9.5%	13.8%
	HBSch	0.0%	0.1%	0.0%	0.5%	9.6%	1.4%	0.3%	0.1%	0.0%	9.9%	11.1%	7.6%	0.0%	19.3%	18.8%	17.2%
	HBO	71.6%	44.7%	52.2%	45.2%	75.1%	52.7%	44.0%	38.1%	0.0%	49.1%	41.9%	42.5%	0.0%	46.8%	44.5%	38.9%
	NHB	24.0%	35.3%	30.2%	22.8%	14.6%	34.9%	35.1%	38.7%	0.0%	29.3%	27.8%	28.6%	0.0%	23.5%	27.2%	30.0%
	All	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	100.0%	100.0%	100.0%	0.0%	100.0%	100.0%	100.0%

Figure 5.14 Percentages of Trips by Household Size, Vehicle Availability, and Trip Purpose by MTC Surveys



School trips had higher frequencies in households with three members and showed growth in shares for four-or-more-member households. The sample size for both household size segments with lower levels of vehicle ownership (zero or one) had too few respondents to draw valid conclusions. However, for households with four or more members, HBSch trips had consistently higher shares than HBW trips indicating fewer workers than school age kids or young adults who are in higher education.

Home Based Work (HBW) trips grew in size as vehicle ownership increased within each household size category. Most of the travel markets had comparable sizes across the MTC surveys. The largest change was observed for two-person households without a vehicle which showed a substantial growth in HBO travel at the expense of HBW trips. However, as stated before there were too few respondents from this segment in MTC II to draw more concrete conclusions.

Figure 5.15 presents household trip rates for travel markets defined by household size, vehicle ownership, and trip purpose. As expected, rates increase as household size increases for all markets. Most of the segments showed comparable trip rates between the two surveys.

The households with three members and one vehicle had a substantial drop in their total trip rate, while households with four or more members with one vehicle showed a significant growth in their trip rates, particularly for HBO trips. However, for both segments, sample size was too small for valid conclusions.

It can be concluded that trip rates by purpose within segments defined by household size and vehicle ownership was generally consistent across MTC surveys. The observed differences were minor and for segments with small sample sizes (less than 30) observed patterns can be considered as unreliable.

Tabulations and plots detailing trip purposes in each travel market and magnitudes of trip rates by household size, auto sufficiency, and trip purpose were also created. Since the analysis of these items yielded very similar observations as described above, these items are presented in the Appendix D, Figures D.1, and D.2.

Figure 5.16 presents the relative sizes of travel markets defined by the number of workers in the household, vehicle ownership, and trip purpose. The relative sizes in each market indicate that in each worker group there is at least one segment that showed some difference in the travel market size.

Zero-worker households without a vehicle had higher shares of HBO trips at the expense of school and NHB trips. This result may imply replacement of NHB trips with shorter HBO trips, but more detailed analysis is needed to draw more concrete conclusions.

Zero-worker households with two vehicles had a lower share of NHB trips while a sizeable growth was observed for share of school trips.

One-worker households without an auto exhibited distinct differences. However, this segment had very few (7 households) observations, as shown in Figure 4.6, for a reliable interpretation of changes in their travel.

Table 5.7 Trip Rates by Household Size, Vehicle Availability, and Trip Purpose by MTC Surveys

		HH Size 1				HH Size 2				HH Size 3				HH Size 4			
		Veh 0	Veh 1	Veh 2	Veh 3+	Veh 0	Veh 1	Veh 2	Veh 3+	Veh 0	Veh 1	Veh 2	Veh 3+	Veh 0	Veh 1	Veh 2	Veh 3+
MTC I	HBW	0.12	0.70	0.89	0.98	0.48	0.81	1.58	1.90	0.87	1.04	1.87	2.65	0.84	1.41	2.02	2.82
	HBSch	0.01	0.03	0.02	0.04	0.30	0.22	0.06	0.05	1.81	1.33	0.85	0.76	3.18	2.81	2.63	2.69
	HBO	1.15	1.82	1.61	1.51	2.25	3.07	3.44	3.33	2.77	4.28	4.37	3.96	5.42	5.78	6.83	6.44
	NHB	0.53	1.30	1.31	1.15	0.88	2.21	2.74	3.08	0.96	3.73	3.55	3.94	2.34	4.27	5.77	5.52
	All	1.81	3.84	3.83	3.71	3.91	6.31	7.83	8.36	6.40	10.39	10.65	11.30	11.78	14.32	17.26	17.47
MTC II	HBW	0.07	0.71	0.60	1.07	0.02	0.59	1.58	1.80	.	0.78	1.89	2.30	.	1.77	1.58	2.31
	HBSch	0.00	0.00	0.00	0.02	0.34	0.08	0.02	0.01	.	0.66	1.09	0.82	.	3.25	3.12	2.87
	HBO	1.11	1.60	1.78	1.54	2.63	2.81	3.38	2.96	.	3.29	4.13	4.58	.	7.90	7.37	6.51
	NHB	0.37	1.27	1.03	0.77	0.51	1.86	2.70	3.00	.	1.97	2.74	3.08	.	3.96	4.51	5.02
	All	1.55	3.62	3.43	3.40	3.50	5.38	7.79	8.03	.	6.89	10.00	10.94	.	17.12	16.99	17.10

Figure 5.15 Trip Rates by Household Size, Vehicle Availability, and Trip Purpose by MTC Surveys

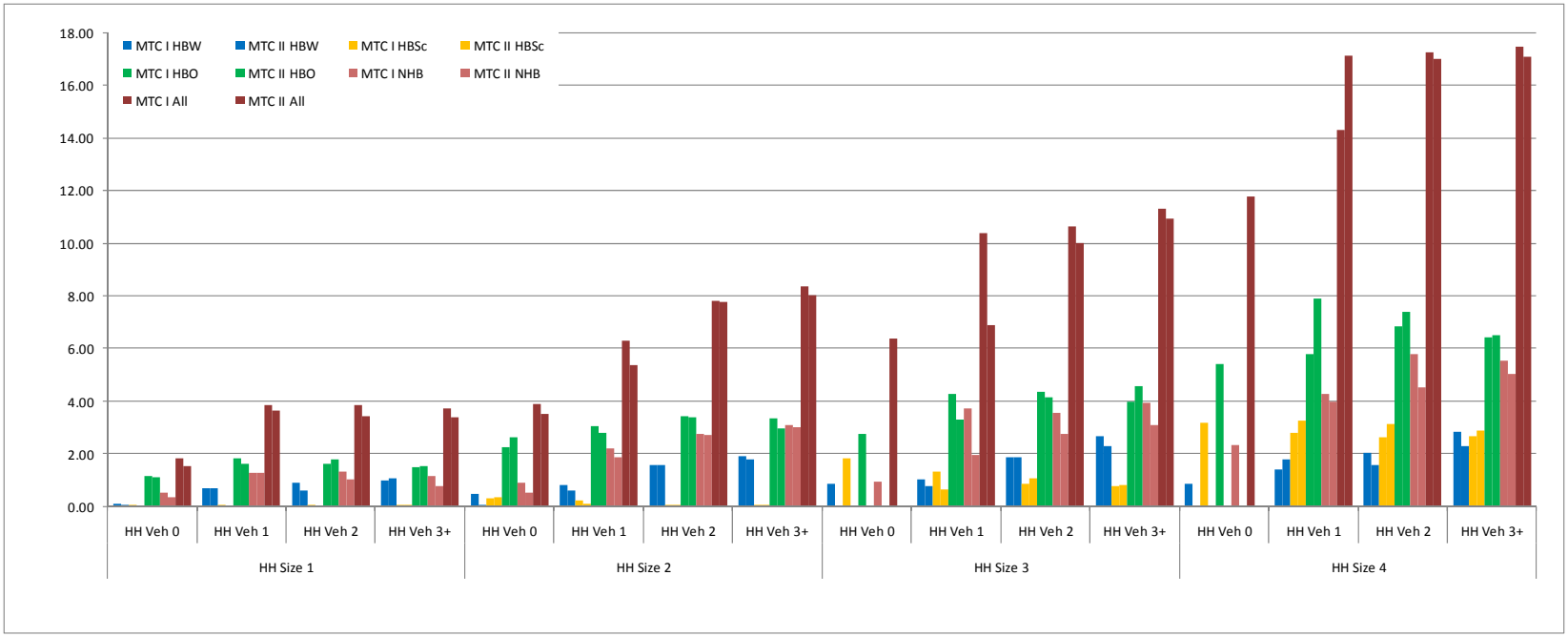
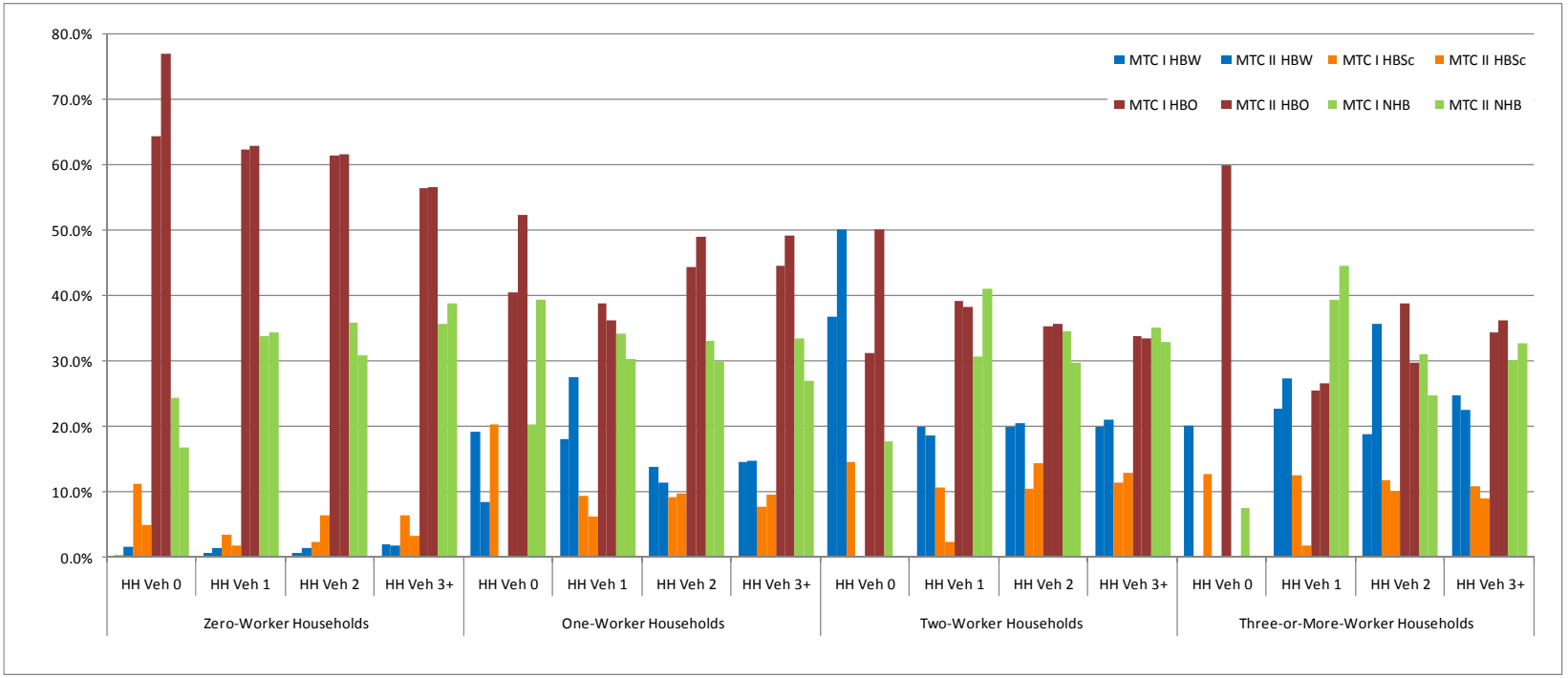


Table 5.8 Percentages of Trips by Workers in the Household, Vehicle Availability, and Trip Purpose by MTC Surveys

		Zero-Worker Households				One-Worker Households				Two-Worker Households				Three-or-More-Worker Households			
		Veh 0	Veh 1	Veh 2	Veh 3+	Veh 0	Veh 1	Veh 2	Veh 3+	Veh 0	Veh 1	Veh 2	Veh 3+	Veh 0	Veh 1	Veh 2	Veh 3+
MTC I	HBW	0.2%	0.5%	0.5%	1.8%	19.1%	17.9%	13.8%	14.6%	36.7%	19.8%	19.8%	19.8%	20.0%	22.7%	18.7%	24.7%
	HBSch	11.2%	3.4%	2.3%	6.4%	20.2%	9.2%	9.1%	7.6%	14.5%	10.6%	10.4%	11.3%	12.6%	12.5%	11.6%	10.9%
	HBO	64.3%	62.3%	61.3%	56.3%	40.5%	38.7%	44.2%	44.4%	31.2%	39.1%	35.3%	33.8%	59.9%	25.4%	38.7%	34.3%
	NHB	24.3%	33.7%	35.9%	35.5%	20.2%	34.2%	33.0%	33.4%	17.7%	30.5%	34.5%	35.1%	7.4%	39.3%	31.0%	30.1%
	All	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
MTC II	HBW	1.6%	1.3%	1.3%	1.7%	8.4%	27.5%	11.4%	14.7%	50.0%	18.5%	20.4%	20.9%	0.0%	27.2%	35.6%	22.4%
	HBSch	4.8%	1.7%	6.4%	3.2%	0.0%	6.1%	9.7%	9.4%	0.0%	2.3%	14.4%	12.8%	0.0%	1.7%	10.1%	8.9%
	HBO	76.8%	62.8%	61.6%	56.5%	52.2%	36.2%	49.0%	49.0%	50.0%	38.2%	35.6%	33.4%	0.0%	26.6%	29.7%	36.2%
	NHB	16.8%	34.2%	30.8%	38.7%	39.4%	30.2%	29.9%	26.9%	0.0%	40.9%	29.7%	32.9%	0.0%	44.5%	24.6%	32.6%
	All	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	100.0%	100.0%	100.0%

Figure 5.16 Percentages of Trips by Workers in the Household, Vehicle Availability, and Trip Purpose by MTC Surveys



For one-worker households with one vehicle a considerable amount of growth was observed in HBW trips (about 10 percent) at the expense of other purposes. This segment may contain more one-person households which may have separated from larger households in MTC I that could be partly responsible for the reduction in average household size. However, more in-depth analysis is needed to draw more concrete conclusions.

Two-worker households with zero vehicles showed significant differences in the shares of HBW and HBO trips. However, there was one observation for this market and the observed changes were considered as inconclusive.

Two-worker households with one vehicle had significant differences in the relative size of school and NHB trips across surveys. The segment had significantly lower levels of school trips in MTC II, while it showed growth in NHB trips. This may imply an increase in trip chaining or differences in household structures in the composition of this segment across surveys.

Households with three or more workers and with one vehicle exhibited a substantial drop in school trip share, and modest levels of growth in HBW and NHB trip shares. However, due to the very low response (three households only) from this segment these results were found inconclusive.

Another segment with a small sample size was households with three or more workers and with two vehicles. There were only eight households in this segment. While the trips for HBW purpose showed substantial growth, these observations were also considered as inconclusive.

Figure 5.17 features trip rates by the number of workers, vehicle ownership, and trip purpose across MTC surveys. The changes in this statistic reflect the change in frequency of trips by purpose across the two surveys.

As stated above, four segments had very few observations to draw concrete conclusions and one segment had no response in MTC II. These segments were not interpreted here. For most of the remaining segments, trip rates were comparable. There were four segments that showed considerable amount of change in their trip rates. Three of those had a reduction in their overall trip rates and only one segment showed growth.

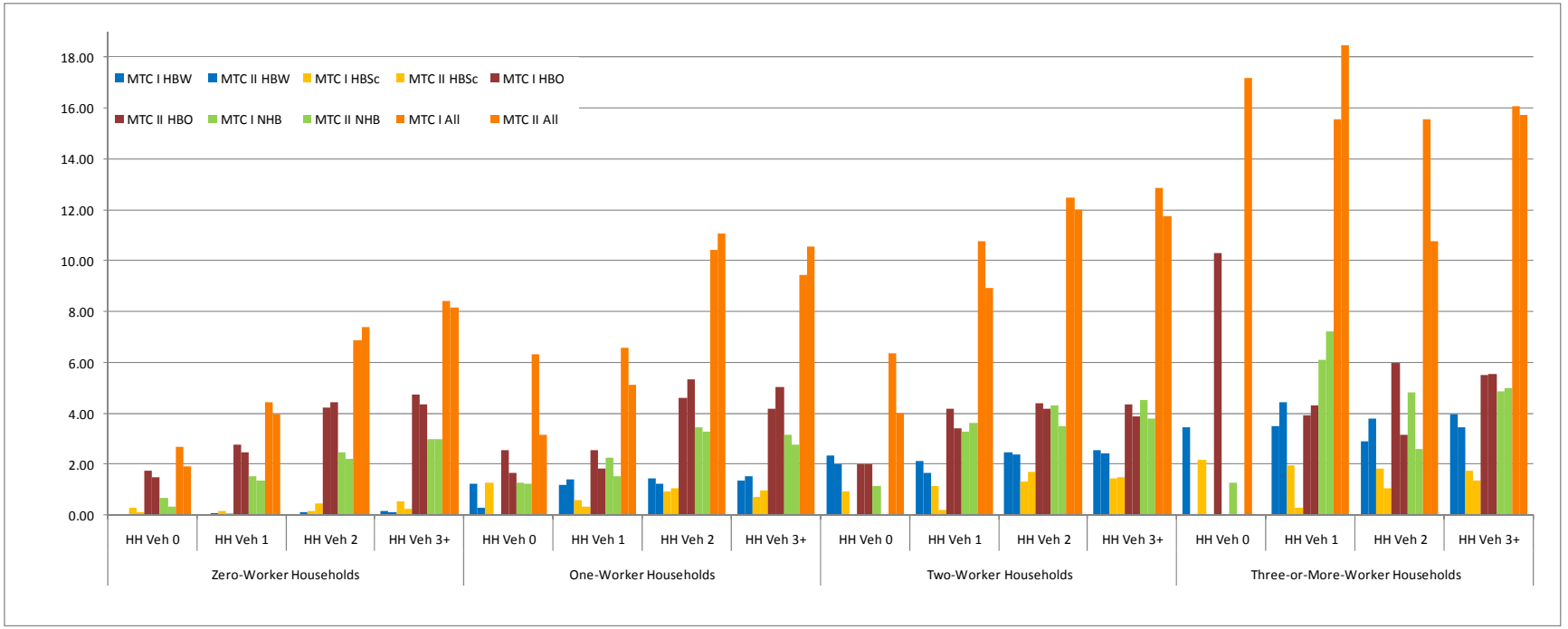
One-worker households with an auto showed a decline in overall trip rates while the trip rate for HBW purpose increased slightly. As aforementioned, this segment may contain more small-size households where their members may spend most of their time at work and travel less for non-mandatory purposes.

One-worker households with three or more autos exhibited a modest growth (about 10 percent) in overall trip rates across MTC surveys. There were slight increases in travel for work, school, and home-based other purposes. More detailed analysis that would control for changes in the household composition and structure across the MTC surveys is needed to interpret possible causes for this outcome more reliably.

Table 5.9 Trip Rates by Workers in the Household, Vehicle Availability, and Trip Purpose by MTC Surveys

		Zero-Worker Households				One-Worker Households				Two-Worker Households				Three-or-More-Worker Households			
		Veh 0	Veh 1	Veh 2	Veh 3+	Veh 0	Veh 1	Veh 2	Veh 3+	Veh 0	Veh 1	Veh 2	Veh 3+	Veh 0	Veh 1	Veh 2	Veh 3+
MTC I	HBW	0.01	0.02	0.03	0.15	1.21	1.18	1.43	1.37	2.33	2.12	2.47	2.54	3.44	3.51	2.90	3.97
	HBSch	0.30	0.15	0.16	0.53	1.28	0.60	0.94	0.72	0.92	1.14	1.29	1.45	2.17	1.94	1.80	1.74
	HBO	1.73	2.76	4.20	4.73	2.56	2.54	4.60	4.19	1.98	4.19	4.40	4.33	10.30	3.93	5.99	5.51
	NHB	0.65	1.50	2.45	2.98	1.28	2.24	3.43	3.15	1.13	3.28	4.30	4.50	1.28	6.08	4.81	4.84
	All	2.68	4.43	6.85	8.42	6.33	6.56	10.41	9.44	6.36	10.78	12.48	12.84	17.19	15.57	15.55	16.06
MTC II	HBW	0.03	0.05	0.10	0.13	0.27	1.39	1.24	1.52	2.00	1.64	2.39	2.42	.	4.41	3.77	3.43
	HBSch	0.09	0.07	0.46	0.24	0.00	0.31	1.06	0.97	0.00	0.21	1.68	1.48	.	0.27	1.07	1.36
	HBO	1.47	2.47	4.43	4.36	1.65	1.82	5.33	5.05	2.00	3.39	4.17	3.86	.	4.31	3.15	5.55
	NHB	0.32	1.35	2.21	2.99	1.24	1.52	3.26	2.77	0.00	3.63	3.48	3.80	.	7.22	2.61	5.00
	All	1.91	3.98	7.37	8.14	3.16	5.10	11.05	10.55	4.00	8.92	11.99	11.76	.	18.45	10.74	15.74

Figure 5.17 Trip Rates by Workers in the Household, Vehicle Availability, and Trip Purpose by MTC



Two-worker households with one vehicle showed a decrease of about 17 percent in total trip rates caused by a substantial reduction in HBSch and modest reductions in HBW and HBO trip rates. These can be partly explained by the oversampling of older age groups. The frequency analysis showed that, school age children made up about 12 percent of the total size of this segment, for the entire population the share of school age children was about 20 percent. This indicated that changes in the household composition and structure in this segment can be responsible for this outcome and more detailed analysis in needed for more reliable interpretation.

Two-worker households with three or more vehicles exhibited a sizeable reduction in total trip rates, mainly driven by reductions in NHB and HBO trip rates.

Tabulations and plots detailing composition of trip purposes in each travel market and magnitudes of trip rates by number of workers, auto sufficiency, and trip purpose were also created. Preliminary analysis of these items yielded similar observations but with lesser level of detail than those described above. Therefore, these items are presented in the Appendix D, Figures D.3, and D.4.

In order to evaluate changes in household trip rates by sample area, trip rates by trip purpose and sample area were summarized in Figure 5.18.

Total household trip rates for each sample area were fairly stable. While all sample areas showed a decline in the trip rates, none of the changes exceeded 10 percent. The highest reduction of trip rates was observed for the Upper Peninsula sample area. Small Cities, TMAs, and SUMAs also had above average reduction in trip rates.

As shown in Table 5.11, when trip purposes were considered, the highest portion of the changes occurred in HBW and NHB trips (10.2 and 14.8 percent decrease respectively), however, HBO and HBSch trip rates were relatively stable in the statewide distribution. The connection between HBW and NHB trips is well known; sizeable portions of NHB trips usually occur around the workplace and more than one NHB trip can be linked to a workplace for many workers.

While the overall trip rate was reduced by six percent, HBW and NHB trips were reduced at a higher rate, which can be linked to oversampling of older respondents in the MTC II survey in addition to reduction in average household size. Moreover, reductions in household size may lead to fewer opportunities to link trips or activities to meet the needs of other members in the household. As a consequence, demand for NHB trips may have been reduced.

There were no major changes in trip rates by purpose for statewide summaries. While the SEMCOG area had similar changes to those for the statewide rates, for other sample areas, changes in trip rates for HBO and HBSch purposes varied.

The trip rates by trip purpose from 2009 NHTS also showed a very similar distribution to MTC II distribution. Table 5.11 shows trip rates by purpose for MTC surveys and 2009 NHTS. MTC trip rates for HBW and HBSc were slightly higher than NHTS, while the HBO rate for NHTS was higher than MTC II. However, deviations are minor and it can be concluded that MTC II trip rates by trip purpose had a similar distribution to the nationwide patterns.

Table 5.10 Household Trip Rates by Sample Area and Trip Purpose by MTC Surveys

		SEMCOG	Small Cities	Upper Peninsula Rural	Northern Lower Peninsula	Southern Lower Peninsula	TMAs	Small Urban Modeled Areas	Statewide
MTC I	HBW	1.43	1.5	1.32	1.28	1.58	1.53	1.53	1.47
	HBSch	0.9	0.68	0.76	0.71	0.85	0.87	0.81	0.86
	HBO	3.85	3.96	3.45	3.06	3.68	3.82	3.93	3.79
	NHB	2.96	2.68	2.87	2.91	3.31	3.3	3.11	3.05
	All Purposes	9.14	8.82	8.40	7.96	9.41	9.53	9.39	9.17
MTC II	HBW	1.25	1.39	1.37	1.21	1.45	1.42	1.41	1.32
	HBSch	0.78	0.63	0.76	0.74	0.97	0.88	0.87	0.82
	HBO	3.84	3.7	3.05	3.12	3.64	3.9	3.53	3.7
	NHB	2.57	2.26	2.32	2.67	2.86	2.51	2.72	2.6
	All Purposes	8.60	8.14	7.64	7.93	9.15	8.83	8.72	8.63

Figure 5.18 Household Trip Rates by Sample Area and Trip Purpose by MTC Surveys

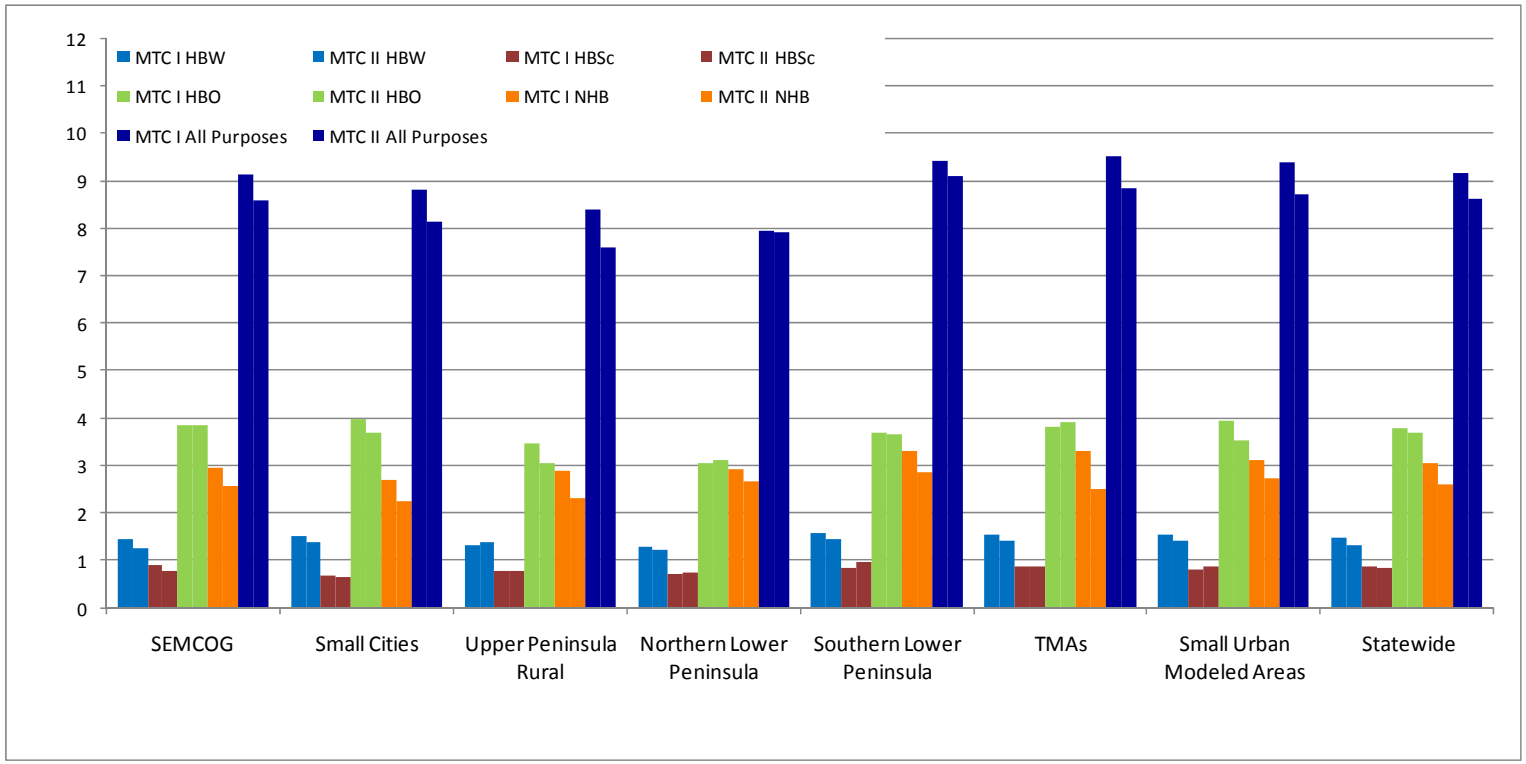


Table 5.11 Household Trip Rates by Purpose for MTC Surveys and 2009 NHTS

	MTC I		MTC II		2009 NHTS	
Trip Purpose	**Rate**	**Shares**	**Rate**	**Shares**	**Rate**	**Shares**
HBW	1.47	16.0%	1.32	15.6%	1.24	14.9%
HBSch	0.86	9.4%	0.82	9.7%	0.66	7.9%
HBO	3.79	41.3%	3.70	43.8%	3.91	47.0%
NHB	3.05	33.3%	2.60	30.8%	2.51	30.1%

Data summaries for travel market composition by trip purpose across sample areas were also created. The preliminary analysis of the patterns yielded the same results observed for those of trip rates as discussed above. Therefore, data summaries for travel market composition by trip purpose across sample areas were presented in Appendix D, Figure D.5.

The analysis of trip purpose compositions and trip rates across different travel market segments provided the following key points:

- Changes in total trip rates and shares of different trip purposes did not change substantially at sample area and state levels.
- The observed changes at the state level can be associated with the decline in the average household sizes.
- When broken into segments, trip rates and shares for different purposes showed substantial changes.
- The nature of changes and potential causes varied by segments.
- Segments with zero-vehicle households with more than one member or one worker had very low response, therefore, patterns in these segments could not be interpreted reliably, and most of the results from these segments were inconclusive.
- HBW and NHB trip rates showed higher rates of decline compared to other trip purposes in MTC II.
- 2009 NHTS provided a very similar distribution of trip rates by purpose to that of MTC II.
- More detailed study designs are needed for different segments that would include statistical controls for household compositions in each segment and changes in the household structure and interrelationships.

5c. Travel Time Distribution

Trip length distribution is one of the key variables that is used to validate travel demand models. However, since MTC I data had information on travel times rather than trip lengths, travel time distributions were summarized in this section and changes in travel times between MTC surveys across sample areas and trip purposes are presented. Since in general, congestion was not a real concern, the findings here would also be valid for

trip lengths. The travel times used for comparisons were travel times obtained from model networks; therefore, it is likely that the values presented here underestimate the total travel times by a few minutes to account for time spent to access or egress network nodes near trip end locations. During the review of time-distance check methodology across the MTC surveys, the project team uncovered a minor difference in the way total travel times were computed. The preliminary analysis of travel times computed with both methods for MTC II trips showed no substantial difference in the distribution of travel times by region. Data summaries for changes in travel time distributions by household and personal characteristics were also created and presented in Appendix D, Figures D.6 to D.11. Appendix D also contains more detailed tabulations and plots for travel time distributions for each purpose by sample area (Figures D.12 to D.15.)

Figure 5.19 shows the travel time distributions for different purposes for MTC I and II. Travel times are regrouped into time bins as shown. The height of the bars indicates the percentage of trips found in each bin for each purpose.

Both datasets had similar relative sizes across trip purposes in each time bin. MTC II data showed sizeable increases in very short trips for all purposes except HBW trips. The growth in very short trips by non-work purposes seems to draw from trips in the 5–10 and the 10–15 minute categories. The longer trips were stable.

HBW trips grew in the "Less than 5 minutes" and "5–10 minutes" categories and seemed to draw from the "10-15" and "15-20" minutes categories. Changes in other time categories were not substantial.

Figure 5.19 Travel Time Distributions by Trip Purpose across MTC Surveys

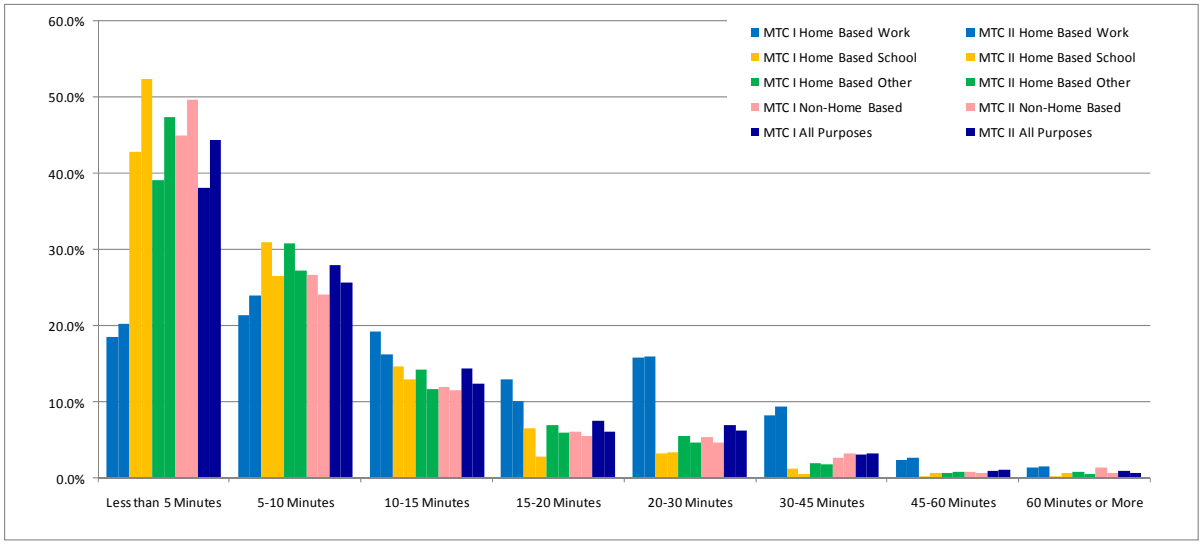
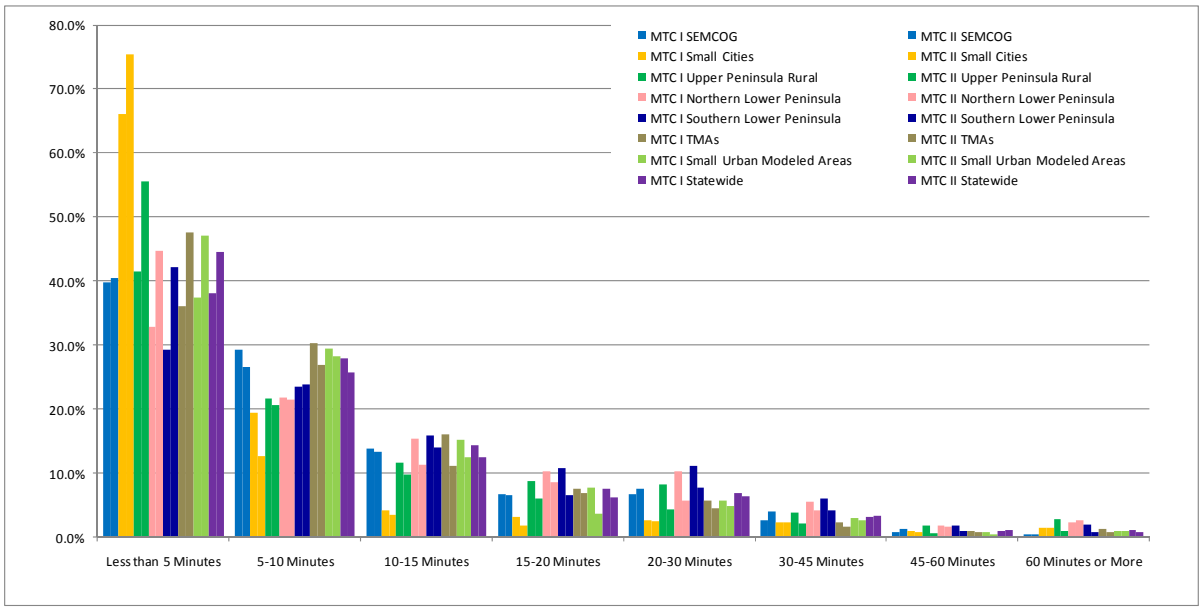


Figure 5.20 features the travel time distribution for each sample area and MTC survey. The statewide distribution showed a higher frequency of very short trips for MTC II and fewer trips in all other categories. The sample area distributions showed some variations while the relative magnitude of trips in each time interval was consistent among the sample areas.

Figure 5.20 Travel Time Distributions by Sample Area across MTC Surveys



The SEMCOG sample area had the most stable distribution among all sample areas, while the rest of the sample areas had higher frequencies in the shortest travel time interval. The Small Cities sample area had the highest fraction of trips shorter than five minutes in both surveys with an increased share in MTC II. Small Cities had a lower frequency of trips in the 5-10 minutes interval. For the remaining intervals, Small Cities had fairly stable shares.

TMAs and SUMA sample areas had relatively higher changes in the 10-15 and 15-20 minute intervals, while for the rural portions of the state, relatively higher differences were observed for longer trips. Based on these patterns the following remarks can be made:

- In more developed urban areas, the travel time distributions were stable between the surveys.
- For small urban areas, the short to medium range trips (5 to 20 minutes) were replaced by shorter trips and resulted in a significant increase in very short trips in MTC II.
- For rural areas, the shift in trip travel times covered a wider range including trips between 30 and 45 minutes long resulting in an increase in very short trips in MTC II.

5d. Modal Shares and Vehicle Occupancy

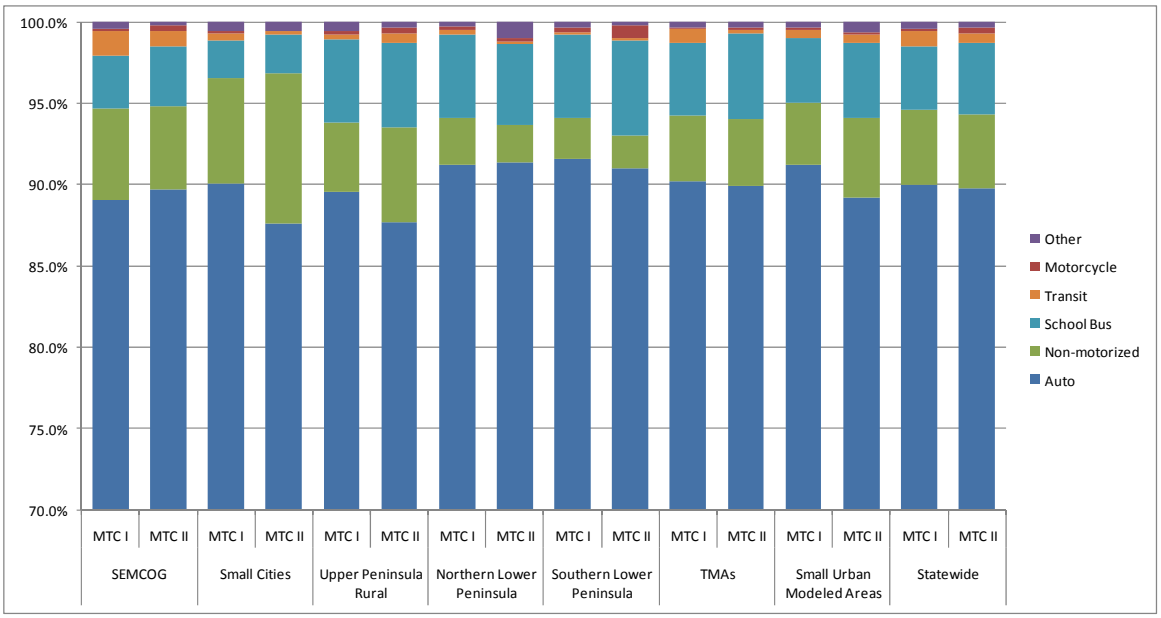
Modal distribution is a major component of a traditional travel demand models. Travel survey data provides information for estimation of mode choice models. The distribution of modal shares for each sample area between the MTC surveys was analyzed and a

closer attention to vehicle occupancy was given by providing summaries for drive alone and shared ride with two and three car occupants.

Detailed summaries for travel time distributions by various modes were also produced. Since the preliminary analyses of these patterns were found similar to those provided in Section 5.c, these items are presented in Appendix D, Figures D.16 to D.21.

Figure 5.21 features modal distributions of trips in each sample area and MTC survey. In order to demonstrate changes in modes other than auto, the y-axis was truncated at the 70 percent level. The statewide distributions indicate that auto trips make up almost 90 percent of the total trips in both MTC surveys. The other distinct modes were non-motorized modes and school bus with almost equal shares of around 4.5 percent. Transit had a market share of about 0.5 percent for both surveys.

Figure 5.21 Modal Distributions of Trips by Sample Area and MTC Survey

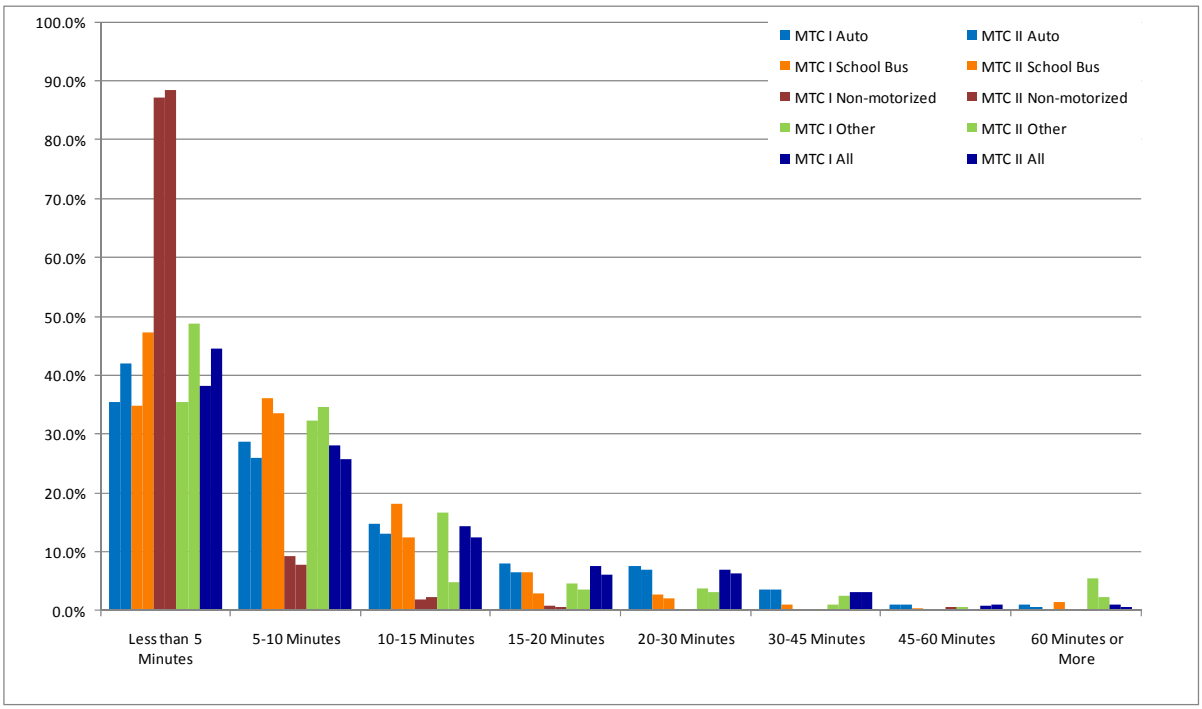


Modal shares across the sample areas show fairly stable patterns. For urbanized sample areas, non-motorized modes had slightly higher shares than rural portions of the state and transit had a measurable share mainly in the SEMCOG sample area. For Small Cities, Upper Peninsula, and SUMA sample areas slight increases in non-motorized trips were observed, but the magnitudes of these changes were not substantial.

The modal shares shown in Figure 5.21 indicate there were no substantial changes in modal shares in total trips. A series of data summaries were created in which travel time distributions from each mode were juxtaposed as shown in Figure 5.22.

Analysis of these distributions indicated that travel time distributions by most of the modes had consistent patterns across time intervals. As expected, observations for non-motorized modes peaked in the shortest travel time category and disappeared after the “10 – 15 Minutes” category.

