INTRODUCTION

This appendix presents the analysis that was carried out to validate data collected in the 2016 Connecticut Statewide Transportation Study (CSTS). The analysis consists of two parts. First, comparisons were made between data from CSTS and 2009 National Household Travel Survey (NHTS) dataset, to assess plausibility of the data collected. Once plausibility was confirmed, CSTS data was then compared against 2010/2011 Regional Household Travel Survey (RHTS) to assess accuracy. While in the former analysis, data for the entire state was used, in the latter analysis, data corresponding to only two counties: Fairfield and New Haven counties, was used.

COMPARISON WITH 2009 NATIONAL HOUSEHOLD TRAVEL SURVEY

The 2009 NHTS provides travel information from a representative set of households from the entire United States. In the 2009 NHTS, demographic and trip information were collected from 150,171 households across the US. The collected data were published in four files including a household file, a person file, a trip file and a vehicle file. To assess plausibility of data collected in CSTS, comparisons for household-, person-, and trip-level attributes were made. These comparisons are discussed in the subsections below.

### Household-level Attributes Comparison

For household level comparison, the study team first compared the household size distribution. Figure M.1 shows both unweighted and weighted household size frequency distributions from CSTS and NHTS. The unweighted comparison shows that the smaller household in CSTS survey is over-represented, while the larger household is under-represented. However, after weighting, the household size distributions of the two surveys show similarities.

Figure M.1: Household Size Comparison between CSTS and NHTS
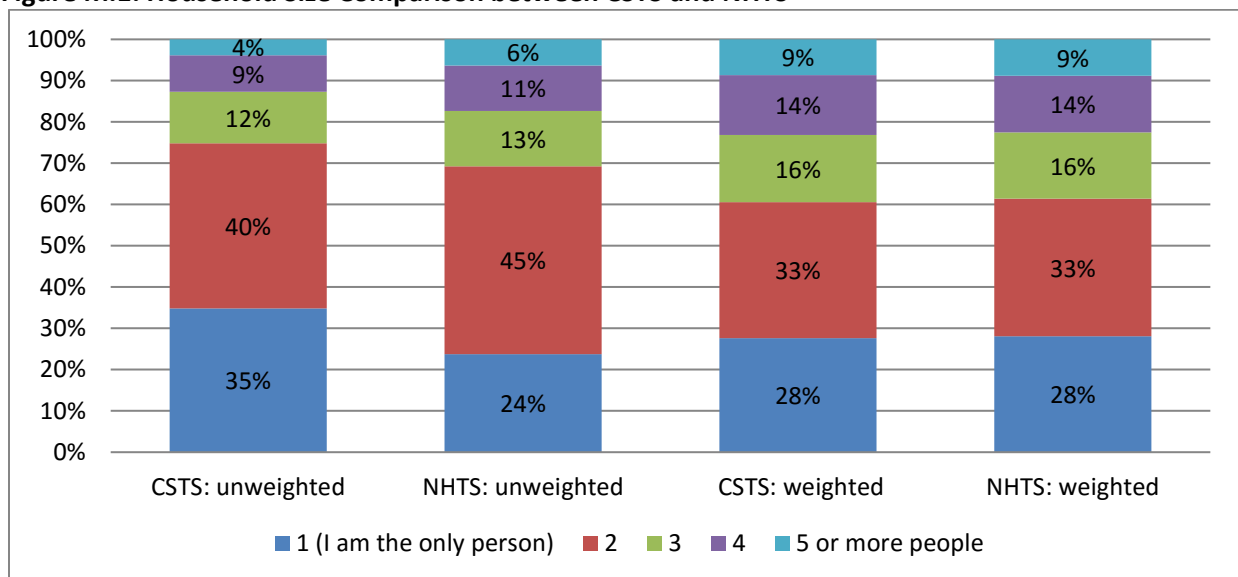

The unweighted comparison of household vehicle ownership shows that 1-vehicle household is over-represented in CSTS survey (see Figure M.2). The weighted comparison, however, shows the distribution from CSTS is similar to the vehicle ownership distribution from NHTS survey.

Figure M.2: Household Vehicle Ownership Comparison between CSTS and NHTS
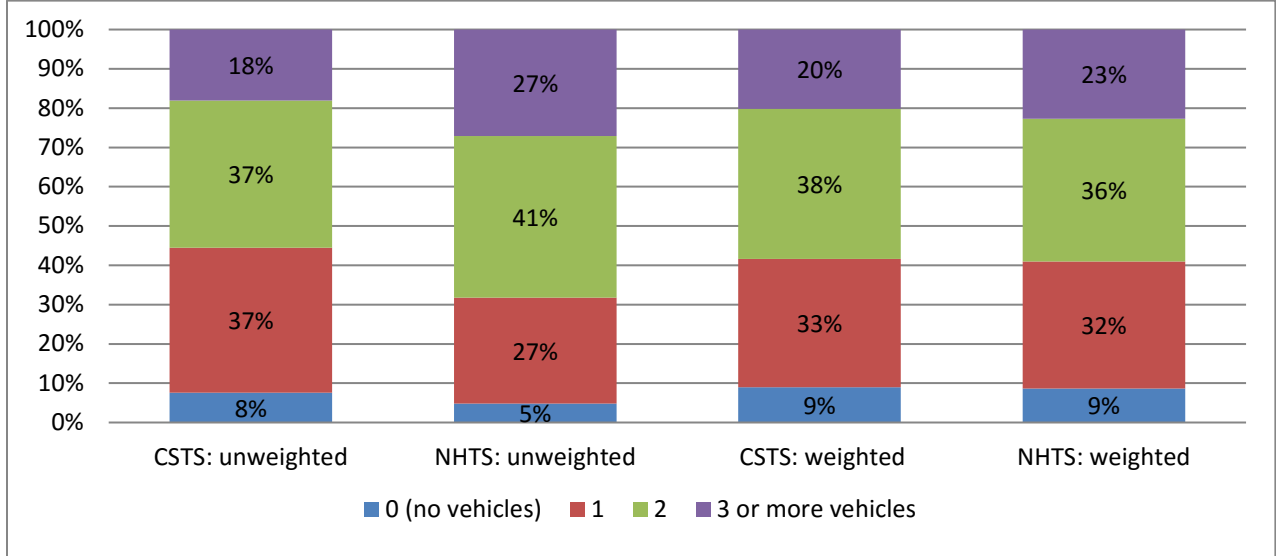
For household income, the study team observed some larger differences (see Figure M.3). Compared with NHTS, CSTS had fewer low-income households, and more high-income households with annual income of $100,000 or more. The difference holds both for weighted and unweighted results. This is reasonable because there is more similarity between Connecticut and United States in terms of variables representing household structures (e.g., household size and vehicle ownership) when compared to income. Income variability across United States can be attributed to differences in cost of living, and regional economy.