Figure 5.22 Travel Time Distributions by Mode across MTC Surveys



Another series of plots in which travel time distributions from each sample area were combined for auto and other trips made by auto were produced (Appendix D, Figures D.16, and D.17.)

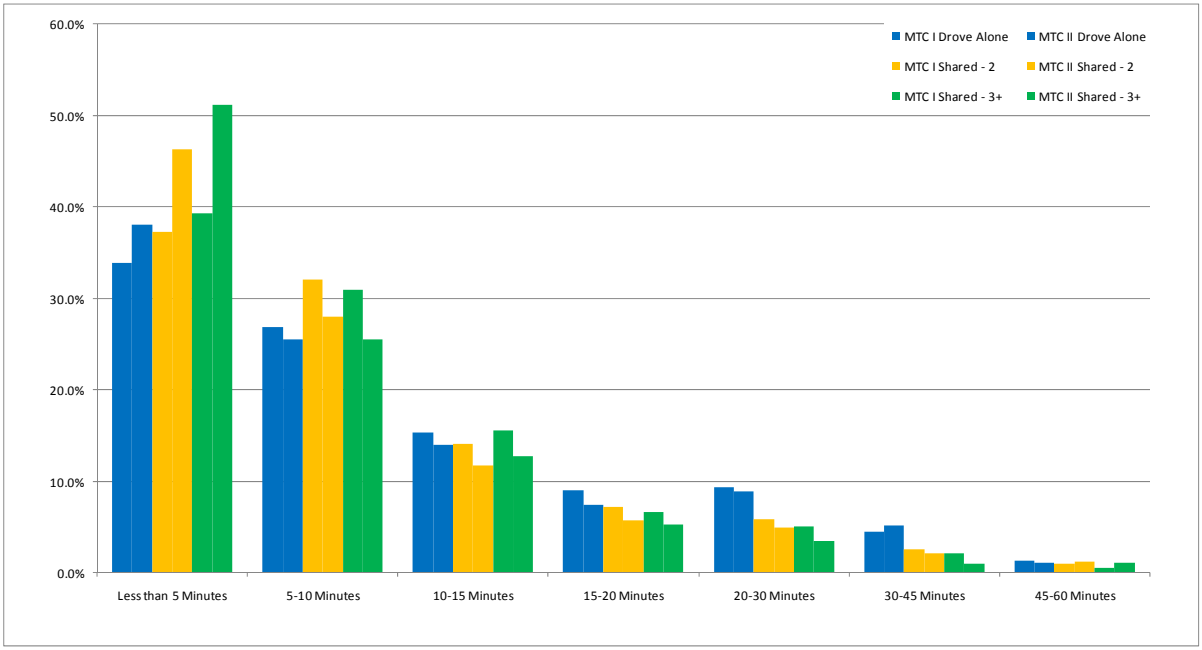
As indicated in Figure 5.21, the majority of trips were made by auto throughout the state. In order to examine the auto modes in greater detail, the shares of drive alone, shared ride with two occupants, and shared ride with three or more occupants were studied.

Figure 5.23 provides a summary of travel time distributions for auto and shared rides in order to investigate whether travel time distributions by auto modes differ across the MTC surveys.

All auto modes showed higher frequencies of shorter trips and frequencies diminished as travel times increased. Drive alone had relatively larger shares of trips longer than 20 minutes when compared to shared rides. Based on the relative sizes of trips, the shorter the trips the more likely that one or more occupants shared the ride. This can be partially explained by the higher incidence of ride sharing for pick-up and drop-off trips which are likely to be shorter. The shift towards shorter trips between the MTC surveys was observed for all auto modes, while the shift for drive alone mode was relatively smaller.

More detailed plots of travel time distribution by sample areas and MTC surveys were created for all auto modes separately and presented in Appendix D, Figures D.18 to D.20.

Figure 5.23 Travel Time Distributions for Auto Modes across MTC Surveys



Based on the analysis of modal distribution of trips, and travel time distributions by mode the following results can be drawn:

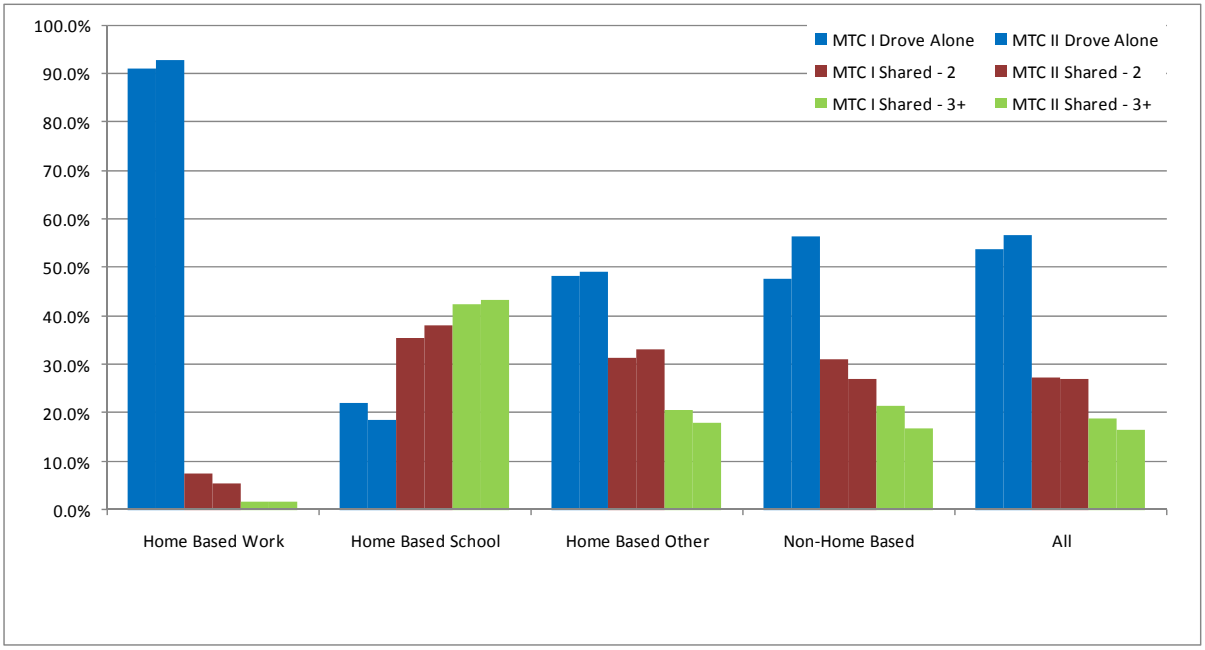
- Auto is the dominant mode for all trips across the sample area.
- Modal distributions across the sample areas and MTC surveys were consistent.
- Non-motorized and motorized modes had fairly clear patterns of travel time distributions.
- Across the MTC surveys, a shift towards shorter trip times was observed for motorized trips, while the relative magnitude of the shift for the auto mode was relatively small.
- Drive alone had a slightly higher share of longer trips, and the relative size of the shift towards shorter trips for drive alone was smaller than those observed for shared rides.

5e. Vehicle Utilization and Auto Sufficiency

The dominance of travel by auto is reflected in that more than 60 percent of the households in Michigan own more than one vehicle. In this section, more detailed summaries that describe differences between drive alone and shared rides are presented. Moreover, distributions of shares of auto modes by household size and household auto sufficiency are presented. Auto sufficiency is a variable that gauges the level of availability of an auto in the household. More detailed descriptions for this variable and category levels were provided in section 5.a, page 51. Figure 5.24 features distributions of auto modes by trip purpose. In MTC II almost 57 percent of the auto

trips were drive alone. Two and three or more occupant shared rides, made up 27 percent and 16 percent of the auto trips, respectively. These patterns were almost identical to the MTC I patterns.

Figure 5.24 Distributions of Auto Shares by Trip Purpose across MTC Surveys

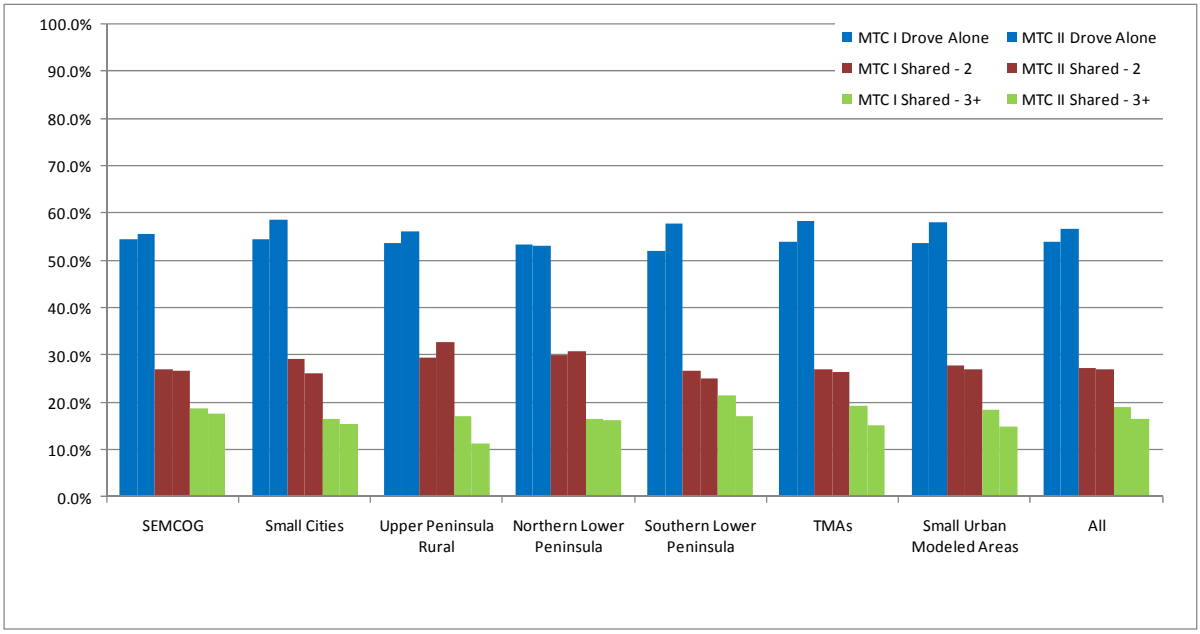


For MTC II, drive alone dominated the HBW trips (93 percent), two-occupant shared rides had a share about five percent and three–occupant, plus shared ride share was about 1.5 percent. These patterns were consistent with MTC I shares which has a slightly higher share of two-occupant shared ride.

Shared rides had a higher proportion than the drive alone mode for HBSch trips with three-occupant shared rides having the highest share of just above 40 percent. For HBO and NHB trips, the drive alone and shared rides had comparable shares, where two-occupant shared rides were more common than rides with three or more occupants. These patterns were also consistent with the MTC I patterns. The only noticeable change was observed for NHB trips where the drive alone mode increased nine percentage points between the MTC surveys. This can be partly explained by changes in trips by purpose and reduction in average household sizes. It could be possible that with smaller household sizes there would be fewer opportunities to share a ride, and due to reductions in HBW trips and, potentially, reductions in the associated NHB trips around the workplace which may include many trips with shared rides (e.g., trip for lunch with coworkers) or walking, the remaining NHB trips might have been made by drive alone mode at higher frequencies.

Figure 5.25 shows the shares of auto modes in each sample area. The relative shares among auto modes were very consistent across the sample areas and showed very small deviations from the statewide patterns of changes between the MTC surveys.

Figure 5.25 Distributions of Auto Shares by Sample Areas across MTC Surveys



Modal shares for auto by household size and auto sufficiency were summarized to compare the changes in auto modes across the MTC surveys (Figure 5.26.) The height of each bar reflects a modal share within the auto modes by household size and auto sufficiency. It could be expected that households with a sufficient supply of autos may shift to shared rides in order to save gas and minimize household costs.

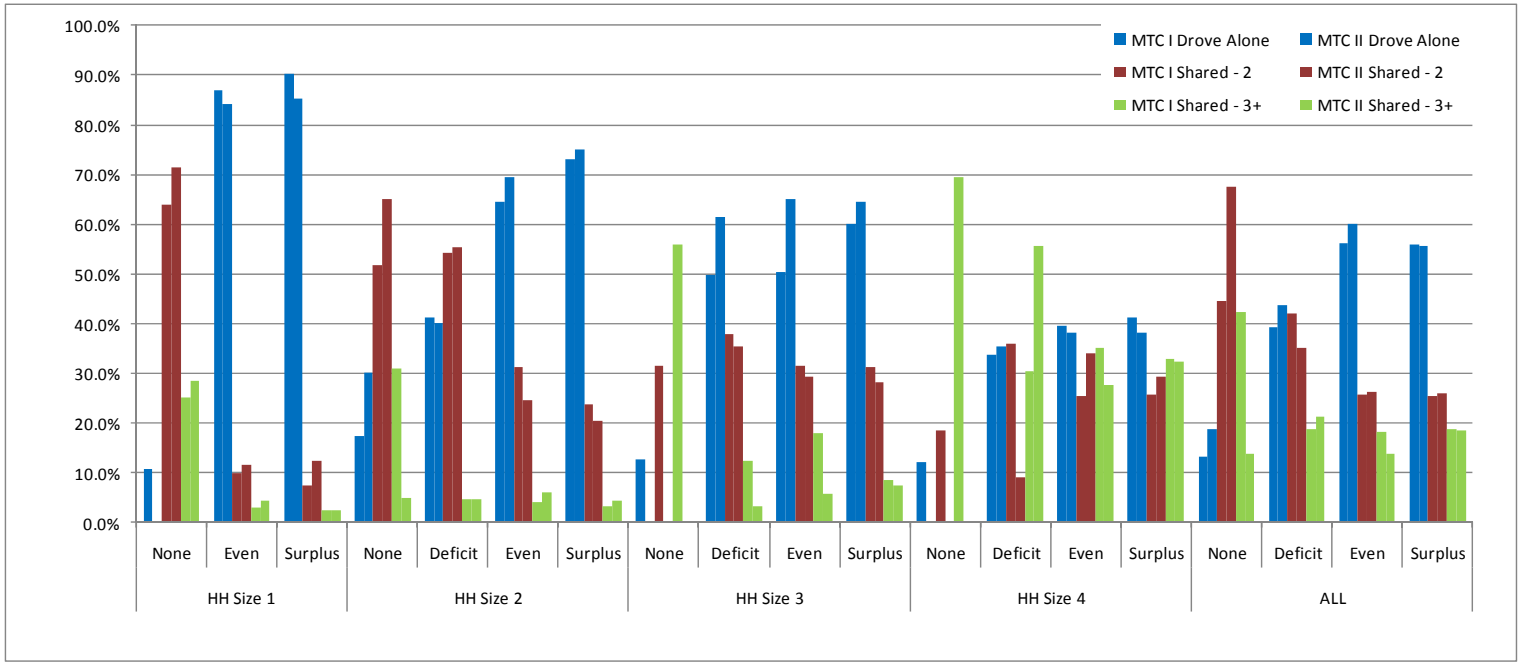
For the zero-vehicle households (as reflected by the "None" category in auto sufficiency), the results were inconclusive due to two different reasons. First, for some of these households, drive alone trips were reported. Although it is possible to observe such responses (rental car or a borrowed vehicle might have been driven), the extent of such cases in both MTC surveys as shown in Table 5.12 (13 and 18 percent) was considered high. Moreover, MTC II data had no response from zero-vehicle households which had three or more members. Therefore, interpretation of the patterns from zero-vehicle households excluded the size dimension.

The examination of the households by auto sufficiency only indicated that most of the changes observed were generally at modest levels. For "Deficit" and "Even" auto sufficiency categories, there was a shift from shared rides to drive alone mode. For households with balanced vehicle supply, there was net loss of three or more occupant shared rides. Even for zero-vehicle households a similar shift from three-occupant to two-occupant shared rides was also seen, however, since MTC II survey did not have any responses from zero-vehicle households with more than two members, this result is inconclusive. The households in "Surplus" category did not show any significant change in vehicle utilization.

Table 5.12 Distribution of Auto Shares by Household Size and Auto Sufficiency across MTC Surveys

		MTC I			MTC II			MTC I			MTC II		
		Drove Alone	Shared - 2	Shared - 3+	Drove Alone	Shared - 2	Shared - 3+	Drove Alone	Shared - 2	Shared - 3+	Drove Alone	Shared - 2	Shared - 3+
HH Size 1	None	17,127	102,363	40,315	-	65,722	26,165	10.7%	64.1%	25.2%	0.0%	71.5%	28.5%
	Even	2,060,982	236,622	70,460	2,138,519	296,263	108,030	87.0%	10.0%	3.0%	84.1%	11.7%	4.2%
	Surplus	589,522	48,690	15,576	552,163	79,515	15,094	90.2%	7.4%	2.4%	85.4%	12.3%	2.3%
HH Size 2	None	23,050	68,310	40,935	45,038	97,650	7,274	17.4%	51.6%	30.9%	30.0%	65.1%	4.9%
	Deficit	342,554	451,954	37,828	300,533	412,680	33,757	41.2%	54.3%	4.5%	40.2%	55.2%	4.5%
	Even	2,779,944	1,347,928	177,976	2,760,056	971,519	236,797	64.6%	31.3%	4.1%	69.6%	24.5%	6.0%
	Surplus	2,495,426	812,999	106,324	3,079,406	839,849	179,841	73.1%	23.8%	3.1%	75.1%	20.5%	4.4%
HH Size 3	None	9,247	22,861	40,647	-	-	-	12.7%	31.4%	55.9%	0.0%	0.0%	0.0%
	Deficit	274,131	208,267	68,852	263,561	151,475	13,764	49.7%	37.8%	12.5%	61.5%	35.3%	3.2%
	Even	1,368,073	853,523	488,978	1,118,120	501,222	98,329	50.5%	31.5%	18.0%	65.1%	29.2%	5.7%
	Surplus	1,533,976	801,012	219,756	1,827,030	798,968	212,247	60.0%	31.4%	8.6%	64.4%	28.2%	7.5%
HH Size 4	None	14,542	21,926	82,982	-	-	-	12.2%	18.4%	69.5%	0.0%	0.0%	0.0%
	Deficit	441,362	470,914	400,600	204,945	52,126	323,635	33.6%	35.9%	30.5%	35.3%	9.0%	55.7%
	Even	2,274,529	1,452,291	2,015,414	1,878,115	1,680,590	1,367,189	39.6%	25.3%	35.1%	38.1%	34.1%	27.8%
	Surplus	2,598,803	1,628,630	2,080,632	2,684,743	2,068,804	2,277,915	41.2%	25.8%	33.0%	38.2%	29.4%	32.4%
ALL	None	63,966	215,461	204,880	45,038	163,372	33,439	13.2%	44.5%	42.3%	18.6%	67.6%	13.8%
	Deficit	1,058,047	1,131,135	507,279	769,039	616,282	371,156	39.2%	41.9%	18.8%	43.8%	35.1%	21.1%
	Even	8,483,528	3,890,364	2,752,828	7,894,811	3,449,595	1,810,345	56.1%	25.7%	18.2%	60.0%	26.2%	13.8%
	Surplus	7,217,727	3,291,332	2,422,288	8,143,342	3,787,135	2,685,096	55.8%	25.5%	18.7%	55.7%	25.9%	18.4%

Figure 5.26 Distribution of Auto Shares by Household Size and Auto Sufficiency across MTC Surveys



When households were also segmented by household size, some changes were observed as shown in Figure 5.26.

One-member households showed a small change as expected, indicating a slightly higher frequency of shared rides and a lower frequency of drive alone. However, both due to the magnitude of observed changes and the smaller impact from this type of households (with the lowest amount of total travel), these changes were not substantial.

Two-member households had consistently higher shares of two-occupant shared rides, implying extensive carpooling by the household members while a slight shift, about five percent, from shared rides to drive alone was observed in MTC II.

Three-member households showed an increase in drive alone mode in MTC II particularly among households with a deficit or a balance in their vehicle supply. The changes observed here can be partially explained by changes in household sizes and the oversampling of older respondents.

Households with four or more members which had a balance or a surplus in their vehicle supply showed no significant change in their vehicle utilization. There was an eight percent shift in shares from three-occupant to two–occupant shared rides for “Even” category. The deficit category showed unexpected changes between the surveys which can be attributed to the high level uncertainty due to low response from this segment. There was a large growth in three or more occupant shared rides at the expense of two-occupant shared rides. The share of drive alone remained stable.

A similar set of summaries was also created to segment trips by a household’s auto sufficiency and by the number of workers in the household. These items are presented in Appendix D, Figure D.21.

The patterns of changes in vehicle utilization at different levels of detail indicated the following results:

- There are differences in modal shares within the auto mode across different purposes that can be explained by the nature of the trip purpose.
- Sample area distributions were consistent with the statewide patterns and almost constant across the sample areas.
- The segmentation by trip purpose did not show any substantial changes in the auto modal shares between MTC surveys.
- Households with a balance or a surplus of vehicles showed very similar patterns of auto modal share distributions.
- Segments defined by auto sufficiency and household size showed a general tendency of shifting towards more private rides, to drive alone or two-occupant shared rides. However, changes in the shares were smaller than 10 percent. There were a few segments with unreliable estimates due to low or no response.

5f. Mode Utilization and Auto Sufficiency

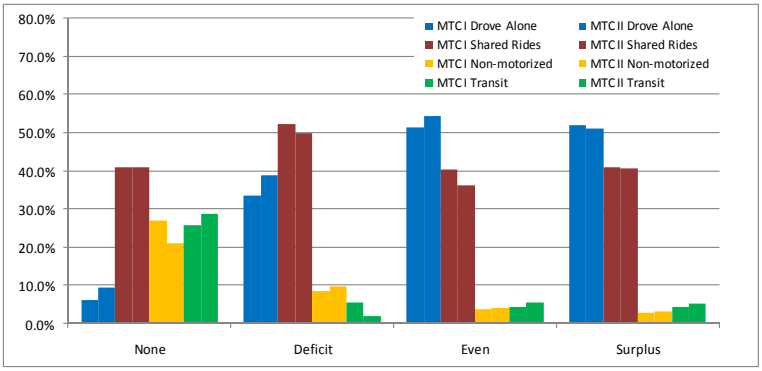
Non-motorized trips and transit were added to the drive alone and shared ride modes to examine whether households with different levels of auto sufficiency changed their mode between the MTC surveys.

Figure 5.27 summarizes modal share distributions by auto sufficiency. Shared rides had the highest share for zero-vehicle households, while non-motorized modes and transit (includes school bus and dial-a-ride) had comparable shares. Change in each mode's share across the surveys was insignificant.

For households which had a deficit in their vehicle supply, shared rides had the highest modal share. Drive alone was the second largest market, and transit and non-motorized mode shares were lower than 10 percent. The observed changes between the surveys were not substantial.

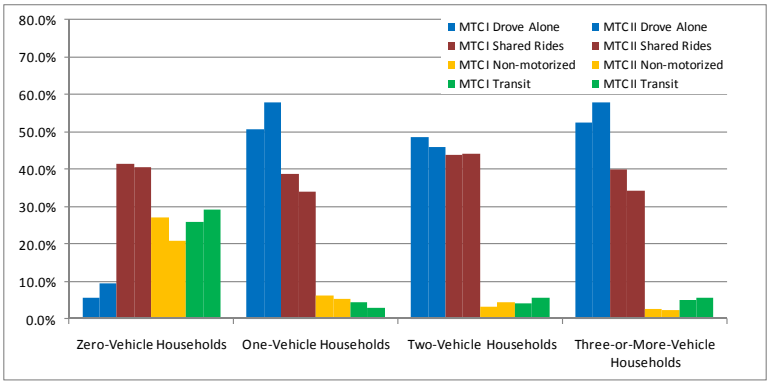
Households which had at least a balanced level of vehicle supply showed a market share of more than 50 percent for drive alone and 40 percent for shared ride modes. The other modes had comparable sizes of around 5 percent. These households also had almost identical mode share distributions across the MTC surveys.

Figure 5.27 Mode Share Distributions by Household Auto Sufficiency and MTC Surveys



The mode share distribution by vehicle ownership levels were also produced and provided in Figure 5.28.

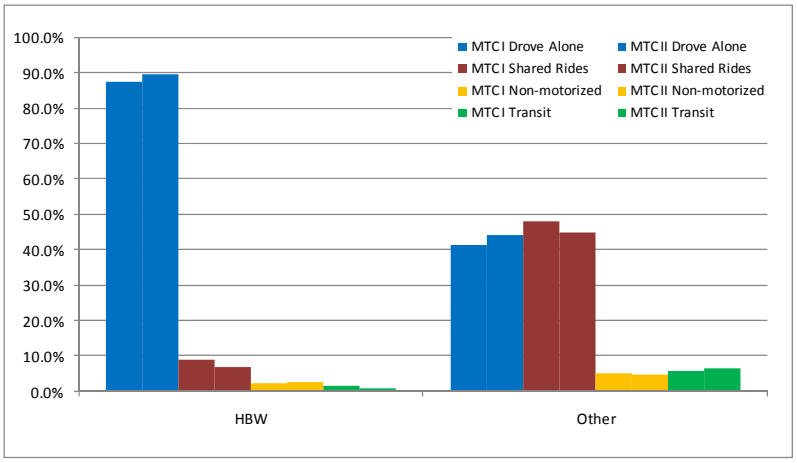
Figure 5.28 Mode Share Distributions by Vehicle Ownership and MTC Surveys



The mode share distributions for zero-vehicle households were the same as that for the "None" category for auto sufficiency by definition. All households which own at least one vehicle showed almost identical mode share distributions. None of the vehicle ownership categories displayed a significant change between MTC surveys.

Finally, the mode share distributions for work and non-work trips were compared (Figure 5.29.)

Figure 5.29 Mode Share Distributions for HBW and Other Trips across MTC Surveys



Work trips had a very large drive-alone share which stayed constant between the surveys. The other purposes had a more balanced distribution between drive alone and shared rides and the respective sizes of the non-motorized and transit market share were about 10 percent each. This pattern also did not change substantially between the two surveys.

The preliminary analysis of mode utilization by auto sufficiency and MTC surveys yielded the following main conclusions:

- Auto sufficiency provided better distinctions in describing differences in mode share distributions than different levels of auto ownership.
- Differences in auto utilization exist when considering the sufficiency of autos available when compared to workers in a household ("None", "Deficit" and "Even" and "Surplus" categories).
- "Even" and "Surplus" categories exhibited very similar modal choices.
- The two MTC surveys showed no significant differences in the distributions of mode choices.

5g. Diurnal Distribution

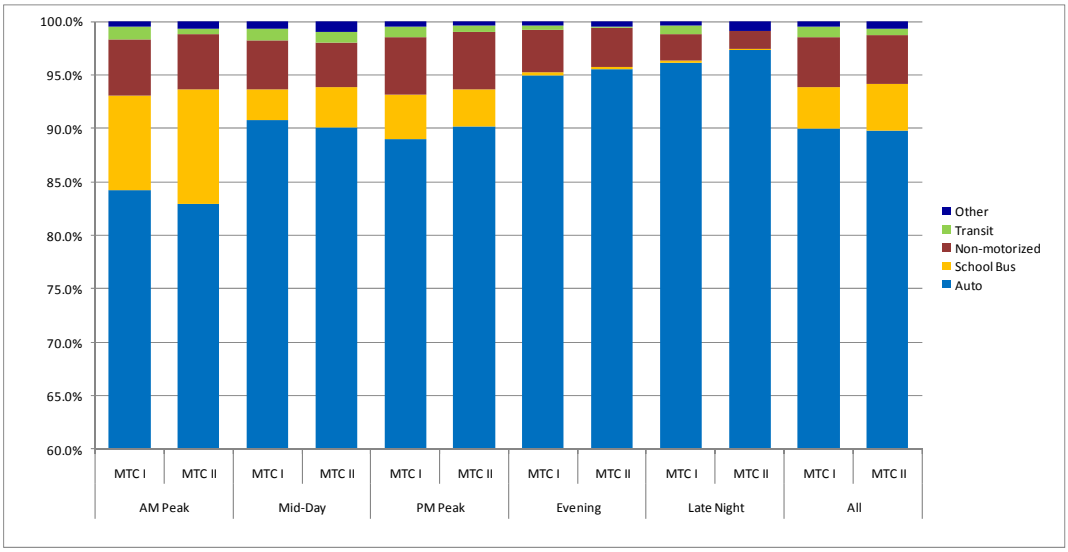
Distributions of modal shares and trip purposes by time of day for both MTC surveys are presented in this section. Since travel demand models usually treat time of day periods as separate segments, confirmation of changes in some key trip characteristics by time period would be useful. The following break points used for defining the time periods include:

AM Peak: 6:00 AM – 8:59 AM
Mid-Day: 9:00 AM – 2:59 PM
PM Peak: 3:00 PM – 5:59 PM
Evening: 6:00 PM – 8:59 PM
Late Night: 9:00 PM – 5:59 AM

An "Unknown" category for time of day is used for trip records with missing departure time values and for artificial trip records that were created during the imputation process.

Figures 5.30 and 5.31 provide the distributions of trips by mode, purposes, time of day, and MTC surveys.

Figure 5.30 Distributions of Trips by Mode and Time of Day across MTC Surveys



Throughout the day, modal distributions showed some changes across time periods, such as a higher share of school bus trips during the AM Peak, more evenly distributed shares for the remainder of the day, and lower shares of non-motorized trips during the evening hours. However, both MTC datasets provided almost identical patterns.

Auto trips were also broken into drive alone and shared ride trips and the distributions for auto modes were also created. However, there were no changes in those distributions between the two MTC surveys. The summaries of distributions of auto modes by time of day are presented in Appendix D, Figure D.22.

The distributions observed in Figure 5.31a were somewhat consistent with those presented in Figure 5.30 including a higher share of HBSch trips during the AM Peak. The distribution of HBW trips also followed a common pattern with higher shares of HBW trips in the morning and more even distributions during later periods. HBW shares were also high for the late night period possibly reflecting some lingering return trips to home and new trips to workplaces by respondents who work at nighttime. These patterns were again almost identical between the two MTC surveys.

Figure 5.31a. Distributions of Trips by Trip Purpose Time of Day and MTC Surveys

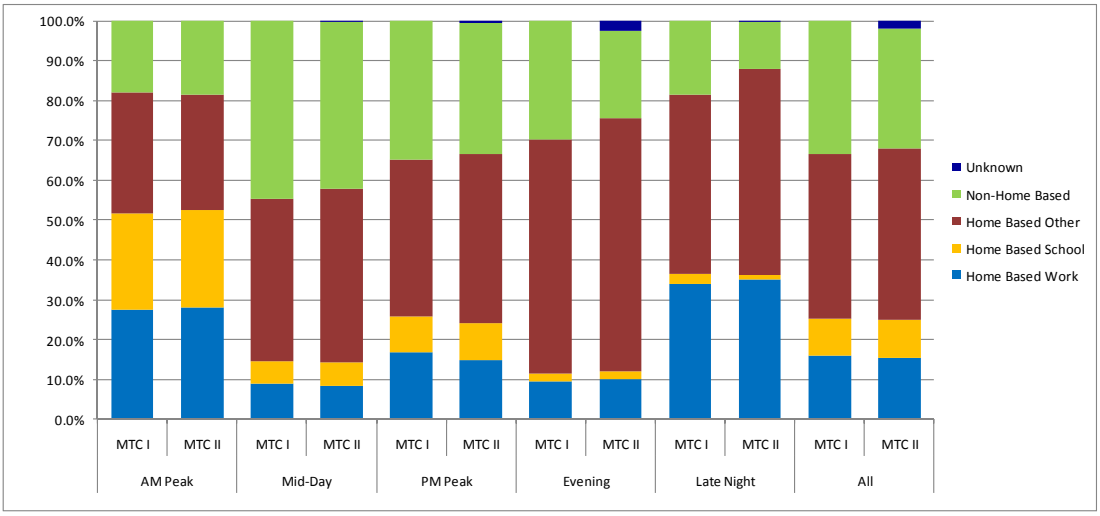
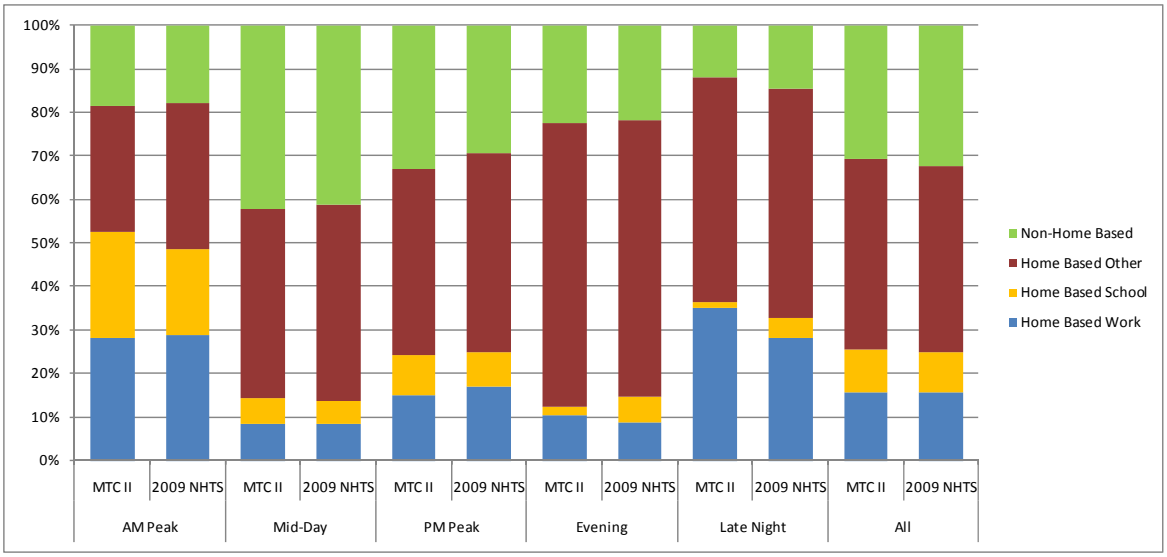


Figure 5.31b shows the distribution of trips by purpose and time of day periods as reflected in 2009 NHTS data which showed an almost identical time of day distribution to that from MTC II. For individual time of day periods, 2009 NHTS showed slightly lower shares of HBSch trips in the "AM Peak" and "PM Peak" where there were slightly higher frequencies of HBW trips. In the "Evening" and "Late Night" periods shares of HBSch trips were slightly higher. None of the differences mentioned here is large enough to raise concerns about the validity of distribution of trips as reflected MTC II survey.

Figure 5.31b. Distributions of Trips by Trip Purpose and Time of Day in MTC II Survey and 2009 NHTS



The analysis of key trip characteristics that are widely used in segmenting trips in travel demand modeling practice by time of day periods did not show any variation across the two MTC surveys.

5h. Time Use

Traveler choices for participating in different activities and durations may be influenced by shifts in socioeconomic characteristics which could be the result of changes in the local economy between the MTC surveys. The average times spent for key daily activities were computed and summaries by various personal characteristics across the two MTC surveys were created. Trip records that had been flagged for failing a time-distance check and outlying durations were excluded to reduce potential bias. Outliers were defined as activity durations that were 3.5 standard deviations away from the mean.

Figure 5.32 features mean durations of key activities by gender for both MTC surveys. The supporting data are also presented in Table 5.13. The computation of activity durations relied on the reported departure and arrival times for typical activities. Travel times were obtained by assigning trip end locations to a nearest node using the model networks. All activity durations are reported in minutes. Activities that were considered include travel, work, school, routine and major shopping. Other activities included dining out, recreational, religious, social, pick-up/drop-off, accompanying a person, personal business, and turn-around activities. The school category combined day care, K-12, and higher education activities.

Figure 5.32. Mean Activity Durations for Main Activities by Gender and MTC Survey

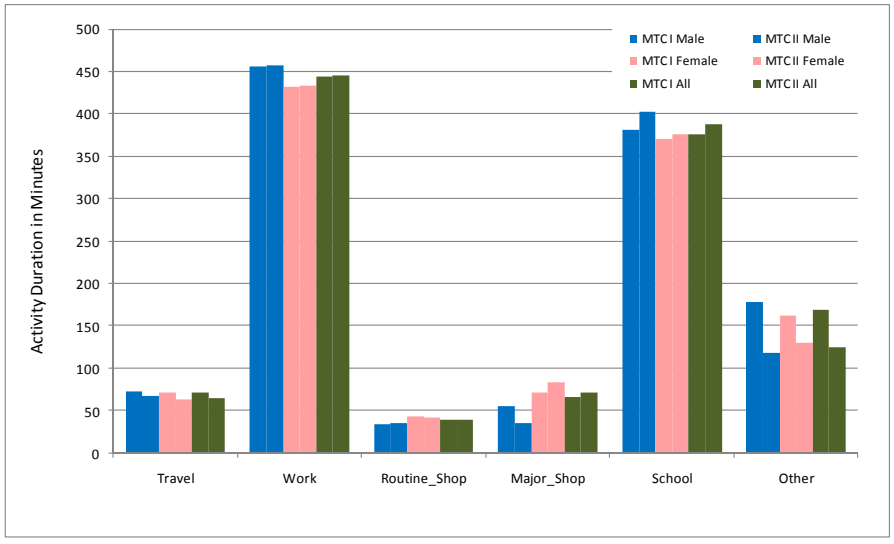


Table 5.13. Mean Activity Durations for Main Activities by Gender and MTC Survey

		Travel	Work	Routine Shopping	Major Shopping	School	Other
MTC I	Male	72.0	456.4	33.0	55.5	380.7	177.7
	Female	70.4	432.1	43.4	71.3	370.4	161.8
	All	71.2	444.4	39.3	65.1	375.6	168.8
MTC II	Male	67.1	457.1	35.5	35.2	402.1	117.4
	Female	63.1	433.6	41.8	83.4	375.2	130.0
	All	65.0	444.6	39.2	71.4	388.2	124.3

Travel times were reduced by six minutes which was consistent with earlier findings. The reduction was slightly higher for females with seven minutes while males had a five-minute drop in their daily travel.

Activity durations for work and routine shopping were equal across the MTC surveys. Males spent 24 minutes more time at work than females and this remained unchanged across the MTC surveys.

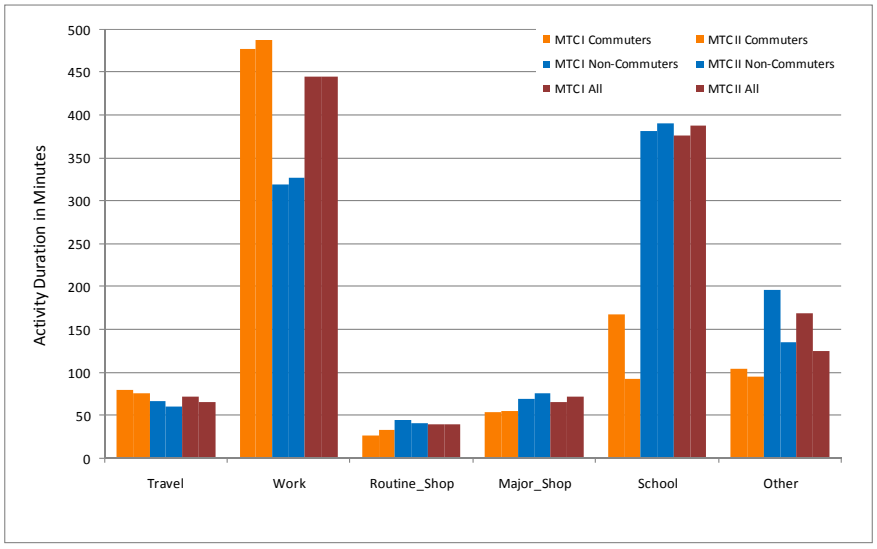
Females tend to do routine shopping for longer periods of time while the gap between gender groups seemed to getting shorter. Time spent for major shopping increased about six minutes, however, the gender gap in this activity had a sizeable growth from about 15 minutes to 48 minutes. Only 85 respondents reported a major shopping activity; therefore, this finding should be considered as preliminary.

School activity had a slight increase across the surveys of about 12 minutes. However, males tend to spend 20 minutes more time in school in 2009. All age groups were included in this category and the differences do not indicate a major change in participating in educational activities by the respondents.

The "Other" category included all non-mandatory activities. There was substantial drop in time spent for other activities of about 45 minutes across MTC surveys. This reduction was more prominent for males with a 60-minute reduction in their other activities, while females had a 30-minute drop. The change in duration of "Other" activities can be a result of economic changes. It is possible that people might be restricting activities such as eating out or other social activities to save money. However, in order to draw more concrete results, potential influences due to socioeconomic and demographic factors should be controlled by the analytical procedure.

Figure 5.33 presents the durations of the same activities for commuters and non-commuters. Commuter was defined as an individual who reported a work activity at his destination location for his/her trip and worked on a full-time basis repeating his/her work trip a number of times each week. The remaining portion of the respondents in the sample was labeled as non-commuters. The data that supported Figure 5.33 are also provided in Table 5.14.

Figure 5.33 Mean Activity Durations for Main Activities by Commuting and MTC Survey



Travel times for commuters were longer than for non-commuters for both MTC Surveys and change in travel times for commuters was smaller than non-commuters (seven vs. four minutes).

Naturally, commuters spent more time at work and for both groups work durations, while having minor deviations, the results can be considered as consistent across the surveys.

Table 5.14. Mean Activity Durations for Main Activities by Commuting and MTC Survey

		Travel	Work	Routine Shopping	Major Shopping	School	Other
MTC I	Non-Commuters	66.6	319.7	44.8	69.2	380.9	196.6
	Commuters	79.8	477.5	26.2	53.3	167.0	104.4
	All	71.2	444.4	39.3	65.1	375.6	168.8
MTC II	Non-Commuters	59.8	326.3	41.0	76.1	390.6	135.1
	Commuters	75.7	487.0	32.8	54.4	92.2	95.5
	All	65.0	444.6	39.2	71.4	388.2	124.3

Routine shopping was attended by non-commuters with longer periods during MTC I however, the gap is closing. Non-commuters shopped 18 minutes longer than commuters in MTC I, while in MTC II the gap was about 8 minutes.

For major shopping while commuters had no change in their duration, non-commuters were spending more time for major shopping.

For non-commuters, which also included school-age children, there was no substantial change in school activities, however, for commuters (full-time workers) the amount of time spent for education dropped 75 minutes. This can be explained by the changes in educational attainment due to graduation of adult respondents in MTC I.

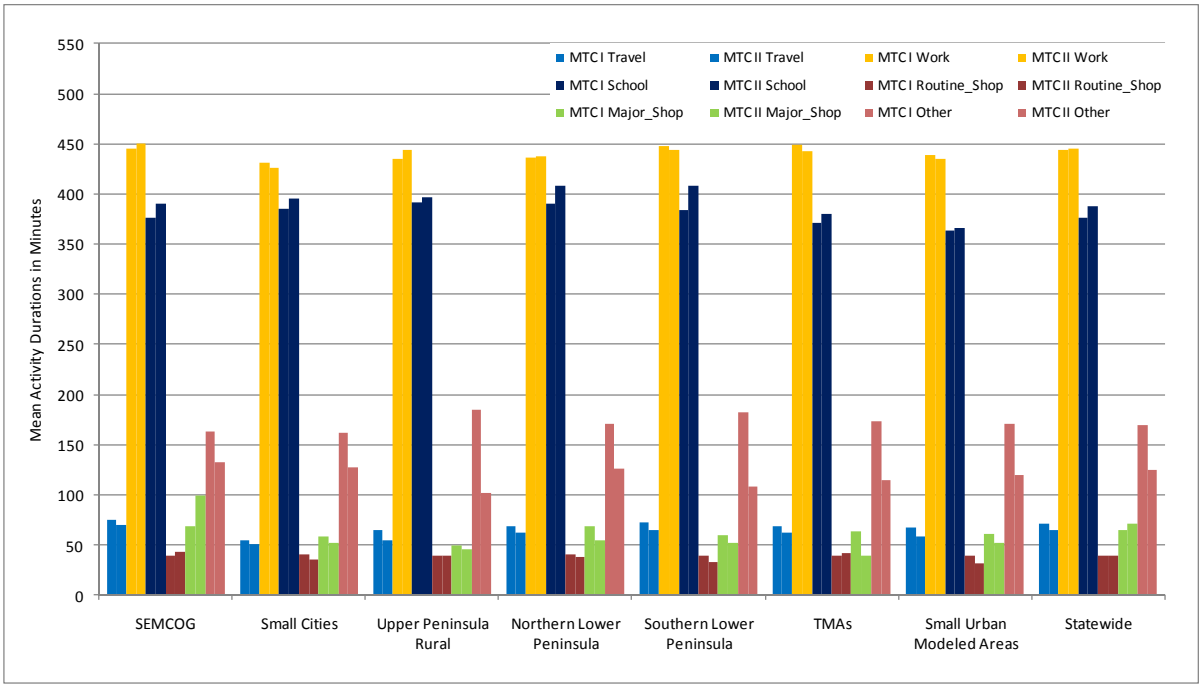
The change in “Other” category was more prominent for non-commuters who cut down their other activities about an hour, while change in commuters was only about nine minutes. This can be partly explained by the adverse economic conditions faced by non-commuters who are likely to be out of labor force due to young age or retirement.

Data summaries for the distribution of activity durations by gender and commuting were also created. The analysis revealed very similar findings as detailed above (Appendix D, Figure D.23).

Figure 5.34 shows the mean activity durations for key daily activities by sample area and MTC survey. The statewide patterns were almost replicated for each of the sampling sample areas expect for the “Major Shopping” category. The reductions in the “Other” activity category in rural and less urbanized areas were higher than urban areas.

Data summaries for the distribution of activity durations by sample area and gender were also created. The analysis revealed very similar findings as detailed above (Appendix D, Figure D.24).

Figure 5.34. Mean Activity Durations for Main Activities by Sample Area and MTC Survey



The analysis of activity durations across MTC surveys yielded the following results:

- MTC II trips were overall six minutes shorter than MTC I.
- For most of the mandatory activity durations, the MTC surveys provided consistent estimates of activity durations.
- Changes in school activities for commuters can be partly explained by changes in educational attainment.
- Non-mandatory activities were reduced substantially, while most reductions came from non-commuters who are more likely to endure economic hardships at a higher level than commuters.
- The changes in activity durations should be carefully re-examined with analytical procedures that can account for influences of socioeconomic and demographic factors.

5i. Trip Chain Patterns

Scheduling a series of activities sequentially and traveling between activities is very common and is referred to as trip or activity-chaining. A series of trips that start from home and has multiple stops on the way back to home is called a tour. Tours are usually categorized by the number of intermediate stops between the start and end location which is home. Tours are of particular interest for advanced travel demand modeling.

Furthermore, changes in the length and the composition of tours can point to important changes in travel behavior over time.

Trip purposes were regrouped into a smaller set of broader activities as follows:

H: Home
W: Work at Home or a workplace
Sch: Day care, K-12, and higher education
Shp: Major and Routine Shopping
O: the rest of the activity categories

For each trip activity, the types for all preceding trips were recorded. As a result, the last trip record for each respondent had the sequence of all activity types that he/she had participated at intermediate destination locations during the day of survey. These data were analyzed to extract the most common tour and activity patterns for each MTC survey.

Table 5.15 features the top nine activity sequences observed for the MTC I and MTC II data. Since the shares of activity sequences dropped sharply after the ninth sequence, the attached summaries focus on the top nine sequences.

Table 5.15 Top Nine Daily Activity Sequence for MTC Surveys

	MTC I		MTC II	
Rank	Activity Sequence	Shares	Activity Sequence	Shares
1	H-W-H	11.1%	H-W-H	11.0%
2	H-Sch-H	8.8%	H-Sch-H	9.7%
3	H-O-H	5.5%	H-O-H	5.7%
4	H-Sch-H-O-H	2.2%	H-Sch-H-O-H	3.5%
5	H-Shp-H	2.0%	H-O-H-O-H	3.1%
6	H-W-H-O-H	1.9%	H-W-H-O-H	2.2%
7	H-O-H-O-H	1.9%	H-Shp-H	2.1%
8	H-W-O-H	1.8%	H-O-O-H	2.0%
9	H-O-O-H	1.5%	H-W-O-H	1.9%
Total		36.6%		41.2%

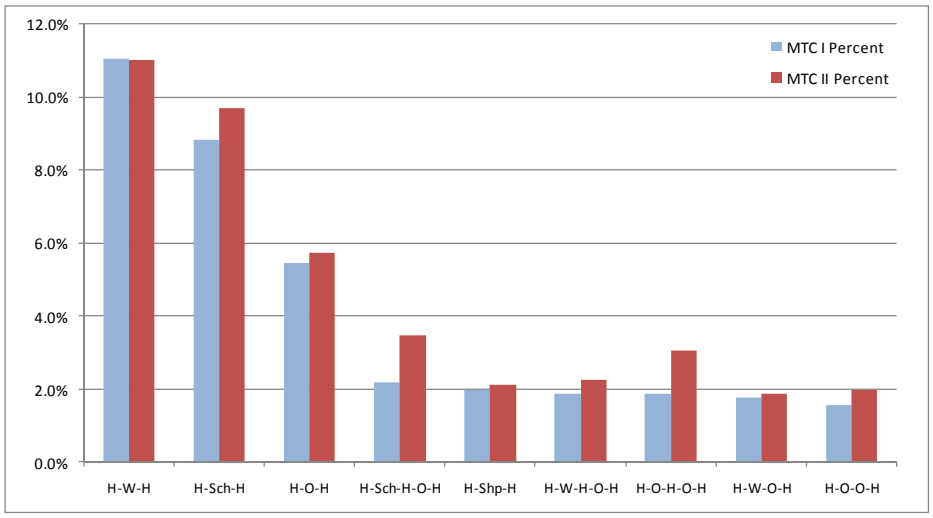
The top four sequences remained the same across surveys and the other sequences in MTC I were also found in MTC II but with a slightly different order. The most common sequence belongs to home-based work tours. Home-based school and home based other tours (excluding shopping) were the other one-stop tours in the top-three tier.

The remainder of the top nine sequences for both surveys consisted of a combination of two one-stop tours, and single tours with two stops. This indicates that the chaining of activities and the tour compositions across the MTC surveys were generally consistent.

Under both surveys, the tours were relatively short and simple consisting of two to four trips with one or two tours per day.

Figure 5.35 shows the distributions of shares of the most common nine daily activity sequences in MTC I along with the shares of the same sequence in MTC II. The MTC II shares for most of the sequences showed a growth mainly due to a greater variety of activity sequences in MTC I. There were more than 5,000 different daily activity sequences in MTC I, while MTC II produced a few sequence types short of 1,000.

Figure 5.35 Relative Sizes of Top Nine Daily Activity Sequences for MTC Surveys



The patterns of tours and stop making in both surveys were quite consistent. The magnitudes of the shares for this nine top activity sequence in MTC II were slightly larger, this implies that MTC I had a slightly higher level of variance in trip chaining.
The preliminary analysis of activity sequences in MTC surveys pointed to the following conclusions:

- Simpler trip patterns made up the most common patterns for both surveys.
- Short and simple activity sequences with two to four trips as part of one or two tours account for nearly 37 and 41 percent of all activity sequences observed in the MTC I and MTC II data, respectively.
- There were no substantial changes in the daily activity compositions between the two surveys of data collection.

5j. Long Distance Trips

Both MTC surveys queried respondents whether they had made a long distance trip (approximately longer than 100 miles) in the past 3 months. Respondents were also asked to report how many times they had repeated this trip in the past three and 12 months.

The queries of long distance data files for MTC surveys yielded the summaries presented in Table 5.16. The total number trips reflect the unweighted size of the long distance databases. Long distance trips were labeled as "Within Michigan" if the state code for the trip was MI and as "Neighboring States" if the state code indicated Indiana, Ohio, or Wisconsin.

Shares of trips with a destination in Michigan, neighboring states and other locations were also presented. Finally, household trip rates for different types of trips were produced to standardize the observed number of trips.

Table 5.16 Summary of Long Distance Trip Counts for MTC Surveys

	MTC I			MTC II		
	Counts	**Percent**	**Trips per Household**	**Counts**	**Percent**	**Trips per Household**
Total Long Distance Trips	32,338		2.18	4,567		2.31
Within Michigan	18,091	55.9%	1.22	2,665	58.4%	1.35
Neighboring States	4,830	14.9%	0.33	717	15.7%	0.36
Other States or International	9,417	29.1%	0.64	1,185	25.9%	0.60
Quarterly Trips	50,724		3.42	6,394		3.24
Annual Trips	108,737		7.34	12,336		6.25
Total Number of Households	14,818			1,975		

Based on the comparisons of shares and household rates the following key conclusions can be drawn:

- The rate of long distance trips per household in the MTC II survey was slightly higher than the MTC I survey.
- The difference in rates for total long-distance trips is not significant.
- Shares for Michigan trips grew slightly at the expense of "Other" and "International" trips.
- Quarterly trip counts per household were consistent, while annual rates decreased about 15 percent.

Section 6: Comparisons of MTC II households between the MTC Surveys

In Brief: *Section 6 features comparisons of households who responded to both MTC surveys. The analyses emphasize changes in socioeconomic status, trip production rates, and trip length distributions.*

The previous section included detailed descriptive analysis of MTC surveys with respect to various dimensions that are known to influence travel behavior. The general conclusions include that household trip rates were reduced due to a reduction in average household size. Moreover, person trip rates were stable. Both surveys had comparable distributions with minor differences in general. For most of the substantial differences, in-depth analysis of trips and household composition, structure, and life cycle was needed to reliably account for the observed changes. In this section, a series of preliminary analysis of MTC II households were presented to:

- Confirm the validity of the MTC II respondents to represent the travel behavior of Michigan residents,
- Document the types of key socioeconomic changes experienced by these households, and
- Test whether such changes in socioeconomics can explain the observed differences in trip rates across MTC surveys.

The MTC II study sampled households who had participated in the MTC I study and had agreed to contribute to later studies. This allows testing a few hypotheses to examine whether MTC II participants differed in their trip making during MTC I, how their socioeconomic characteristics had changed, and whether there is a meaningful difference in the trip production rates and trip length distributions. The results of each set of comparisons are detailed in three subsections. The first day diaries of the MTC I data are analyzed in this section. All trip lengths were derived using model networks for each study area.

6a. MTC II Participants in MTC I Survey

This section concentrates on the question of whether the households that responded to MTC II had a different pattern of trip making compared to the rest of the sample during the MTC I study. This hypothesis is tested by the one-way analysis of variance (ANOVA) procedure. The one-way ANOVA design simply tests whether the variance in the dependent variable (such as trip rates) can be explained by partitioning the sample as reflected by a categorical independent variable (such as MTC II participation). The assessment of the results considers two main aspects of the analysis output: statistical and practical significance. Statistical significance is measured by the p-value for the F-test in ANOVA. The p-value indicates the probability that the variances across the groups are equivalent. For most applications, a p-value smaller than five percent indicates statistically significant differences are present.

Another statistical measure that measures statistical significance is R-Square which gauges the amount of variance that was accounted for by the independent variable. In other words, it reflects the success of the independent variable representing the variation in the dependent variable. The assessment of R-Square is quite subjective and acceptable levels vary by the possibility of controlling for potential influential factors. For example most engineering studies require an R-Square value of 0.90, while for social science studies values around 0.15 even can be considered as acceptable.

Furthermore, analyses of large sample sizes (usually close to or exceeding 1,000) tend to yield statistically significant results for small differences with no practical value. Therefore, analysts supplement statistical results with professional judgment within the context of the parameters under study.

Both statistical and practical dimensions were considered in the evaluation of the statistical results in this section.

MTC I data were divided into two groups based on their MTC II participation and the trip making and average trip lengths of the two groups were contrasted. There were 1,973 MTC I households which were interviewed during the MTC II study and 12,845 households that were interviewed during the MTC I study only. Table 6.1 shows the summary of the findings of the ANOVA procedure which evaluates differences in household trip productions.

Table 6.1 Summary of Comparisons of Trip Rates in MTC I by MTC II Participation

Survey Participation	N	Mean	Std Dev
MTC I Only	12,845	9.12	7.51
Both Surveys	1,973	9.49	7.43
All	14,818	9.17	7.50

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	R-Square
Model	1	58,350	58349.7	4.05	0.044	0.00027
Error	14816	213,203,708	14390.1			
Corrected Total	14817	213,262,058				

Homogeneity of variance across the groups is a key assumption in evaluating differences using analysis of variance. The Levene test is used for evaluating this assumption. The p-value from Levene's test (0.88) confirmed that the variance across the two groups was homogenous and therefore no modification to the existing analysis was needed.

The average trip rate for the "Both Surveys" group was only 0.37 trips higher than the "MTC I Only" households. While the analysis of variance of the weighted data provides a statistically significant F-value of 4.05 with a p-value less than five percent, the test is marginally acceptable with a p-value of 4.4 percent. Moreover, the R-Square, which is a measure of variance accounted for by the ANOVA model is at a negligible level. Based on these results, the observed difference in trip production rate of 0.37 trips/household across the "MTC I Only" and the "Both Surveys" groups can be considered insignificant. Therefore, it can be concluded that respondents who participated in MTC II survey are not likely to cause any bias due to their intensity of trip making.

Table 6.2 features the summary of the ANOVA procedure evaluating the differences in average trip lengths at the household level.

Table 6.2 Summary of Results for Comparisons of Average Trip Lengths in MTC I

Survey Participation	N	Mean	Std Dev
MTC I Only	10,975	12.18	26.78
Both Surveys	1,783	12.88	34.10
All	12,758	12.27	26.04

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	R-Square
Model	1	193,391	193391	0.97	0.325	0.00008
Error	12,756	2,550,440,663	199940			
Corrected Total	12,757	2,550,634,054				

The Levene test was also insignificant for average trip lengths suggesting homogenous variances. The average trip length for the "Both Surveys" group was only 0.7 miles longer than for the "MTC I Only" group. Given the variation in the data, this difference was statistically insignificant as reflected in the p-value of 0.325.

The trip data were further broken down into time of day periods as defined in Section 5.g and the relative sizes of trips in each time period were computed. The relative shares for "Both Surveys" and "MTC I Only" groups were compared by conducting a Chi-Square test which evaluates whether the marginal distribution of a parameter (trips) in one dimension (time of day periods) is independent across the levels of another variable (survey participation). The p-value associated with the Chi-Square statistic determines the statistical significance.

Table 6.3 shows the distributions of trips to time of day periods by survey participation. The statistical details are presented in Appendix E, Table E.1 which indicate that there are no significant changes in the diurnal distribution across the two groups.

Table 6.3 Summary of Results for Comparisons of Trips by Time of Day

	TOD	Frequency	Weighted Frequency	Percent
MTC I ONLY	**AM Peak**	21,861	5,826,896	19.4%
	Mid-Day	39,888	10,089,192	33.6%
	PM Peak	30,979	7,960,714	26.5%
	Evening	16,506	4,526,659	15.1%
	Late Night	6,125	1,642,495	5.5%
BOTH SURVEYS	**AM Peak**	3,434	869,803	18.6%
	Mid-Day	6,449	1,579,833	33.8%
	PM Peak	5,028	1,257,706	26.9%
	Evening	2,769	732,238	15.7%
	Late Night	927	231,923	5.0%
TOTAL	**AM Peak**	25,295	6,696,699	19.3%
	Mid-Day	46,337	11,669,025	33.6%
	PM Peak	36,007	9,218,420	26.6%
	Evening	19,275	5,258,897	15.1%
	Late Night	7,052	1,874,419	5.4%
	Total	133,966	34,717,460	100.0%

An additional test was conducted to examine whether MTC II participants had a similar distribution of trips by purpose with the "MTC I Only" group using the broadly defined trip purposes discussed in Section 4.c, page 31. Table 6.4 provides the distribution of trips by purpose and survey participation. The Chi-Square test that compared the distribution of trips by purpose indicated a significant difference between the "Both Surveys" and "MTC I Only" groups, Appendix E, Table E.2.

Table 6.4 Summary of Results for Comparisons of Trips by Purpose

	Trip Purpose	Frequency	Weighted Frequency	Percent
MTC I ONLY	Home Based Other	47,447	12,406,390	41.3%
	Home Based School	10,565	2,884,050	9.6%
	Home Based Work	18,777	4,797,238	16.0%
	Non-Home Based	38,577	9,963,223	33.2%
BOTH SURVEYS	Home Based Other	7,581	1,928,122	41.3%
	Home Based School	1,456	367,096	7.9%
	Home Based Work	3,099	765,251	16.4%
	Non-Home Based	6,461	1,607,113	34.4%
TOTAL	Home Based Other	55,028	14,334,512	41.3%
	Home Based School	12,021	3,251,145	9.4%
	Home Based Work	21,876	5,562,489	16.0%
	Non-Home Based	45,038	11,570,336	33.3%
	Total	133,963	34,718,482	100.0%

Although statistics provided in the table indicated statistical significance, a closer examination of the segment sizes across the two groups suggests that the distribution of trip purposes is very similar. The differences in school (HBSch) and non-home based (NHB) purposes are primarily responsible for the statistically significant result. However, from a practical standpoint, such differences of about 1.5 percentage points can be considered as non-substantial.

Based on the findings of ANOVA and Chi-Square tests to compare MTC II participants ("Both Surveys" group) and "MTC I Only" households, it was concluded that the MTC II sample respondents exhibited equivalent levels of total trip production rates, similar average travel distances, and equivalent distributions of trips by time of day and by trip purpose. Based on the comparisons between key characteristics of MTC II survey participants in MTC I survey respondents, it can be confirmed that the travel data collected from MTC II participants would produce unbiased estimates for key travel characteristics.

6b. Changes in Socioeconomic Characteristics of MTC II Participants across Surveys

This section highlights how some of the key socioeconomic characteristics of MTC II survey participants had changed during the past 4-5 years. This set of comparisons is intended to document these changes and shed some light on how such changes may have influenced their observed travel behavior. These comparisons also provide

guidance for future study designs that are needed to describe how a particular change in one socioeconomic parameter affects the observed changes in travel behavior.

The data analysis in this section was conducted without weights to trace individual households in both surveys. Socioeconomic characteristics of households at each survey are presented in a matrix format where rows and columns indicate the variable of interest in the MTC I and MTC II surveys respectively.

Table 6.5 presents the change in household sample area across the MTC surveys. These patterns indicate that respondents did not change their sample area to an extent that would bias travel behavior comparisons. Only about one percent of the MTC II households moved to a different sample area. Most of the exchange occurred between Small Cities and Upper and Southern Lower Peninsula Rural sample areas.

Table 6.5 Changes in Residential Location at Sample Area Level

				MTC II – REGION				
MTC I - REGION	**SEMCOG**	**Small Cities**	**Upper Peninsula Rural**	**Northern Lower Peninsula**	**Southern Lower Peninsula**	**TMAs**	**Small Urban Model Areas**	**Statewide**
SEMCOG	278	.	.	.	.	.	.	278
Small Cities	.	283	4	.	6	.	.	293
Upper Peninsula Rural	1	4	276	.	.	.	.	281
Northern Lower Peninsula	.	.	.	280	.	.	.	280
Southern Lower Peninsula	.	4	.	.	278	.	.	282
TMAs	.	.	.	.	.	279	.	279
Small Urban Model Areas	.	.	.	.	.	1	279	280
Statewide	279	291	280	280	284	280	279	1973
Percent Change in MTC II	0.36%	2.75%	1.43%	0.00%	2.11%	0.36%	0.00%	1.01%

The next set of comparisons involved household size, number of vehicles, and workers in the household. While the multivariate distribution of these variables was controlled for through the sampling plan and the weighting process, the extent of changes within the same households may require further analysis to account for changes in the household structure.

Table 6.6 features the changes in household size. Transitions in household size that will reflect to some extent the aging of household members and to some extent the changes in household structure are expected. Increases in household size will reflect the formation of families from one-person households and the birth of children. Decreases in household size will reflect the aging of the population and the growing up of children who leave the nest to form their own households. Between the two MTC surveys, 27 percent of the households experienced a change in their size.

About 21 percent of one-person households observed in the second survey came from larger households that had experienced a reduction in household size. Two-person households in MTC II also experienced an overall reduction in size relative to the first survey. Among the two-person households where a change occurred, 85 percent showed a reduction in household size (191 out of 228 households which had a change).

The three-person household category is the smallest, but most dynamic category. More than 47 percent of these households experienced a change in size, while 83 percent saw a reduction in size. Just over 16 percent of the households with four or more people in MTC II were smaller compared to the MTC I wave.

Table 6.6 Changes in the Household Size across MTC Surveys

	MTC II - Household Sizes					
MTC I - Household Sizes	**One-Person**	**Two-Person**	**Three-Person**	**Four-Person or More**	**All**	**Percent MTC I**
One-Person	472	37	9	4	522	26.5%
Two-Person	88	560	27	11	686	34.8%
Three-Person	26	125	139	37	327	16.6%
Four-Person or More	13	66	90	269	438	22.2%
All	599	788	265	321	1973	
Percent Changed in MTC II	21.2%	28.9%	47.5%	16.2%	27.0%	
Percent MTC II	30.4%	39.9%	13.4%	16.3%		

The patterns above and changes in marginal totals indicate that household sizes got smaller. The average household size during the MTC I survey was 2.44 persons/household while in 2009 the average household size for the same households was 2.23 reflecting an overall decrease in household size of 8.5 percent.

Changes in vehicle ownership levels are provided in Table 6.7. Overall, almost one-third of the households in MTC II survey had a change in their vehicle ownership levels between the surveys. The patterns in the marginal totals indicate that vehicle ownership remained stable in the sample; however, the change in each level showed a considerable amount of variation.

Table 6.7 Changes in the Number of Vehicles in the Household across MTC Surveys

	MTC II - Number of Vehicles in the Household					
MTC I - Number of Vehicles in the Household	**Zero-Vehicle**	**One-Vehicle**	**Two-Vehicle**	**Three-Vehicle or More**	**All**	**Percent MTC I**
Zero-Vehicle	73	14	8	1	96	4.9%
One-Vehicle	12	486	94	21	613	31.1%
Two-Vehicle	1	116	503	189	809	41.0%
Three-Vehicle or More	1	30	168	256	455	23.1%
All	87	646	773	467	1973	

Percent Change in MTC II	16.1%	24.8%	34.9%	45.2%	33.2%
Percent MTC II	4.4%	32.7%	39.2%	23.7%	

The relative size of zero-vehicle households in the sample was quite stable and small with less than 5 percent of the sample. About 16 percent of the zero-vehicle households in MTC II used to own at least one vehicle in 2005, while 24 percent of zero-vehicle households in 2005 had gained access to at least one vehicle in 2009.

About 25 percent of the one-vehicle households in MTC II had a change in their vehicle ownership levels since 2005. However, the great majority of this change was a reduction.

A similar pattern was observed for two-vehicle households, of which 35 percent had a change in vehicle ownership which was usually a reduction from the three or more vehicle level of ownership.

For vehicle ownership levels higher than three or more vehicles in MTC II, 45 percent added at least one vehicle to their existing vehicles. The number of workers for both surveys is tabulated in Table 6.8. Overall, more than 38 percent of the households in MTC II experienced a change in the number of workers.

Table 6.8 Changes in the Number of Workers in the Household across MTC Surveys

	MTC II - Number of Workers in the Household					
MTC I - Number of Workers in the Household	**Zero-Worker**	**One-Worker**	**Two-Worker**	**Three-Worker or More**	**All**	**Percent MTC I**
Zero-Worker	426	32	5	.	463	23.5%
One-Worker	221	422	104	6	753	38.2%
Two-Worker	63	165	344	50	622	31.5%
Three-Worker or More	8	38	69	20	135	6.8%
All	718	657	522	76	1973	
Percent Change in MTC II	40.7%	35.8%	34.1%	73.7%	38.6%	
Percent MTC II	36.4%	33.3%	26.5%	3.9%		

The biggest change occurred in zero-worker households. Over forty percent of the zero-worker households in MTC II had at least one worker in 2005. The relative size of the zero-worker household segment grew by nearly 50 percent from 23.5 in 2005 to 36.4 percent of the sample in 2009.

About 36 percent of the one-worker households in MTC II had a change in the number of workers compared to 2005 levels. More than 85 percent of these households experienced a reduction.

For two-worker households in the MTC II survey, the pattern was different. More than 60 percent of the two-worker households that had experienced a change since 2005 had gained at least one worker.

Three-or-more-worker households segment was the smallest segment in both surveys. However, since 2005, 85 percent of the households in this segment moved into a lower level category. Nearly half of this reduction was offset by 56 households gaining at least one worker in the household. As a result the share of this segment was reduced to four percent in 2009.

Finally, changes in auto sufficiency are examined in Table 6.9. Overall, more than one third of the households had experienced a change in their auto sufficiency level. While marginal totals indicated minor deviations from MTC I shares, there was a shift towards the "Surplus" category in the MTC II survey wave.

Table 6.9 Changes in the Household Auto Sufficiency across MTC Surveys

	MTC II - Household Auto Sufficiency					
MTC I - Household Auto Sufficiency	**None**	**Deficit**	**Even**	**Surplus**	**All**	**Percent MTC I**
None	81	4	10	7	102	5.2%
Deficit	3	61	61	31	156	7.9%
Even	12	48	708	265	1033	52.4%
Surplus	1	20	212	449	682	34.6%
All	97	133	991	752	1973	
Percent Changed in MTC II	16.5%	54.1%	28.6%	40.3%	34.2%	
Percent MTC II	4.9%	6.7%	50.2%	38.1%		

The patterns described in this section indicate that the characteristics of the households that participated in both MTC surveys changes as follows:

- The average household size was reduced by about 8.5 percent.
- While one-third of the households had a change in their vehicle ownership level, there was no net gain or loss in the sample.
- The incidence of zero-worker households grew substantially compared to 2005.

Moreover, changes within each type of household were often substantial. In the MTC II survey, households were grouped on the basis of household size, number of vehicles available, and number of workers in the households to develop 106 unique "sampling cells" for data collection purposes. For MTC I, a more disaggregate sampling frame had been used. The MTC I households were regrouped based on the sample cell definitions adopted for MTC II. The tabulation of MTC II respondents by 2005 vs. 2009 sample cell assignments showed that more than 47 percent of the households moved to a different sampling cell between the two MTC surveys.

Based on these changes, it is reasonable to expect that household trip rates may decrease due to the reduction in household size. In addition, the change in workers in the household may have mixed impacts on overall trip rates. Although home based work trips will be reduced, they may be replaced with additional home-based non-work trips and other non-home based activities and trips.

6c. Changes in Total Trip Production Rates and Travel Times

This section focuses on comparisons of household trip rates and average travel times across the MTC surveys for households participating in both studies. One of the key objectives of these comparisons is to evaluate the statistical significance of changes in total trip rates across the MTC surveys and examine the explanatory power of key household level socioeconomic parameters in accounting for these observed differences.

Table 6.10 shows the group means. Prior to conducting the test, a few outliers in the data were excluded from the analysis. Households with trip rates that were higher or lower than approximately three times the standard deviation were identified as outliers and 32 households were excluded from the comparisons. Therefore, the trip rates shown in the tables in this section are slightly different from the rates presented in earlier sections.

Table 6.10 Comparison of Household Trip Rates across MTC Surveys by MTC II Participants

Total Trip Rates	Mean	Std Dev
In MTC I Survey	9.166	6.921
In MTC II Survey	7.824	6.510

The difference in the total trip rates across MTC surveys is about 1.34 trips per household indicating a drop in trip rates during the 2009 MTC II survey. The t-test results, as shown in Appendix E, Table E.3, strongly indicate that this difference is statistically significant. However, this difference needs to be viewed in the context of the differences in socioeconomic characteristics discussed earlier.

The question is whether the observed reduction of 1.34 trips per household in 2009 should be attributed primarily to changes in household characteristics or whether there is a deeper structural change in travel behavior that has been observed during the last four years and is driven by broader economic factors.

To account for the effect of changes in socioeconomic characteristics on travel, the survey trip rates only for those households that remained in the same “sampling cell” both during the 2005 and 2009 MTC surveys were tested. This approach would isolate those households that had the same combinations of number of persons, vehicles, and workers during both surveys and would make the comparison of travel patterns more relevant.

Table 6.11 features the total trip rates for households without a major socioeconomic change by MTC surveys. The results of a paired t-test conducted for these households are presented in Appendix E, Table E.4.

Table 6.11 Comparison of Household Trip Rates across MTC Surveys for Households without Major Socioeconomic Changes

Total Trip Rates	Mean	Std Dev
In MTC I Survey	7.976	6.974
In MTC II Survey	7.472	6.827

These results confirm the hypothesis that the observed changes in the overall trip rates were to a great extent due to changes in socioeconomic characteristics at the household level. The gap between the 2005 and 2009 trip rates for households maintaining the same sample cell was 0.5 trips per household compared to 1.34 trips per household identified earlier for all households. While for some practical purposes a difference of 0.5 trips can be considered as non-substantial, the statistical results imply that this difference is still significant. This finding points to the need for a more detailed study design to account for the remaining difference. Additional socioeconomic variables or different combinations of variables other than those defined sampling cells can be tested to help explain this difference.

While these results above strongly suggest the link between socioeconomic characteristics and trip rates, they do not distinguish which socioeconomic parameter is more influential. To identify this, a set of ANOVAs was performed to test which parameter had more explanatory power in explaining the observed differences.

Households that had experienced a change in their sampling cell were analyzed using the changes in the daily number of trips as the dependent variable. For households that had experienced a change in household size, vehicle ownership, number of workers, or auto-sufficiency, dummy variables were created. These variables indicated whether a household grew in size, acquired an additional vehicle, or had an additional member joining the workforce.

For example, a value of 1 in the HHSIZE+ variable indicates that a household grew in size between the two MTC surveys. Similarly, a value of 1 in the HHSIZE- variable indicates that at least one member of the household had left the household at the time of MTC II survey. During testing, only the set of variables presented in Table 6.12 provided statistically significant results. Interestingly, none of the vehicle ownership indicators provided a significant effect on trip making.

Based on these results detailed in Appendix E, Table E.5, changes in household size was a significant contributor to the observed changes in trip rates. While the reduction in number of workers also had a marginal effect on the observed differences in trip rates, it was even more important when considered together with the reduction in household size.

This means that trip rates were significantly affected among households that experienced a decrease in size together with a reduction in the number of workers.

Alternatively stated, when there is reduction in the household workforce the effect of this change is greater when it is also accompanied by a reduction in the household size.

Table 6.12 Group Means for Household Total Trip Rates

Main Effects HHSIZE +	N	MTC I - MTC II Mean	Std Dev
0	896	2.858	6.207
1	123	-3.325	5.629

Main Effects HHSIZE -	N	MTC I - MTC II Mean	Std Dev
0	626	0.284	6.157
1	393	5.023	5.840

Main Effects HHWRKR -	N	MTC I - MTC II Mean	Std Dev
0	499	1.391	6.686
1	520	2.804	6.163

Interaction HHSIZE -	HHWRKR -	N	MTC I - MTC II Mean	Std Dev
0	**0**	313	-0.240	6.619
0	**1**	313	0.808	5.620
1	**0**	186	4.134	5.863
1	**1**	207	5.821	5.716

Although these impacts were statistically significant, the ANOVA model can explain only about 18 percent of the variation in the difference in trip rates. This indicates that there is still room to explain more of the observed variance in trip making. Even for those households with no change in their sample cells, there is some variance to be explained by other household and/or personal characteristics.

Finally, the paired t-test results for household level average travel times by MTC survey as shown in Appendix E, Table E.6 indicated no significant differences across the two MTC surveys.

The effects of household characteristics on travel behavior are fairly complex and require an in-depth study to systematically gauge the effects of all possible parameters. Our descriptive analysis of MTC surveys in this section highlighted changes in specific types of trips and market segments. Similar analyses can be conducted for these segments with higher levels of detail in their household and personal characteristics.

Moreover, a cohort study can also be designed for which certain household structure and life cycle groups can be treated as cohorts. In general terms, cohort is a group of subjects who have shared a particular experience during a particular time span. In order to define a relevant set of cohorts, more disaggregate level comparisons are needed. Based on these comparisons and through a literature review, a reliable cohort study can be designed to account for impacts of socioeconomic and demographic factors and to isolate the effects of changes in the economic climate on travel behavior.

Section 7: Summary of Findings and Future Recommendations

In Brief: *In this section key comparison findings are summarized and recommendations for further analysis of MTC survey data and future surveying efforts are presented.*

7a. Summary of Findings

The objectives of the comparative analysis of the two datasets include the following:

- Understand the changes in household travel behavior characteristics between the two surveys,
- Examine the changes in household socioeconomic characteristics and their impacts on the observed travel behavior, and
- Identify if the surveys provide evidence for the observed reduction in travel as reflected in changes in traffic volumes in the recent years.

Sampling and Weighting

The MTC I and MTC II surveys which were conducted five years apart had important differences in scale. MTC II sampled almost one-eighth the households who responded to MTC I. Moreover, MTC I was a two-day survey, while MTC II collected trip records for a single day. For comparison purposes, the first day of the MTC I survey was used.

The sample design for both surveys divided the State of Michigan into seven geographic sample areas. The seven sample areas were the following:

1. SEMCOG (Seven counties of Detroit Area)
2. Small Cities (Population of 5,000-50,000 outside small urban and TMA areas)
3. Upper Peninsula Rural
4. Northern Lower Peninsula Rural
5. Southern Lower Peninsula Rural
6. Transportation Management Areas (TMAs) (Population over 200,000)
7. Small Urban Modeled Areas (Population between 50,000-200,000)

MTC II used a sampling method adapted from the MTC I study. The sampling considered household size, number of vehicles available and number of workers. The MTC II sampling plan was further revised based on a statistical review of MTC I data and additional expert reviews. This revision resulted in a reduction in sample cells from 169 to 106 cells. However, due to low response from some respondent categories, some of the sampling cells were merged for weighting. This yielded 86 distinct cells.

Expansion weights for the MTC I data were revised using the 2000 Census CTPP. A new set of weights was developed for MTC II survey using the 3-year 2006-2008 ACS data in conjunction with the Census Population Estimates and County Level Housing Unit Estimates datasets. However, for rural sections of Michigan estimates of the number of households were found to produce unrealistic estimates of population. Therefore, for MTC II, population was used as the source to develop more reasonable estimates of the number of households which provided target values for the MTC II survey.

The descriptive statistics from MTC II indicated that the sample had lower response from younger population groups. This may lead to lower rates for home-based work and school trips, and potentially higher estimates for home-based other trip rates. In order to remove any bias due to age, the existing households level expansion weights can be further adjusted for age and gender categories for future analysis of the data.

In addition, the MTC II survey collected travel data from respondents who traveled on Fridays. The comparisons based on unweighted data yielded Friday trip rates that were comparable with trip rates from other days of the work week. However, weighted data provided larger differences due to larger weights associated with Friday travel. In general, Friday travel indicated more trips per household with slightly increased share of shared rides and lower levels of home-based work trips. For more accurate estimates, Friday travel can be adjusted for frequency and purpose.

Socioeconomic Comparisons of Survey Data

Household socioeconomic characteristics estimated from MTC II were compared with MTC I and 2009 NHTS data and there were some modest levels of differences. In MTC II there was a slight increase in the shares of small households (one and two-member households) and the share of households with higher levels of vehicle ownership (two or more) compared to MTC I. There was also a slight reduction in three-or-more worker households in MTC II. Finally, the MTC II and 2009 NHTS household profiles with respect to size, number of vehicles and workers were very similar.

The MTC II income distribution showed a higher share for the mid-to-high income group at the expense of lowest and highest income groups when compared to the 2009 NHTS.

Distribution of age groups in MTC II showed higher shares for older age groups, while school age children and young adults were underrepresented when compared to MTC I.

The MTC II survey did not reflect the increase in unemployment that is currently experienced in Michigan. There was an increase of survey respondents reporting that they were not workers at the time of the survey. The percent of respondents working declined by about two percent and there was also an increase in non-workers looking for work.

Overall Trip Making

The household trip rate obtained in the MTC II survey was 8.63 trips per household compared to 9.17 trips per household reported in the MTC I survey. The 2009 NHTS

estimate of 8.46 trips per household, was very close to the MTC II estimate. Both of the MTC surveys and the 2009 NHTS data showed a person trip rate of 3.65 trips/person.

The comparison of trip rates across the MTC surveys indicated that there had been a decrease of about six percent in household trip rates while person trip rates remained stable. The combined effect of these comparisons suggests that the decrease in household travel reflects a change in average household size of about five percent between the two studies.

Home-based work (HBW) and non-home based (NHB) trips declined at a higher rate than other trip purposes. This pattern can be linked to the oversampling of older respondents in the MTC II survey. Moreover, the reduction in household size leads to fewer opportunities to link trips or activities to meet the needs of other members in the household resulting in the reduction of demand for NHB trips.

These results indicate that between the MTC surveys, person-trip making did not change while sizeable changes occurred in household structure. Based on the survey estimates, changes in traffic volumes are more likely to be related to changes in household size and structure rather than changes in trip making or changes in activities.

Trip Making by Segment

The analysis of trip rates by different market segments defined by key socioeconomic parameters such as household size, vehicle ownership, and number of workers revealed that at an aggregate level there were no major differences. However, as the level of segmentation increases, there were a few segments with different trip patterns across the MTC surveys.

There were no major changes in trip rates by purpose at the statewide level between the two MTC surveys. A similar pattern of differences also existed when the travel market was segmented by geography.

The analysis of travel times showed that for urbanized areas the travel time distributions remained stable while for small urban areas there was a shift to very short trips (one to five minutes) from medium range trips (five to 20 minutes). In rural areas there was a similar shift to shorter trips from the medium range and from longer trips (30-45 minutes).

The analysis by mode indicated that mode shares were stable across the two MTC surveys. The analysis of travel times by mode suggests a shift towards shorter trips. The shift to shorter trips was higher for shared ride modes compared to drive alone.

Vehicle Utilization

Vehicle utilization by trip purpose, sample area, and auto sufficiency levels was also analyzed. The auto utilization differences by trip purpose can be explained by the nature of the trip. For example, the home-based work purpose had a higher share of drive alone trips while home-based school trips had a higher share of shared ride. Home-based other and non-home based trips had comparable shares of drive alone and shared

rides. Moreover, segmentation by trip purpose did not show any substantial changes in the auto modal shares across the MTC surveys.

Segmentation by sample area also showed consistent shares.

Households with a surplus of vehicles showed very similar patterns of auto modal share distributions. For households with vehicles equal to or less than the number of workers, there was a shift from shared ride to the drive alone mode during the MTC II survey potentially reflecting the aging of the households in the sample. This could reflect a reduction in the household size or the growing up of younger household members who used to share a ride. Households with vehicles equal to or greater than the number of workers exhibited very similar modal choices across the two surveys. Non-motorized modes and transit were used by a substantial share of zero-vehicle households, while households with an insufficient supply of vehicles relied on non-motorized modes more than transit.

Time of Day and Activity Duration

The distributions of trips by time of day and trip purpose across MTC surveys were stable and had consistent patterns when compared with the 2009 NHTS.

Average time spent for various activities by the respondents of both MTC surveys were computed and contrasted to examine whether there were any changes in activities and activity durations. For most of the mandatory activity durations such as work or education, the MTC surveys provided consistent estimates of activity durations. Non-mandatory activities such as dining-out or recreation were reduced substantially. Most reductions came from non-commuters who are more likely to endure economic hardships at a higher level than commuters.

In order to examine whether trip patterns had changed over time, each person's travel diary was summarized into a sequence of trips by purpose. The frequency analysis of daily trip sequences across MTC surveys showed that simpler trip patterns made up the most common patterns for both surveys. Short and simple activity sequences with two to four trips as part of one or two tours accounted for nearly 37 and 41 percent of all activity sequences observed in the MTC I and MTC II data, respectively. There were no substantial changes in the daily activity compositions between the two surveys.

Long Distance Travel

The final descriptive analysis of MTC survey data was conducted for long-distance trips. The respondents were asked to report whether they have made a trip longer than 100 miles in the last three months and also to report how many such trips were made in the past three and 12 months. The analysis of the data summaries indicated that the rate of long distance trips per household in the MTC II survey was slightly higher than the MTC I survey but the difference in rates for total long-distance trips is not significant. The share of trips made within Michigan grew slightly at the expense of "Other States and International" trips.

Quarterly retrospective trip counts per household were consistent, while the annual rates decreased slightly by about 15 percent.

Detailed Comparisons of Trip Rates and Household Profiles

The set of statistical analysis presented in the final section of this report focused on the disaggregate characteristics of MTC II households. These analyses were conducted at three different levels of detail:

1. Comparison of trip rates. First it is established that respondents in the MTC II survey represent the travel behavior of Michigan residents. To accomplish that, their trip rates during the MTC I survey were compared to the trip rates of the rest of the MTC I sample who were not interviewed during the MTC II survey.
2. Examination of key socioeconomic characteristics. Since the MTC II households have changed over time, the socioeconomics as reported in MTC I and MTC II surveys were compared to document key changes over time.
3. The presence of differences in household-specific trip rates over time was examined. Furthermore, the analysis examined whether differences in trip rates across the surveys can be explained by the changes in socioeconomic characteristics.

Based on the findings of the *first level* statistical tests, it was concluded that the MTC II sample respondents exhibited equivalent levels of total trip production rates, similar average travel distances, and equivalent distributions of trips by time of day and by trip purpose during MTC I survey. This confirmed the validity of the sample and pointed out that the travel data collected from MTC II participants would produce unbiased estimates for key travel characteristics.

The descriptive analysis of the key socioeconomic characteristics in the *second level* of analysis of MTC II participants indicated that the average household size was reduced by about 8.5 percent for the sample (MTC II households only) across the surveys. While one-third of the households had a change in vehicle ownership, there was no net gain or loss in the overall vehicle ownership of the sample. Moreover, the incidence of zero-worker households grew in 2009 substantially compared to 2005 in part reflecting the aging of the sample respondents and potentially reflecting a decrease in employment.

Based on these changes, it is reasonable to conclude that household trip rates may decrease due to the reduction in household size. On the other hand, the reduction of workers in a household may have mixed impacts on overall trip rates. Although home based work trips will be reduced, those trips may be replaced with additional home-based non-work trips and other non-home based trips.

To accomplish the *third level* of the analysis, the change in trip rates was examined. However, household structure had also changed over time. To isolate the effect of socioeconomic characteristics, the sample was divided into two groups.

The first group included households whose composition had changed between 2005 and 2009 because of a change in household size, number of vehicles or number of workers.

The second group included only those households that had remained stable. These households had similar characteristics in 2005 and 2009 and belonged to the same sample cell in both surveys. By focusing on the trip rates of these households, the differences in the household composition over time were controlled.

The analysis indicated that 47 percent of the MTC II households changed their sampling cells across the surveys. These results showed a fairly dynamic sample with respect to socioeconomic characteristics.

The third level of statistical tests revealed the following:

- There were statistically significant differences in the unweighted trip rates for MTC II households between the two surveys. There was a reduction in trip rates from 9.17 trips per household in MTC I to 7.82 trips per household in MTC II.
- For households which remained in the same sampling cell in MTC II, the difference became much smaller at 0.5 trips per household.
- This implies that the households that had a change in socioeconomics and their sampling cell were responsible for most of the observed difference.
- For households that had moved to a different sampling cell, the change in household size was a significant contributor to the observed change in trip rates. The reduction in the number of workers was found to have only a marginal effect.
- Overall, changes in socioeconomics had statistically significant explanatory power to explain the observed changes in trip rates. However, more detailed study designs are needed to isolate the effects of the economic downturn on the trip rates more reliably.

7b. Future Recommendations

The analysis of MTC II survey data along with MTC I survey and 2009 NHTS provided important insights about the change in travel behavior in Michigan. The experience gained throughout the study pointed out several recommendations for further analysis of the data and for future data collection efforts.

The response from zero-vehicle households with at least one worker or with two or more persons was very low in MTC II. For similar studies in the future, MDOT could consider a sampling approach that focuses on two dimensions such as household size and number of vehicles available. Moreover, incentives for participation may also help improve response from zero-vehicle or low-income households as was the case in MTC I.

It is proposed that MTC II weights be revised once a more comprehensive and reliable national data source such as Census 2010 or the five-year ACS becomes available. Current rates for MTC II data rely on the estimated number of households derived from the population estimates.

Based on the observed differences in age and income groups and the underrepresentation of unemployment, the addition of person-level adjustment factors is recommended. This adjustment would help account for these key socioeconomic parameters as they would be reflected in regional and statewide data.

The patterns observed for non-travel among participating households were somewhat higher in MTC II compared to MTC I. Although non-travel is a valid survey response, future studies should monitor and compare incidence of non-travel at the household level against other data sources such as NHTS to minimize any potential biases.

The effects of household characteristics on travel behavior are fairly complex and require an in-depth study to systematically gauge the effects of all possible parameters. Our descriptive analysis of MTC surveys in this report highlighted changes in specific types of trips and market segments. Similar analyses can be conducted for these segments to incorporate additional variables such as household and personal characteristics.