Figure M.3: Household Income Comparison between CSTS and NHTS
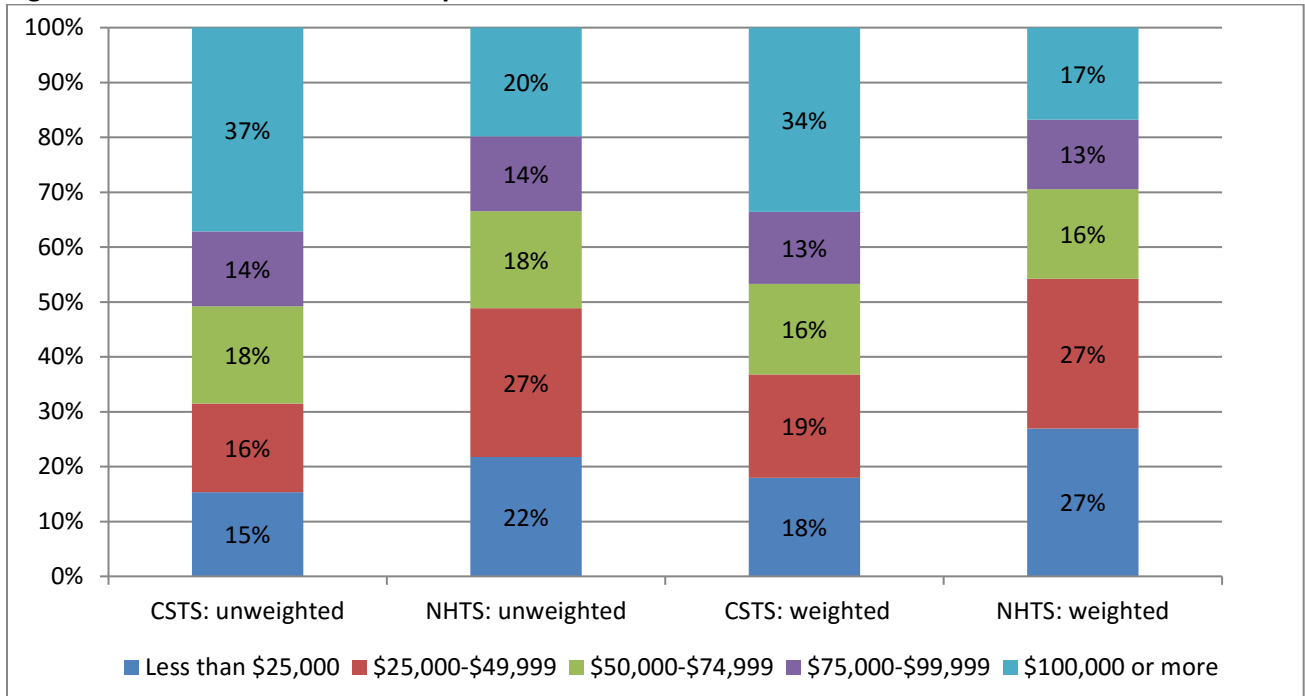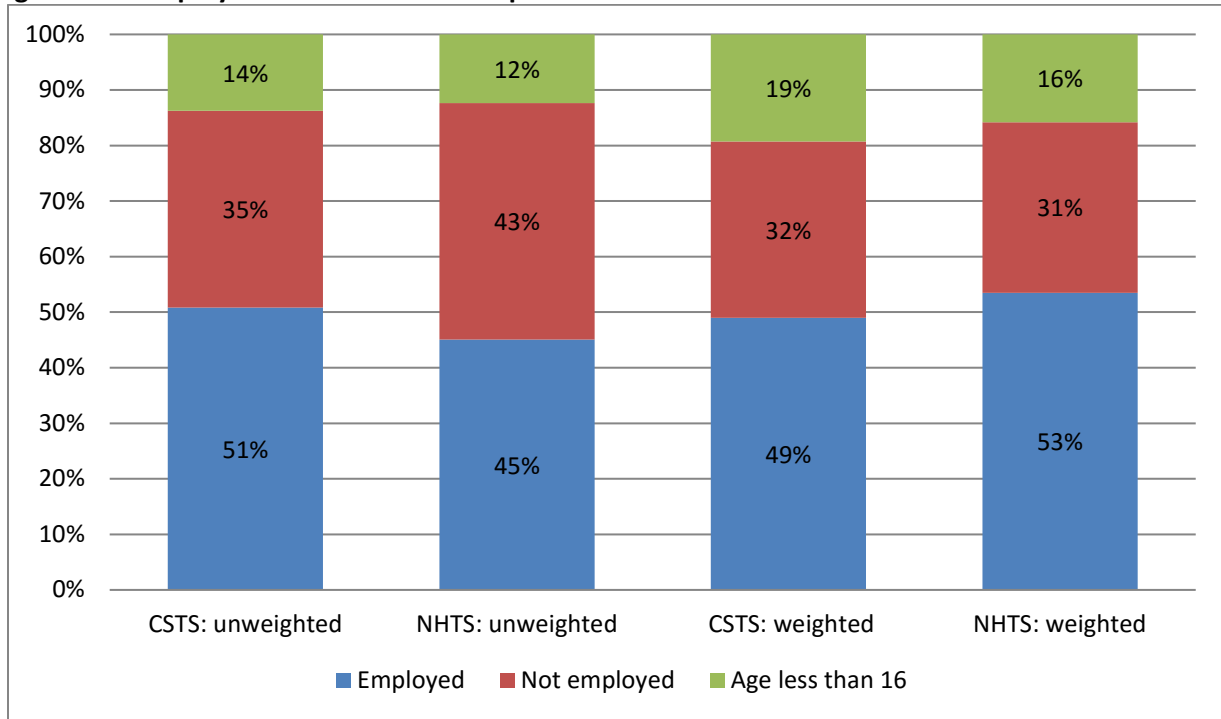
Person-level Attributes Comparison

Age, employment, and gender variables were selected for person-level comparison (see Figure M.4, Figure M.5, and Figure M.6 respectively). The unweighted age distributions from the two surveys are slightly different. After applying the weights, the distributions are similar. When comparing the weighted distributions, CSTS had a greater proportion of people under 18 years old than NHTS. This may be attributed to the absence of people under 5 years old in the NHTS dataset.