Moreover, a cohort study can also be designed for which certain household structure and life cycle groups can be treated as cohorts. In general terms, a cohort is a group of subjects who have shared a particular experience during a particular time span. In order to define a relevant set of cohorts, more disaggregate level comparisons are needed. Based on these comparisons and through a literature review, a reliable cohort study can be designed to account for impacts of socioeconomic and demographic factors and to isolate the effects of changes in the economic climate on travel behavior.

APPENDIX A

Memorandum

TO: Laurie Wargelin, AbtSRBI

FROM: Cemal Ayvalik, Cambridge Systematics

DATE: 06/21/2010
RE: MDOT - MI Travel Counts II - Findings from QA/QC Checks for the Final Dataset

---

This memo summarizes the findings of a subset of Quality Control procedures that have been implemented by Cambridge Systematics (CS) to assure accuracy and validity of the MTC II survey data. The third round of QA/QC checks identified 771 household trip diaries to be reviewed due to flags from a set of critical checks. Since removal of these dairies would have violated sample area size targets, the project team in corporation with MDOT staff, conducted a thorough review of 429 household trip diaries and revised geocoding and updated arrival and departure times where possible. The effort yielded a dataset of 1,975 households that meets each sample area's size target.

This memo supplements the findings of the third QA/QC checks and summarizes the findings of few critical checks that have not been completed in the previous round. These include an overview of data retrieval and sample target achievement, completeness of travel diaries, a set trip file checks that could not be conclusively completed, assessment of geocoding process, and time-distance checks.

The detailed descriptions of all logical checks for the Household, Person and Trip data and the geocoding of trip ends are provided in the October 4, 2009, memo titled "Quality Control, Geocoding Process, and Data Checking Manual for Implementation."

The 04/14/2010 memo titled "MDOT - MI Travel Counts II - Findings from QA/QC Checks for the Third Interim Dataset " provides detailed summaries of the rest of the checks that were not included in this memo.

This memo is organized in five technical sections and a summary section which is provided next. In each technical section, a brief description of each check and a summary of its findings are presented. When a large number of records did not pass a check, relevant information is provided in the Appendix A, for tables exceeding two or more pages, data are provided spreadsheets. Finally, descriptions of steps taken to conduct time-distance checks were given in Appendix B. This memo is also accompanied by a master spreadsheet named "All_Flags_Final.xls" which contains dummy variables for each check listed in this memo for the entirety of the household, person and trip records.

Summary of Key Findings

A selection of logical checks as detailed in the "Quality Control, Geocoding Process, and Data Checking Manual for Implementation" memo which pointed out critical error through the study were repeated after a thorough review of household diaries were completed.

The Final MTC II data set is composed of three files that are interrelated with common identifiers. The dataset is free of major structural problems. All three files contain consistent number of records for household, person and trip level data.

The dataset contains information from 1,975 households, 4,410 individuals, and 16,419 trips, while 685 trip records indicated no actual trips were made for these records reducing the total to 15,374 actual trips. This corresponds to an average household size of 2.23 persons and an average trip rate of 7.97 trips per household and 3.57 trips per person. The data from entire MTC I sample indicated an average household size of 2.5 persons and a trip rate of 9.1 trips per household which seemed higher than MTC II, while for both datasets trip rate per person was very close to each other; 3.60 vs. 3.57 trips per person.

All of the household diaries had an acceptable level of missing geocoding information as set forth by the quality standards for the study.

A procedure was developed to impute trip records for respondents whose trip records were not complete. The process yielded an addition of 293 trips to the dataset. The time-distance checks using SEMCOG and Michigan Statewide model networks indicated that there is substantial level of agreement between reported and modeled travel times. A small portion of the trips (about 2.2 percent) still remains with significant differences, which can be targeted with future efforts.

None of the checks detailed in this memo produced substantial amount of critical errors to impact the overall data quality. However, due to reasons beyond control of the project team, response from zero-vehicle households and households with lower levels of auto-sufficiency were found to be lower than desired levels.

1. Data Retrieval and Sample Targets

The Third Interim QA/QC Checks identified

The final dataset contains 1,975 households, which exceeds the overall sample target by 15 households. As shown in Table 1.1, number of sampled households by sample area shows that sample area targets were consistently met in each sample area.

Moreover, nearly eleven percent (214 households) of the sampled households did not report a trip for day of the survey. The issue is slightly more prevalent in less urbanized areas. The Final Report on Michigan Travel Counts (MTC I) reported a rate of almost 10 percent for non-traveling households in the sample, while the rate of non-traveling households is found to be consistent with the MTC I data, percent non-traveling households in MTC II is slightly higher.

Table 1.1. Number of Households in the Data by Sample Area

Sample Area	Survey Targets	Sampled Hhs	No-Trip Households	No-Trip Households (%)	HHs w/ Trips
SEMCOG	280	280	22	7.9%	258
TMAs	280	280	25	8.9%	255
Small Urban Model Areas	280	280	31	11.1%	249
Small City	280	291	30	10.3%	261
UP Rural	280	280	34	12.1%	246
NLP Rural	280	280	37	13.2%	243
SLP Rural	280	284	35	12.3%	249
Total	1,960	1,975	214	10.8%	1,761

The sampling plan for the MTC II consisted of 106 separate cells defined by sample area, household size, number of workers and vehicles in the household. The details of the plan can be found in the technical memo dated October 8, 2009 and titled "Revised MDOT Household Survey Scheme". Table 1.2 shows the total number of households retrieved by each target cell. For nearly 45 percent of the cells, targets were reached or exceeded.

More than 26 percent of the cells (28 cells) had minor deviations (a deficit of less than or equal 30 percent of the cell target) from the target values. However, for 29 percent of the cells (31 cells), generally for zero-vehicle households, response was weaker (no response from more than 30 percent of the cell target). For these cells data can be aggregated by combining sample areas into urban and rural areas for further analysis. Further details about sampling target achievement and recommendations can be found in AbtSRBI's Methodology Report.

Furthermore, as discussed in Chapter 3 of this report, the sampling cells were rearranged for weighting purposes. This process yielded a 86-cell sampling scheme. Table 1.3 shows the total number of households retrieved by each revised target cell. Under new scheme,

targets were reached or exceeded for 49 percent of the cells. There were 25 cells (29 percent) with minor deviations and 19 cells (22 percent) with low response.

Table 1.2. Survey Retrieval by Sampling Cells

MTC II Cell	Region	Cell Description	Survey Freq	Survey Targets	Minor Deviaton	Low Response	Target Reached
1	SEMCOG	HH Size=1 Autos=0 Workers=0,1	10	15	0	1	0
2	SEMCOG	HH Size=1 Autos=1+ Workers=0	44	21	0	0	1
3	SEMCOG	HH Size=1 Autos=1+ Workers=1	40	34	0	0	1
4	SEMCOG	HH Size=2 Autos=0 Workers=0,1,2	3	10	0	1	0
5	SEMCOG	HH Size=2 Autos=1 Workers=1,2	8	14	0	1	0
6	SEMCOG	HH Size=2 Autos=1,2+ Workers=0	38	19	0	0	1
7	SEMCOG	HH Size=3 Autos=1,2,3+ Workers=0	6	10	0	1	0
8	SEMCOG	HH Size=2 Autos=2+ Workers=1	33	14	0	0	1
9	SEMCOG	HH Size=2 Autos=2+ Workers=2	22	24	1	0	0
10	SEMCOG	HH Size=3,4+ Autos=0 Workers=0,1,2.3+	0	10	0	1	0
11	SEMCOG	HH Size=3 Autos=1,2,3+ Workers=1	15	16	1	0	0
12	SEMCOG	HH Size=3 Autos=1,2 Workers=2,3	8	15	0	1	0
13	SEMCOG	HH Size=3 Autos=3+ Workers=2,3	15	10	0	0	1
14	SEMCOG	HH Size=4+ Autos=1,2,3+ Workers=0	1	10	0	1	0
15	SEMCOG	HH Size=4+ Autos=1,2 Workers=1	9	18	0	1	0
16	SEMCOG	HH Size=4+ Autos=1,2 Workers=2,3+	14	18	1	0	0
17	SEMCOG	HH Size=4+ Autos=3+ Workers=1,2	11	12	1	0	0
18	SEMCOG	HH Size=4+ Autos=3+ Workers=3+	3	10	0	1	0
SEMCOG SUBTOTAL			280	280	4	9	5
19	TMAs	HH Size=1 Autos=0 Workers=0,1	4	10	0	1	0
20	TMAs	HH Size=1 Autos=1+ Workers=0	40	23	0	0	1
21	TMAs	HH Size=1 Autos=1+ Workers=1	33	34	1	0	0
22	TMAs	HH Size=2,3,4+ Autos=0 Workers=0,1,2,3+	5	10	0	1	0
23	TMAs	HH Size=2 Autos=1 Workers=0,1	22	19	0	0	1
24	TMAs	HH Size=2 Autos=1,2+ Workers=2	43	37	0	0	1
25	TMAs	HH Size=2 Autos=2+ Workers=0	25	14	0	0	1
26	TMAs	HH Size=2 Autos=2+ Workers=1	30	17	0	0	1
27	TMAs	HH Size=3 Autos=1,2,3+ Workers=0,1	13	19	0	1	0
28	TMAs	HH Size=3 Autos=2,3+ Workers=2	9	18	0	1	0
29	TMAs	HH Size=3 (Autos=1 Workers=2,3) and (Autos=2,3+ Workers=3)	3	10	0	1	0
30	TMAs	HH Size=4+ Autos=1,2,3+ Workers=0,1	19	24	1	0	0
31	TMAs	HH Size=4+ Autos=1,2 Workers=2,3+	19	23	1	0	0
32	TMAs	HH Size=4+ Autos=3+ Workers=2	9	10	1	0	0
33	TMAs	HH Size=4+ Autos=3+ Workers=3+	6	12	0	1	0
TMA SUBTOTAL			280	280	4	6	5
34	Small_Urb	HH Size=1 Autos=0 Workers=0,1	11	12	1	0	0
35	Small_Urb	HH Size=1 Autos=1+ Workers=0	52	26	0	0	1
36	Small_Urb	HH Size=1 Autos=1+ Workers=1	31	31	0	0	1
37	Small_Urb	HH Size=2,3,4+ Autos=0 Workers=0,1,2,3+	1	10	0	1	0
38	Small_Urb	HH Size=2 Autos=1 Workers=0,1	24	21	0	0	1
39	Small_Urb	HH Size=2 Autos=1,2+ Workers=2	36	36	0	0	1
40	Small_Urb	HH Size=2 Autos=2+ Workers=0	29	19	0	0	1
41	Small_Urb	HH Size=2 Autos=2+ Workers=1	21	19	0	0	1
42	Small_Urb	HH Size=3 Autos=1,2,3+ Workers=0,1	13	18	1	0	0
43	Small_Urb	HH Size=3 Autos=1,2 Workers=2,3	9	14	0	1	0
44	Small_Urb	HH Size=3 Autos=3+ Workers=2,3	13	12	0	0	1
45	Small_Urb	HH Size=4+ Autos=1,2,3+ Workers=0,1	18	21	1	0	0
46	Small_Urb	HH Size=4+ Autos=1,2 Workers=2+	9	21	0	1	0
47	Small_Urb	HH Size=4+ Autos=3+ Workers=2	9	10	1	0	0
48	Small_Urb	HH Size=4+ Autos=3+ Workers=3+	4	10	0	1	0
SUMA SUBTOTAL			280	280	4	4	7

Table 1.2. (Continued) Survey Retrieval by Sampling Cells

MTC II Cell	Region	Cell Description	Survey Freq	Survey Targets	Minor Deviaton	Low Response	Target Reached
49	Small_City	HH Size=1 Autos=0 Workers=0,1	14	14	0	0	1
50	Small_City	HH Size=1 Autos=1+ Workers=0	44	24	0	0	1
51	Small_City	HH Size=1 Autos=1+ Workers=1	34	29	0	0	1
52	Small_City	HH Size=2,3,4+ Autos=0 Workers=0,1,2,3+	6	10	0	1	0
53	Small_City	HH Size=2 Autos=1 Workers=0,1	17	20	1	0	0
54	Small_City	HH Size=2 Autos=1,2+ Workers=2	36	31	0	0	1
55	Small_City	HH Size=2 Autos=2+ Workers=0	22	18	0	0	1
56	Small_City	HH Size=2 Autos=2+ Workers=1	23	18	0	0	1
57	Small_City	HH Size=3 Autos=1,2,3+ Workers=0,1	15	19	1	0	0
58	Small_City	HH Size=3 Autos=1,2 Workers=2,3	12	18	0	1	0
59	Small_City	HH Size=3 Autos=3+ Workers=2,3	14	12	0	0	1
60	Small_City	HH Size=4+ Autos=1,2,3+ Workers=0,1	16	24	0	1	0
61	Small_City	HH Size=4+ Autos=1,2 Workers=2,3+	25	26	1	0	0
62	Small_City	HH Size=4+ Autos=3+ Workers=2,3+	13	17	1	0	0
Small Cities SUBTOTAL			291	280	4	3	7
63	UP_Rural	HH Size=1 Autos=0 Workers=0,1	12	14	1	0	0
64	UP_Rural	HH Size=1 Autos=1,2,3+ Workers=0	39	32	0	0	1
65	UP_Rural	HH Size=1 Autos=1,2,3+ Workers=1	32	30	0	0	1
66	UP_Rural	HH Size=2,3,4+ Autos=0 Workers=0,1,2+	0	10	0	1	0
67	UP_Rural	HH Size=2 Autos=1 Workers=0,1	23	21	0	0	1
68	UP_Rural	HH Size=2 Autos=1,2,3+ Workers=2	33	30	0	0	1
69	UP_Rural	HH Size=2 Autos=2,3+ Workers=0	26	21	0	0	1
70	UP_Rural	HH Size=2 Autos=2,3+ Workers=1	32	19	0	0	1
71	UP_Rural	HH Size=3 (Autos=1,2,3+ Workers=0) and (Autos 1,3+ Workers=1)	11	12	1	0	0
72	UP_Rural	HH Size=3 Autos=2 Workers=1	6	10	0	1	0
73	UP_Rural	HH Size=3 Autos=1,2 Workers=2,3	8	14	0	1	0
74	UP_Rural	HH Size=3 Autos=3+ Workers=2,3	15	10	0	0	1
75	UP_Rural	HH Size=4+ Autos=1,2,3+ Workers=0,1	13	16	1	0	0
76	UP_Rural	HH Size=4+ Autos=1,2 Workers=2,3+	18	21	1	0	0
77	UP_Rural	HH Size=4+ Autos=3+ Workers=2	8	10	1	0	0
78	UP_Rural	HH Size=4+ Autos=3+ Workers=3+	4	10	0	1	0
UP Rural SUBTOTAL			280	280	5	4	7
79	NLP_Rural	HH Size=1 Autos=0 Workers=0,1	11	10	0	0	1
80	NLP_Rural	HH Size=1 Autos=1+ Workers=0	42	32	0	0	1
81	NLP_Rural	HH Size=1 Autos=1+ Workers=1	30	28	0	0	1
82	NLP_Rural	(HH Size=2 Autos=1 Workers=0,1) and (HH Size=2,3,4+ Autos=0 Workers=0,1,2,3+)	31	28	0	0	1
83	NLP_Rural	HH Size=2 Autos=1,2+ Workers=2	33	30	0	0	1
84	NLP_Rural	HH Size=2 Autos=2+ Workers=0	31	26	0	0	1
85	NLP_Rural	HH Size=2 Autos=2+ Workers=1	23	22	0	0	1
86	NLP_Rural	HH Size=3 Autos=1,2,3+ Workers=0,1	21	18	0	0	1
87	NLP_Rural	HH Size=3 Autos=1,2 Workers=2,3	8	12	0	1	0
88	NLP_Rural	HH Size=3 Autos=3+ Workers=2,3	11	10	0	0	1
89	NLP_Rural	HH Size=4+ Autos=1,2,3+ Workers=0,1	17	24	1	0	0
90	NLP_Rural	HH Size=4+ Autos=1,2 Workers=2,3+	11	24	0	1	0
91	NLP_Rural	HH Size=4+ Autos=3+ Workers=2,3+	11	16	0	1	0
NLPSUBTOTAL			280	280	1	3	9
92	SLP_Rural	HH Size=1 Autos=0 Workers=0,1	8	10	1	0	0
93	SLP_Rural	HH Size=1 Autos=1+ Workers=0	39	24	0	0	1
94	SLP_Rural	HH Size=1 Autos=1+ Workers=1	30	31	1	0	0
95	SLP_Rural	HH Size=2,3,4+ Autos=0 Workers=0,1,2,3+	1	10	0	1	0
96	SLP_Rural	HH Size=2 Autos=1 Workers=0	13	10	0	0	1
97	SLP_Rural	HH Size=2 Autos=1 Workers=1	7	10	1	0	0
98	SLP_Rural	HH Size=2 Autos=1,2+ Workers=2	37	35	0	0	1
99	SLP_Rural	HH Size=2 Autos=2+ Workers=0	27	20	0	0	1
100	SLP_Rural	HH Size=2 Autos=2+ Workers=1	27	20	0	0	1
101	SLP_Rural	HH Size=3 Autos=1,2,3+ Workers=0,1	16	18	1	0	0
102	SLP_Rural	HH Size=3 Autos=1,2 Workers=2,3	11	15	1	0	0
103	SLP_Rural	HH Size=3 Autos=3+ Workers=2,3	13	12	0	0	1
104	SLP_Rural	HH Size=4+ Autos=1,2,3+ Workers=0,1	19	22	1	0	0
105	SLP_Rural	HH Size=4+ Autos=1,2 Workers=2,3+	15	23	0	1	0
106	SLP_Rural	HH Size=4+ Autos=3+ Workers=2,3+	21	20	0	0	1
SLP SUBTOTAL			284	280	6	2	7
TOTAL			1975	1960	28	31	47

Table 1.3. Survey Retrieval by Revised Cell Definitions After Weighting

New Cells	Region	Cell Description	Survey Freq	Survey Targets	Minor Deviaton	Low Response	Target Reached
1	SEMCOG	HH Size=1,2,3,4+ Autos=0 Workers=0,1,2,3+	13	35	0	1	0
2	SEMCOG	HH Size=1 Autos=1+ Workers=0	44	21	0	0	1
3	SEMCOG	HH Size=1 Autos=1+ Workers=1	40	34	0	0	1
4	SEMCOG	HH Size=2 (Autos=1 Workers=1,2) and (Autos=2+ Workers=2)	30	38	1	0	0
5	SEMCOG	HH Size=2 Autos=1,2+ Workers=0	38	19	0	0	1
6	SEMCOG	HH Size=3 Autos=1,2,3+ Workers=0,1	21	26	1	0	0
7	SEMCOG	HH Size=2 Autos=2+ Workers=1	33	14	0	0	1
8	SEMCOG	HH Size=3 Autos=1,2,3+ Workers=2,3+	23	25	1	0	0
9	SEMCOG	HH Size=4+ (Autos=1,2 Workers=2,3+) and (Autos=3+ Workers=3+)	10	28	0	1	0
10	SEMCOG	HH Size=4+ Autos=1,2,3+ Workers=2,3+	17	28	0	1	0
11	SEMCOG	HH Size=4+ Autos=3+ Workers=1,2	11	12	1	0	0
SEMCOG SUBTOTAL			280	280	4	3	4
12	TMA	HH Size=1,2,3,4+ Autos=0 Workers=0,1,2,3+	9	20	0	1	0
13	TMA	HH Size=1 Autos=1+ Workers=0	40	23	0	0	1
14	TMA	HH Size=1 Autos=1+ Workers=1	33	34	1	0	0
15	TMA	HH Size=2 Autos=1 Workers=0,1	22	19	0	0	1
16	TMA	HH Size=2 Autos=1,2+ Workers=2	43	37	0	0	1
17	TMA	HH Size=2 Autos=2+ Workers=0	25	14	0	0	1
18	TMA	HH Size=2 Autos=2+ Workers=1	30	17	0	0	1
19	TMA	HH Size=3 Autos=1,2,3+ Workers=0,1	13	19	0	1	0
20	TMA	HH Size=3 Autos=1,2,3+ Workers=2,3+	12	28	0	1	0
21	TMA	HH Size=4+ Autos=1,2,3+ Workers=0,1	19	24	1	0	0
22	TMA	HH Size=4+ Autos=1,2 Workers=2,3+	19	23	1	0	0
23	TMA	HH Size=4+ Autos=3+ Workers=2,3+	15	22	0	1	0
TMA SUBTOTAL			280	280	3	4	5
24	SUMA	HH Size=1,2,3,4+ Autos=0 Workers=0,1,2,3+	12	22	0	1	0
25	SUMA	HH Size=1 Autos=1+ Workers=0	52	26	0	0	1
26	SUMA	HH Size=1 Autos=1+ Workers=1	31	31	0	0	1
27	SUMA	HH Size=2 Autos=1 Workers=0,1	24	21	0	0	1
28	SUMA	HH Size=2 Autos=1,2+ Workers=2	36	36	0	0	1
29	SUMA	HH Size=2 Autos=2+ Workers=0	29	19	0	0	1
30	SUMA	HH Size=2 Autos=2+ Workers=1	21	19	0	0	1
31	SUMA	HH Size=3 Autos=1,2,3+ Workers=0,1	13	18	1	0	0
32	SUMA	HH Size=3 Autos=1,2 Workers=2,3+	9	14	0	1	0
33	SUMA	HH Size=3 Autos=3+ Workers=2,3+	13	12	0	0	1
34	SUMA	HH Size=4+ Autos=1,2,3+ Workers=0,1	18	21	1	0	0
35	SUMA	HH Size=4+ Autos=1,2 Workers=2+	9	21	0	1	0
36	SUMA	HH Size=4+ Autos=3+ Workers=2,3+	13	20	0	1	0
SUMA SUBTOTAL			280	280	2	4	7
37	Small City	HH Size=1,2,3,4+ Autos=0 Workers=0,1,2,3+	20	24	1	0	0
38	Small City	HH Size=1 Autos=1+ Workers=0	44	24	0	0	1
39	Small City	HH Size=1 Autos=1+ Workers=1	34	29	0	0	1
40	Small City	HH Size=2 Autos=1 Workers=0,1	17	20	1	0	0
41	Small City	HH Size=2 Autos=1,2+ Workers=2	36	31	0	0	1
42	Small City	HH Size=2 Autos=2+ Workers=0	22	18	0	0	1
43	Small City	HH Size=2 Autos=2+ Workers=1	23	18	0	0	1
44	Small City	HH Size=3 Autos=1,2,3+ Workers=0,1	15	19	1	0	0
45	Small City	HH Size=3 Autos=1,2 Workers=2,3+	12	18	0	1	0
46	Small City	HH Size=3 Autos=3+ Workers=2,3+	14	12	0	0	1
47	Small City	HH Size=4+ Autos=1,2,3+ Workers=0,1	16	24	0	1	0
48	Small City	HH Size=4+ Autos=1,2 Workers=2,3+	25	26	1	0	0
49	Small City	HH Size=4+ Autos=3+ Workers=2,3+	13	17	1	0	0
Small Cities SUBTOTAL			291	280	5	2	6

Table 1.3. (Continued) Survey Retrieval by Revised Cell Definitions After Weighting

New Cells	Region	Cell Description	Survey Freq	Survey Targets	Minor Deviaton	Low Response	Target Reached
50	UP Rural	HH Size=1,2,3,4+ Autos=0 Workers=0,1,2,3+	12	24	0	1	0
51	UP Rural	HH Size=1 Autos=1,2,3+ Workers=0	39	32	0	0	1
52	UP Rural	HH Size=1 Autos=1,2,3+ Workers=1	32	30	0	0	1
53	UP Rural	HH Size=2 Autos=1 Workers=0,1	23	21	0	0	1
54	UP Rural	HH Size=2 Autos=1,2,3+ Workers=2	33	30	0	0	1
55	UP Rural	HH Size=2 Autos=2,3+ Workers=0	26	21	0	0	1
56	UP Rural	HH Size=2 Autos=2,3+ Workers=1	32	19	0	0	1
57	UP Rural	HH Size=3 Autos=1,2,3+ Workers=0,1	17	22	1	0	0
58	UP Rural	HH Size=3 Autos=1,2,3+ Workers=2,3+	23	24	1	0	0
59	UP Rural	HH Size=4+ Autos=1,2,3+ Workers=0,1	13	16	1	0	0
60	UP Rural	HH Size=4+ Autos=1,2 Workers=2,3+	18	21	1	0	0
61	UP Rural	HH Size=4+ Autos=3+ Workers=2,3+	12	20	0	1	0
UP Rural SUBTOTAL			280	280	4	2	6
62	NLP Rural	HH Size=1 Autos=0 Workers=0,1	11	10	0	0	1
63	NLP Rural	HH Size=1 Autos=1+ Workers=0	42	32	0	0	1
64	NLP Rural	HH Size=1 Autos=1+ Workers=1	30	28	0	0	1
65	NLP Rural	(HH Size=2 Autos=1 Workers=0,1) and (HH Size=2,3,4+ Autos=0 Workers=0,1,2,3+)	31	28	0	0	1
66	NLP Rural	HH Size=2 Autos=1,2+ Workers=2	33	30	0	0	1
67	NLP Rural	HH Size=2 Autos=2+ Workers=0	31	26	0	0	1
68	NLP Rural	HH Size=2 Autos=2+ Workers=1	23	22	0	0	1
69	NLP Rural	HH Size=3 Autos=1,2,3+ Workers=0,1	21	18	0	0	1
70	NLP Rural	HH Size=3 Autos=1,2,3+ Workers=2,3+	19	22	1	0	0
71	NLP Rural	HH Size=4+ Autos=1,2,3+ Workers=0,1	17	24	1	0	0
72	NLP Rural	HH Size=4+ Autos=1,2 Workers=2,3+	11	24	0	1	0
73	NLP Rural	HH Size=4+ Autos=3+ Workers=2,3+	11	16	0	1	0
NLP SUBTOTAL			280	280	2	2	8
74	SLP Rural	HH Size=1,2,3,4+ Autos=0 Workers=0,1,2,3+	9	20	0	1	0
75	SLP Rural	HH Size=1 Autos=1+ Workers=0	39	24	0	0	1
76	SLP Rural	HH Size=1 Autos=1+ Workers=1	30	31	1	0	0
77	SLP Rural	HH Size=2 Autos=1 Workers=0	13	10	0	0	1
78	SLP Rural	HH Size=2 (Autos=1 Workers=1) and (Autos=1,2+ Workers=2)	44	45	1	0	0
79	SLP Rural	HH Size=2 Autos=2+ Workers=0	27	20	0	0	1
80	SLP Rural	HH Size=2 Autos=2+ Workers=1	27	20	0	0	1
81	SLP Rural	HH Size=3 Autos=1,2,3+ Workers=0,1	16	18	1	0	0
82	SLP Rural	HH Size=3 Autos=1,2 Workers=2,3	11	15	1	0	0
83	SLP Rural	HH Size=3 Autos=3+ Workers=2,3	13	12	0	0	1
84	SLP Rural	HH Size=4+ Autos=1,2,3+ Workers=0,1	19	22	1	0	0
85	SLP Rural	HH Size=4+ Autos=1,2 Workers=2,3+	15	23	0	1	0
86	SLP Rural	HH Size=4+ Autos=3+ Workers=2,3+	21	20	0	0	1
SLP SUBTOTAL			284	280	5	2	6
TOTAL			1975	1960	25	19	42

The Final MTC II data set is composed of three files that are interrelated with common identifiers. The dataset contains information from 1,975 households, 4,410 individuals, and 16,419 trips, while 685 trip records indicated no actual trips were made for these records reducing the total to 15,374 actual trips. This corresponds to an average household size of 2.23 persons and an average trip rate of 7.97 trips per household and 3.57 trips per person. The data from entire MTC I sample indicated an average household size of 2.5 persons and a trip rate of 9.1 trips per household which seemed higher than MTC II, while for both datasets trip rate per person was very close to each other; 3.60 vs. 3.57 trips per person.

2. Critical Checks on the Trip File

Before conducting the full set of all checks, a set of few critical checks was performed on the trip file which were known from the previous surveys to produce flags pointing to critical errors or missing information. These included missing geocodes, repeated origins or destinations for subsequent trips from the same person, missing trip records for persons making more than nine trips a day and substantial differences between travel times reported by the respondents and travel times derived from model skims. The results of time-distance checks are discussed in a separate section in this memo.

A trip producing household which had more than 25 percent of its total trips with a missing geocode was flagged. There is only one household found in the data with this flag. This household (Qno=109431) is 2-person and produced six trips between five locations. One of the locations had missing geocodes therefore yielding a rate of 33 percent ungeocoded trips. When locations are considered the ungeocoded location rate is 20 percent. Based on these findings, it can be concluded that data is free of geocoding flags. This record was kept in the data and the missing geocode flag was removed.

The second critical check that was considered in the project was the observation of repeated origin location information for subsequent trips from the same person record. There are 38 trips in the trip file (from 32 households) that appears to have started from the same location. The size of this unexpected observation dropped substantially from 169 trips due to rejection of diaries during the review process. However, these diaries need to be reviewed or may be rejected for further applications.

The third critical check involves the missing trip records for respondents making more than nine trips at the day of the survey. The data compilation process for the trip file seems to truncate trips after the ninth trip. This resulted in loss of data. The final dataset contained 149 trip records for a ninth trip which was not the final trip in the diary. A SAS code was developed which searched whether the ninth trip from these diaries was accompanied by another member of the household. The search process found 37 such trips. The trip records for these respondents were imputed from the accompanying member in their households. There are 69 imputed trips in the data for which some of the fields, such as trip purpose, have missing values.

The imputation process also revealed that as an average, there were about 2 additional trips (69/37 = 1.86 trips) for respondents that had more than nine trips per day. In order to adjust the total number trips in the data, two additional trip records were created and appended to the data for respondents who had more than nine trips but had not been accompanied by a household member. These artificial trip records have missing values for most of the data fields and their use is limited to adjust overall trip counts and rates. A new categorical

variable field called "Imputed" was introduced for which the value of "0" indicates that the record is original, "1" for records imputed from another member of the household, and the value of "2" identifies the artificial trip records.

3. Person File Checks

There are 16 different logical checks for the person file. Only one check was identified to be repeated after the data revision. The other checks have either did not produce any flag or the flags were not critical to impact the overall quality of the data.

3.1. Zip Codes For Work Addresses Should be Consistent with the Sample Area (Check 5.12).

The "Zip Code" and "the State" fields from the workplace addresses were queried. The query resulted in 31 person records that showed out of state workplace locations. These records are listed in Table 3.1.

Table 3.1. Out of State Workplaces

No	Per_ID	W1 State	W1 State Corr.	W1 Zip	W1 Zip Corr.	W2 State	W2 Zip	Work Trip Distance
1	1003691000	MI		49877	49887	WI	54143	25.6
2	1003693000	WI		54143		MI	49858	4.1
3	1013502000	IN	MI	48001				No Work Trip
4	1020021000	IN		46703				No Skim Found
5	1026953000	AK	MI	49707				1.3
6	1030821000	MO	MI	49098				16.3
7	1036112000	OH		43560				9.0
8	1041761000	WI		54143				23.2
9	1045451000	IN		46514				28.8
10	1062181000	TN		38401				616.1
11	1063973000	OH		43623				18.8
12	1064841000	WI		54121				No Skim Found
13	1076591000	ZZ		99998				15.5
14	1077882000	AK	MI	49423				4.4
15	1080511000	OH		43610				5.3
16	1084913000	IN		46545				7.9
17	1089652000	WI		54143				1.6
18	1090572000	WI		54157				6.4
19	1091041000	OH		43537				29.0
20	1099291000	AK	MI	49601				2.5
21	1102572000	WI		54143				3.6
22	1112251000	WI		54151				4.9
23	1119631000	WI		54151				0.1
24	1125462000	MA		2142				No Work Trip
25	1126301000	IN		46761				22.8
26	1126481000	WI		54512				0.1
27	1131302000	WI		54143				3.8
28	1136022000	OH		43624				44.5
29	1137891000	WI		54143				5.2
30	1137892000	WI		54143				5.9
31	1139991000	IN		46628				25.7

Further review of these records indicated that for five of the records State field were miscoded, while zip codes belonged to Michigan. In addition one of these records did not report a work trip (Per_ID=1125462000). Since most of these locations are in the neighboring states, the distance traveled to workplaces outside the state was found reasonable except for one person with Per_ID =1062181000 who reported two trips between Tennessee and Michigan with more than 600 miles. These trips should be excluded.

4. Trip File Checks

The trip file checks included 29 different logical checks as described in the Task 4.4 of the "Quality Control, Geocoding Process, and Data Checking Manual for Implementation" Memorandum. In the third Interim Data QA/QC Report 10 trip file checks were identified to be repeated with the final dataset.

As mentioned in Section 1, there were 214 households without an actual trip. These 685 trip records are listed in the attached spreadsheet. There were 47 one-way trips in the trip file. While potentially all of these can be justified, these trips were listed in the attached spreadsheet.

4.1 If the Trip Number is Greater than Zero, Check Time of Departure and Type of Transportation Used (Check 6.3).

For six trip records departure time was missing. These trip records listed in Table 4.1. For all trip records, type of transportation fields had valid values. Table 4.2 and 4.3 show the number of trips by time of day and travel mode used, respectively. The "Unknown" values for travel mode and the remaining 224 "Unknown" labels for the departure time variables are result of the imputation process as described in Section 2.

Table 4.1. Trips with Missing Departure Times

No	Trip_ID
1	1026812010
2	1043281010
3	1060571010
4	1101562010
5	1111272010
6	1114703010

Table 4.2. Trips by Time of Day Periods

TOD Periods	Frequency	Percent	Cum. Frequency	Cum. Percent
Early AM	206	1.31	3,195	20.31
AM Peak	2,989	19	2,989	19
Mid-Day	5,679	36.09	11,287	71.74
PM Peak	4,178	26.55	15,465	98.29
Evening	2,018	12.83	5,213	33.13
Late Night	395	2.51	5,608	35.64
Past Midnight	39	0.25	15,504	98.54
Unknown	230	1.46	15,734	100

Table 4.3. Trips by Travel Mode

Travel Modes	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Bike/Scooter	82	0.52	82	0.52
Bus	60	0.38	142	0.90
Car	14,001	88.99	14,143	89.89
Motorcycle	46	0.29	14,189	90.18
Other	63	0.39	14,251	90.57
Plane	2	0.01	14,253	90.59
School Bus	614	3.90	14,867	94.49
Walk	642	4.08	15,509	98.57
Unknown	224	1.43	15,734	100.00

4.2. Check that Respondent is not Listed as a Household Member in the Vehicle (Check 6.7).

This check was also expanded slightly to query number of household members and the number of occupants in a vehicle and to conduct some comparisons along with the values reported in the household member identifiers as occupants. The key variables for this check are VTNUM: number of other individuals in a vehicle and VHNUM: number of household members in a vehicle. Tables 4.4 and 4.5 show the frequency distribution for each variable.

Table 4.4. Frequency Distribution Number of Additional People in a Vehicle

VTNUM	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	8,241	52.38	8241	52.38
1	3,786	24.06	12,027	76.44
2	1,222	7.77	13,249	84.21
3	428	2.72	13,677	86.93
4	143	0.91	13,820	87.84
5	40	0.25	13,860	88.09
6	63	0.40	13,923	88.49
Unknown	119	0.76	14,042	89.25
Missing	1,692	10.75	15,734	100.00

Table 4.5. Frequency Distribution Number of Additional Household Members in a Vehicle

VHNUM	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	11,064	70.32	11,064	70.32
1	3,243	20.61	14,307	90.93
2	837	5.32	15,144	96.25
3	239	1.52	15,383	97.77
4	84	0.53	15,467	98.30
5	9	0.06	15,476	98.36
6	34	0.22	15,510	98.58
Missing	224	1.42	15,734	100.00

The frequency table for VTNUM shows that that are 1,811 cases with "Unknown" and "Missing" values, however, for all these cases, VHNUM was zero. While this confirms for these cases there was no additional household member traveled, it cannot be concluded that the respondent was traveling alone.

The manifest variables (WHOACC1 – 8) denote the person numbers for household members traveling with the respondent. For none of the cases, the respondent was listed as an additional household member in company. Therefore, the first logical check is satisfied. However, three additional checks were added to confirm;

- whether total number of persons listed in manifest variables is less than or equal to household size
- whether all additional household members in the vehicle are listed in manifest variables, and
- whether VTNUM is not missing or greater than zero when VHNUM is greater than zero.

For none of the records, total number of persons listed in the manifest variables exceeded household size. The second additional check also produced a flag for seven trip records where VHNUM implied no household member in the company, manifest variables listed at least one household member in the vehicle. These trip records are listed in Table 4.6. The third check is satisfied.

Table 4.6. Trips with Inconsistent Manifest and Accompanying Household Member Count

Trip_ID	VHNUM	whoacc_1	whoacc_3	HHMEM
1011735060	0	1	3	2
1017403090	0	2		1
1049762060	0	1		1
1132651020	0	2		1
1132652040	0	1		1
1132652050	0	1		1
1133372080	0	1		1

4.3. Trips Where Origin and Destination Location are the Same (Check 6.12).

There were 64 trip records which had the same location as origin and destination. These cases are listed in the attached spreadsheet. Based on the review of information for these trips, there are only few trips that qualify as a turn-around trip, and seven of these trips were also flagged by a previous check due repetition of origin information for subsequent trips.

While the total size of records with this problem is only about 0.4 percent of all trip records, it may point out a logical gap in the design of CATI codes or a non-systematic coding error. When a respondent reports a trip which occurs between two points which can be identified by the same address, it is possible to observe such records. These trips may take place in a campus or large industrial complex or even between a house and a mailbox if separated by a substantial distance (in rural areas banks of mailboxes on arterials may serve houses that can only be accessed by local roads). While such in-depth analysis of these records has not been conducted, for future efforts, the interview process can be designed to produce

immediate flags and additional questions to clear such patterns. For further applications these trips can be deleted and diaries may be updated.

4.4. When Origin of Trip #1 is not Residence or Work Places, or School for Students Attending Higher Education (Check 6.13).

The query that would conduct this check uses information about the type of origin and activity type at the origin. Flags are created when an origin location is not a place of residence, or cannot offer accommodation, and whether the type of activities at these locations are different from home related, traveling, or visiting someone else. Workers and students in higher education were allowed to be present at work or school locations as the base for their first trip of the day. The query pointed to 35 cases with unexpected base locations and/or activity types at base. There were 12 trip records which no trip was made, however, the activity type was not consistent with origin type. Moreover, only two records were found to have an unexpected base location. These two trip records are listed in the attached spreadsheet. For trip records indicating a travel, and a home or a medical institution as a base flags were cleared.

4.5. When Destination of the Last Trip is not Residence or Work Place, or School for Students Attending Higher Education (Check 6.14).

Similar to the previous check, this check queried whether the final destination is able to offer accommodation or activity type was consistent with home, lodging, work or school for workers, and students, respectively. Outdoor recreation was also allowed as a reasonable final destination for the day. There were 69 trip records with an unexpected final destination or activity type at the final destination. Similar to the previous check, for trip records of those final stop locations that can offer accommodation were cleared of flags. There are 11 trip records with unexpected end locations. These trip records are listed in the attached spreadsheet.

4.6. Check Reasonableness of Walk and Transit Trips, e.g., Walk Trips More Than 45 Minutes for Non-Recreational Purposes (Check 6.15).

There were nine trip records which had an unexpectedly long travel times. These trips are listed in Table 4.7. While walk trips may occasionally exceed typical walking distances trips that reported more than 60 minutes can be considered for a closer review, or capping.

Table 4.7 Unexpectedly Long Walk Trips

No	Trip_ID	Travel Time	Mode
1	1017401010	60	Walk
2	1099295030	440	Walk
3	1101092050	90	Walk
4	1113541030	60	Walk
5	1129253010	50	Walk
6	1132461010	55	Walk
7	1133814020	129	Walk
8	1143064010	150	Walk
9	1143065010	60	Walk

Trip records that reported regular travel times of more than or equal to 75 minutes by school bus, shuttle or taxi, dial-a-ride, public bus, or train are selected as unexpectedly long transit trips. There were 27 trip records that met this criterion. Table 4.8 shows these records. The majority of these records reported "School Bus" as a travel mode. While the trips made by a school bus may not follow a shortest route between a person's origin and destination, it is also unlikely to observe very long routine trips. For few of the trips flagged by this check trip purpose was recorded as recreational. However, majority of the flags seem to pointing to regular daily trips.

Table 4.8. Unexpectedly Long Transit Trips

No	Trip_ID	Travel Time	Mode	Activity at the Destination
1	1001893010	93	Dial a Ride	Social
2	1024273020	87	School Bus	Home
3	1028283010	80	School Bus	School
4	1028284010	80	School Bus	School
5	1036455010	92	Dial a Ride	School
6	1036455020	95	Dial a Ride	Home
7	1044222020	95	School Bus	School
8	1047001010	80	Public Bus	Recreation
9	1051771010	85	School Bus	Work
10	1051771040	80	School Bus	Home
11	1051775010	85	School Bus	School
12	1051775020	90	School Bus	Home
13	1063003010	81	School Bus	School
14	1102123030	144	School Bus	School
15	1102123040	155	School Bus	Home
16	1118183020	75	School Bus	Home
17	1118184020	75	School Bus	Home
18	1129454020	135	School Bus	Home
19	1133373030	205	School Bus	Recreation
20	1133373040	120	School Bus	Pick-Up/Drop-Off Passenger
21	1137433010	105	School Bus	School
22	1137434010	105	School Bus	School
23	1141002020	120	School Bus	Recreation
24	1141002030	90	School Bus	Recreation
25	1141003020	120	School Bus	Recreation
26	1141003030	90	School Bus	Recreation
27	1145683010	90	School Bus	School

4.7. Flag Walk, Bicycle, and Taxi/Shuttle Modes Coded As Primary Travel Modes For Long Distance (Longer Than 100 Miles) Trips (Check 6.16).

The query of travel distances and transportation modes used indicated that none of the trip records had an unexpectedly long trip made by non-motorized modes or taxi/shuttle modes. The condition is satisfied.

4.8. Check For Unusual Activity Durations; Less than an Hour of Work or School Activities or Discretionary Activities More than Two or Three Hours Should be Flagged (Check 6.17).

This check identifies work and school activities that are shorter than 60 minutes as unexpectedly short. Furthermore, it creates flags for discretionary activities such as eating out, personal business, everyday shopping, or pick-up/drop-off someone, that are longer than 180 minutes. The queries resulted in 466 short and 82 long activities. These trip records are listed in the attached spreadsheet. The review procedure found some errors in the reported departure and arrival times, however, these records may have not been exposed to review process. It would be beneficial to review arrival and departure times and reported activities for further applications.

4.9. Check Percentage of Workers Who did not Make a Work Trip, and Non-Workers Who did (Check 6.27).

This check involves a query that flags person records of paid workers if they have not made a work trip, or person records of non-workers who reported a work trip during the date of survey. A work trip is defined by a trip which has a work activity at the origin or destination.
The query considers whether a trip has been made to a location where a work purpose had been reported and tabulates employment status of respondents. The trip file included records from 1,835 paid workers, 113 volunteers and 1,765 non-workers (including students and a children younger than 16).

The query indicated that there were 316 person records of workers (17.2 percent) who did not travel for work and 43 person records of non-workers (2.3 percent) who traveled for work. When workers were segmented by work schedule type nearly 11 percent (146 of 1,329) of full-time workers did not travel for work, and approximately one-third (170 of 506) of the part-time workers did not travel for work at the day of the survey.

These person records are listed in the attached spreadsheet. Most of the flagged records may not contain errors, since some of the flags may account for absenteeism in the workplace or workers not scheduled to work on the travel day. Moreover, similar gaps are usually observed between Census Journey to Work data and other data sources that estimate sample area employment.

4.10. Check Number and Percentage of Trips Made by Drive Alone Mode from Zero-Vehicle Households (Check 6.28).

Two of the zero-vehicle households reported seven trips with a drive alone mode. Table 4.9 lists these records. While it is not necessarily an error, since a person may have borrowed a vehicle from somebody outside the household, driven a company car if provided, or rented a car to run errands.