**Figure M.4: Age Distribution Comparison between CSTS and NHTS**
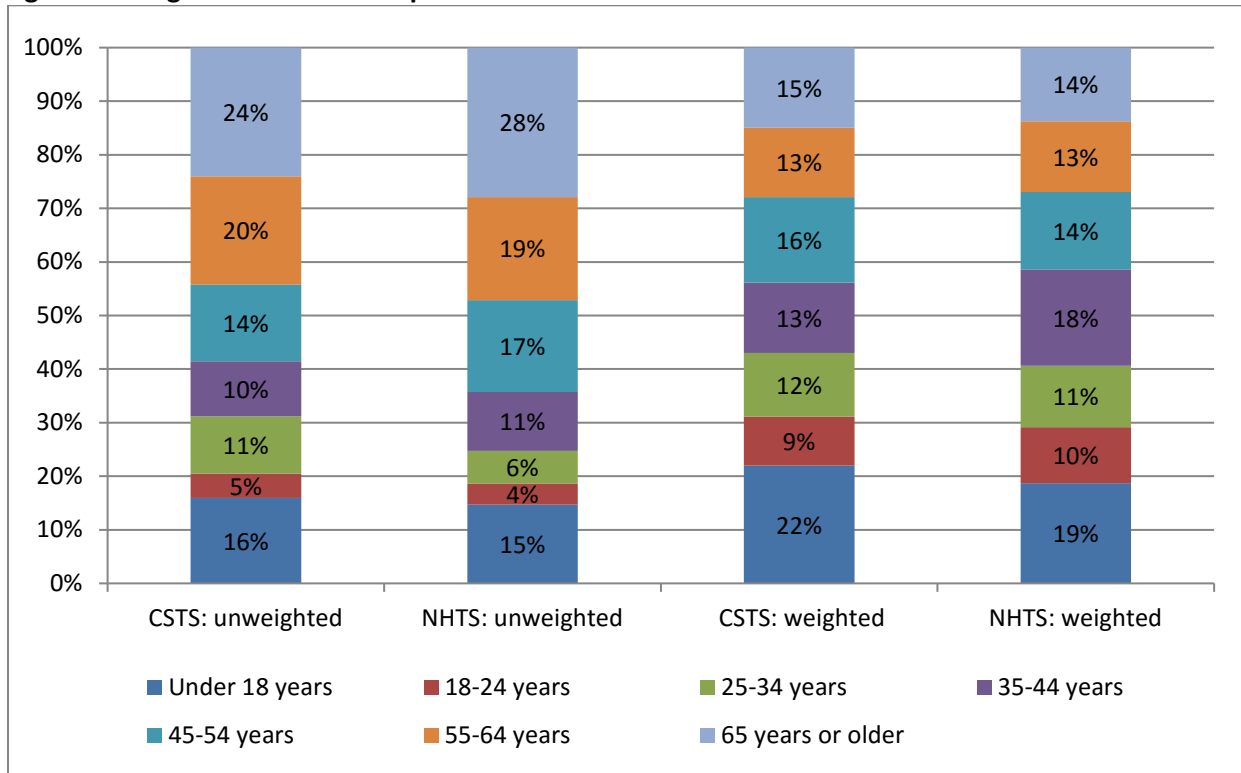
The unweighted employment frequency distributions show that CSTS has a greater proportion of employed and a smaller proportion of unemployed persons. However, the weighted distributions are very similar. CSTS has a slightly smaller proportion of employed and a greater proportion of people under 16 years old. This can also be attributed to the absence of people under 5 years old in the NHTS dataset.

Figure M.5: Employment Distribution Comparison between CSTS and NHTS

The comparison of both unweighted and weighted gender distributions from two surveys shows similarities.

Figure M.6: Gender Distribution Comparison between CSTS and NHTS
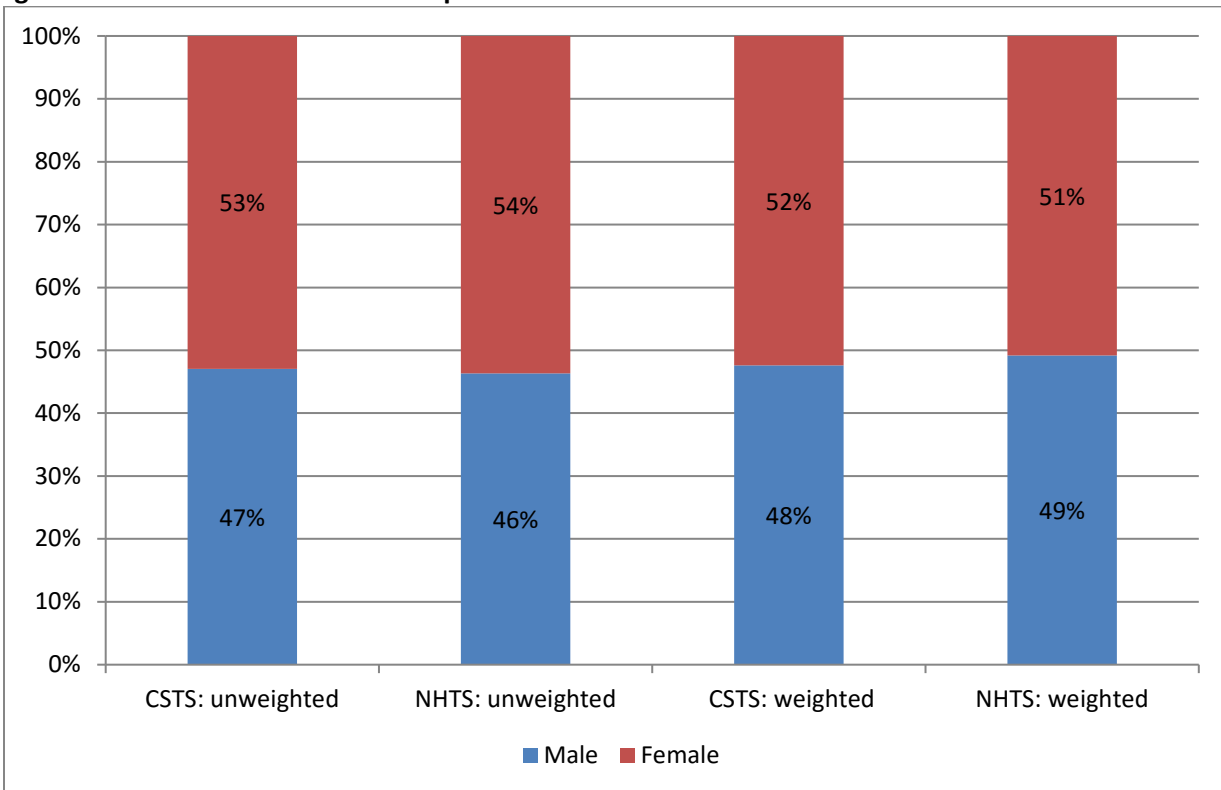
Trip-level Attributes Comparison