Table 4.9. Drove Alone Trips from Zero-vehicle households

Trip ID	Others in the Vehicle	Household Vehicle Identifier	Mode	Number of Vehicles in the Household
1111651010	0	No	Car, Van, Truck	0
1111651020	0	No	Car, Van, Truck	0
1145611010	0	No	Car, Van, Truck	0
1145611020	0	No	Car, Van, Truck	0
1145611030	0	No	Car, Van, Truck	0
1145611040	0	No	Car, Van, Truck	0
1145611050	0	No	Car, Van, Truck	0

5. Geocoding, Travel Time and Distance Checks

5.1. Basic Geocoding Checks

CS conducted three different basic checks on the geocoding information in the trip file. These involved the level of accuracy in the reporting of coordinates, sign consistency, and range. All longitude and latitude information was recorded with at least six decimal digits, all longitudes were negative and 142 trips had a trip end outside the predefined coordinate range. CS created a slightly more detailed set of broad ranges that covered the entire State of Michigan and its vicinity. These trip records with a trip end outside the sample area are labeled in the attached spreadsheet.

5.2. Missing Geocodes

In order to evaluate the impact of missing geocodes at the household level, a query is designed to check whether any household location has a missing geocode. The result of this query indicated that all households had a valid geocode. Furthermore, number of trips with missing geocoding information is counted per each household. Every household which had 25 percent or more of its trips having geocoding problems is flagged. The query of these flags indicated that was only one household with a flag for geocoding problems. As discussed in Section 1, further review of the ungeocoded locations in the diary indicated only 20 percent of the locations had a missing geocode and the flag was cleared.

Trip records that have a missing value in any of the origin or destination coordinates are flagged. There were 366 trip records that had missing geocoding information. This corresponds to an incomplete geocoding rate of 2.4 percent when 15,510 trip records with an actual trip are considered.

The trip file included 4,266 actual work trips (where work activity was defined at origin or destination) and 2.6 percent (109 trips) of those had a missing geocode. Furthermore, the trip file contained 1,709 actual school trips where only 1.5 percent (26 trips) had a missing geocode.

5.3. Travel Time and Distance

Another means of examining the adequacy of geocoding efforts is to compare reported travel times against travel times obtained from travel demand model networks. For trips with both an origin and a destination within the SEMCOG sample area, the SEMCOG travel demand model network was used. For other trips, the Michigan Statewide travel demand model network was examined.

Trips with missing geocodes, and imputed trips were excluded, however, imputed trip records were merged with model skims based on their original trip identifier. The resultant trip file included 15,077 trips, while 2,041 trips took place within the SEMCOG area and 13,036 trips assigned to Michigan Statewide model.

Geocodes at trip ends are used to assign the nearest node to that location in the model networks, and the shortest paths between the associated nodes were computed by skimming travel times under free flow conditions for each trip. The procedure produces an estimate of travel time and distance. Detailed descriptions of the steps involved in the procedure are repeated in the Appendix A of this memo. For short trips with a network skim smaller than 5 minutes, network travel times are coded as five minutes to allow extra time to access to and egress from the network. Reported travel times and network distances were used to generate an estimate of average speed.

Five separate checks were conducted on 14,515 motorized trips. Reported travel times ranged between 1 and 740 minutes, and travel distances ranged between 0.005 and 616.1 miles. Travel times representing free flow conditions ranged between 0.007 and 564.3 minutes. The range of travel time discrepancy (reported minus network travel time) ranged between -519.3 and +730 minutes. These ranges were fairly large and implied potential errors in geocoding or coding of reported arrival and departure times.

The following sections detail the findings of time and distance checks performed. All records flagged with a time-distance check are featured in the attached spreadsheet.

5.3.1. Travel Time Differences Greater than 60 minutes

When there is a difference greater than 60 minutes between reported travel time and network travel time, the trip record is flagged. There were 137 trips (less than 1.0 percent) which had such a large discrepancy. A total of 125, reported shorter travel times and the remaining 12 reported longer travel times than model travel times. Table 5.1 shows the distribution of absolute magnitude of differences between reported and network travel times.

More than 7,300 (50 percent) of the differences were less than five minutes, and more than 11,000 (76 percent) were less than 10 minutes. This indicates that there is generally a good level of agreement between reported and network travel times. About 12,240 trips (84 percent) reported a slower trip than the model networks suggested. This is expected since free flow conditions are used in computing model travel times, and these exclude access and egress times. However, larger discrepancies in this group possibly pointing to geocoding and/or reporting or coding errors.

Table 5.1. Distribution of Differences between Reported and Network Travel Times

Absolute Value of Travel Time Differences	Faster Reported Trips	Slower Reported Trips	Total
Less than 5 Minutes	2,015	5,288	7,303
5-10 Minutes	170	3,635	3,805
10-15 Minutes	42	1,643	1,685
15-20 Minutes	17	622	639
20-30 Minutes	12	570	582
30-45 Minutes	2	275	277
45-60 Minutes	3	82	85
60 Minutes or More	12	127	139
Total	2,273	12,242	14,515

5.3.2. Long Intracity Trips

Trips that have their origins and destinations within the same city limits were flagged when the reported travel times were greater than 60 minutes. This threshold is 90 minutes for trips that took place in Detroit. There were 47 trips flagged by this condition.

5.3.3. Very Slow Trips

All trips slower than 5 mph were flagged. For trips that were shorter than 2 miles and took less than 30 minutes flags were removed for consistency with check number five. There were 263 trips flagged due to low speeds.

5.3.4. High Speed Trips

Trips that are longer than 30 miles and with average speeds of more than 70 mph were flagged. Trips that were shorter than 30 miles but reported average speeds greater than 45 mph were also flagged. The second criterion was added to identify unusual speeds for shorter distance trips. There were 1,422 trips that were flagged by this check. The majority of the flagged trips (1,382 records) was shorter than 30 miles with speeds higher than 45 mph; there were 40 trips longer than 30 miles with high speeds.

5.3.5. Short and Slow Trips

Trips that were shorter than 2 miles but took more than 30 minutes were flagged. This check resulted in 154 flags due to short trip distances and low speeds.

The first round of travel time and distance checks identified a total of 1,742 trip records out of 14,515 (about 12 percent) that needed further review due discrepancies flagged by the first round of time-distance checks.

In order to test the severity of the observed differences, reported travel times were altered by 10 minutes. Depending on the flag type, reported travel times were either inflated or deflated by 10 minutes and speeds were recalculated to check whether the same flag still existed. Table 5.2 summarizes the number of flags that still remain after this adjustment.

Table 5.2. Number of Flags Created by Time and Distance Checks Before and After 10-minute Travel Time Sensitivity Adjustment

Time and Distance Check Type	Number of Flagged Records	
	First Round	Second Round
1 : Travel Time Differences Greater than 60 minutes	137	104
2: Long Intracity Trips	47	37
3: Very Slow Trips	263	206
4: High Speed Trips	1,422	92
5: Short and Slow Trips	154	71

The fourth check produced substantially smaller number flags after a 10-minute increase in reported travel times. This may imply that most of flags were not pointing to severe discrepancies.

After the adjusted travel time and distance checks, there were 325 trip records (2.24 percent) that need a further examination. All these trip records are also featured in the attached spreadsheet.

Table 5.3 features the frequency distribution of status of trip records after the completion of time-distance checks. Trip records that did not show an actual trip were exempted, while, trips made by non-motorized modes and trips with missing geocodes a time-distance check was not available.

Table 5.3. Summary of Time – Distance Check Results

Time Distance Check Results	Frequency	Percent	Cumulative Frequency	Cumulative Percent
TD Check - Exempt	649	3.95	649	3.95
TD Check - PASS	14,191	86.43	14,840	90.38
TD Check - Not Available	1,255	7.64	16,095	98.02
Large Differences	26	0.16	16,121	98.18
Very Fast Trips	80	0.49	16,201	98.67
Very Slow Trips	98	0.6	16,299	99.27
Multiple Flags	120	0.73	16,419	100

APPENDIX A.A

A. Steps Followed to Conduct Time-Distance Checks

This section concerns the Geographic Information Systems (GIS) methodology used in the validation of geocoding results in the Michigan Department of Transportation (MIDOT) Statewide Household Survey Add-On (MTC II) study.

The process involves two major set of activities;

1-) Assignment of nearest model nodes to trip ends, and

2-) Skimming appropriate model networks to extract skims for the given O-D pair.

A1. Data Used

Table A.1 shows the data sources used during this task.

Table A.1 The Data Sources

Data Type	**File Name / Source**
Household locations and trip data	MTC II Household and Trip Files / AbtSRBI
Michigan statewide network road file in TransCAD format	MI Travel Counts II TTime Network.dbd / MIDOT
Michigan statewide network traffic analysis zones (TAZs) file in TransCAD format	Ver8NATAZ.dbd / MIDOT
SEMCOG network road file in TransCAD format	HwyFG05ForMDOT.dbd / MIDOT
SEMCOG network traffic analysis zones (TAZs) file in TransCAD format	Zones_2899.dbd / MIDOT
Michigan statewide road layer in TransCAD format	ver9 all roads.cdf / MIDOT

A2. Geocoding Household and Other Locations

a. Undertook an automatic process using TransCAD as the geocoding engine.

b. Loaded a database file with locations into TransCAD and launched the "Locate by Address" tool, using U.S. Caliper Streets as the address reference.

c. Generated latitude and longitude coordinates for locations which matched an address in the reference index.

d. Conducted a series of post-processing checks to ensure matched geocoded results were logical.

A3. Separating Statewide Locations and SEMCOG Locations

a. Compiled a list of household, trip end, and other locations with corresponding latitude and longitude coordinates.

b. Utilized ESRI's ArcGIS software as the location engine.

c. Plotted these locations using the "Display XY Data" tool in ArcMap and North American 1983 as the geographic coordinate reference system.

d. Exported the resulting locations into an ArcGIS shapefile.

e. Exported TAZ layers for both the statewide and SEMCOG networks from TransCAD into ArcGIS shapefile format.

f. Associated in ArcMap using spatial join tools individual locations with the appropriate model area. This process used the Michigan GeoRef, which conforms to the state's spatial standards, as the map projection.

g. Flagged locations with their corresponding model network as an attribute in the location file's database.

A4. Validating Trip Lengths and Travel Times

a. For each model network area, loaded trip end locations into TransCAD as a geographic file along with the corresponding model network geographic file.

b. Added to the location file an attribute field named "NODE_ID" as a 10 character integer.

c. Using the Fill / Tag feature in TransCAD, associated each location with the nearest model node identification number.

d. Exported tagging results to a .dbf file.

e. Created a list of unique nodes.

f. Created for each model network area a subset network file (.net) using the unique nodes in each area, noting the travel time and length fields.

g. Created an IJ database table to house node trip ends as origin nodes (I Nodes) and destination nodes (J Nodes).

h. Loaded IJ table for each model area into TransCAD.

i. Generated trips for each unique IJ pair using the "Point-to-Point Distance" tool in TransCAD. Node IDs were used for the origins and destinations, while the subset network was employed. Additionally, the process was asked to skim lengths and free flow travel times.

j. Exported the newly created IJ_results dataview to a database table file.

k. Performed manual distance and travel time checks using TransCAD's shortest path toolbox.

APPENDIX B

Table B.1 Weights for MTC I Data

		CTTP - Part 1			MTC 1	
Strata	**Region**	**Households-074**	**Households-Total**	**Proportions**	**HH Counts**	**Weight CTTP**
1	Semcog	88,416	88,916	2.3%	125	711.33
2	Semcog	167,725	168,673	4.5%	185	911.75
3	Semcog	244,322	245,704	6.5%	297	827.28
4	Semcog	32,170	32,352	0.9%	44	735.27
5	Semcog	66,561	66,937	1.8%	80	836.72
6	Semcog	63,854	64,215	1.7%	89	721.52
7	Semcog	25,012	25,153	0.7%	30	838.45
8	Semcog	80,502	80,957	2.1%	89	909.63
9	Semcog	113,785	114,428	3.0%	121	945.69
10	Semcog	187,024	188,082	5.0%	211	891.38
11	Semcog	40,439	40,668	1.1%	60	677.79
12	Semcog	28,197	28,356	0.7%	33	859.29
13	Semcog	36,138	36,342	1.0%	41	886.40
14	Semcog	23,147	23,278	0.6%	30	775.93
15	Semcog	64,480	64,845	1.7%	97	668.50
16	Semcog	69,007	69,397	1.8%	99	700.98
17	Semcog	36,608	36,815	1.0%	41	897.93
18	Semcog	27,535	27,691	0.7%	32	865.33
19	Semcog	29,874	30,043	0.8%	31	969.13
20	Semcog	34,039	34,231	0.9%	36	950.87
21	Semcog	43,588	43,834	1.2%	31	1414.02
22	Semcog	85,458	85,941	2.3%	124	693.07
23	Semcog	110,102	110,725	2.9%	127	871.85
24	Semcog	77,862	78,302	2.1%	90	870.03
25	Semcog	60,051	60,391	1.6%	78	774.24
26	TMA	22,837	23,152	0.6%	78	296.82
27	TMA	49,640	50,324	1.3%	172	292.58
28	TMA	76,619	77,674	2.1%	258	301.06
29	TMA	15,858	16,076	0.4%	56	287.08
30	TMA	19,598	19,868	0.5%	67	296.54
31	TMA	19,583	19,853	0.5%	78	254.52
32	TMA	8,839	8,961	0.2%	29	308.99
33	TMA	28,486	28,878	0.8%	100	288.78
34	TMA	35,966	36,461	1.0%	128	284.85
35	TMA	65,330	66,230	1.7%	245	270.33
36	TMA	7,477	7,580	0.2%	47	161.28
37	TMA	11,118	11,271	0.3%	42	268.36
38	TMA	7,612	7,717	0.2%	26	296.80
39	TMA	17,320	17,559	0.5%	54	325.16
40	TMA	22,349	22,657	0.6%	93	243.62
41	TMA	12,181	12,349	0.3%	45	274.42
42	TMA	9,390	9,519	0.3%	35	271.98
43	TMA	7,622	7,727	0.2%	61	126.67
44	TMA	10,008	10,146	0.3%	36	281.83
45	TMA	12,978	13,157	0.3%	31	424.41
46	TMA	24,446	24,783	0.7%	85	291.56
47	TMA	40,787	41,349	1.1%	144	287.14
48	TMA	25,568	25,920	0.7%	71	365.07
49	TMA	19,930	20,205	0.5%	84	240.53
50	SUMA	21,969	22,330	0.6%	91	245.38
51	SUMA	53,391	54,267	1.4%	199	272.70
52	SUMA	64,158	65,211	1.7%	234	278.68
53	SUMA	14,222	14,455	0.4%	51	283.44
54	SUMA	19,989	20,317	0.5%	80	253.96
55	SUMA	18,573	18,878	0.5%	80	235.97
56	SUMA	7,088	7,204	0.2%	29	248.42
57	SUMA	33,628	34,180	0.9%	135	253.18
58	SUMA	36,875	37,480	1.0%	141	265.82
59	SUMA	60,520	61,513	1.6%	235	261.76
60	SUMA	6,773	6,884	0.2%	42	163.91
61	SUMA	10,376	10,546	0.3%	41	257.23
62	SUMA	6,919	7,033	0.2%	19	370.13
63	SUMA	16,406	16,675	0.4%	42	397.03
64	SUMA	20,401	20,736	0.5%	85	243.95
65	SUMA	11,227	11,411	0.3%	45	253.58
66	SUMA	8,640	8,782	0.2%	35	250.91
67	SUMA	6,713	6,823	0.2%	48	142.15
68	SUMA	8,260	8,396	0.2%	31	270.82
69	SUMA	11,781	11,974	0.3%	23	520.62
70	SUMA	20,173	20,504	0.5%	76	269.79
71	SUMA	36,982	37,589	1.0%	140	268.49
72	SUMA	24,277	24,675	0.7%	71	347.54
73	SUMA	17,408	17,694	0.5%	72	245.75

Table B.1 (Continued) Weights for MTC I Data

		CTTP - Part 1			MTC 1	
Strata	**Region**	**Households-074**	**Households-Total**	**Proportions**	**HH Counts**	**Weight CTTP**
74	Small_Cities	9,748	9,818	0.3%	118	83.21
75	Small_Cities	16,309	16,427	0.4%	216	76.05
76	Small_Cities	16,519	16,638	0.4%	258	64.49
77	Small_Cities	3,580	3,606	0.1%	47	76.72
78	Small_Cities	5,798	5,840	0.2%	87	67.13
79	Small_Cities	5,842	5,884	0.2%	89	66.11
80	Small_Cities	2,692	2,711	0.1%	32	84.73
81	Small_Cities	6,438	6,485	0.2%	150	43.23
82	Small_Cities	6,898	6,948	0.2%	152	45.71
83	Small_Cities	11,866	11,952	0.3%	224	53.36
84	Small_Cities	1,860	1,873	0.0%	67	27.96
85	Small_Cities	2,947	2,968	0.1%	38	78.11
86	Small_Cities	2,069	2,084	0.1%	34	61.29
87	Small_Cities	3,218	3,241	0.1%	55	58.93
88	Small_Cities	4,548	4,581	0.1%	116	39.49
89	Small_Cities	1,946	1,960	0.1%	53	36.98
90	Small_Cities	1,512	1,523	0.0%	40	38.07
91	Small_Cities	1,329	1,339	0.0%	53	25.26
92	Small_Cities	2,165	2,181	0.1%	34	64.14
93	Small_Cities	3,092	3,114	0.1%	44	70.78
94	Small_Cities	3,772	3,799	0.1%	103	36.89
95	Small_Cities	7,534	7,588	0.2%	178	42.63
96	Small_Cities	3,710	3,737	0.1%	74	50.50
97	Small_Cities	3,049	3,071	0.1%	66	46.53
98	UP	4,048	3,938	0.1%	104	37.87
99	UP	11,343	11,035	0.3%	246	44.86
100	UP	8,451	8,221	0.2%	218	37.71
101	UP	1,887	1,836	0.0%	24	76.49
102	UP	4,332	4,214	0.1%	100	42.14
103	UP	2,609	2,538	0.1%	69	36.78
104	UP	1,070	1,041	0.0%	31	33.58
105	UP	8,775	8,536	0.2%	171	49.92
106	UP	7,075	6,883	0.2%	152	45.28
107	UP	8,388	8,160	0.2%	198	41.21
108	UP	1,531	1,489	0.0%	49	30.40
109	UP	1,232	1,199	0.0%	32	37.45
110	UP	1,047	1,019	0.0%	30	33.95
111	UP	3,023	2,941	0.1%	42	70.02
112	UP	3,238	3,150	0.1%	75	42.00
113	UP	2,077	2,021	0.1%	43	46.99
114	UP	1,206	1,173	0.0%	28	41.90
115	UP	1,118	1,088	0.0%	40	27.19
116	UP	1,108	1,078	0.0%	30	35.93
117	UP	1,603	1,559	0.0%	32	48.73
118	UP	2,896	2,817	0.1%	62	45.44
119	UP	4,822	4,691	0.1%	135	34.75
120	UP	4,247	4,132	0.1%	59	70.03
121	UP	2,423	2,357	0.1%	57	41.35
122	NLP	6,781	6,616	0.2%	72	91.89
123	NLP	26,014	25,382	0.7%	246	103.18
124	NLP	18,216	17,773	0.5%	211	84.23
125	NLP	4,943	4,823	0.1%	30	160.76
126	NLP	12,408	12,106	0.3%	110	110.06
127	NLP	6,259	6,107	0.2%	71	86.01
128	NLP	2,610	2,547	0.1%	27	94.32
129	NLP	25,180	24,568	0.6%	189	129.99
130	NLP	16,292	15,896	0.4%	148	107.41
131	NLP	18,912	18,452	0.5%	206	89.57
132	NLP	3,994	3,897	0.1%	55	70.85
133	NLP	3,121	3,045	0.1%	35	87.00
134	NLP	2,523	2,462	0.1%	17	144.80
135	NLP	6,682	6,520	0.2%	46	141.73
136	NLP	6,670	6,508	0.2%	70	92.97
137	NLP	4,121	4,021	0.1%	47	85.55
138	NLP	2,380	2,322	0.1%	29	80.07
139	NLP	3,312	3,231	0.1%	51	63.36
140	NLP	2,980	2,908	0.1%	35	83.07
141	NLP	4,431	4,323	0.1%	35	123.52
142	NLP	6,908	6,740	0.2%	78	86.41
143	NLP	11,401	11,124	0.3%	141	78.89
144	NLP	9,770	9,533	0.3%	66	144.43
145	NLP	5,439	5,307	0.1%	58	91.50

Table B.1 (Continued) Weights for MTC I Data

		CTTP - Part 1			MTC 1	
Strata	Region	Households-074	Households-Total	Proportions	HH Counts	Weight CTTP
146	SLP	9,569	9,476	0.3%	73	129.80
147	SLP	36,777	36,419	1.0%	194	187.72
148	SLP	36,618	36,261	1.0%	233	155.63
149	SLP	8,246	8,166	0.2%	27	302.43
150	SLP	14,935	14,789	0.4%	76	194.60
151	SLP	10,810	10,705	0.3%	66	162.19
152	SLP	4,625	4,580	0.1%	32	143.12
153	SLP	30,684	30,385	0.8%	155	196.03
154	SLP	31,215	30,911	0.8%	148	208.86
155	SLP	45,524	45,080	1.2%	237	190.21
156	SLP	5,289	5,237	0.1%	45	116.39
157	SLP	6,321	6,259	0.2%	40	156.48
158	SLP	5,175	5,125	0.1%	26	197.10
159	SLP	14,642	14,499	0.4%	45	322.21
160	SLP	14,621	14,478	0.4%	87	166.42
161	SLP	10,826	10,720	0.3%	47	228.10
162	SLP	7,009	6,941	0.2%	35	198.31
163	SLP	5,603	5,548	0.1%	57	97.34
164	SLP	5,666	5,611	0.1%	31	180.99
165	SLP	9,268	9,178	0.2%	44	208.58
166	SLP	16,622	16,460	0.4%	77	213.77
167	SLP	27,959	27,686	0.7%	138	200.63
168	SLP	25,592	25,343	0.7%	76	333.45
169	SLP	14,876	14,731	0.4%	70	210.44

Table B.2 Weights for MTC II Data

New Cells	Region	Cell Description	Target Households	Survey Frequency	Weights4
1	SEMCOG	HH Size=1,2,3,4+ Autos=0 Workers=0,1,2,3+	161,086	13	12,391
2	SEMCOG	HH Size=1 Autos=1+ Workers=0	240,427	44	5,464
3	SEMCOG	HH Size=1 Autos=1+ Workers=1	270,795	40	6,770
4	SEMCOG	HH Size=2 (Autos=1 Workers=1,2) and (Autos=2+ Workers=2)	298,681	30	9,956
5	SEMCOG	HH Size=2 Autos=1,2+ Workers=0	165,454	38	4,354
6	SEMCOG	HH Size=3 Autos=1,2,3+ Workers=0,1	148,901	21	7,091
7	SEMCOG	HH Size=2 Autos=2+ Workers=1	165,809	33	5,025
8	SEMCOG	HH Size=3 Autos=1,2,3+ Workers=2,3+	153,311	23	6,666
9	SEMCOG	HH Size=4+ (Autos=1,2 Workers=2,3+) and (Autos=3+ Workers=3+)	157,034	10	15,703
10	SEMCOG	HH Size=4+ Autos=1,2,3+ Workers=2,3+	206,930	17	12,172
11	SEMCOG	HH Size=4+ Autos=3+ Workers=1,2	103,357	11	9,396
12	TMA	HH Size=1,2,3,4+ Autos=0 Workers=0,1,2,3+	40,957	9	4,551
13	TMA	HH Size=1 Autos=1+ Workers=0	69,241	40	1,731
14	TMA	HH Size=1 Autos=1+ Workers=1	81,036	33	2,456
15	TMA	HH Size=2 Autos=1 Workers=0,1	43,126	22	1,960
16	TMA	HH Size=2 Autos=1,2+ Workers=2	74,055	43	1,722
17	TMA	HH Size=2 Autos=2+ Workers=0	32,803	25	1,312
18	TMA	HH Size=2 Autos=2+ Workers=1	47,729	30	1,591
19	TMA	HH Size=3 Autos=1,2,3+ Workers=0,1	47,140	13	3,626
20	TMA	HH Size=3 Autos=1,2,3+ Workers=2,3+	47,079	12	3,923
21	TMA	HH Size=4+ Autos=1,2,3+ Workers=0,1	53,551	19	2,818
22	TMA	HH Size=4+ Autos=1,2 Workers=2,3+	46,355	19	2,440
23	TMA	HH Size=4+ Autos=3+ Workers=2,3+	39,855	15	2,657
24	SUMA	HH Size=1,2,3,4+ Autos=0 Workers=0,1,2,3+	41,959	12	3,497
25	SUMA	HH Size=1 Autos=1+ Workers=0	70,886	52	1,363
26	SUMA	HH Size=1 Autos=1+ Workers=1	67,687	31	2,183
27	SUMA	HH Size=2 Autos=1 Workers=0,1	42,052	24	1,752
28	SUMA	HH Size=2 Autos=1,2+ Workers=2	70,610	36	1,961
29	SUMA	HH Size=2 Autos=2+ Workers=0	41,580	29	1,434
30	SUMA	HH Size=2 Autos=2+ Workers=1	48,072	21	2,289
31	SUMA	HH Size=3 Autos=1,2,3+ Workers=0,1	41,884	13	3,222
32	SUMA	HH Size=3 Autos=1,2 Workers=2,3+	22,106	9	2,456
33	SUMA	HH Size=3 Autos=3+ Workers=2,3+	22,242	13	1,711
34	SUMA	HH Size=4+ Autos=1,2,3+ Workers=0,1	48,097	18	2,672
35	SUMA	HH Size=4+ Autos=1,2 Workers=2+	40,257	9	4,473
36	SUMA	HH Size=4+ Autos=3+ Workers=2,3+	36,124	13	2,779
37	Small City	HH Size=1,2,3,4+ Autos=0 Workers=0,1,2,3+	17,665	20	883
38	Small City	HH Size=1 Autos=1+ Workers=0	18,513	44	421
39	Small City	HH Size=1 Autos=1+ Workers=1	21,047	34	619
40	Small City	HH Size=2 Autos=1 Workers=0,1	12,146	17	714
41	Small City	HH Size=2 Autos=1,2+ Workers=2	19,040	36	529
42	Small City	HH Size=2 Autos=2+ Workers=0	6,600	22	300
43	Small City	HH Size=2 Autos=2+ Workers=1	11,095	23	482
44	Small City	HH Size=3 Autos=1,2,3+ Workers=0,1	10,533	15	702
45	Small City	HH Size=3 Autos=1,2 Workers=2,3+	5,233	12	436
46	Small City	HH Size=3 Autos=3+ Workers=2,3+	4,464	14	319
47	Small City	HH Size=4+ Autos=1,2,3+ Workers=0,1	8,153	16	510
48	Small City	HH Size=4+ Autos=1,2 Workers=2,3+	6,442	25	258
49	Small City	HH Size=4+ Autos=3+ Workers=2,3+	6,189	13	476

Table B.2 (Continued) Weights for MTC II Data

New Cells	Region	Cell Description	Target Households	Survey Frequency	Weight
50	UP Rural	HH Size=1,2,3,4+ Autos=0 Workers=0,1,2,3+	3,503	12	292
51	UP Rural	HH Size=1 Autos=1,2,3+ Workers=0	13,627	39	349
52	UP Rural	HH Size=1 Autos=1,2,3+ Workers=1	7,681	32	240
53	UP Rural	HH Size=2 Autos=1 Workers=0,1	6,139	23	267
54	UP Rural	HH Size=2 Autos=1,2,3+ Workers=2	11,285	33	342
55	UP Rural	HH Size=2 Autos=2,3+ Workers=0	9,191	26	354
56	UP Rural	HH Size=2 Autos=2,3+ Workers=1	8,488	32	265
57	UP Rural	HH Size=3 Autos=1,2,3+ Workers=0,1	4,395	17	259
58	UP Rural	HH Size=3 Autos=1,2,3+ Workers=2,3+	8,161	23	355
59	UP Rural	HH Size=4+ Autos=1,2,3+ Workers=0,1	6,212	13	478
60	UP Rural	HH Size=4+ Autos=1,2 Workers=2,3+	5,980	18	332
61	UP Rural	HH Size=4+ Autos=3+ Workers=2,3+	5,891	12	491
62	NLP Rural	HH Size=1 Autos=0 Workers=0,1	7,044	11	640
63	NLP Rural	HH Size=1 Autos=1+ Workers=0	31,572	42	752
64	NLP Rural	HH Size=1 Autos=1+ Workers=1	18,336	30	611
65	NLP Rural	(HH Size=2 Autos=1 Workers=0,1) and (HH Size=2,3,4+ Autos=0 Workers=0,1,2,3+)	21,959	31	708
66	NLP Rural	HH Size=2 Autos=1,2+ Workers=2	25,184	33	763
67	NLP Rural	HH Size=2 Autos=2+ Workers=0	25,015	31	807
68	NLP Rural	HH Size=2 Autos=2+ Workers=1	19,249	23	837
69	NLP Rural	HH Size=3 Autos=1,2,3+ Workers=0,1	13,142	21	626
70	NLP Rural	HH Size=3 Autos=1,2,3+ Workers=2,3+	14,359	19	756
71	NLP Rural	HH Size=4+ Autos=1,2,3+ Workers=0,1	17,154	17	1,009
72	NLP Rural	HH Size=4+ Autos=1,2 Workers=2,3+	13,452	11	1,223
73	NLP Rural	HH Size=4+ Autos=3+ Workers=2,3+	11,771	11	1,070
74	SLP Rural	HH Size=1,2,3,4+ Autos=0 Workers=0,1,2,3+	10,564	9	1,174
75	SLP Rural	HH Size=1 Autos=1+ Workers=0	44,851	39	1,150
76	SLP Rural	HH Size=1 Autos=1+ Workers=1	33,853	30	1,128
77	SLP Rural	HH Size=2 Autos=1 Workers=0	13,686	13	1,053
78	SLP Rural	HH Size=2 (Autos=1 Workers=1) and (Autos=1,2+ Workers=2)	61,854	44	1,406
79	SLP Rural	HH Size=2 Autos=2+ Workers=0	33,772	27	1,251
80	SLP Rural	HH Size=2 Autos=2+ Workers=1	40,179	27	1,488
81	SLP Rural	HH Size=3 Autos=1,2,3+ Workers=0,1	28,375	16	1,773
82	SLP Rural	HH Size=3 Autos=1,2 Workers=2,3	15,223	11	1,384
83	SLP Rural	HH Size=3 Autos=3+ Workers=2,3	18,964	13	1,459
84	SLP Rural	HH Size=4+ Autos=1,2,3+ Workers=0,1	41,194	19	2,168
85	SLP Rural	HH Size=4+ Autos=1,2 Workers=2,3+	33,373	15	2,225
86	SLP Rural	HH Size=4+ Autos=3+ Workers=2,3+	37,056	21	1,765
			4,157,125	1975	2,105

APPENDIX C

Table C.1 Average Household Trip Rates by Purpose and Sample Area (Unweighted)

	Household Trip Rates by Purpose			
	HBW	HBSch	HBO	NHB
SEMCOG	1.12	0.54	3.50	2.43
Small Cities	1.51	0.79	4.09	2.50
Upper Peninsula Rural	1.33	0.64	2.96	2.28
Northern Lower Peninsula	1.15	0.58	2.96	2.48
Southern Lower Peninsula	1.37	0.74	3.25	2.56
TMAs	1.36	0.70	3.67	2.48
Small Urban Modeled Areas	1.27	0.62	3.29	2.53
Statewide	1.30	0.66	3.39	2.46

Figure C.1 Distribution of Average Household Trip Rates by Purpose and Sample Area (Unweighted)

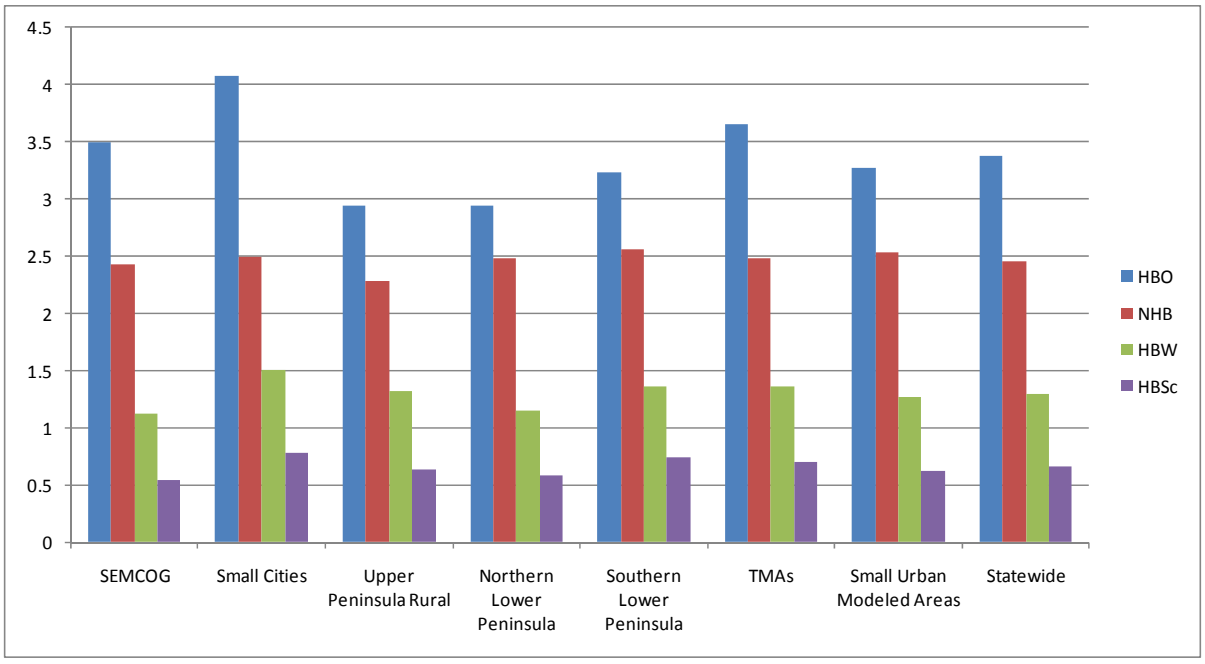


Table C.2 Average Travel Times (Network Skims) by Trip Purpose and Sample Area (Unweighted)

	Mean Travel Times by Trip Purpose				
	Home Based Work	**Home Based Other**	**Home Based School**	**Non-Home Based**	**All**
SEMCOG	18.34	8.70	7.89	9.34	10.28
Small Cities	7.29	6.31	2.54	7.30	6.49
Upper Peninsula Rural	11.94	10.11	7.16	6.78	9.19
Northern Lower Peninsula	15.28	14.48	7.92	11.37	13.10
Southern Lower Peninsula	15.33	9.56	8.77	9.75	10.57
TMAs	13.69	8.43	6.65	7.74	9.02
Small Urban Modeled Areas	12.23	8.06	6.65	7.32	8.47
Statewide	13.21	9.12	6.75	8.52	9.48

Figure C.2 Distribution of Average Travel Times (Network Skims) by Trip Purpose and Sample Area (Unweighted)

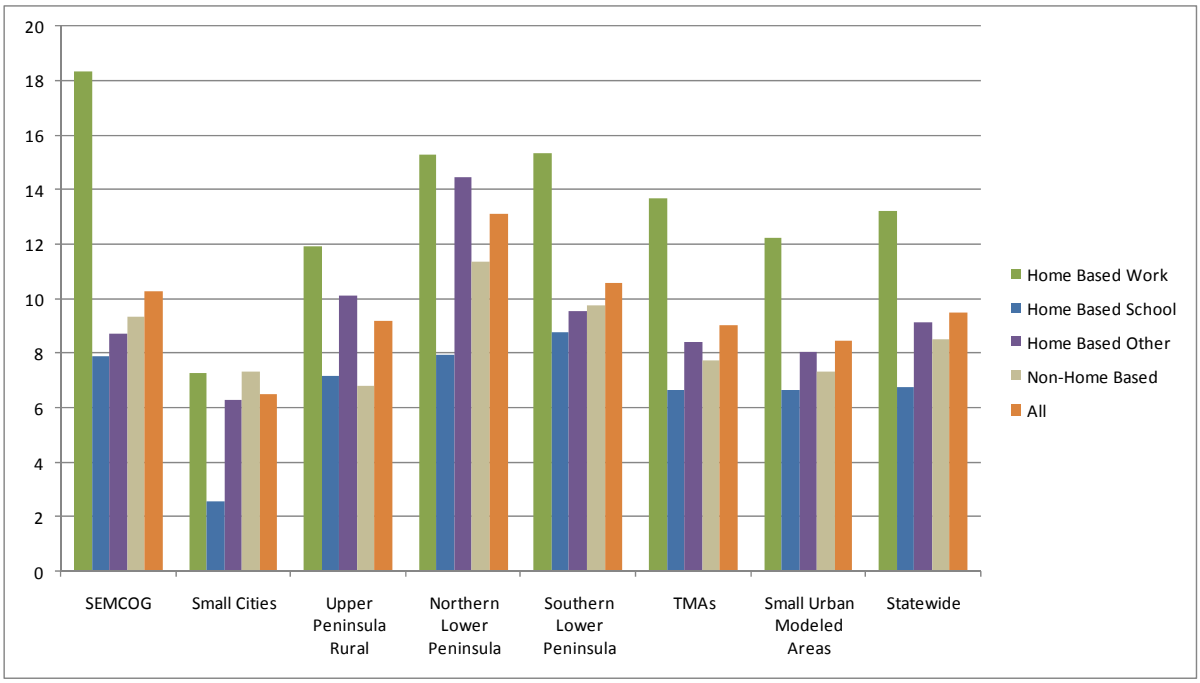


Table C.3 Household Trip Rates by Purpose and Sample Area on Fridays and Other Days of the Week – (Weighted)

Household Trip Rates by Purpose						
		HBW	HBSch	HBO	NHB	Total
SEMCOG	Friday	0.97	1.03	4.71	3.51	10.22
	Regular	1.31	0.73	3.65	2.37	8.06
Small Cities	Friday	1.36	0.31	3.20	1.81	6.68
	Regular	1.40	0.69	3.80	2.35	8.24
UP - Rural	Friday	1.28	0.15	3.64	2.17	7.24
	Regular	1.39	0.88	2.93	2.36	7.56
NLP - Rural	Friday	0.93	0.50	3.94	2.10	7.47
	Regular	1.27	0.78	2.95	2.79	7.79
SLP - Rural	Friday	1.42	1.28	4.23	3.54	10.47
	Regular	1.45	0.90	3.49	2.69	8.53
TMAs	Friday	1.20	1.01	4.84	3.13	10.18
	Regular	1.46	0.86	3.73	2.39	8.44
SUMA	Friday	1.21	0.45	3.97	2.92	8.55
	Regular	1.46	0.96	3.43	2.68	8.53
Statewide	Friday	1.11	0.89	4.44	3.19	9.63
	Regular	1.37	0.81	3.55	2.48	8.21

Figure C.3 Distributions of Household Trip Rates by Purpose and Sample Area on Fridays and Other Days of the Week – (Weighted)

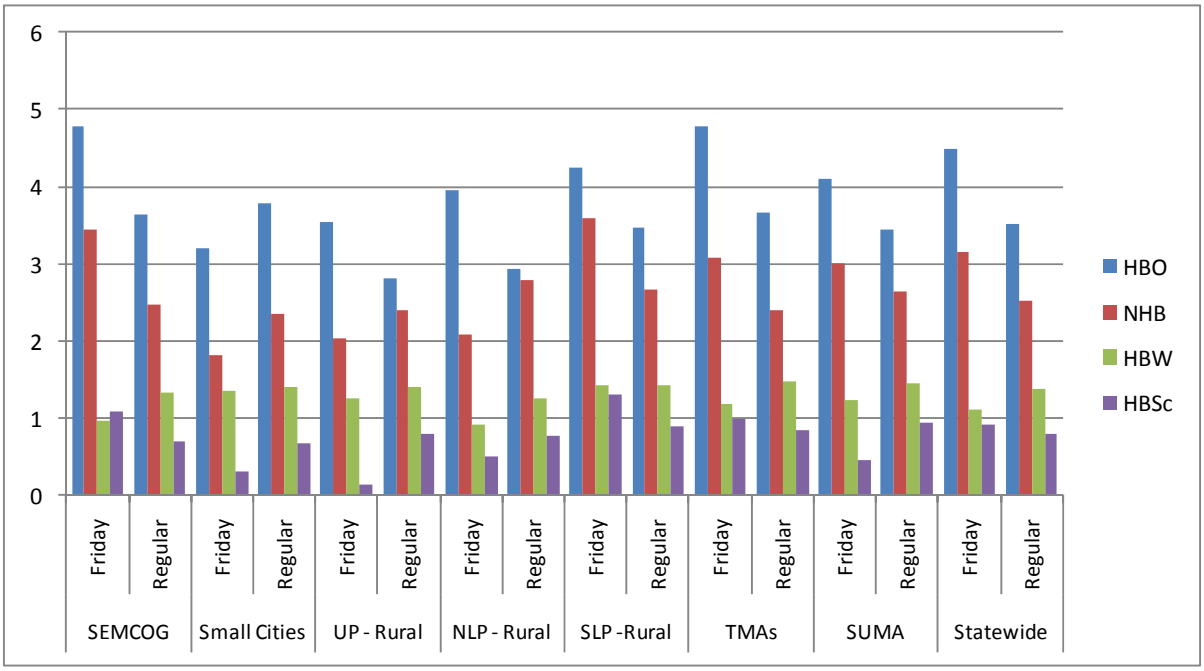
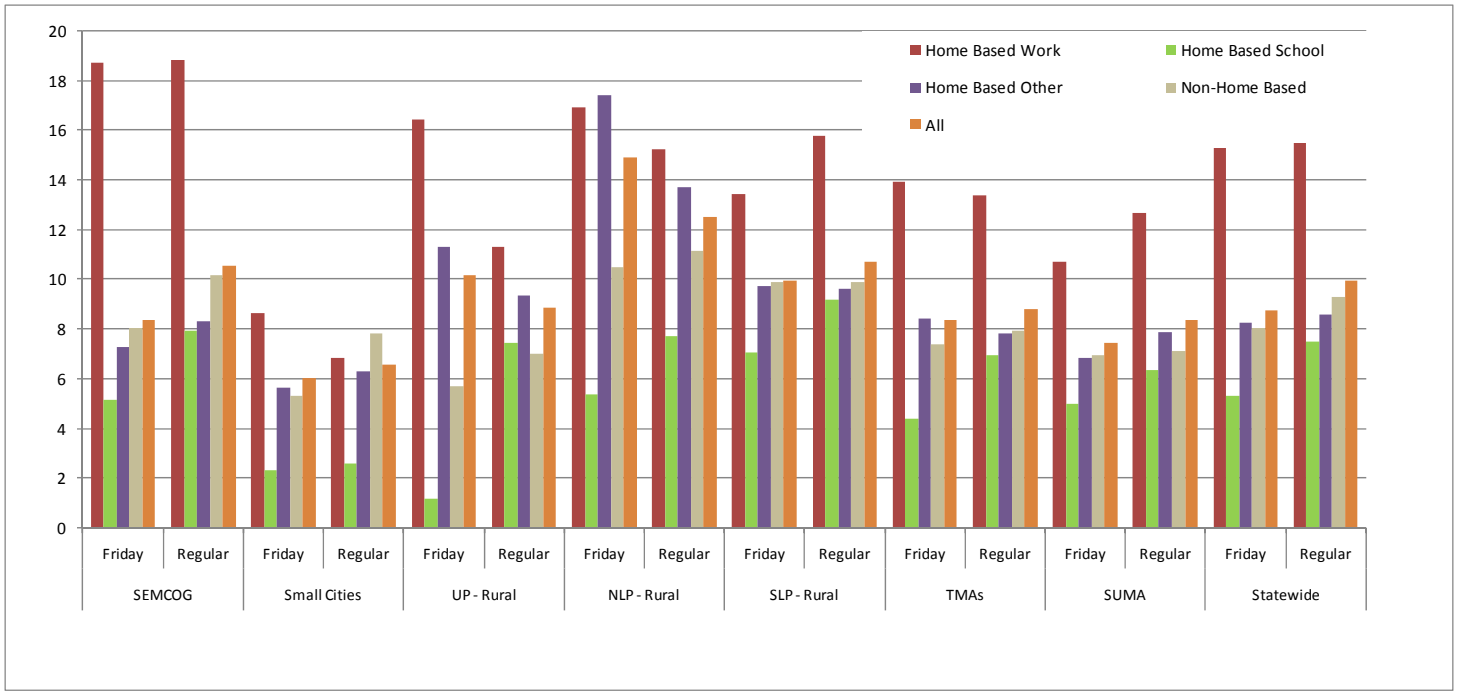


Table C.4 Average Travel Times (Network Times) by Trip Purpose and Sample Area on Fridays and Other Days of the Week – (Weighted)

		Home Based Work	Home Based School	Home Based Other	Non-Home Based	Unknown	All
SEMCOG	**Friday**	18.7	5.2	7.3	8.1	4.5	8.4
	Regular	18.8	7.9	8.3	10.2	3.6	10.6
Small Cities	**Friday**	8.6	2.3	5.6	5.3	.	6.0
	Regular	6.8	2.6	6.3	7.8	16.4	6.6
UP - Rural	**Friday**	16.4	1.2	11.3	5.7	.	10.2
	Regular	11.3	7.4	9.4	7.0	7.3	8.8
NLP - Rural	**Friday**	16.9	5.4	17.4	10.5	35.5	14.9
	Regular	15.2	7.7	13.7	11.1	12.0	12.5
SLP - Rural	**Friday**	13.4	7.1	9.7	9.9	1.9	9.9
	Regular	15.8	9.2	9.6	9.9	8.6	10.7
TMAs	**Friday**	13.9	4.4	8.4	7.4	3.3	8.4
	Regular	13.4	6.9	7.8	7.9	7.0	8.8
SUMA	**Friday**	10.7	5.0	6.8	7.0	10.6	7.4
	Regular	12.7	6.4	7.9	7.1	8.4	8.4
Statewide	**Friday**	15.3	5.3	8.3	8.0	6.5	8.7
	Regular	15.8	7.5	8.6	9.3	6.2	9.9

Figure C.4 Distribution of Average Travel Times (Network Times) by Trip Purpose and Sample Area on Fridays and Other Days of the Week – (Weighted)



APPENDIX D

Table D.1 Shares of Trips by Purpose, Auto Sufficiency, and Household Size across MTC Surveys

		HH Size 1				HH Size 2				HH Size 3				HH Size 4			
		None	Deficit	Even	Surplus	None	Deficit	Even	Surplus	None	Deficit	Even	Surplus	None	Deficit	Even	Surplus
MTC I	HBW	7.4%	0.0%	18.1%	23.9%	12.2%	12.5%	19.5%	20.3%	13.5%	18.4%	17.6%	18.4%	7.3%	15.7%	13.0%	12.6%
	HBSch	0.6%	0.0%	0.7%	0.6%	7.4%	0.8%	1.9%	0.8%	28.3%	7.3%	9.6%	7.5%	27.7%	15.4%	16.1%	15.6%
	HBO	63.1%	0.0%	47.4%	42.0%	57.7%	50.9%	43.7%	42.8%	43.2%	43.4%	37.3%	40.4%	45.5%	39.9%	37.6%	39.6%
	NHB	29.0%	0.0%	33.8%	33.5%	22.7%	35.7%	34.9%	36.1%	15.0%	30.9%	35.5%	33.7%	19.4%	28.9%	33.3%	32.2%
	All	100.0%	0.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
MTC II	HBW	4.4%	0.0%	20.0%	20.6%	1.8%	6.9%	21.0%	20.7%	0.0%	26.2%	21.8%	17.1%	0.0%	7.0%	12.4%	10.5%
	HBSch	0.0%	0.0%	0.1%	0.1%	9.5%	0.0%	0.8%	0.2%	0.0%	6.1%	10.3%	9.0%	0.0%	14.8%	20.3%	17.0%
	HBO	71.8%	0.0%	44.6%	50.7%	74.2%	55.9%	44.0%	41.5%	0.0%	41.2%	39.8%	45.1%	0.0%	49.2%	38.9%	44.7%
	NHB	23.9%	0.0%	35.4%	28.6%	14.4%	37.2%	34.2%	37.6%	0.0%	26.5%	28.1%	28.9%	0.0%	29.0%	28.4%	27.7%
	All	100.0%	0.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	100.0%	100.0%	100.0%	0.0%	100.0%	100.0%	100.0%

Figure D.1 Shares of Trips by Purpose, Auto Sufficiency, and Household Size across MTC Surveys

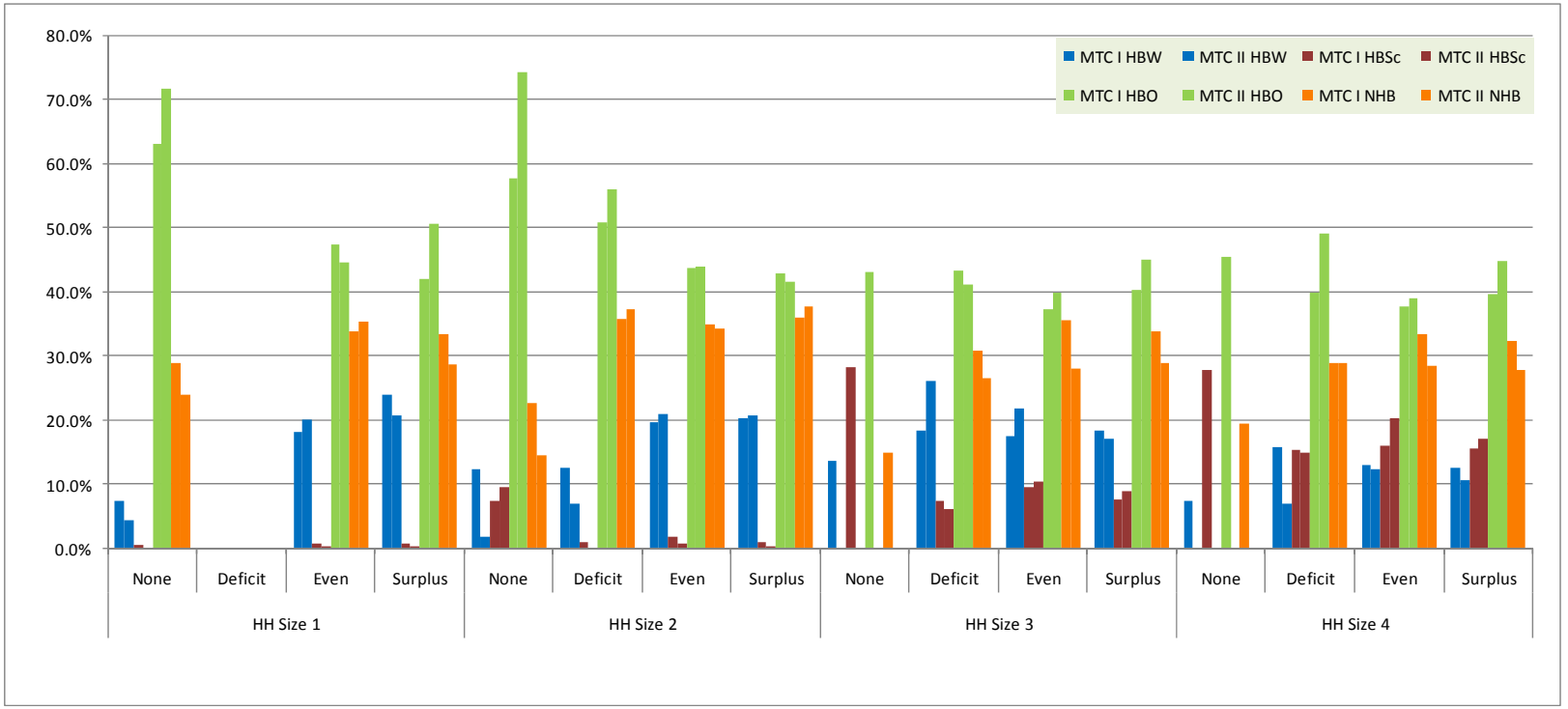


Table D.2 Trip Rates by Trip Purpose, Auto Sufficiency, and Household Size across MTC Surveys

		HH Size 1				HH Size 2				HH Size 3				HH Size 4			
		None	Deficit	Even	Surplus	None	Deficit	Even	Surplus	None	Deficit	Even	Surplus	None	Deficit	Even	Surplus
MTC I	HBW	0.13	.	0.7	0.91	0.48	0.8	1.46	1.63	0.86	1.88	1.92	1.98	0.86	2.49	2.22	2.16
	HBSch	0.01	.	0.03	0.02	0.29	0.05	0.14	0.07	1.81	0.75	1.05	0.81	3.26	2.44	2.74	2.67
	HBO	1.14	.	1.83	1.6	2.28	3.25	3.26	3.43	2.76	4.44	4.08	4.35	5.36	6.32	6.41	6.77
	NHB	0.52	.	1.3	1.28	0.89	2.28	2.6	2.89	0.96	3.16	3.89	3.63	2.29	4.58	5.67	5.52
	All	1.8	.	3.86	3.81	3.95	6.39	7.46	8.01	6.38	10.23	10.94	10.77	11.77	15.82	17.04	17.11
MTC II	HBW	0.07	.	0.72	0.71	0.06	0.43	1.47	1.57	.	2.07	2.16	1.74	.	1.16	1.99	1.79
	HBSch	0	.	0	0	0.32	0	0.05	0.02	.	0.49	1.02	0.91	.	2.46	3.28	2.9
	HBO	1.09	.	1.61	1.74	2.51	3.53	3.07	3.16	.	3.25	3.96	4.6	.	8.15	6.27	7.62
	NHB	0.36	.	1.28	0.98	0.49	2.35	2.39	2.86	.	2.09	2.79	2.94	.	4.8	4.58	4.72
	All	1.52	.	3.65	3.44	3.39	6.33	7.08	7.79	.	8.01	10.12	10.34	.	17.45	16.61	17.33

Figure D.2 Trip Rates by Trip Purpose, Auto Sufficiency, and Household Size across MTC Surveys

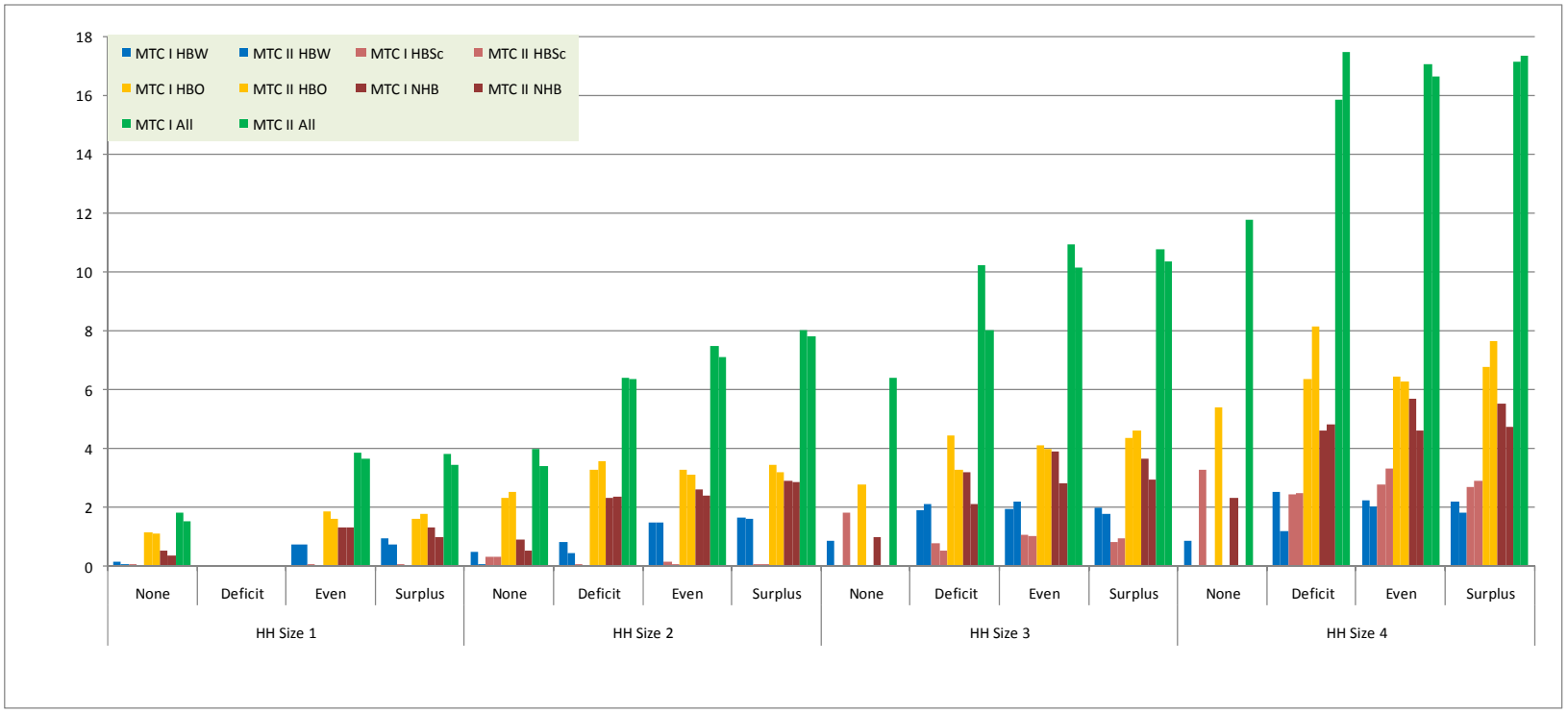


Table D.3 Shares of Trips by Purpose, Auto Sufficiency, and Number of Workers in the Household across MTC Surveys

		Zero-Worker Households				One-Worker Households				Two-Worker Households				Three-or-More-Worker Households			
		None	Deficit	Even	Surplus	None	Deficit	Even	Surplus	None	Deficit	Even	Surplus	None	Deficit	Even	Surplus
MTC I	HBW	0.2%	0.5%	0.6%	1.3%	19.3%	0.0%	17.9%	13.9%	36.7%	19.7%	19.8%	19.8%	23.6%	19.4%	24.6%	25.0%
	HBSch	11.0%	4.4%	2.6%	5.6%	20.2%	0.0%	9.2%	8.7%	14.5%	10.6%	10.4%	11.3%	31.1%	11.7%	10.7%	10.7%
	HBO	64.4%	62.5%	61.3%	58.8%	40.5%	0.0%	38.7%	44.3%	31.2%	39.4%	35.3%	33.8%	41.0%	37.5%	34.2%	34.1%
	NHB	24.4%	32.7%	35.5%	34.2%	20.0%	0.0%	34.2%	33.1%	17.7%	30.4%	34.5%	35.1%	4.3%	31.4%	30.4%	30.2%
	All	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
MTC II	HBW	1.5%	2.2%	1.0%	1.6%	8.4%	0.0%	27.5%	12.4%	74.3%	18.1%	20.4%	20.9%	0.0%	32.4%	22.3%	22.5%
	HBSch	4.8%	7.3%	3.2%	2.0%	0.0%	0.0%	6.1%	9.6%	0.0%	2.3%	14.4%	12.8%	0.0%	9.8%	6.2%	12.9%
	HBO	76.9%	62.1%	61.3%	60.9%	52.2%	0.0%	36.2%	49.0%	25.7%	38.4%	35.6%	33.4%	0.0%	30.0%	37.2%	34.4%
	NHB	16.8%	28.4%	34.5%	35.5%	39.4%	0.0%	30.2%	29.0%	0.0%	41.1%	29.7%	32.9%	0.0%	27.9%	34.2%	30.2%
	All	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	100.0%	100.0%	100.0%

Figure D.3 Shares of Trips by Purpose, Auto Sufficiency, and Number of Workers in the Household across MTC Surveys

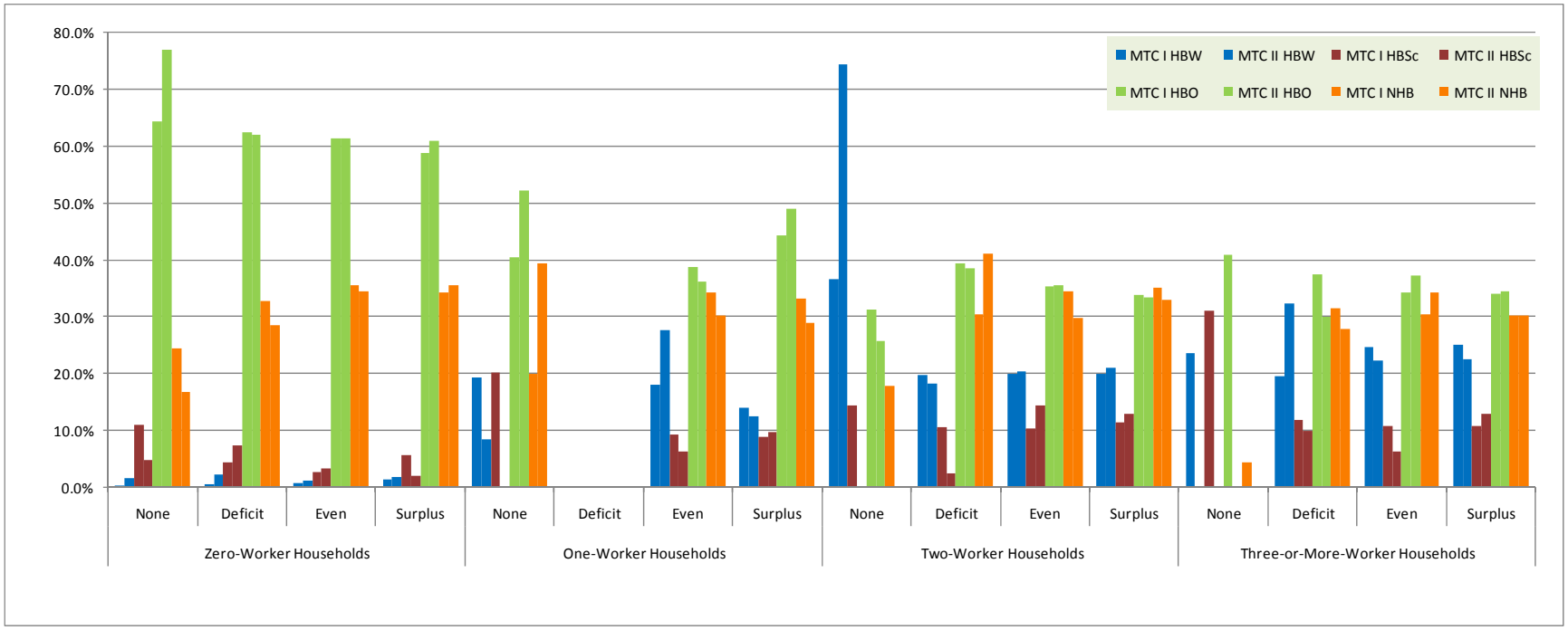


Table D.4 Trip Rates by Trip Purpose, Auto Sufficiency, and Number of Workers in the Household across MTC Surveys

		Zero-Worker Households				One-Worker Households				Two-Worker Households				Three-or-More-Worker Households			
		None	Deficit	Even	Surplus	None	Deficit	Even	Surplus	None	Deficit	Even	Surplus	None	Deficit	Even	Surplus
MTC I	HBW	0.01	0.03	0.03	0.08	1.22	.	1.18	1.42	2.33	2.12	2.47	2.55	2.53	3.06	4.02	3.92
	HBSch	0.30	0.27	0.14	0.36	1.27	.	0.60	0.89	0.92	1.14	1.29	1.45	3.33	1.86	1.74	1.68
	HBO	1.72	3.85	3.25	3.71	2.55	.	2.54	4.51	1.98	4.24	4.41	4.34	4.39	5.93	5.58	5.34
	NHB	0.65	2.02	1.88	2.16	1.26	.	2.24	3.37	1.13	3.28	4.30	4.50	0.47	4.96	4.96	4.73
	All	2.68	6.17	5.30	6.31	6.30	.	6.56	10.18	6.36	10.78	12.48	12.84	10.72	15.81	16.30	15.67
MTC II	HBW	0.03	0.16	0.05	0.09	0.24	.	1.39	1.33	2.00	1.63	2.39	2.42	.	3.93	3.28	3.66
	HBSch	0.09	0.55	0.16	0.10	0.00	.	0.31	1.03	0.00	0.21	1.68	1.48	.	1.19	0.92	2.09
	HBO	1.44	4.64	3.00	3.16	1.51	.	1.83	5.24	0.69	3.47	4.17	3.86	.	3.63	5.47	5.59
	NHB	0.31	2.12	1.69	1.84	1.14	.	1.53	3.10	0.00	3.71	3.48	3.80	.	3.38	5.03	4.90
	All	1.87	7.67	4.96	5.43	2.88	.	5.12	10.89	2.69	9.08	11.99	11.76	.	12.49	15.31	16.28

Figure D.4 Trip Rates by Trip Purpose, Auto Sufficiency, and Number of Workers in the Household across MTC Surveys

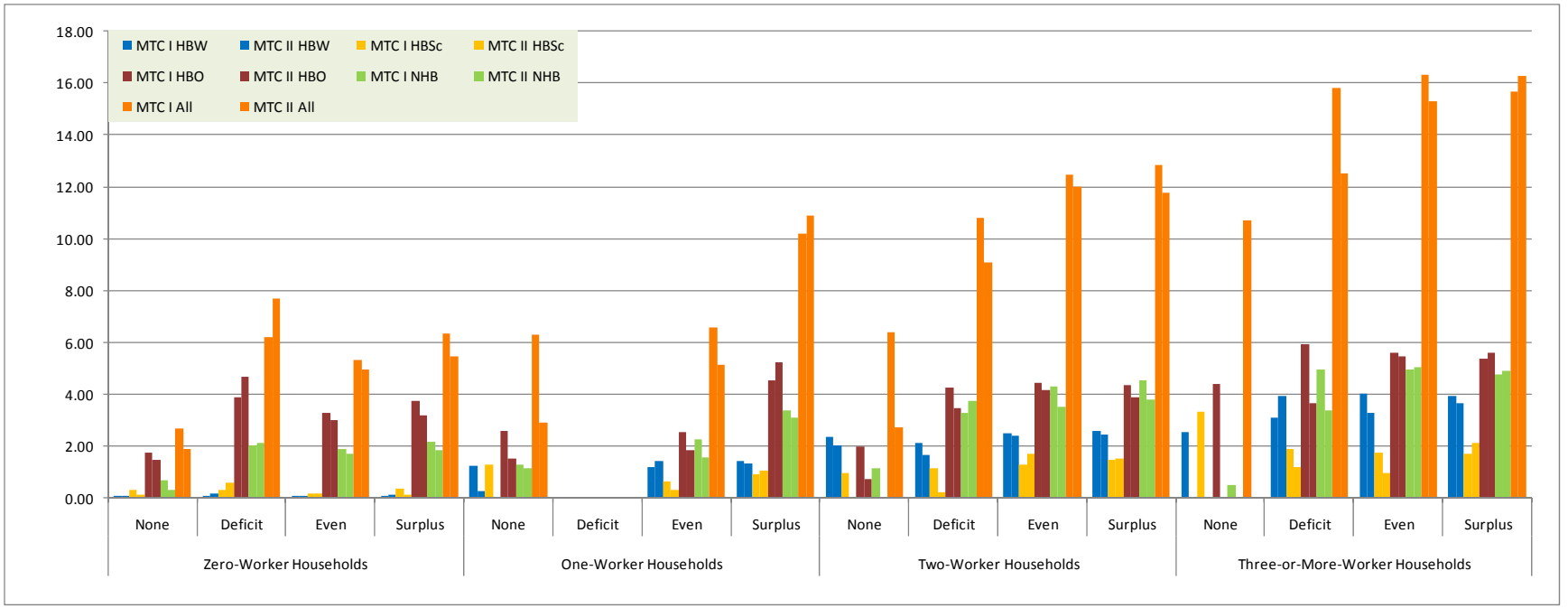


Table D.5 Shares of Trips by Purpose, and Sample Area across MTC Surveys

		SEMCOG	Small Cities	Upper Peninsula Rural	Northern Lower Peninsula	Southern Lower Peninsula	TMAs	Small Urban Modeled Areas	Statewide
MTC I	HBW	15.7%	17.0%	15.7%	16.1%	16.7%	16.1%	16.3%	16.0%
	HBSch	9.9%	7.7%	9.0%	8.9%	9.0%	9.1%	8.7%	9.4%
	HBO	42.1%	44.9%	41.1%	38.5%	39.1%	40.1%	41.9%	41.3%
	NHB	32.4%	30.4%	34.2%	36.5%	35.1%	34.6%	33.1%	33.3%
	All Purposes	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
MTC II	HBW	14.5%	17.1%	18.0%	15.3%	15.9%	16.1%	16.2%	15.4%
	HBSch	9.1%	7.7%	10.0%	9.3%	10.7%	10.0%	10.0%	9.5%
	HBO	44.6%	45.4%	40.2%	39.4%	40.0%	44.2%	40.4%	43.0%
	NHB	29.8%	27.7%	30.6%	33.8%	31.4%	28.4%	31.2%	30.2%
	All Purposes	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Figure D.5 Shares of Trips by Purpose, and Sample Area across MTC Surveys

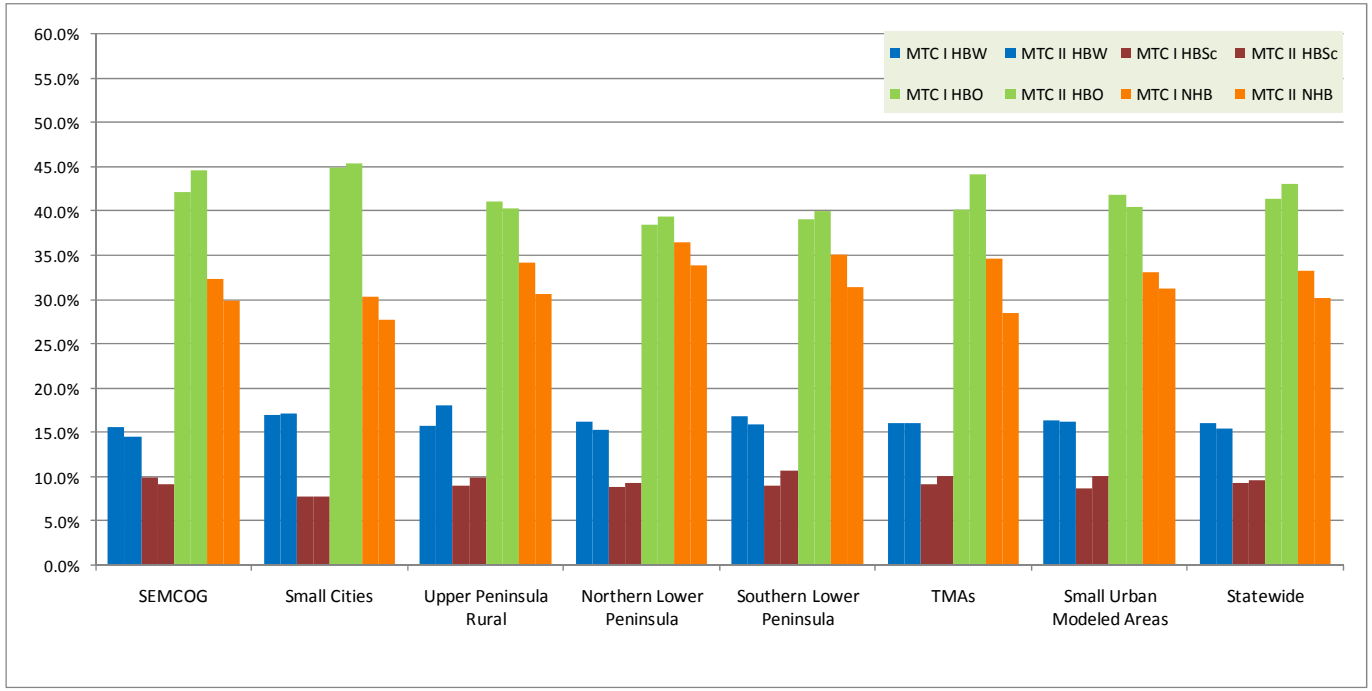


Table D.6 Travel Time Distribution of Trips by Auto Sufficiency across MTC Surveys

		Less Than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	None	503,409	183,781	82,974	41,821	16,331	6,238	876	1,509
	Deficit	1,034,107	587,349	270,600	132,415	98,903	36,554	13,912	18,891
	Even	5,610,048	4,123,331	2,028,941	998,525	929,288	391,468	120,605	120,520
	Surplus	4,205,054	3,442,285	1,892,664	1,079,170	1,015,072	509,824	138,951	160,760
	All	11,352,618	8,336,747	4,275,179	2,251,930	2,059,594	944,084	274,343	301,680
MTC II	None	304,614	195,955	5,294	5,898	1,455	22,781	850	6,641
	Deficit	956,785	503,315	165,435	164,146	88,373	32,556	8,454	6,301
	Even	6,606,659	3,406,287	1,719,546	857,760	927,221	483,788	164,037	89,609
	Surplus	6,561,941	4,226,321	2,137,822	958,990	1,023,207	531,274	162,988	131,470
	All	14,429,999	8,331,878	4,028,097	1,986,795	2,040,256	1,070,398	336,329	234,021

Figure D.6 Travel Time Distribution of Trips by Auto Sufficiency across MTC Surveys

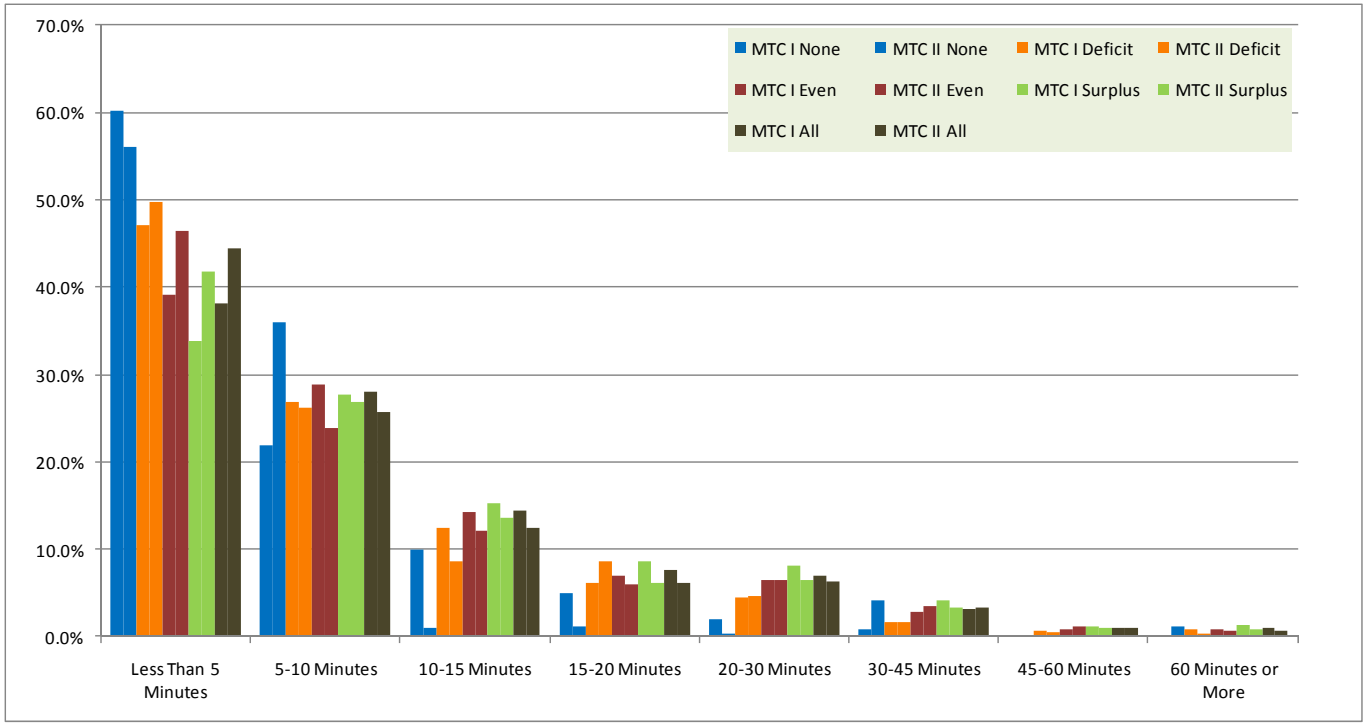


Table D.7 Travel Time Distribution of Trips by Household Size across MTC Surveys

		Less Than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	HH Size 1	1,410,412	874,389	441,615	239,570	218,013	91,744	27,465	30,473
	HH Size 2	3,083,111	2,288,027	1,199,086	672,234	647,330	311,605	101,820	130,933
	HH Size 3	1,977,707	1,496,490	759,084	403,592	383,278	174,338	56,218	59,168
	HH Size 4	4,881,387	3,677,841	1,875,394	936,535	810,973	366,397	88,840	81,106
	All	11,352,618	8,336,747	4,275,179	2,251,930	2,059,594	944,084	274,343	301,680
MTC II	HH Size 1	1,617,746	926,536	400,577	157,171	285,903	136,044	51,915	32,921
	HH Size 2	3,771,477	2,395,860	1,119,007	702,613	701,533	364,568	100,472	72,763
	HH Size 3	2,194,691	1,383,101	778,219	396,983	464,251	214,103	50,856	33,701
	HH Size 4	6,846,085	3,626,380	1,730,294	730,029	588,570	355,683	133,085	94,635
	All	14,429,999	8,331,878	4,028,097	1,986,795	2,040,256	1,070,398	336,329	234,021

Figure D.7 Travel Time Distribution of Trips by Household Size across MTC Surveys

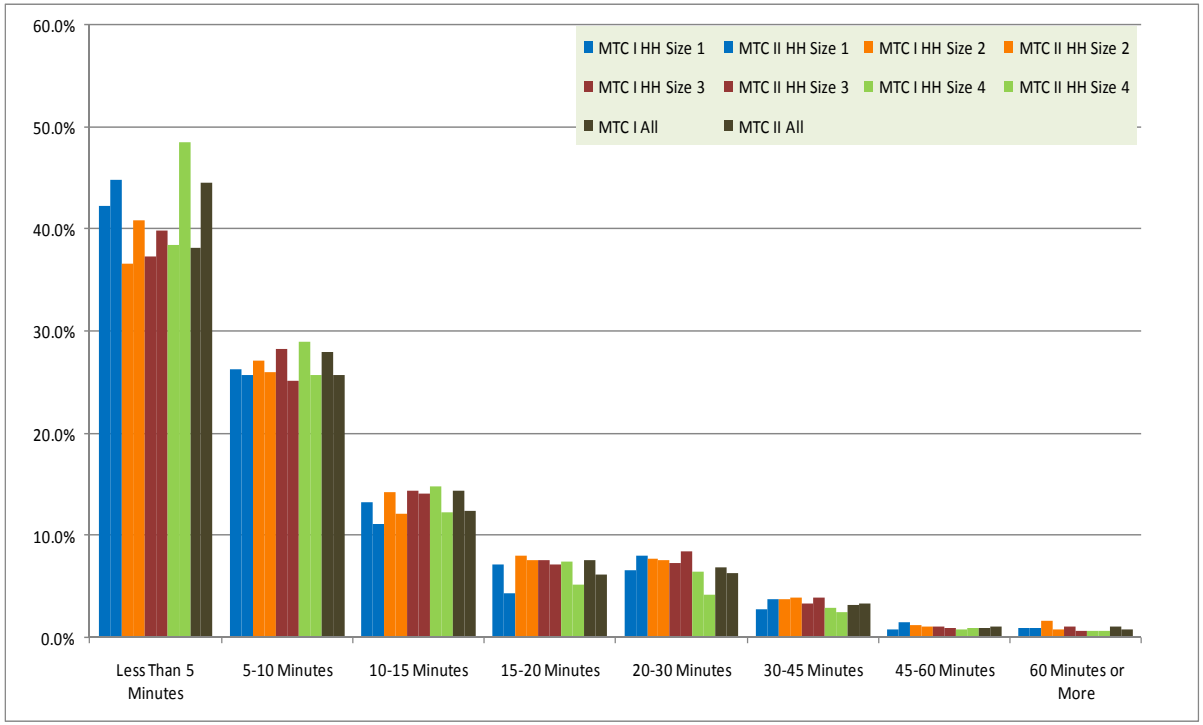


Table D.8 Travel Time Distribution of Trips by Household Size and Auto Sufficiency across MTC Surveys

			Less Than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More	Less Than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	HH Size 1	None	155,433	64,146	29,688	11,784	8,144	2,564	723	356	57.0%	23.5%	10.9%	4.3%	3.0%	0.9%	0.3%	0.1%
		Even	1,051,013	646,428	307,914	161,631	148,484	62,686	16,498	21,627	43.5%	26.8%	12.7%	6.7%	6.1%	2.6%	0.7%	0.9%
		Surplus	203,966	163,815	104,013	66,155	61,385	26,494	10,243	8,490	31.6%	25.4%	16.1%	10.3%	9.5%	4.1%	1.6%	1.3%
	HH Size 2	None	107,934	46,106	19,245	8,689	3,412	1,166	-	322	57.8%	24.7%	10.3%	4.6%	1.8%	0.6%	0.0%	0.2%
		Deficit	335,297	212,729	106,760	57,829	33,695	14,548	9,023	12,461	42.9%	27.2%	13.6%	7.4%	4.3%	1.9%	1.2%	1.6%
		Even	1,537,118	1,157,109	594,429	312,354	296,162	128,671	46,972	54,919	37.2%	28.0%	14.4%	7.6%	7.2%	3.1%	1.1%	1.3%
		Surplus	1,102,762	872,082	478,652	293,362	314,062	167,219	45,825	63,231	33.0%	26.1%	14.3%	8.8%	9.4%	5.0%	1.4%	1.9%
	HH Size 3	None	95,709	32,697	16,666	7,996	537	1,930	-	831	61.2%	20.9%	10.7%	5.1%	0.3%	1.2%	0.0%	0.5%
		Deficit	208,159	141,634	53,723	15,844	12,483	5,701	1,671	2,990	47.1%	32.0%	12.1%	3.6%	2.8%	1.3%	0.4%	0.7%
		Even	890,098	661,237	327,698	174,264	174,083	66,311	22,601	17,504	38.1%	28.3%	14.0%	7.5%	7.5%	2.8%	1.0%	0.8%
		Surplus	783,742	660,922	360,997	205,488	196,174	100,396	31,946	37,842	33.0%	27.8%	15.2%	8.6%	8.3%	4.2%	1.3%	1.6%
	HH Size 4	None	144,333	40,833	17,375	13,352	4,239	578	153	-	65.3%	18.5%	7.9%	6.0%	1.9%	0.3%	0.1%	0.0%
		Deficit	490,651	232,986	110,116	58,742	52,725	16,304	3,217	3,439	50.7%	24.1%	11.4%	6.1%	5.4%	1.7%	0.3%	0.4%
		Even	2,131,819	1,658,557	798,901	350,276	310,560	133,799	34,534	26,470	39.2%	30.5%	14.7%	6.4%	5.7%	2.5%	0.6%	0.5%
		Surplus	2,114,585	1,745,466	949,002	514,165	443,451	215,715	50,936	51,196	34.8%	28.7%	15.6%	8.5%	7.3%	3.5%	0.8%	0.8%
MTC II	HH Size 1	None	181,600	113,635	5,294	4,444	-	850	850	6,641	58.0%	36.3%	1.7%	1.4%	0.0%	0.3%	0.3%	2.1%
		Even	1,172,145	653,021	305,128	107,903	201,226	116,001	42,776	25,587	44.7%	24.9%	11.6%	4.1%	7.7%	4.4%	1.6%	1.0%
		Surplus	264,001	159,881	90,155	44,825	84,677	19,194	8,289	693	39.3%	23.8%	13.4%	6.7%	12.6%	2.9%	1.2%	0.1%
	HH Size 2	None	123,014	82,320	-	1,455	1,455	21,931	-	-	53.4%	35.8%	0.0%	0.6%	0.6%	9.5%	0.0%	0.0%
		Deficit	406,292	216,124	52,590	87,910	22,303	7,822	7,670	5,876	50.4%	26.8%	6.5%	10.9%	2.8%	1.0%	1.0%	0.7%
		Even	1,720,046	909,228	553,493	319,977	338,267	142,831	23,972	27,887	42.6%	22.5%	13.7%	7.9%	8.4%	3.5%	0.6%	0.7%
		Surplus	1,522,124	1,188,189	512,924	293,271	339,508	191,985	68,830	39,000	36.6%	28.6%	12.3%	7.1%	8.2%	4.6%	1.7%	0.9%
	HH Size 3	None	-	-	-	-	-	-	-	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		Deficit	197,107	112,525	58,942	39,693	58,079	4,665	-	-	41.8%	23.9%	12.5%	8.4%	12.3%	1.0%	0.0%	0.0%
		Even	867,622	470,787	234,791	90,203	211,108	45,144	11,243	7,329	44.8%	24.3%	12.1%	4.7%	10.9%	2.3%	0.6%	0.4%
		Surplus	1,129,961	799,788	484,486	267,086	195,065	164,294	39,613	26,372	36.4%	25.7%	15.6%	8.6%	6.3%	5.3%	1.3%	0.8%
	HH Size 4	None	-	-	-	-	-	-	-	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		Deficit	353,385	174,666	53,903	36,543	7,991	20,069	784	424	54.6%	27.0%	8.3%	5.6%	1.2%	3.1%	0.1%	0.1%
		Even	2,846,845	1,373,251	626,134	339,677	176,621	179,813	86,045	28,806	50.3%	24.3%	11.1%	6.0%	3.1%	3.2%	1.5%	0.5%
		Surplus	3,645,855	2,078,464	1,050,258	353,808	403,958	155,801	46,256	65,405	46.7%	26.6%	13.5%	4.5%	5.2%	2.0%	0.6%	0.8%

Table D.9 Travel Time Distribution of Trips by Number of Workers across MTC Surveys

		Less than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	Zero Worker	2,037,771	1,281,901	582,097	280,853	211,518	86,374	31,173	60,129
	One Worker	3,837,374	2,715,279	1,366,000	727,315	645,285	298,677	90,451	85,263
	Two Worker	4,433,337	3,508,898	1,825,262	973,190	930,611	436,590	118,673	127,624
	Three+ Worker	1,044,135	830,669	501,820	270,572	272,179	122,444	34,046	28,663
	All	11,352,618	8,336,747	4,275,179	2,251,930	2,059,594	944,084	274,343	301,680
MTC II	Zero Worker	2,801,965	1,582,605	587,858	235,581	230,556	107,827	38,244	44,872
	One Worker	5,250,024	2,907,019	1,641,352	721,776	764,627	361,596	89,932	97,107
	Two Worker	5,430,791	3,097,825	1,534,313	869,378	852,778	520,846	200,689	87,692
	Three+ Worker	947,219	744,429	264,573	160,060	192,296	80,129	7,464	4,349
	All	14,429,999	8,331,878	4,028,097	1,986,795	2,040,256	1,070,398	336,329	234,021

Figure D.8 Travel Time Distribution of Trips by Number of Workers across MTC Surveys