Table M.1 shows the household and person daily trip rates from CSTS and NHTS. CSTS has a slightly higher household trip rate than NHTS, while the person daily rates from two surveys are very similar.

Table M.1: Daily Trip Rates Comparison between CSTS and NHTS

| Trip Rate Measure	CSTS		NHTS	
	Unweighted	Weighted	Unweighted	Weighted
Daily household trips	7.7	8.7	7.8	8.0
Daily person trips	3.7	3.5	3.8	3.8

Figure M.7 shows person daily trip rates by purpose. The weighted distribution indicates that Connecticut residents made on average of 1.3 home-based other trips per day, which is higher than 0.8 from the NHTS. However, the average home-based shopping trip rate is only 0.3 from CSTS, while it is 0.8 from NHTS.

Figure M.7: Person Trip Rate by Purpose Comparison between CSTS and NHTS
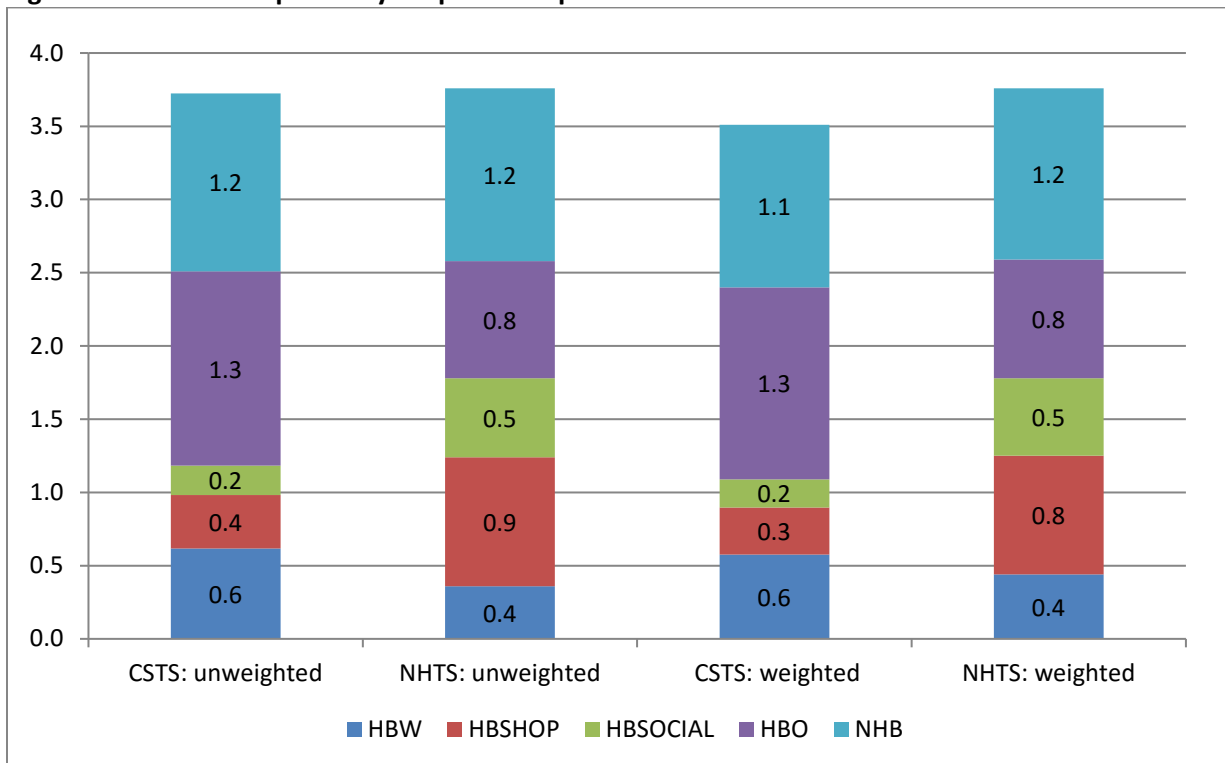
See Figure M.8 for travel mode comparisons. The results from CSTS show more single occupancy vehicle (SOV) and walk/bike trips compared with NHTS, but fewer high occupancy vehicle (HOV) and transit trips.

**Figure M.8: Travel Mode Distribution Comparison between CSTS and NHTS**
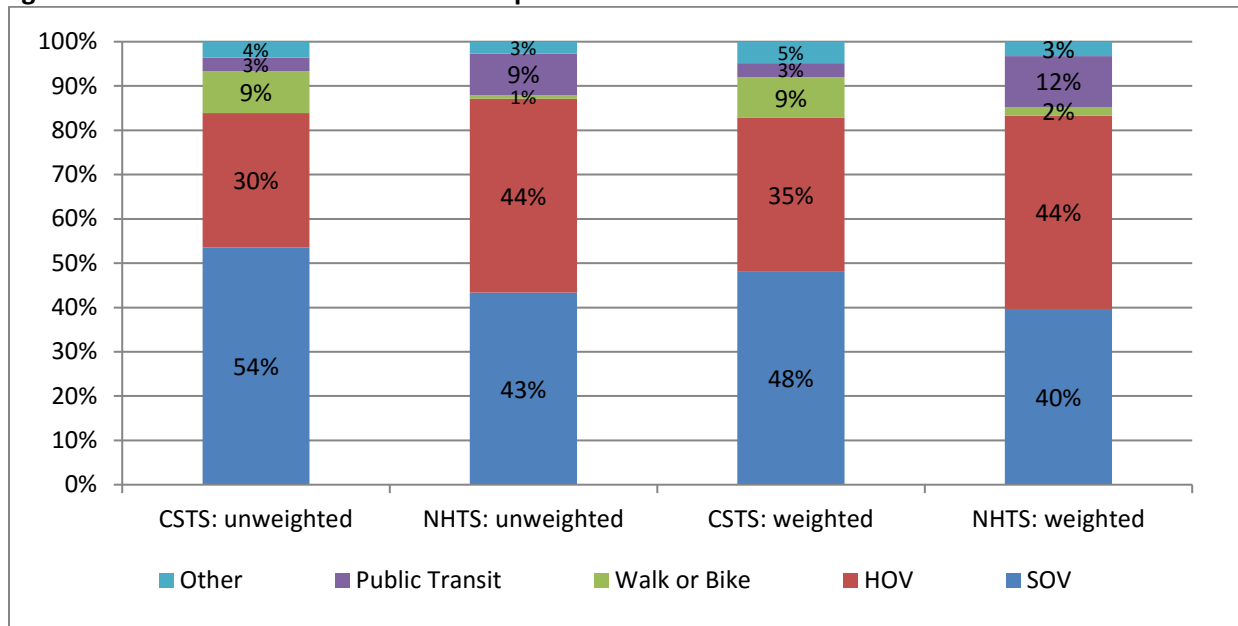
Based on the comparisons described above, it can be seen that after applying the weighting process survey sample bias is rectified. Subsequently, weighted results from the CSTS compare well with national trends and allude to the plausibility of data collected in the CSTS. The weighted household attributes and person attributes from the two surveys are comparable, except for the household income that shows differences. The average person and household daily trip rates from the two surveys are also very close. Differences in trip purpose and travel mode distribution were observed between the two surveys. However, this is reasonable because travel patterns are very region specific and will tend to differ when they are compared against travel trends from the entire nation. In order to verify accuracy of the CSTS data, the study team conducted a more focused and localized comparison by comparing data from the CSTS and the 2010/2011 RHTS.

COMPARISON WITH 2010/2011 REGIONAL HOUSEHOLD TRAVEL SURVEY

The 2010/2011 Regional Household Travel Survey (RHTS) was conducted by New York Metropolitan Transportation Council (NYMTC) and North Jersey Transportation Planning Authority (NJTPA). The data was collected between September 2010 and November 2011 from a representative set of households in 28 counties across New York, New Jersey, and Connecticut. From Connecticut, data was collected from two counties: Fairfield and New Haven. In the RHTS, data was collected from 18,800 households, including a subsample of 1,880 households who provided travel data using wearable global positioning system (GPS) devices. The reason for including GPS subsample is to improve accounting for short, and non-motorized trips. For the comparative analysis, only data that is common to both CSTS and RHTS was considered so as to conduct a more focused and localized analysis. The common region includes the counties of Fairfield and New Haven, as shown as Figure M.9. Since data from the common areas is considered and because these data were collected within a short time window of each other, it was expected that the demographic and travel measures from the two surveys should be very comparable. Any differences would require deeper introspection to identify the reason for the differences. Similar to the first comparative analysis, the localized comparison also included comparison of household-, person- and trip-level attributes.
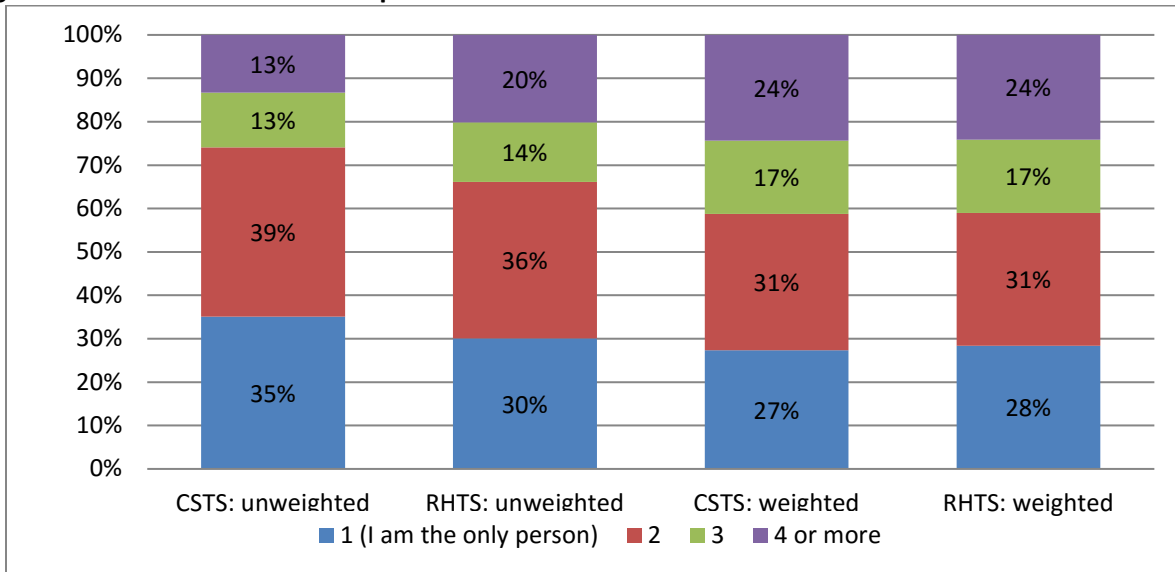
Figure M.9: Map Showing Fairfield and New Haven County
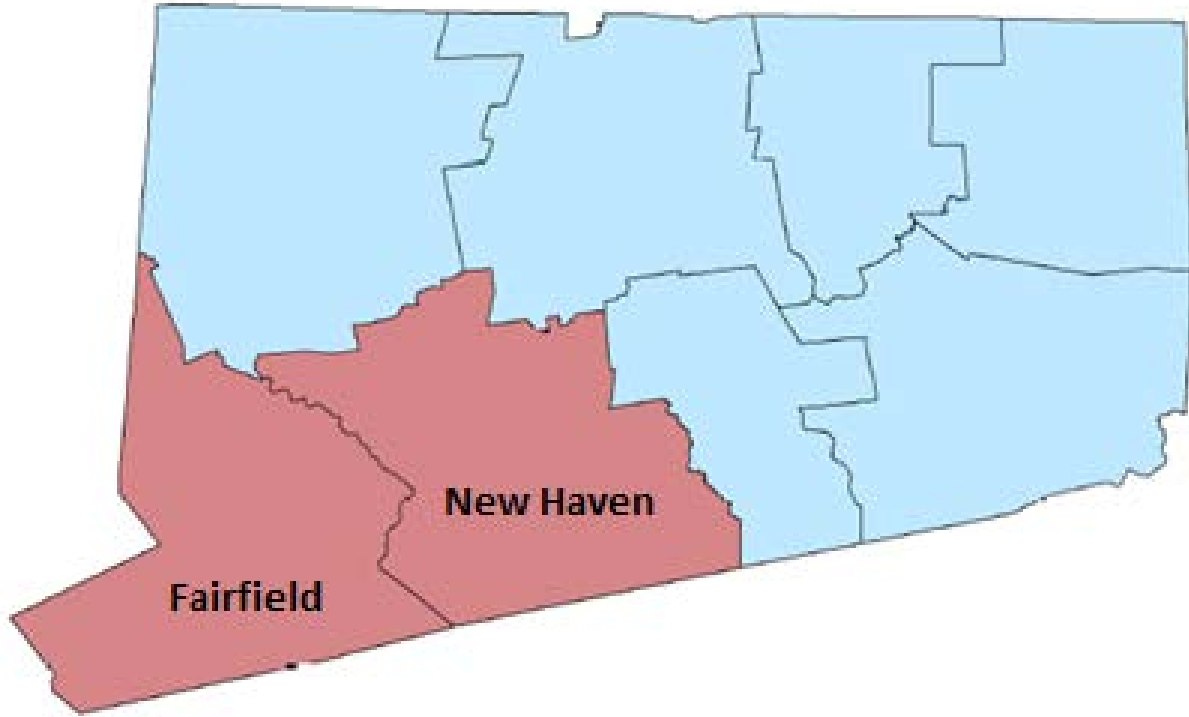
## Household-level Attributes Comparison