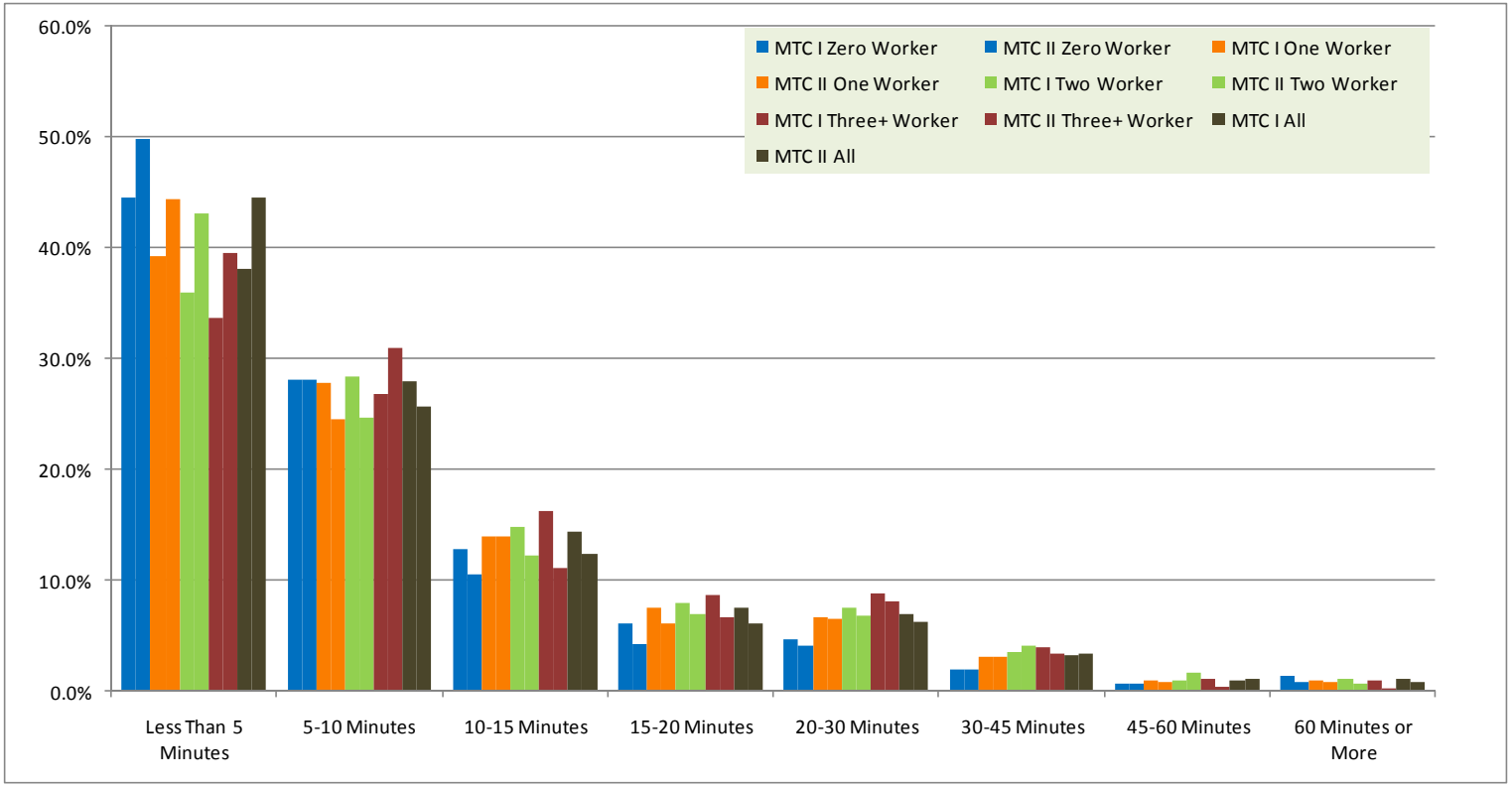


Table D.10 Travel Time Distribution of Trips by Number of Workers in the Household and Auto Sufficiency across MTC Surveys

			Less than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More	Less Than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	Zero Worker	None	270,963	101,765	37,334	23,266	9,328	2,554	686	509	60.7%	22.8%	8.4%	5.2%	2.1%	0.6%	0.2%	0.1%
		Deficit	271,498	179,357	86,398	40,612	29,207	10,246	6,164	12,204	42.7%	28.2%	13.6%	6.4%	4.6%	1.6%	1.0%	1.9%
		Even	1,221,891	796,195	361,322	161,460	125,999	57,791	16,929	33,765	44.0%	28.7%	13.0%	5.8%	4.5%	2.1%	0.6%	1.2%
		Surplus	273,419	204,585	97,044	55,516	46,985	15,782	7,394	13,651	38.3%	28.6%	13.6%	7.8%	6.6%	2.2%	1.0%	1.9%
	One Worker	None	219,461	70,467	40,660	16,665	5,741	2,842	191	999	61.5%	19.7%	11.4%	4.7%	1.6%	0.8%	0.1%	0.3%
		Even	1,371,426	869,308	391,111	193,916	172,410	63,703	24,323	16,388	44.2%	28.0%	12.6%	6.3%	5.6%	2.1%	0.8%	0.5%
		Surplus	2,246,488	1,775,504	934,228	516,734	467,134	232,131	65,938	67,876	35.6%	28.2%	14.8%	8.2%	7.4%	3.7%	1.0%	1.1%
	Two Worker	None	10,151	9,810	3,431	1,890	1,263	842	-	-	37.1%	35.8%	12.5%	6.9%	4.6%	3.1%	0.0%	0.0%
		Deficit	434,250	219,218	96,077	52,685	32,219	12,653	3,889	3,600	50.8%	25.7%	11.2%	6.2%	3.8%	1.5%	0.5%	0.4%
		Even	2,582,138	2,105,351	1,066,129	525,776	518,570	219,396	66,628	60,861	36.1%	29.5%	14.9%	7.4%	7.3%	3.1%	0.9%	0.9%
		Surplus	1,406,798	1,174,519	659,625	392,839	378,559	203,699	48,156	63,164	32.5%	27.1%	15.2%	9.1%	8.7%	4.7%	1.1%	1.5%
	Three+ Worker	None	2,834	1,739	1,548	-	-	-	-	-	46.3%	28.4%	25.3%	0.0%	0.0%	0.0%	0.0%	0.0%
		Deficit	328,359	188,774	88,126	39,118	37,477	13,654	3,859	3,087	46.7%	26.9%	12.5%	5.6%	5.3%	1.9%	0.5%	0.4%
		Even	434,592	352,478	210,379	117,373	112,309	50,578	12,724	9,506	33.4%	27.1%	16.2%	9.0%	8.6%	3.9%	1.0%	0.7%
		Surplus	278,349	287,678	201,767	114,081	122,394	58,211	17,463	16,069	25.4%	26.2%	18.4%	10.4%	11.2%	5.3%	1.6%	1.5%
MTC II	Zero Worker	None	242,069	195,955	5,294	5,898	1,455	850	850	6,641	52.7%	42.7%	1.2%	1.3%	0.3%	0.2%	0.2%	1.4%
		Deficit	577,491	321,664	83,237	44,456	25,587	11,557	6,766	5,876	53.6%	29.9%	7.7%	4.1%	2.4%	1.1%	0.6%	0.5%
		Even	1,592,885	799,735	382,091	124,503	172,759	59,828	20,673	23,681	50.2%	25.2%	12.0%	3.9%	5.4%	1.9%	0.7%	0.7%
		Surplus	389,520	265,251	117,236	60,724	30,755	35,592	9,955	8,673	42.4%	28.9%	12.8%	6.6%	3.4%	3.9%	1.1%	0.9%
	One Worker	None	56,879	-	-	-	-	21,931	-	-	72.2%	0.0%	0.0%	0.0%	0.0%	27.8%	0.0%	0.0%
		Even	1,019,753	546,642	360,008	122,925	239,569	85,813	28,052	17,164	42.1%	22.6%	14.9%	5.1%	9.9%	3.5%	1.2%	0.7%
		Surplus	4,173,392	2,360,377	1,281,345	598,850	525,058	253,852	61,880	79,943	44.7%	25.3%	13.7%	6.4%	5.6%	2.7%	0.7%	0.9%
	Two Worker	None	5,666	-	-	-	-	-	-	-	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		Deficit	225,195	100,510	45,114	101,244	30,805	16,334	904	424	43.3%	19.3%	8.7%	19.5%	5.9%	3.1%	0.2%	0.1%
		Even	3,500,920	1,644,759	818,275	504,415	433,474	290,833	112,449	47,810	47.6%	22.4%	11.1%	6.9%	5.9%	4.0%	1.5%	0.7%
		Surplus	1,699,009	1,352,556	670,925	263,719	388,498	213,680	87,336	39,458	36.0%	28.7%	14.2%	5.6%	8.2%	4.5%	1.9%	0.8%
	Three+ Worker	None	-	-	-	-	-	-	-	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		Deficit	154,099	81,141	37,085	18,447	31,980	4,665	784	-	47.0%	24.7%	11.3%	5.6%	9.7%	1.4%	0.2%	0.0%
		Even	493,100	415,151	159,172	105,917	81,419	47,314	2,863	954	37.8%	31.8%	12.2%	8.1%	6.2%	3.6%	0.2%	0.1%
		Surplus	300,020	248,137	68,317	35,697	78,896	28,150	3,817	3,395	39.1%	32.4%	8.9%	4.7%	10.3%	3.7%	0.5%	0.4%

Table D.11 Travel Time Distribution of Trips by Respondent's Age Group across MTC Surveys

		Less than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	18 to 34	1,393,043	1,084,855	628,213	365,527	357,356	184,045	49,106	38,217
	35 to 54	3,823,587	2,903,095	1,593,570	898,495	926,960	457,377	130,578	123,224
	55 to 64	1,654,899	1,196,225	651,006	353,371	350,667	159,030	48,019	70,403
	65 and over	1,576,353	1,114,869	467,420	252,773	197,231	75,448	33,090	53,101
	Refused or Unknown	2,346	5,107	-	241	380	1,783	-	-
	All	8,450,229	6,304,152	3,340,209	1,870,406	1,832,593	877,683	260,793	284,945
MTC II	18 to 34	936,112	416,786	239,286	129,524	210,804	111,354	17,187	7,152
	35 to 54	4,922,859	3,074,093	1,625,757	864,179	915,930	576,580	186,176	78,741
	55 to 64	2,394,889	1,674,320	743,034	430,783	513,778	239,424	70,411	74,906
	65 and over	2,429,040	1,384,558	614,836	327,293	249,365	114,362	41,011	45,076
	Refused or Unknown	8,282	-	-	-	-	-	-	-
	All	10,691,182	6,549,757	3,222,913	1,751,779	1,889,878	1,041,720	314,785	205,875

Figure D.9 Travel Time Distribution of Trips by Respondent's Age Group across MTC Surveys

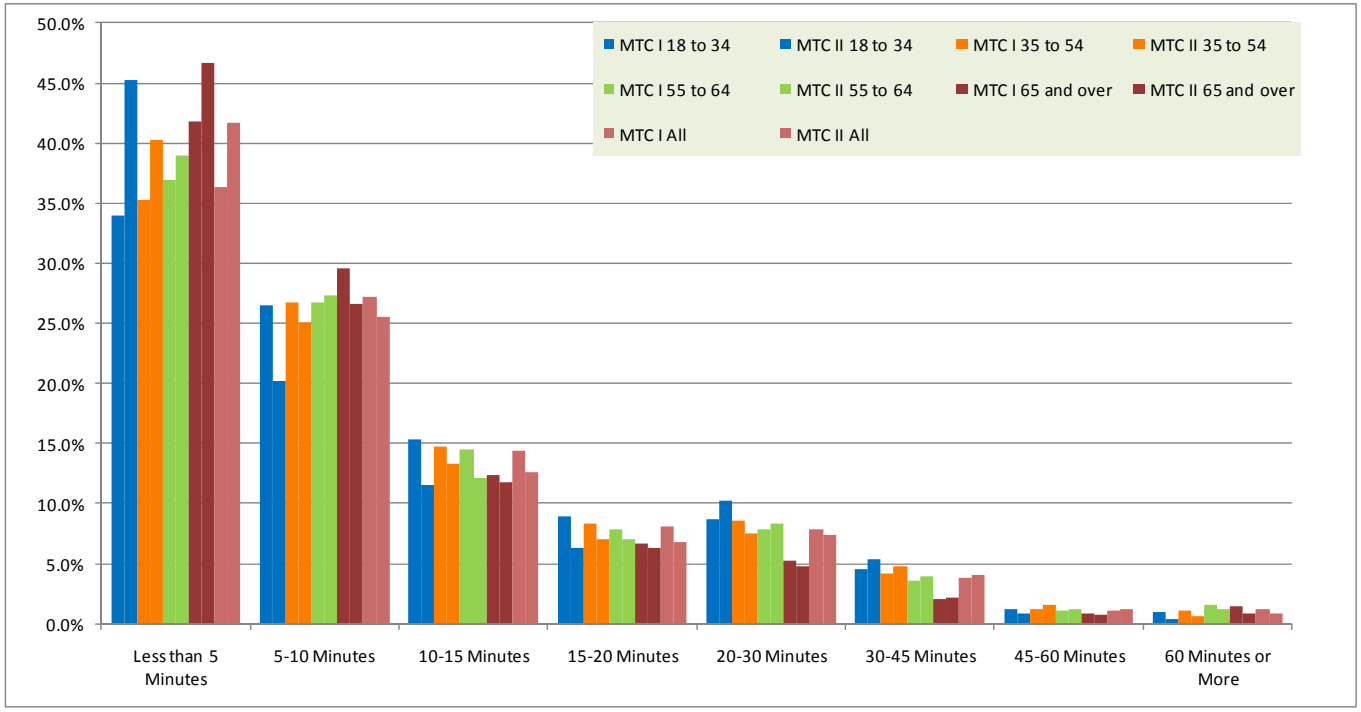


Table D.12 Travel Time Distribution of Trips by Respondent's Gender across MTC Surveys

		Less than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	Male	4,744,349	3,648,918	1,942,716	1,098,625	1,073,262	543,906	171,601	175,872
	Female	6,607,058	4,683,000	2,332,212	1,152,084	984,677	400,178	102,742	125,808
	Refused	1,211	4,829	251	1,222	1,655	-	-	-
	All	11,352,618	8,336,747	4,275,179	2,251,930	2,059,594	944,084	274,343	301,680
MTC II	Male	6,228,543	3,603,354	1,966,808	990,800	1,027,627	661,022	175,930	123,874
	Female	8,201,456	4,728,524	2,061,289	995,996	1,012,629	405,205	160,399	110,147
	Refused	-	-	-	-	-	4,171	-	-
	All	14,429,999	8,331,878	4,028,097	1,986,795	2,040,256	1,070,398	336,329	234,021

Figure D.10 Travel Time Distribution of Trips by Respondent's Gender across MTC Surveys

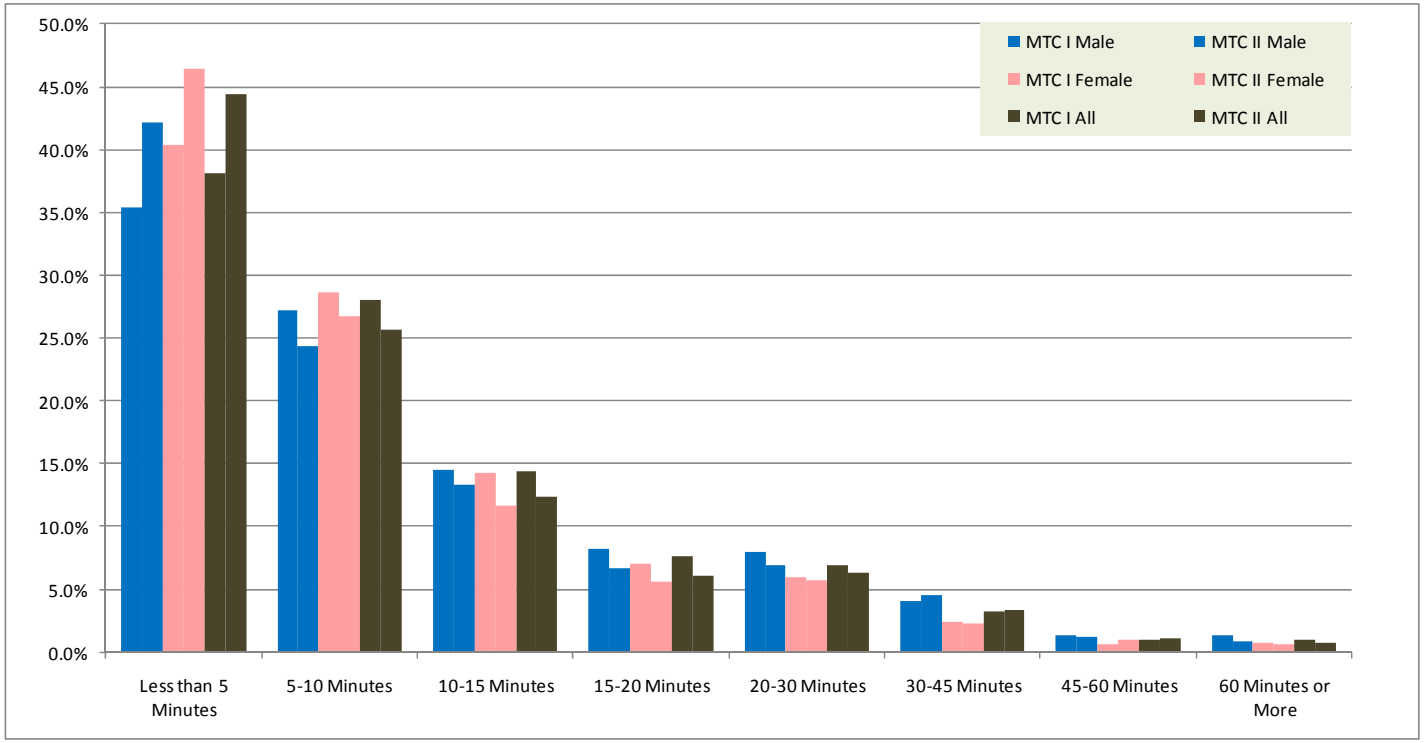


Table D.13 Travel Time Distribution of Trips by Respondent's Employment Status across MTC Surveys

		Less than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	Non-Worker	5,887,350	4,105,295	1,850,501	835,205	585,980	221,360	69,861	105,720
	Paid Worker	5,462,278	4,230,828	2,422,503	1,416,219	1,473,614	722,582	203,755	195,959
	All	11,349,628	8,336,123	4,273,004	2,251,424	2,059,594	943,942	273,616	301,680
MTC II	Non-Worker	8,149,318	4,132,378	1,887,814	742,187	528,273	197,554	82,663	100,849
	Paid Worker	6,181,460	4,143,915	2,129,341	1,233,182	1,486,364	860,553	253,666	133,172
	All	14,330,777	8,276,292	4,017,155	1,975,369	2,014,638	1,058,107	336,329	234,021

Figure D.11 Travel Time Distribution of Trips by Respondent's Employment Status across MTC Surveys

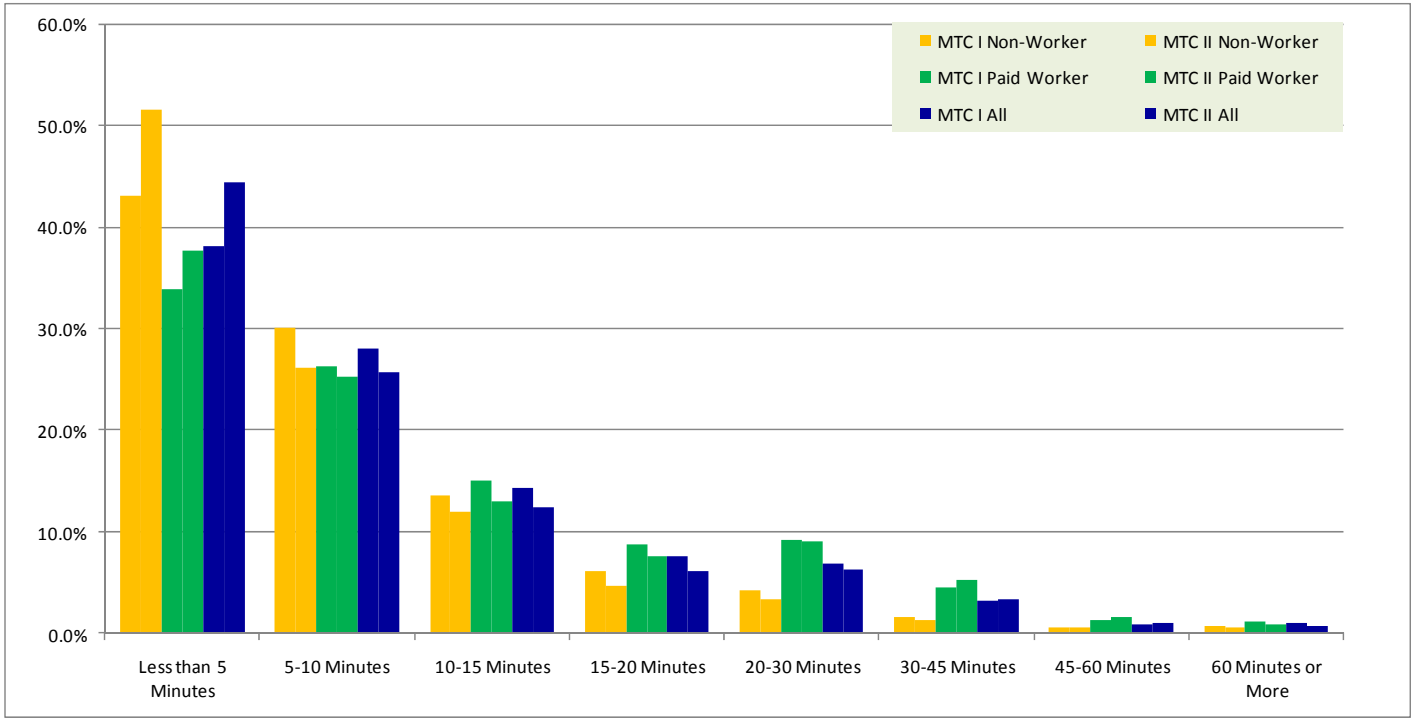


Table D.14 Travel Time Distribution of Home Based Work Trips by Sample Area across MTC Surveys

		Less than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	SEMCOG	358,163	453,332	469,020	280,005	417,317	182,860	56,402	12,302
	Small Cities	87,790	31,232	6,986	6,039	5,567	8,392	2,643	2,619
	Upper Peninsula Rural	28,361	22,012	13,279	13,297	12,001	5,433	2,764	2,264
	Northern Lower Peninsula	46,452	40,504	35,807	29,030	36,105	19,652	6,421	6,103
	Southern Lower Peninsula	78,429	89,401	89,443	69,288	104,396	81,457	20,624	14,573
	TMAs	117,323	188,008	174,928	114,746	96,430	46,569	15,574	15,370
	Small Urban Modeled Areas	162,161	192,572	129,092	102,552	83,549	49,378	10,887	9,629
	Statewide	878,679	1,017,062	918,556	614,957	755,364	393,740	115,316	62,860
MTC II	SEMCOG	259,264	494,033	338,111	230,669	499,847	285,890	84,023	41,373
	Small Cities	110,713	26,271	6,868	5,064	4,712	6,161	2,234	1,821
	Upper Peninsula Rural	68,066	28,726	26,566	15,824	14,299	6,374	459	1,665
	Northern Lower Peninsula	87,293	81,323	44,840	37,332	30,819	32,975	9,061	8,134
	Southern Lower Peninsula	148,758	110,366	88,868	52,351	100,443	50,425	14,610	4,197
	TMAs	193,717	248,255	146,169	118,789	75,627	44,498	18,934	11,771
	Small Urban Modeled Areas	165,090	236,552	176,712	54,117	88,725	56,276	4,348	6,641
	Statewide	1,032,900	1,225,527	828,133	514,146	814,471	482,598	133,668	75,603

Figure D.12 Travel Time Distribution of Home Based Work Trips by Sample Area across MTC Surveys

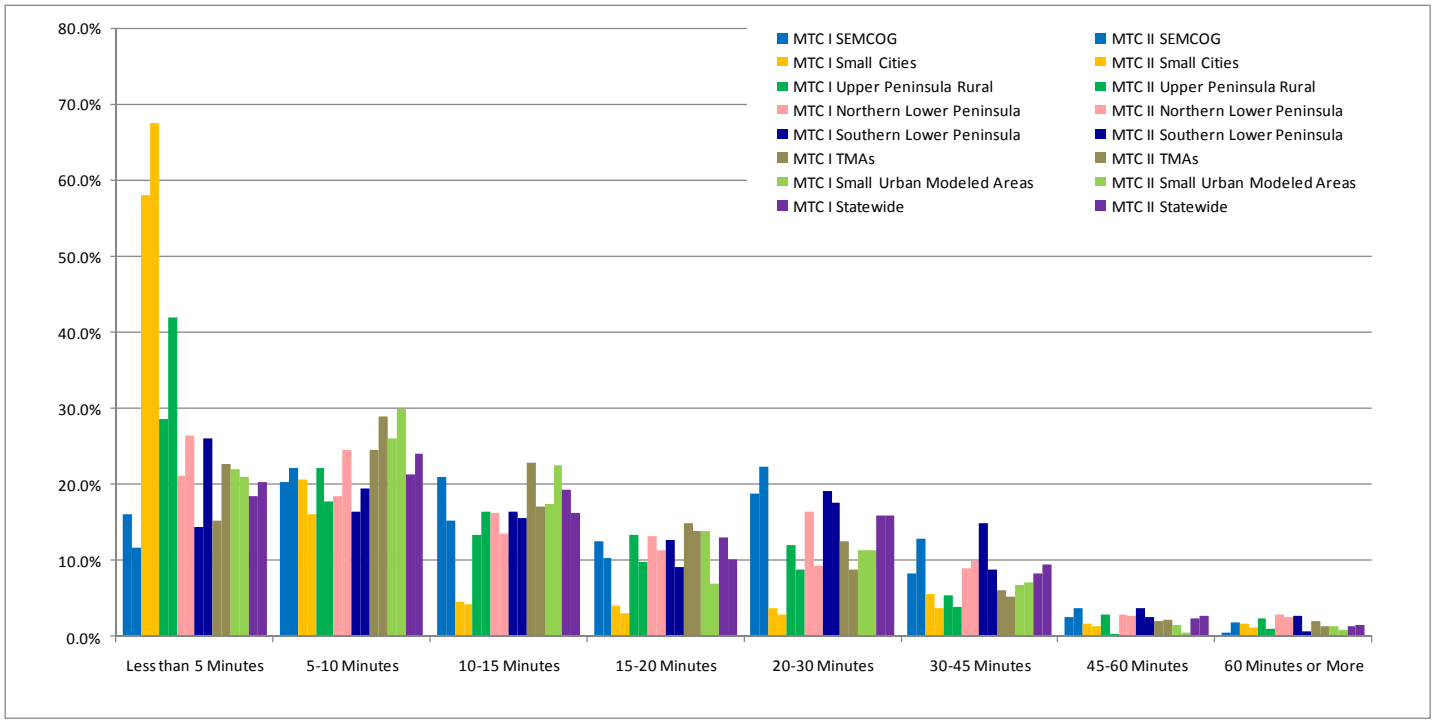


Table D.15 Travel Time Distribution of Home Based School Trips by Sample Area across MTC Surveys

		Less than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	SEMCOG	736,874	440,446	167,324	82,600	31,525	15,987	2,613	3,338
	Small Cities	55,975	12,803	1,526	1,577	619	335	169	109
	Upper Peninsula Rural	21,497	16,810	10,271	5,118	6,022	1,459	343	423
	Northern Lower Peninsula	31,253	35,044	30,854	17,656	11,479	5,025	1,220	529
	Southern Lower Peninsula	74,210	114,680	70,883	31,463	14,110	4,882	2,638	900
	TMAs	175,549	163,999	73,014	21,213	14,403	2,032	270	1,359
	Small Urban Modeled Areas	159,007	123,619	77,219	29,883	15,516	7,222	1,971	-
	Statewide	1,254,365	907,400	431,092	189,509	93,674	36,942	9,225	6,658
MTC II	SEMCOG	731,873	343,484	253,780	31,255	40,976	11,797	21,543	-
	Small Cities	70,199	5,392	359	-	-	-	-	-
	Upper Peninsula Rural	54,505	19,631	6,162	5,598	4,181	-	-	-
	Northern Lower Peninsula	88,261	78,040	14,100	12,466	6,942	1,267	1,909	-
	Southern Lower Peninsula	149,539	150,274	52,574	12,752	15,437	2,819	-	5,481
	TMAs	327,599	110,900	53,164	8,067	26,102	-	-	-
	Small Urban Modeled Areas	255,472	140,680	36,619	18,334	16,009	-	-	16,991
	Statewide	1,677,448	848,400	416,758	88,471	109,647	15,883	23,452	22,472

Figure D.13 Travel Time Distribution of Home Based School Trips by Sample Area across MTC Surveys

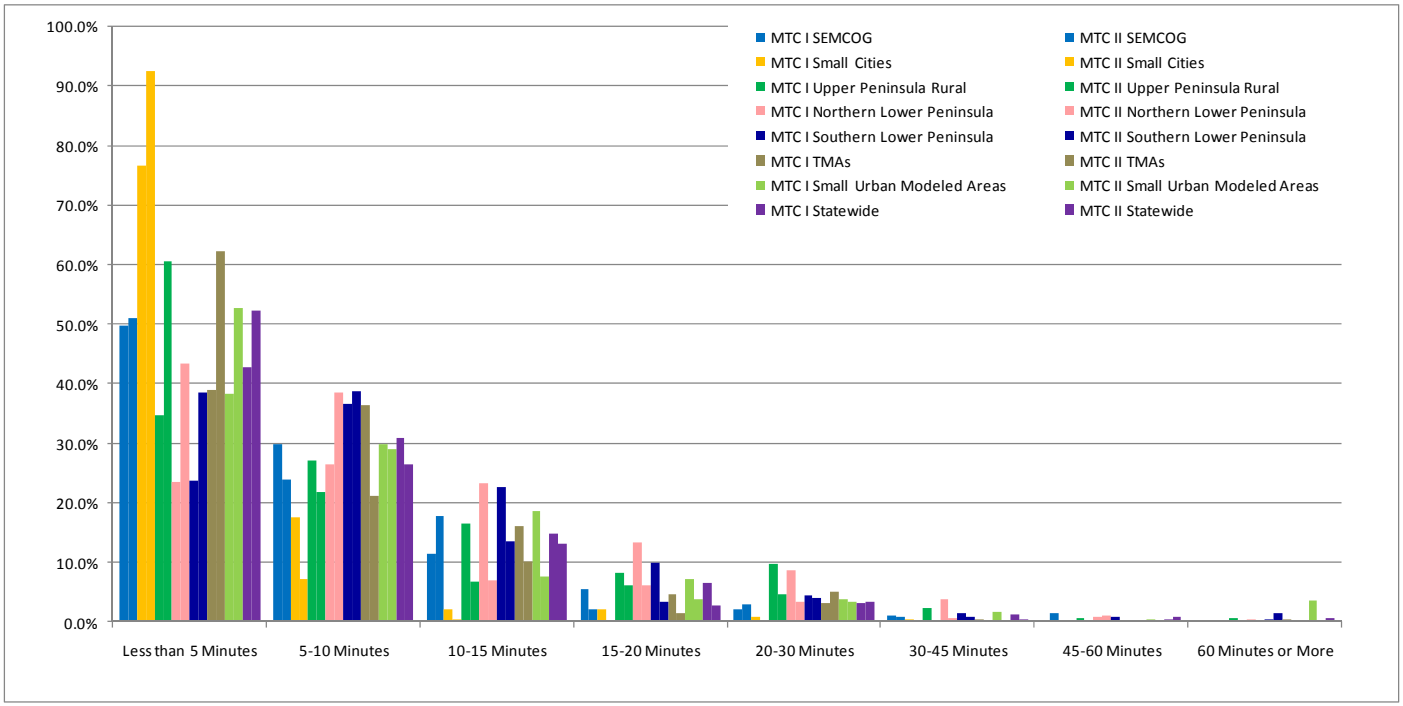


Table D.16 Travel Time Distribution of Home Based Other Trips by Sample Area across MTC Surveys

		Less than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	SEMCOG	2,546,828	1,954,133	755,797	313,496	264,800	71,208	19,350	19,868
	Small Cities	270,039	77,261	16,196	9,953	8,720	5,949	3,209	4,181
	Upper Peninsula Rural	97,871	56,789	34,686	23,944	22,505	10,469	4,304	7,563
	Northern Lower Peninsula	137,188	129,908	99,685	65,623	60,825	31,920	8,383	12,980
	Southern Lower Peninsula	317,568	338,109	235,703	157,636	142,719	61,816	18,033	20,879
	TMAs	720,326	618,426	292,813	127,750	87,953	28,428	11,305	16,252
	Small Urban Modeled Areas	684,288	596,852	301,602	143,505	91,064	34,295	10,557	13,724
	Statewide	4,774,108	3,771,478	1,736,482	841,907	678,586	244,085	75,141	95,446
MTC II	SEMCOG	3,206,010	1,940,042	789,242	412,586	326,957	119,103	60,988	4,835
	Small Cities	330,963	58,402	17,313	5,976	7,020	7,635	833	7,662
	Upper Peninsula Rural	178,500	90,146	35,433	19,719	13,263	8,356	5,193	4,749
	Northern Lower Peninsula	332,340	185,711	122,141	83,262	51,702	31,253	17,258	23,197
	Southern Lower Peninsula	605,057	350,233	229,548	103,381	97,370	34,200	6,902	5,900
	TMAs	1,147,468	645,609	249,294	159,541	88,805	17,770	15,195	9,041
	Small Urban Modeled Areas	942,294	601,888	207,117	64,235	74,105	37,868	3,487	13,972
	Statewide	6,742,632	3,872,031	1,650,089	848,700	659,222	256,185	109,855	69,356

Figure D.14 Travel Time Distribution of Home Based Other Trips by Sample Area across MTC Surveys

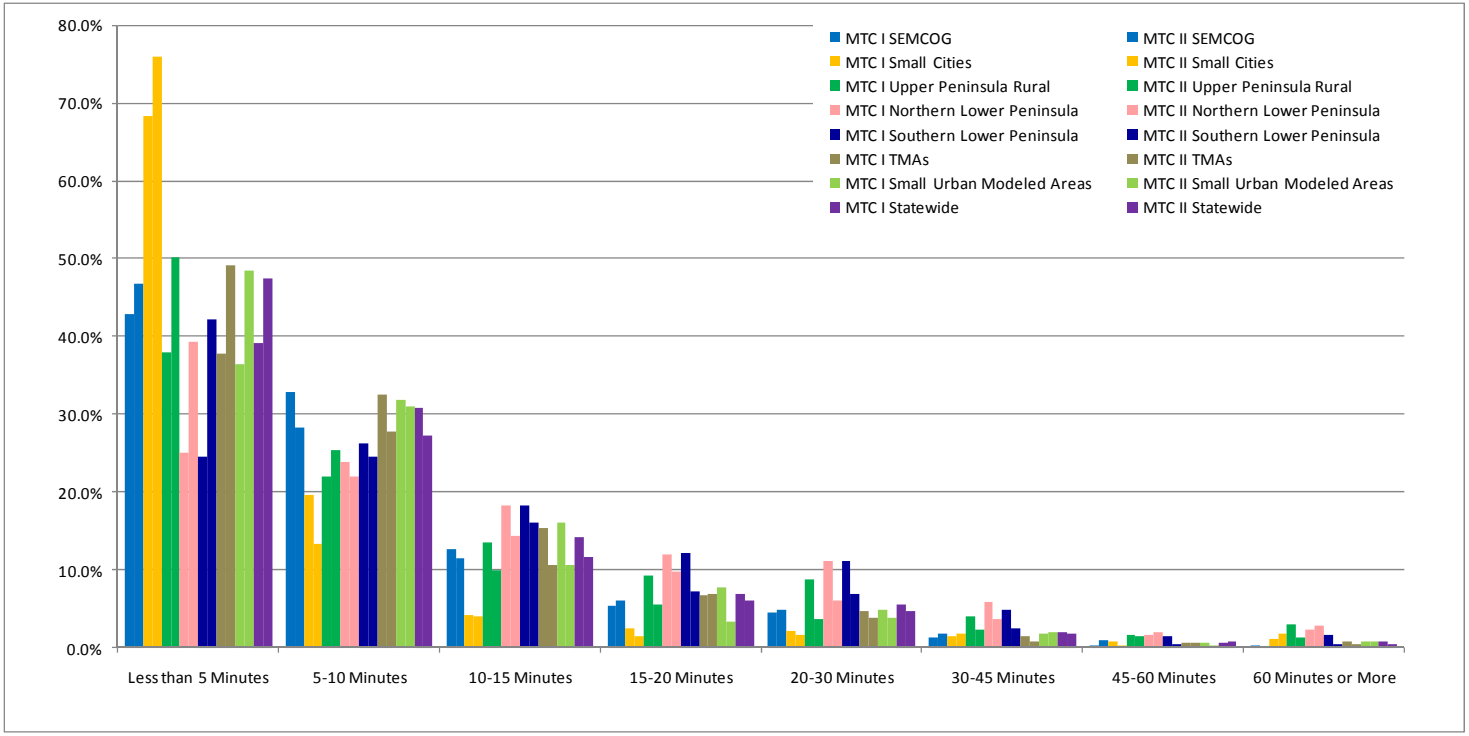


Table D.17 Travel Time Distribution of Non-Home Based Trips by Sample Area across MTC Surveys

		Less than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	SEMCOG	2,022,316	1,314,437	584,746	276,807	232,900	109,580	17,706	31,592
	Small Cities	172,399	51,070	11,824	9,421	8,452	5,795	2,794	5,184
	Upper Peninsula Rural	117,516	42,046	15,918	13,387	11,567	6,375	4,175	7,716
	Northern Lower Peninsula	247,747	102,894	49,754	32,693	36,190	20,990	9,543	11,325
	Southern Lower Peninsula	500,339	238,319	129,771	99,491	105,451	52,105	15,542	29,687
	TMAs	701,721	475,322	220,062	97,682	72,045	31,107	13,098	30,817
	Small Urban Modeled Areas	683,429	416,719	176,973	76,075	65,364	43,363	11,804	20,394
	Statewide	4,445,466	2,640,807	1,189,048	605,556	531,970	269,317	74,661	136,716
MTC II	SEMCOG	1,818,846	1,214,145	628,309	306,661	258,397	176,626	31,137	8,315
	Small Cities	194,382	28,010	8,052	5,149	10,951	6,904	4,084	2,904
	Upper Peninsula Rural	187,044	42,002	17,203	11,239	6,808	3,602	-	2,135
	Northern Lower Peninsula	430,127	101,127	55,514	46,186	28,885	19,278	5,263	22,313
	Southern Lower Peninsula	568,695	218,976	120,405	60,682	54,953	59,400	12,214	7,981
	TMAs	795,961	386,666	131,469	70,034	45,327	18,215	7,910	17,463
	Small Urban Modeled Areas	847,471	353,969	162,985	32,995	45,469	25,970	8,745	4,264
	Statewide	4,842,525	2,344,895	1,123,937	532,945	450,791	309,995	69,354	65,374

Figure D.15 Travel Time Distribution of Non-Home Based Trips by Sample Area across MTC Surveys

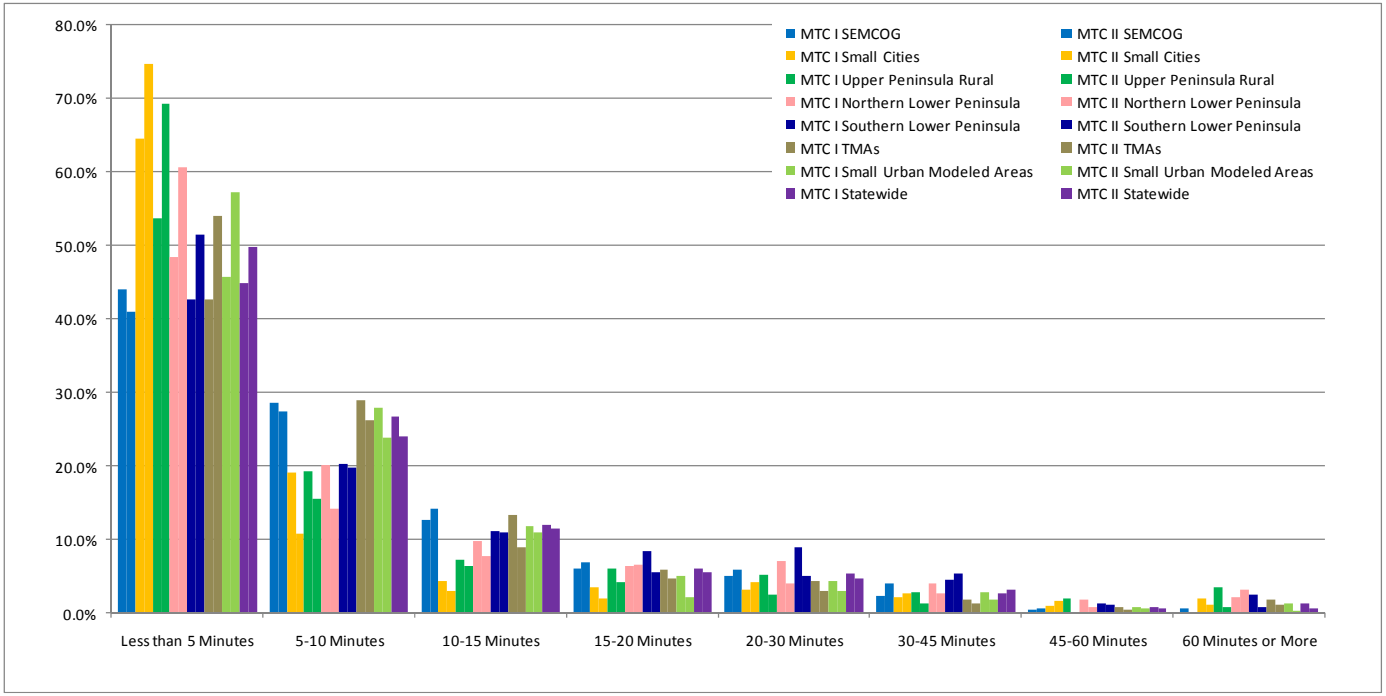


Table D.18 Travel Time Distribution for Auto Trips by Sample Area across MTC Surveys

		Less than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	SEMCOG	4,532,345	3,781,546	1,819,327	906,315	926,803	372,067	93,815	54,123
	Small Cities	495,404	158,086	35,065	26,038	22,725	20,188	8,655	11,418
	Upper Peninsula Rural	227,779	124,027	65,386	50,628	47,229	21,517	11,257	17,214
	Northern Lower Peninsula	407,185	279,809	189,469	129,826	136,814	74,982	24,807	29,766
	Southern Lower Peninsula	854,966	692,125	471,474	334,077	357,588	197,337	53,560	62,776
	TMAs	1,423,373	1,306,893	713,076	346,606	262,218	106,053	38,831	57,455
	Small Urban Modeled Areas	1,421,398	1,230,635	638,008	338,072	250,700	131,913	33,526	39,149
	Statewide	9,362,450	7,573,122	3,931,806	2,131,561	2,004,077	924,058	264,450	271,902
MTC II	SEMCOG	5,078,687	3,651,683	1,879,423	941,971	1,111,093	573,161	197,691	54,523
	Small Cities	599,626	111,590	32,592	16,189	22,683	21,136	7,151	12,202
	Upper Peninsula Rural	403,842	168,711	80,345	50,021	34,825	18,332	4,801	8,549
	Northern Lower Peninsula	840,351	402,299	226,435	173,978	115,654	82,833	30,950	48,808
	Southern Lower Peninsula	1,333,116	712,543	457,729	226,409	259,303	143,448	33,726	23,558
	TMAs	2,130,909	1,288,461	536,329	344,003	225,483	80,482	32,448	38,275
	Small Urban Modeled Areas	1,849,261	1,246,229	579,188	165,956	228,002	124,462	16,580	18,236
	Statewide	12,235,793	7,581,516	3,792,040	1,918,527	1,997,044	1,043,854	323,348	204,152

Table D.16 Travel Time Distribution for Auto Trips by Sample Area across MTC Surveys

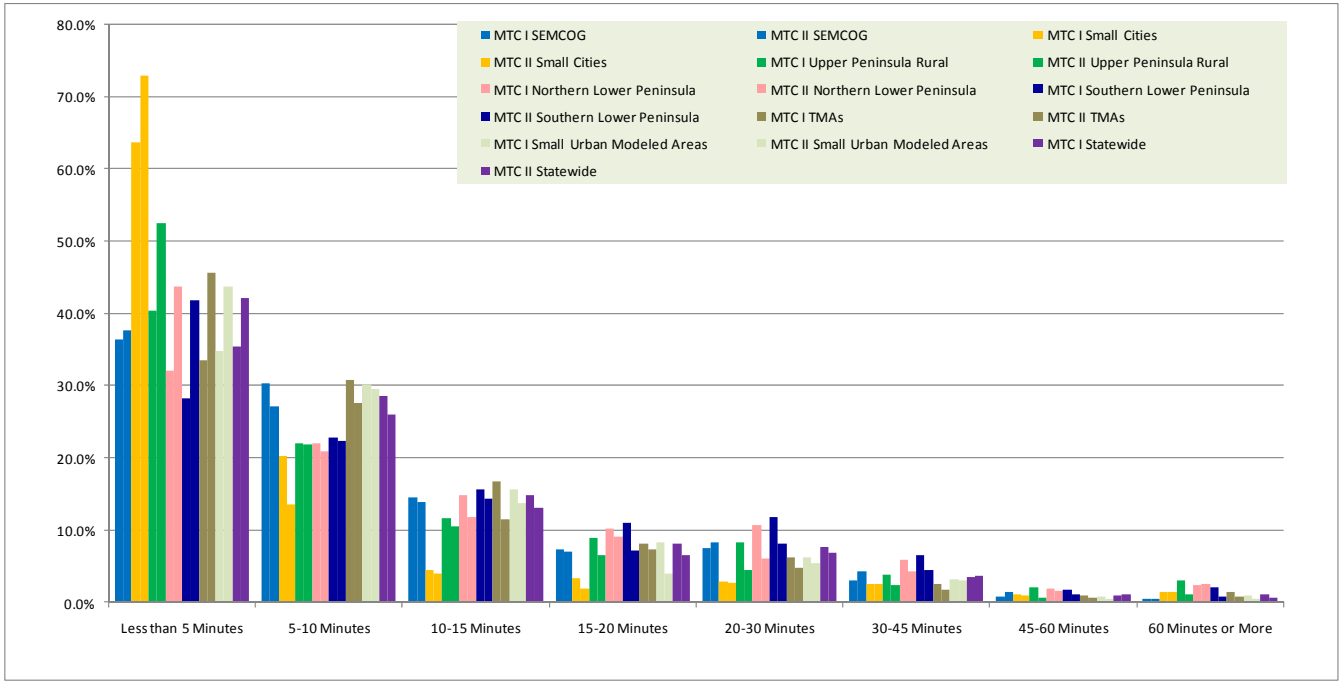


Table D.19 Travel Time Distribution for Non-Auto Trips by Sample Area across MTC Surveys