While there are small differences in the unweighted household size distributions between CSTS and RHTS, the weighted distributions are nearly identical (see Figure M.10).

**Figure M.10: Household Size Comparison between CSTS and RHTS**

For household vehicle ownership comparison, the weighted distributions from the two surveys are close for most categories except the zero vehicle households (See Figure M.11). CSTS has higher shares of zero vehicle households compared to the RHTS. It must be noted that in the CSTS weighting analysis, the study team controlled for the vehicle ownership distribution. Therefore, the proportions of different categories of vehicle ownership in the weighted CSTS mirrors the actual population distributions more closely compared to RHTS. Subsequently they are not subject to biases with respect to the variable when compared to RHTS.

Figure M.11: Household Vehicle Ownership Comparison between CSTS and RHTS
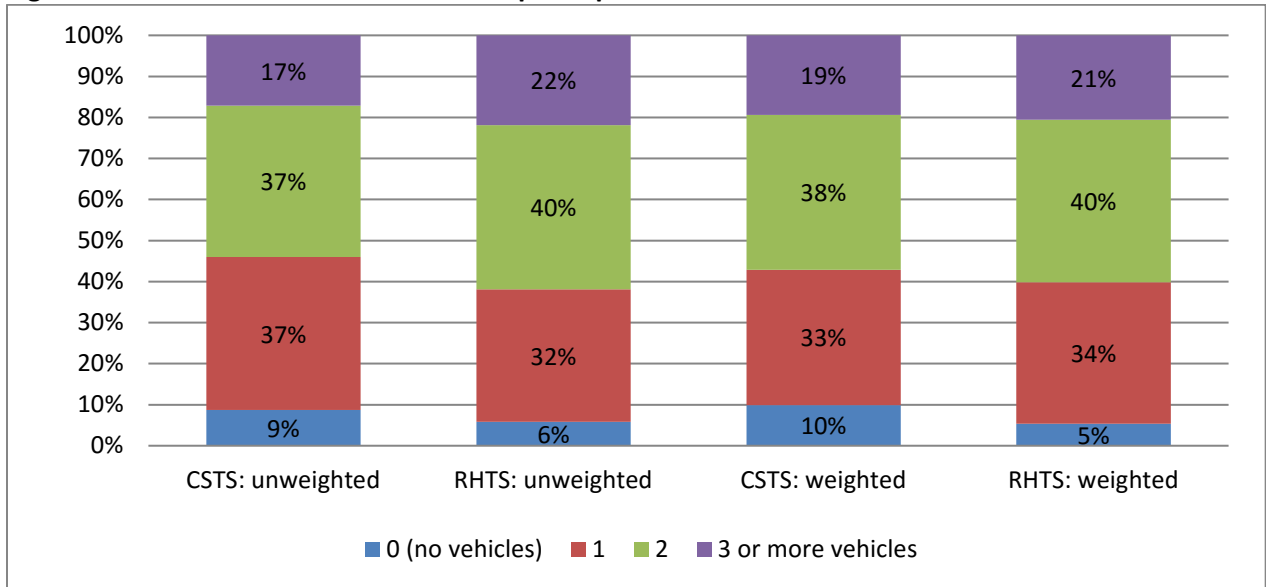
The comparison of weighted household income shows that CSTS has slightly fewer low income households than RHTS (see Figure M.12). But the overall distributions are similar from the two surveys. The distributions do not show a sizeable difference as what we observed when comparing results with NHTS.
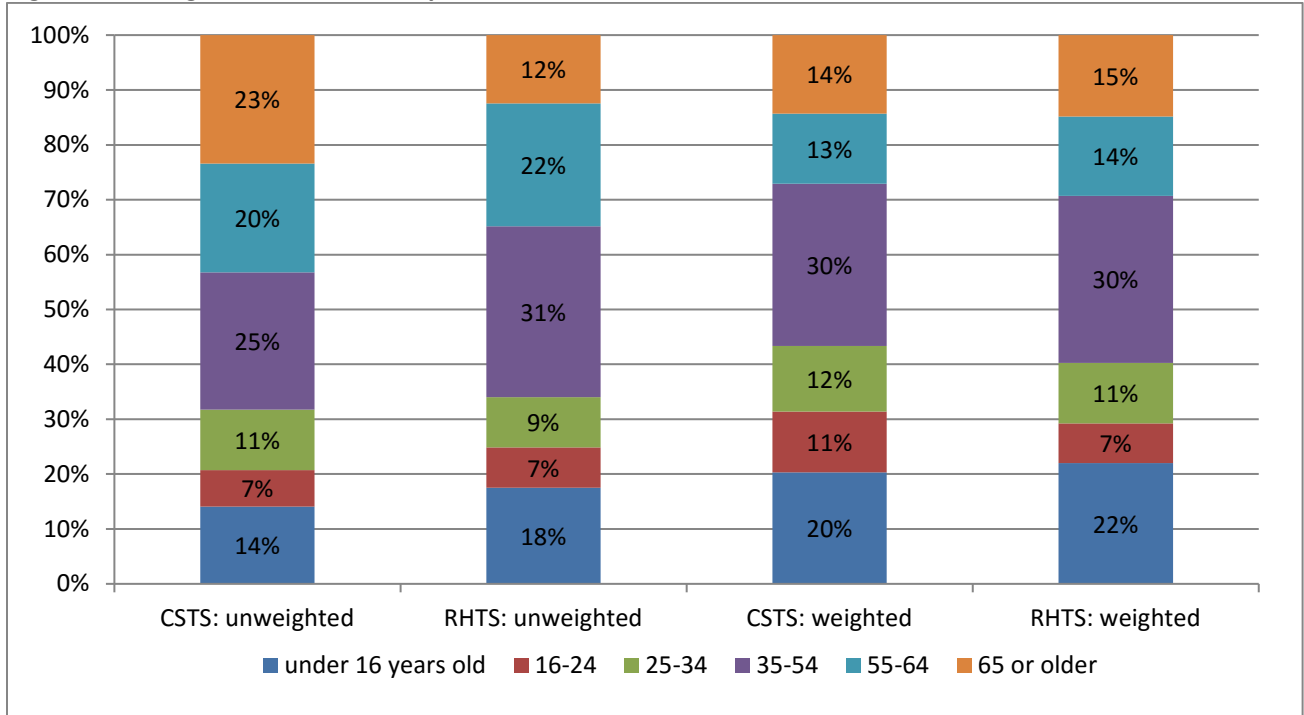
Figure M.12: Household Income Comparison between CSTS and RHTS
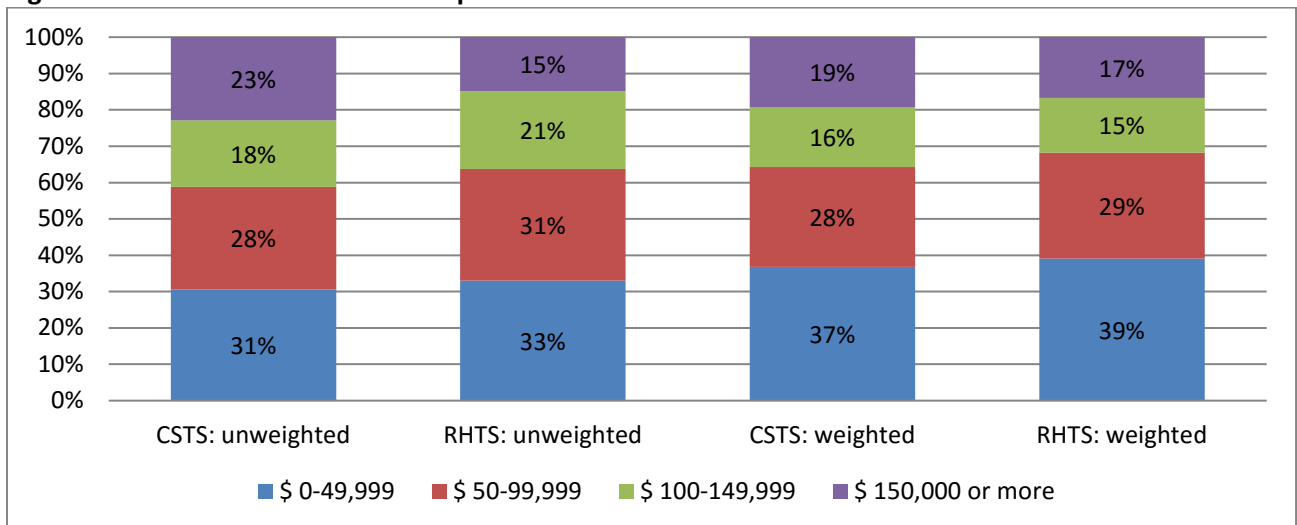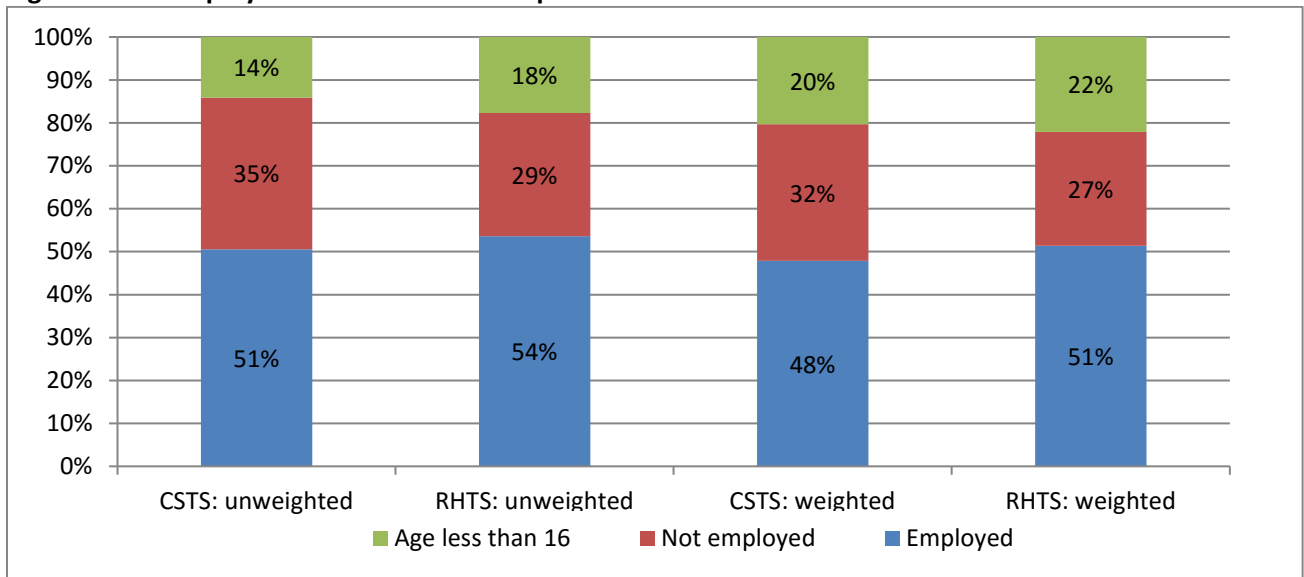
Person-level Attributes Comparison