		Less than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	SEMCOG	1,131,836	380,802	157,561	46,593	19,738	7,568	2,256	12,977
	Small Cities	90,799	14,123	1,467	952	634	283	161	676
	Upper Peninsula Rural	37,465	13,629	8,629	5,119	4,866	2,218	329	753
	Northern Lower Peninsula	54,951	28,417	26,631	15,175	7,785	2,605	760	1,171
	Southern Lower Peninsula	115,580	88,384	54,326	23,800	9,088	2,924	3,277	3,262
	TMAs	291,546	138,736	47,742	14,786	8,613	2,083	1,416	6,342
	Small Urban Modeled Areas	266,997	97,045	45,835	13,944	4,793	2,346	1,694	4,598
	Statewide	1,989,173	761,136	342,192	120,369	55,517	20,027	9,893	29,778
MTC II	SEMCOG	1,026,663	365,417	133,872	39,199	15,085	7,706	-	-
	Small Cities	108,157	6,485	-	-	-	-	-	397
	Upper Peninsula Rural	85,159	12,425	5,019	2,360	3,726	-	850	-
	Northern Lower Peninsula	101,800	47,783	11,427	7,802	3,746	2,894	2,540	5,840
	Southern Lower Peninsula	147,135	121,120	35,395	2,757	10,278	3,395	-	-
	TMAs	343,646	107,734	43,767	12,426	10,378	-	9,591	-
	Small Urban Modeled Areas	381,647	89,398	6,577	3,725	-	-	-	23,632
	Statewide	2,194,206	750,362	236,057	68,269	43,212	13,995	12,981	29,869

Table D.17 Travel Time Distribution for Non-Auto Trips by Sample Area across MTC Surveys

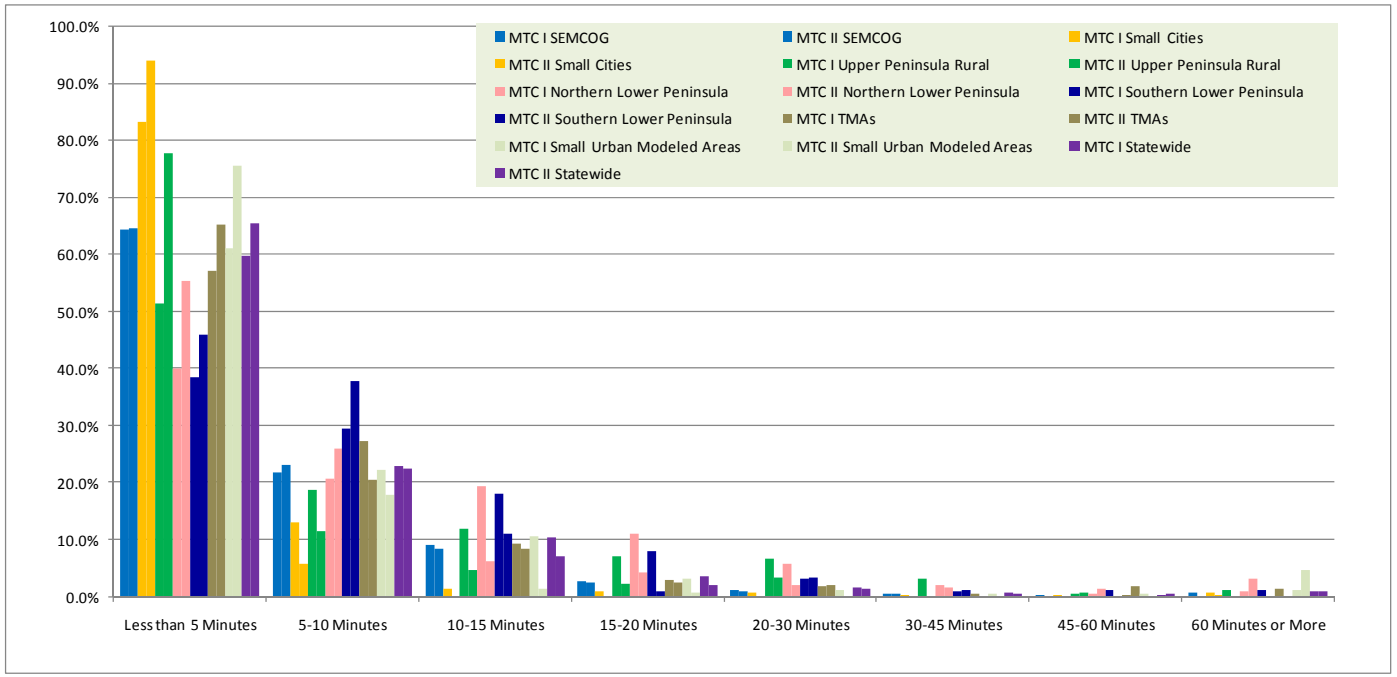


Table D.20 Travel Time Distribution for Drive Alone Trips by Sample Area and MTC Surveys

		Less than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	SEMCOG	2,366,804	1,944,628	1,068,112	612,058	721,263	300,332	77,062	27,550
	Small Cities	282,901	94,586	19,042	13,952	12,981	12,376	4,783	5,652
	Upper Peninsula Rural	130,432	66,959	36,087	28,807	25,440	11,011	4,613	6,634
	Northern Lower Peninsula	228,029	148,478	103,234	70,391	76,402	43,708	13,248	12,450
	Southern Lower Peninsula	447,936	321,804	249,994	176,038	203,489	130,396	36,802	29,446
	TMAs	753,436	690,737	421,979	224,095	167,801	72,911	25,555	27,996
	Small Urban Modeled Areas	773,408	672,712	346,979	203,439	158,353	79,431	20,972	19,965
	Statewide	4,982,945	3,939,904	2,245,427	1,328,780	1,365,730	650,165	183,036	129,693
MTC II	SEMCOG	2,301,971	1,953,422	1,144,497	620,535	844,246	506,744	103,458	49,688
	Small Cities	342,269	70,443	17,107	9,489	15,183	12,699	5,440	4,045
	Upper Peninsula Rural	221,500	81,092	59,049	29,346	21,216	10,797	459	3,943
	Northern Lower Peninsula	430,276	227,393	109,803	96,308	71,737	45,980	13,249	18,070
	Southern Lower Peninsula	746,190	367,565	237,214	136,492	189,215	101,906	26,218	17,690
	TMAs	1,157,433	751,751	336,718	204,310	144,864	67,324	18,807	20,647
	Small Urban Modeled Areas	995,961	697,699	373,540	111,510	164,859	88,303	13,423	12,874
	Statewide	6,195,599	4,149,366	2,277,928	1,207,992	1,451,319	833,752	181,054	126,957

Figure D.18 Travel Time Distribution for Drive Alone Trips by Sample Area and MTC Surveys

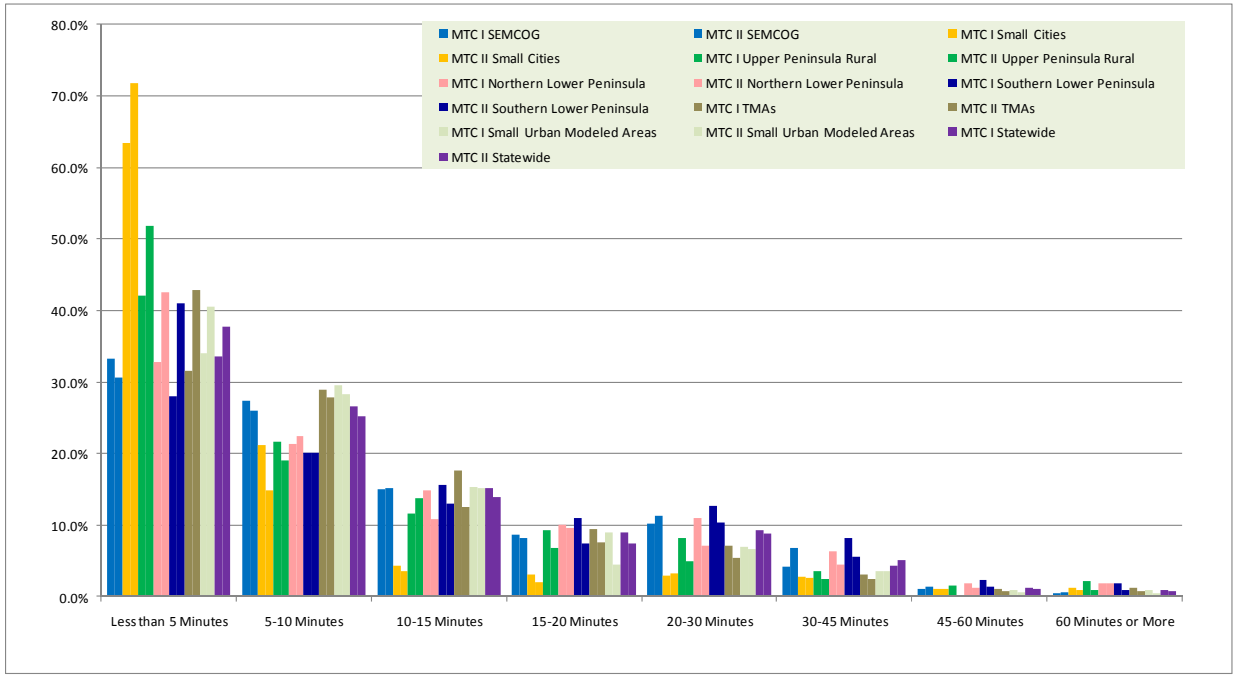


Table D.21 Travel Time Distribution for Trips by Shared Rides with Two Occupants by Sample Area and MTC Surveys

		Less than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	SEMCOG	1,240,541	1,131,930	439,140	196,793	147,925	45,622	17,623	19,587
	Small Cities	142,358	44,732	10,096	7,228	6,492	5,989	1,994	3,960
	Upper Peninsula Rural	65,199	34,421	17,236	14,274	13,001	6,944	4,818	6,802
	Northern Lower Peninsula	119,300	83,153	56,368	39,504	42,512	20,363	9,052	12,465
	Southern Lower Peninsula	228,230	203,589	110,548	90,143	81,316	44,990	13,679	21,197
	TMAs	394,611	372,536	174,906	71,084	54,793	18,337	8,149	20,738
	Small Urban Modeled Areas	391,076	345,979	169,607	80,335	60,554	36,746	7,922	9,339
	Statewide	2,581,314	2,216,340	977,902	499,360	406,593	178,990	63,237	94,088
MTC II	SEMCOG	1,441,203	1,086,816	465,350	210,119	214,382	68,132	51,897	4,835
	Small Cities	170,886	22,687	8,979	1,712	1,951	5,288	871	4,361
	Upper Peninsula Rural	135,604	57,162	16,377	16,210	10,138	5,651	4,343	4,154
	Northern Lower Peninsula	287,118	116,795	65,225	40,484	26,776	29,623	16,164	15,946
	Southern Lower Peninsula	361,676	209,548	98,074	57,763	40,664	15,426	3,373	-
	TMAs	622,193	370,981	93,641	64,199	44,822	8,034	13,641	12,124
	Small Urban Modeled Areas	553,498	296,211	156,989	49,333	36,677	33,002	-	2,723
	Statewide	3,572,180	2,160,201	904,635	439,820	375,410	165,156	90,289	44,144

Figure D.19 Travel Time Distribution for Trips by Shared Rides with Two Occupants by Sample Area and MTC Surveys

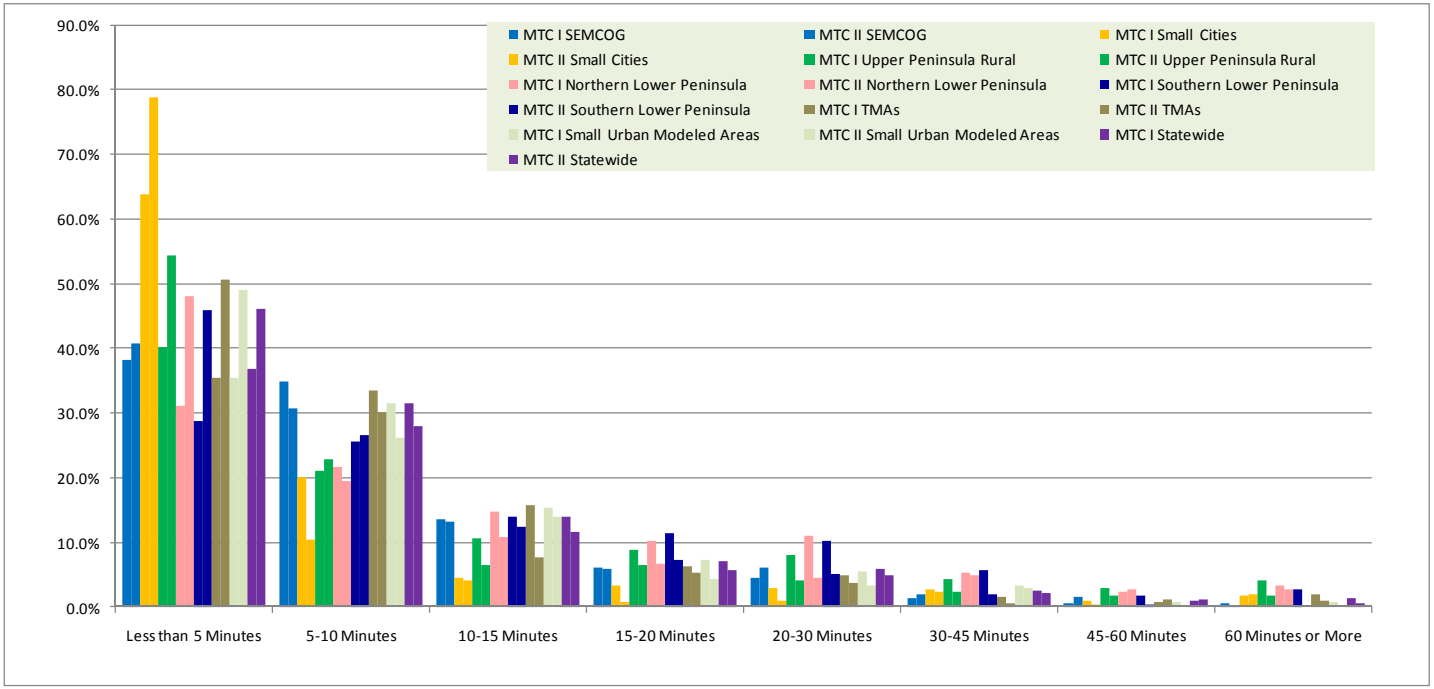


Table D.22 Travel Time Distribution for Trips by Shared Rides with Three or More Occupants by Sample Area and MTC Surveys

		Less than 5 Minutes	5-10 Minutes	10-15 Minutes	15-20 Minutes	20-30 Minutes	30-45 Minutes	45-60 Minutes	60 Minutes or More
MTC I	SEMCOG	928,183	703,934	315,871	96,593	56,743	26,112	-	5,203
	Small Cities	70,236	19,123	6,033	4,858	3,359	1,823	1,878	1,712
	Upper Peninsula Rural	32,119	22,962	12,229	7,792	8,862	3,455	1,784	3,629
	Northern Lower Peninsula	60,381	48,359	30,378	20,782	17,717	11,043	2,507	4,598
	Southern Lower Peninsula	179,680	168,359	111,143	68,652	72,769	22,160	5,116	10,701
	TMAs	274,581	244,433	116,717	52,828	39,877	15,062	5,127	7,894
	Small Urban Modeled Areas	257,548	212,810	123,876	54,292	31,252	15,474	4,631	9,846
	Statewide	1,802,728	1,419,981	716,247	305,797	230,580	95,129	21,043	43,582
MTC II	SEMCOG	1,361,833	576,053	269,577	102,506	52,466	-	42,336	-
	Small Cities	84,392	17,767	6,505	4,988	5,549	3,149	839	3,796
	Upper Peninsula Rural	44,477	28,747	4,535	4,465	3,019	1,884	-	-
	Northern Lower Peninsula	127,189	58,111	51,407	37,185	17,142	7,231	1,537	13,827
	Southern Lower Peninsula	200,219	136,492	117,607	27,732	28,046	24,737	2,757	4,171
	TMAs	340,053	158,073	109,456	72,026	30,608	5,125	-	5,504
	Small Urban Modeled Areas	291,314	244,037	50,615	5,112	26,466	3,157	3,157	2,639
	Statewide	2,449,478	1,219,279	609,701	254,015	163,296	45,283	50,626	29,937

Figure D.20 Travel Time Distribution for Shared Rides with Three or More Occupants by Sample Area and MTC Surveys

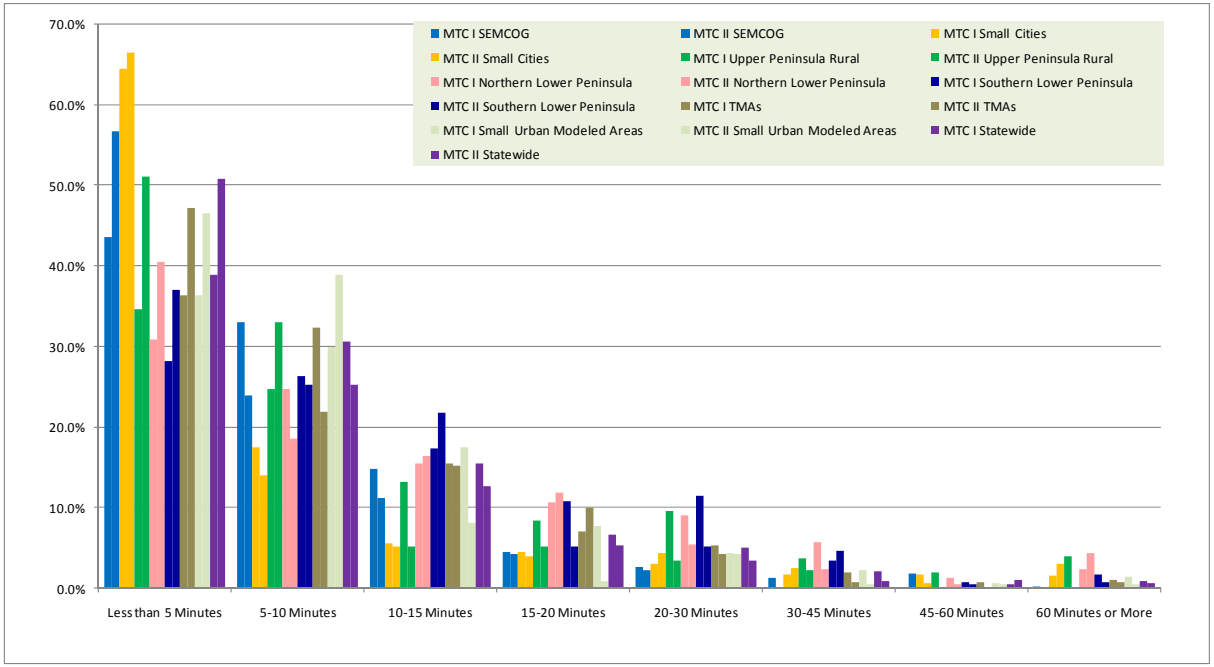


Table D.23 Modal Distribution of Trips by Number of Workers in the Household, Auto Sufficiency and MTC Surveys

		MTC I			MTC II			MTC I			MTC II		
		Drove Alone	Shared - 2	Shared - 3+	Drove Alone	Shared - 2	Shared - 3+	Drove Alone	Shared - 2	Shared - 3+	Drove Alone	Shared - 2	Shared - 3+
Zero Worker	None	30,776	150,238	109,122	45,038	121,783	33,439	10.6%	51.8%	37.6%	22.5%	60.8%	16.7%
	Deficit	232,085	352,840	78,487	387,783	372,919	285,300	35.0%	53.2%	11.8%	37.1%	35.7%	27.3%
	Even	1,604,643	949,039	268,161	1,832,880	895,237	286,849	56.9%	33.6%	9.5%	60.8%	29.7%	9.5%
	Surplus	427,822	227,741	79,496	547,338	293,732	26,725	58.2%	31.0%	10.8%	63.1%	33.8%	3.1%
One Worker	None	22,143	59,403	88,918	-	38,679	-	13.0%	34.8%	52.2%	0.0%	100.0%	0.0%
	Even	2,002,919	835,517	723,075	1,606,878	516,738	182,582	56.2%	23.5%	20.3%	69.7%	22.4%	7.9%
	Surplus	3,373,113	1,769,679	1,527,369	4,170,133	2,439,082	1,978,405	50.6%	26.5%	22.9%	48.6%	28.4%	23.0%
Two Worker	None	7,176	5,820	6,273	-	2,910	-	37.2%	30.2%	32.6%	0.0%	100.0%	0.0%
	Deficit	397,258	380,677	213,978	179,220	175,568	77,552	40.0%	38.4%	21.6%	41.5%	40.6%	17.9%
	Even	3,919,827	1,785,231	1,598,625	3,649,699	1,666,275	1,264,767	53.7%	24.4%	21.9%	55.5%	25.3%	19.2%
	Surplus	2,548,006	1,025,351	725,872	2,988,801	887,260	540,339	59.3%	23.8%	16.9%	67.7%	20.1%	12.2%
Three or More Worker	None	3,871	-	567	-	-	-	87.2%	0.0%	12.8%	0.0%	0.0%	0.0%
	Deficit	428,704	397,618	214,813	202,036	67,795	8,304	41.2%	38.2%	20.6%	72.6%	24.4%	3.0%
	Even	956,138	320,577	162,968	805,354	371,345	76,146	66.4%	22.3%	11.3%	64.3%	29.6%	6.1%
	Surplus	868,786	268,561	89,550	437,070	167,061	139,627	70.8%	21.9%	7.3%	58.8%	22.5%	18.8%
All	None	63,966	215,461	204,880	45,038	163,372	33,439	13.2%	44.5%	42.3%	18.6%	67.6%	13.8%
	Deficit	1,058,047	1,131,135	507,279	769,039	616,282	371,156	39.2%	41.9%	18.8%	43.8%	35.1%	21.1%
	Even	8,483,528	3,890,364	2,752,828	7,894,810	3,449,595	1,810,345	56.1%	25.7%	18.2%	60.0%	26.2%	13.8%
	Surplus	7,217,727	3,291,332	2,422,288	8,143,343	3,787,135	2,685,096	55.8%	25.5%	18.7%	55.7%	25.9%	18.4%

Figure D.21 Modal Distribution of Trips by Number of Workers in the Household, Auto Sufficiency and MTC Surveys

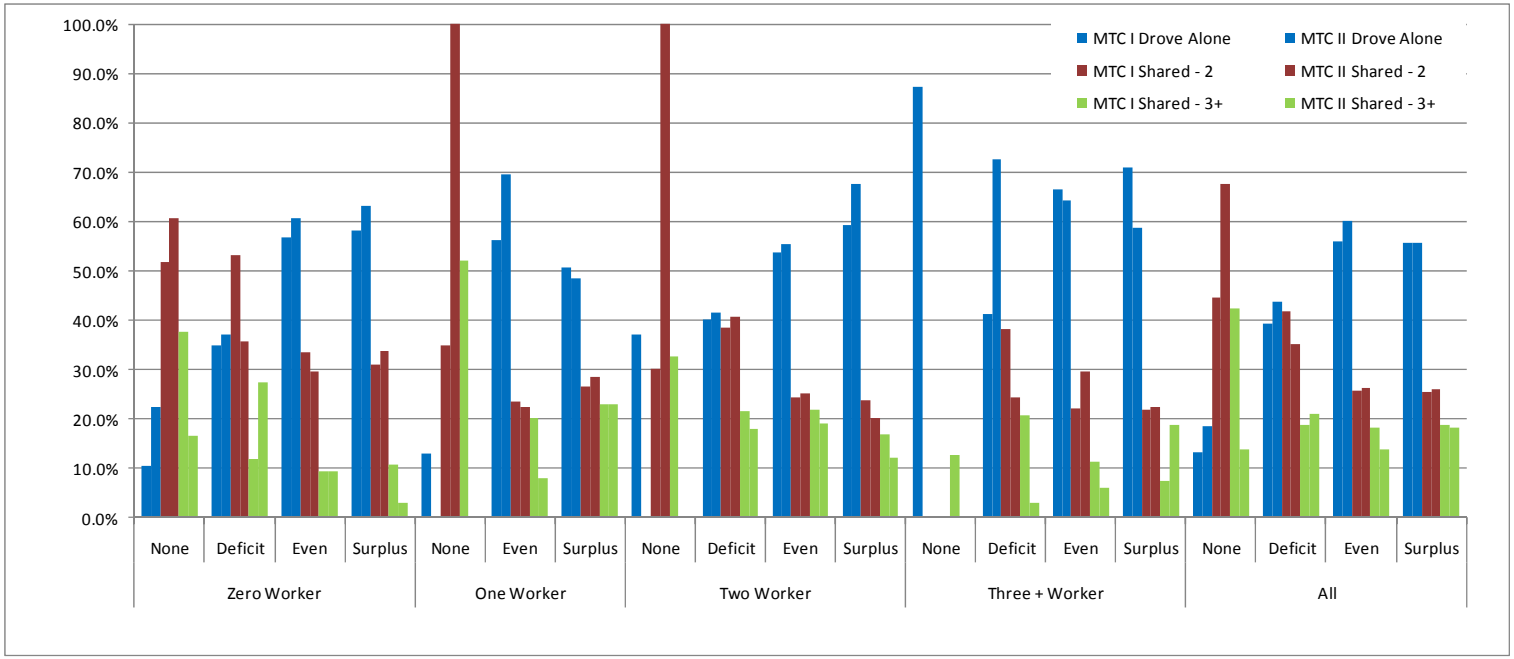


Table D.24 Trip Distribution by Purpose, Time of Day Periods and MTC Surveys

	MTC I			MTC II		
	Drove Alone	Shared - 2	Shared - 3+	Drove Alone	Shared - 2	Shared - 3+
AM Peak	3,165,182	1,329,596	1,138,978	3,278,909	1,283,421	953,250
Mid-Day	6,199,174	3,074,659	1,325,107	6,539,846	2,652,387	896,202
PM Peak	4,213,622	2,183,883	1,808,992	4,209,345	2,181,755	1,821,286
Evening	2,109,761	1,518,671	1,368,643	1,888,044	1,593,849	1,055,250
Late Night	1,134,582	421,482	245,555	989,363	304,973	174,047
Unknown	946	-	-	6,902	-	-
All	16,823,267	8,528,291	5,887,276	16,912,409	8,016,384	4,900,036

Figure D.22 Trip Distribution by Purpose, Time of Day Periods and MTC Surveys

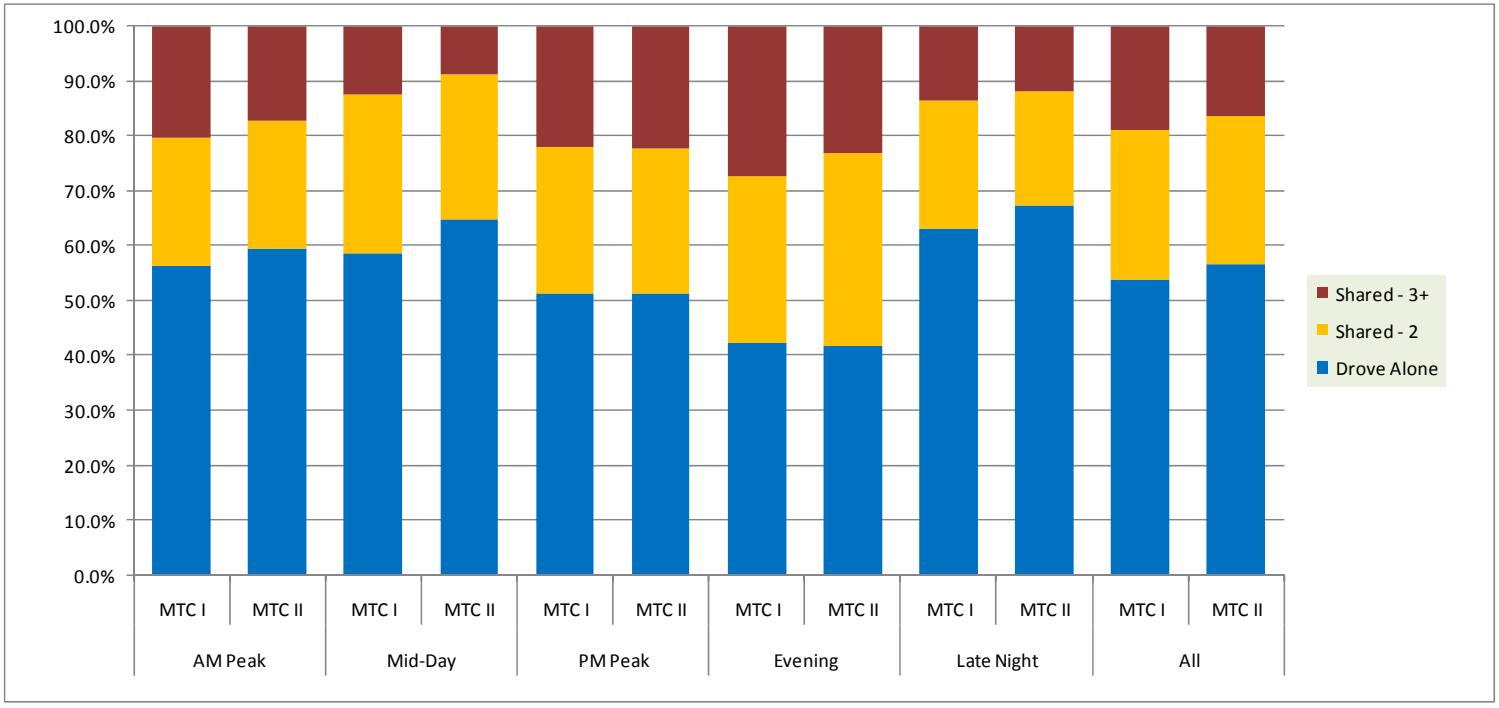


Table D.25 Mean Activity Durations by Activity Type, Gender and Commuting across MTC Surveys

			Travel	Home	Work at Home	Work	Routine Shop	Major Shop	School	Other
MTC I	Male	Non-Commuters	65.04	1026.22	677.26	301.97	40.06	61.43	386.7	215.52
		Commuters	81.61	746.12	431.93	480.31	20.92	43.83	187.53	112.37
	Female	Non-Commuters	67.68	1065.99	614.9	328.03	47.31	73.37	374.99	184.02
		Commuters	77.4	776.39	436.87	473.88	31.42	63.47	133.61	95.37
MTC II	Male	Non-Commuters	59.76	1119.3	755.75	311.16	36.27	35.76	402.2	133.74
		Commuters	78.64	752.16	413.33	489.17	33.27	32.85	325.99	83.02
	Female	Non-Commuters	59.86	1132.66	799.13	333.45	44.05	89.77	379.47	136.12
		Commuters	71.69	779.53	349.86	484.6	32.27	60.74	60.52	109.72

Figure D.23 Mean Activity Durations by Activity Type, Gender and Commuting across MTC Surveys

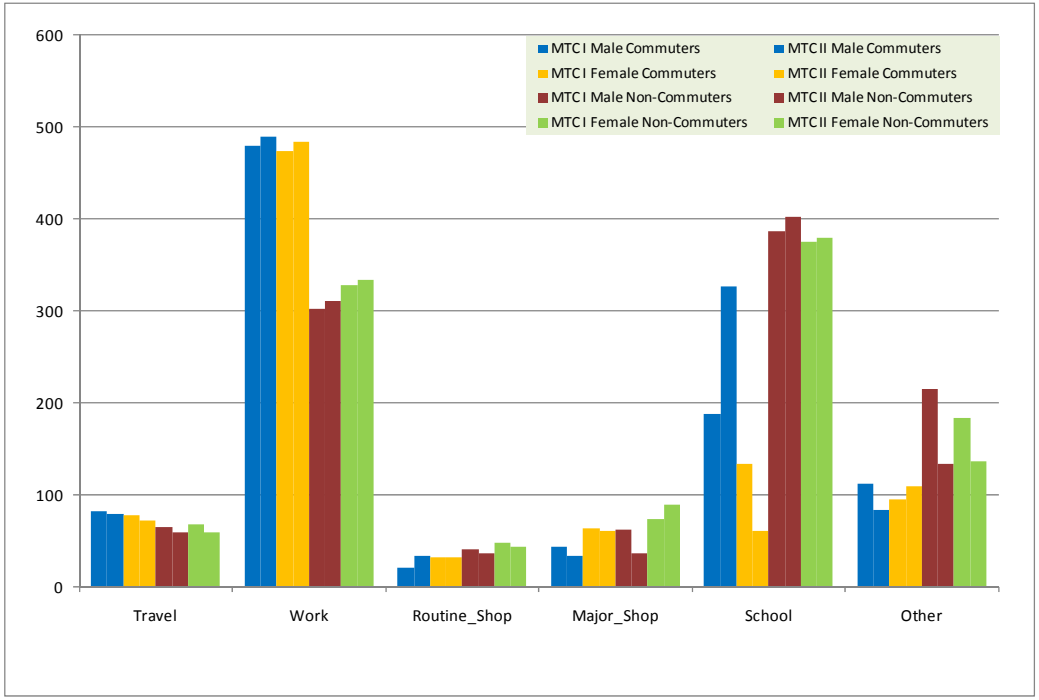
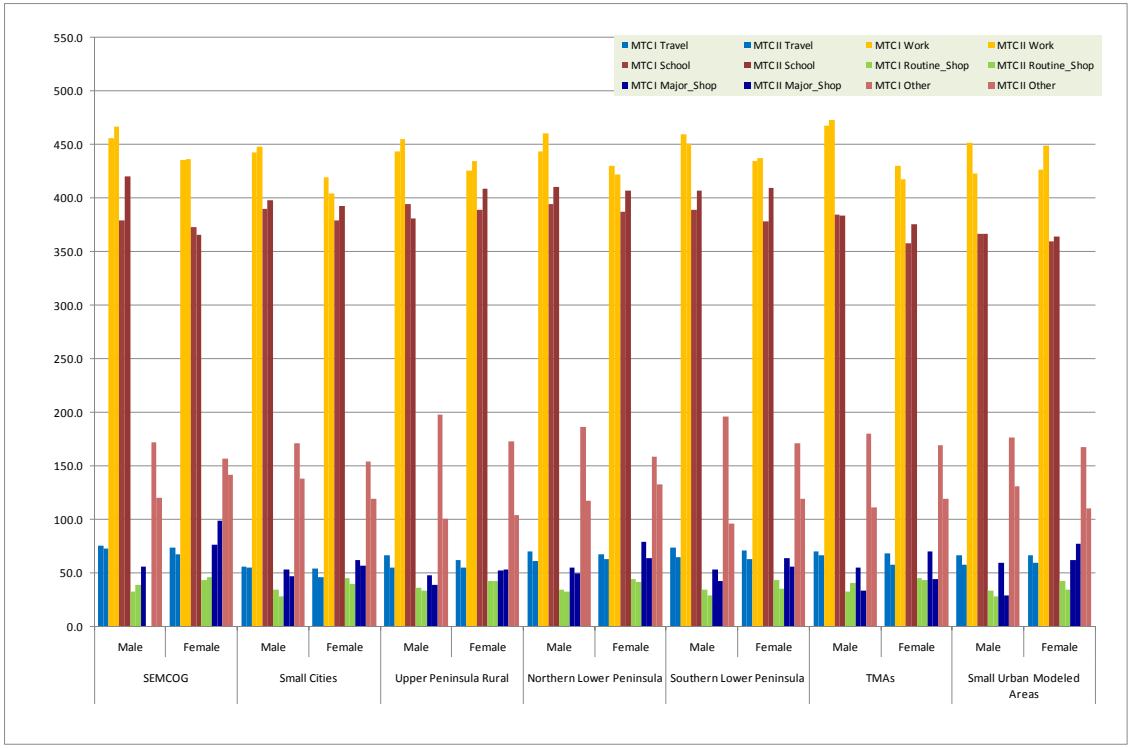


Table D.26 Mean Activity Durations by Activity Type, Sample Areas and Gender across MTC Surveys

		MTC I								MTC II							
		Travel	Home	Work at Home	Work	Routine Shop	Major Shop	School	Other	Travel	Home	Work at Home	Work	Routine Shop	Major Shop	School	Other
SEMCOG	Male	75.3	926.0	564.6	456.1	32.5	55.7	379.5	171.8	72.7	982.1	699.4	466.4	38.7	.	420.2	119.8
	Female	73.7	997.1	484.1	435.3	43.4	76.3	372.8	156.6	67.1	1037.3	257.6	436.6	45.9	98.6	366.0	141.4
Small Cities	Male	56.0	960.6	450.3	442.7	34.3	52.9	389.9	171.3	54.7	1032.0	424.5	448.1	28.4	46.5	397.7	137.5
	Female	54.2	1037.1	576.9	419.2	44.6	62.2	379.0	153.8	45.9	1090.9	647.6	404.0	39.7	56.4	392.2	119.0
Upper Peninsula Rural	Male	65.9	954.6	547.4	443.9	35.7	47.3	394.2	197.8	55.0	1064.7	275.8	454.7	33.4	38.4	380.7	100.7
	Female	62.3	1021.7	537.7	425.7	42.5	51.7	388.9	172.9	54.7	1109.4	309.1	434.2	42.5	53.2	408.4	103.6
Northern Lower Peninsula	Male	70.3	965.3	467.0	443.6	34.2	54.9	394.3	186.4	61.3	1064.9	1400.0	460.2	32.8	49.8	410.2	117.4
	Female	67.5	1032.6	614.9	430.1	44.4	79.0	387.4	158.1	62.4	1057.4	669.3	421.9	41.6	63.4	406.6	132.7
Southern Lower Peninsula	Male	73.8	898.7	472.2	459.8	33.9	53.1	388.6	196.0	64.8	1012.9	631.4	451.0	28.6	42.5	407.0	96.1
	Female	71.3	993.5	459.3	434.2	42.8	63.3	378.1	170.9	63.2	1050.7	716.4	436.8	35.1	55.2	409.6	119.2
TMAs	Male	70.1	900.4	418.2	467.5	32.0	54.9	384.1	179.8	66.4	995.2	190.5	472.6	40.7	33.1	383.2	111.0
	Female	68.1	978.5	605.5	430.1	44.7	70.1	357.9	168.7	57.1	1074.1	646.8	417.4	43.0	43.9	375.6	118.9
Small Urban Modeled Areas	Male	66.5	931.5	544.3	451.2	33.6	59.6	366.7	176.0	57.5	985.5	612.9	423.3	27.6	29.2	367.0	130.8
	Female	66.8	996.3	623.5	426.5	42.0	61.6	359.1	167.0	59.4	1092.5	541.6	449.1	34.0	77.1	363.9	110.5

Figure D.24 Mean Activity Durations by Activity Type, Sample Areas and Gender across MTC Surveys



APPENDIX E

Table E.1 Summary of Results for Comparisons of Trips by Time of Day

	TOD	Frequency	Weighted Frequency	Percent
MTC I ONLY	AM Peak	21,861	5,826,896	19.4%
	Mid-Day	39,888	10,089,192	33.6%
	PM Peak	30,979	7,960,714	26.5%
	Evening	16,506	4,526,659	15.1%
	Late Night	6,125	1,642,495	5.5%
BOTH SURVEYS	AM Peak	3,434	869,803	18.6%
	Mid-Day	6,449	1,579,833	33.8%
	PM Peak	5,028	1,257,706	26.9%
	Evening	2,769	732,238	15.7%
	Late Night	927	231,923	5.0%
TOTAL	AM Peak	25,295	6,696,699	19.3%
	Mid-Day	46,337	11,669,025	33.6%
	PM Peak	36,007	9,218,420	26.6%
	Evening	19,275	5,258,897	15.1%
	Late Night	7,052	1,874,419	5.4%
	Total	133,966	34,717,460	100.0%

Rao-Scott Chi-Square Test			
Sample Size	133,966	Rao-Scott Chi-Square	8.7524
Pearson Chi-Square	17.2834	DF	4
Design Correction	1.9747	Pr > ChiSq	0.0676

Table E.2 Summary of Results for Comparisons of Trips by Purpose

	Trip Purpose	Frequency	Weighted Frequency	Percent
MTC I ONLY	Home Based Other	47,447	12,406,390	41.3%
	Home Based School	10,565	2,884,050	9.6%
	Home Based Work	18,777	4,797,238	16.0%
	Non-Home Based	38,577	9,963,223	33.2%
BOTH SURVEYS	Home Based Other	7,581	1,928,122	41.3%
	Home Based School	1,456	367,096	7.9%
	Home Based Work	3,099	765,251	16.4%
	Non-Home Based	6,461	1,607,113	34.4%
TOTAL	Home Based Other	55,028	14,334,512	41.3%
	Home Based School	12,021	3,251,145	9.4%
	Home Based Work	21,876	5,562,489	16.0%
	Non-Home Based	45,038	11,570,336	33.3%
	Total	133,963	34,718,482	100.0%

Rao-Scott Chi-Square Test			
Sample Size	133,963	Rao-Scott Chi-Square	30.1126
Pearson Chi-Square	59.4015	DF	3
Design Correction	1.9726	Pr > ChiSq	<.0001

Table E.3 Comparison of Household Trip Rates across MTC Surveys

Total Trip Rates	Mean	Std Dev
MTC I	9.166	6.921
MTC II	7.824	6.510

		Mean			Standard Deviation			
Difference in Trip Rates	N	Lower Confidence Level		Upper Confidence Level	Lower Confidence Level		Upper Confidence Level	Standard Error
MTC I - MTC II	1941	1.069	1.342	1.615	5.95	6.14	6.34	0.139

T-Tests			
Difference in Trip Rates	DF	t Value	Pr > |t|
MTC I - MTC II	1940	9.63	<.0001

Table E.4 Comparison of Household Trip Rates across MTC Surveys for Households without Major Socioeconomic Changes

Total Trip Rates	Mean	Std Dev
MTC I	7.976	6.974
MTC II	7.472	6.827

		Mean			Standard Deviation			
Difference in Trip Rates	N	Lower Confidence Level		Upper Confidence Level	Lower Confidence Level		Upper Confidence Level	Standard Error
MTC I - MTC II	922	0.127	0.491	0.856	5.40	5.64	5.91	0.186

T-Tests			
Difference in Trip Rates	DF	t Value	Pr > |t|
MTC I - MTC II	921	2.64	0.008

Table E.5 Summary of ANOVA Results for Households with a Key Socioeconomic Change

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	R-Square
Model	4	7696.6	1924.1	56.09	<.0001	0.181
Error	1014	34786.7	34.3			
Corrected Total	1018	42483.2				

Source	DF	Mean Square	F Value	Pr > F
HHSIZE +	1	4135.3	120.54	<.0001
HHSIZE -	1	3280.2	95.62	<.0001
HHWRKR -	1	91.2	2.66	0.1032
HHSIZE - * HHWRKR -	1	189.8	5.53	0.0189

Table E.6 Comparison of Average Travel Times across MTC Surveys

Average Travel Times	Mean	Std Dev
MTC I	11.165	13.86
MTC II	10.736	8.00

		Mean			Standard Deviation			
Difference in Average Travel Times	N	Lower Confidence Level		Upper Confidence Level	Lower Confidence Level		Upper Confidence Level	Standard Error
MTC I - MTC II	1604	-0.441	0.077	0.596	10.24	10.59	10.97	0.264

T-Tests			
Difference in Average Travel Times	DF	t Value	Pr > |t|
MTC I - MTC II	1603	0.29	0.770