The weighted age distribution from CSTS is similar to that from RHTS (See Figure M.13). CSTS has slightly fewer young people under 16 years old, and more people from 16 to 24 years old.

Figure M.13: Age Distribution Comparison between CSTS and RHTS


Employment distributions from the two survey show similarities, but the result from CSTS shows a higher proportion of unemployed people compared with that of RHTS (See Figure M.14).

Figure M.14: Employment Distribution Comparison between CSTS and RHTS

The gender split from the two surveys is very close (See Figure M.15).

Figure M.15: Gender Distribution Comparison between CSTS and RHTS
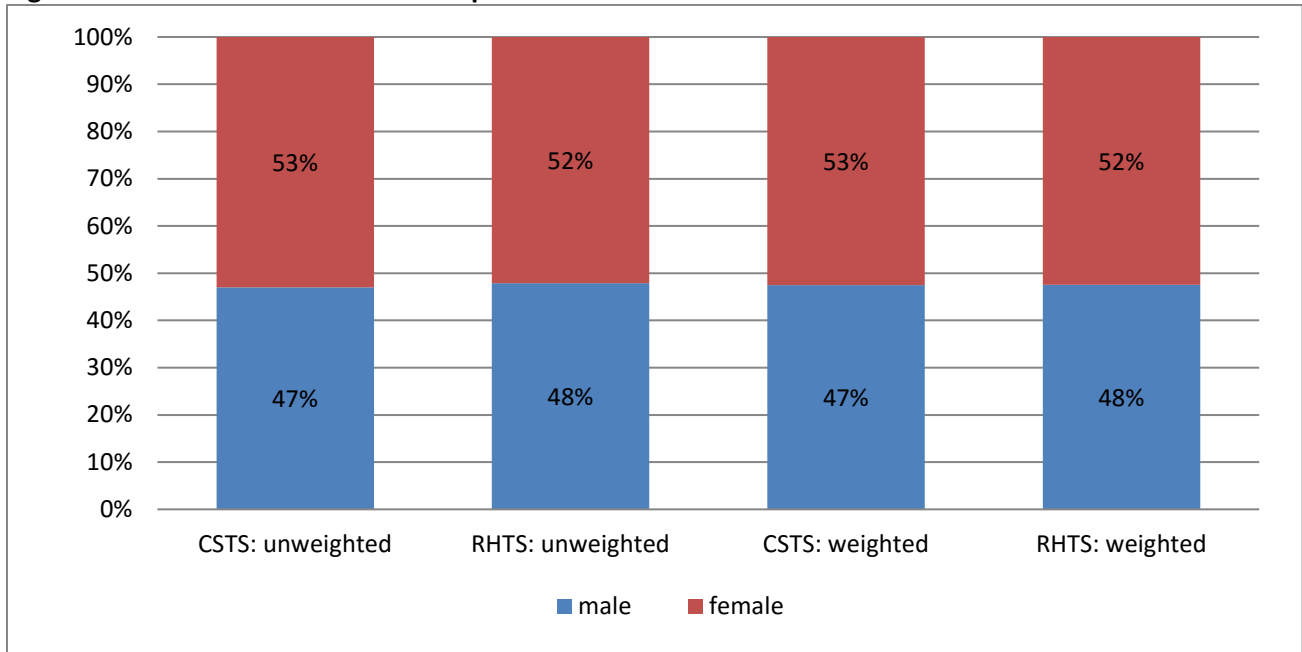
Trip-level Attributes Comparison

Both weighted and unweighted average household trip rates and person trip rates from CSTS are almost equal to those from RHTS (see Table M.2). However, when comparing the trip rates from CSTS with GPS corrected trip rates from RHTS, there are large differences. The weighted household trip rate from CSTS is 8.7, and it is nearly two trips less than the GPS corrected household trip rate from RHTS. The weighted person trip rate from CSTS is 3.5, which is also lower when compared to the GPS corrected person trip rate of 4.5 from RHTS. The GPS correction rectifies potential trip underreporting in the RHTS. Therefore, it can be said that there may also be potential underreporting issues in the CSTS survey. However, caution must be exercised when borrowing underreporting correction factors from RHTS.

Table M.2: Daily Trip Rates Comparison between CSTS and RHTS

| Trip Rate Measure	CSTS		RHTS	
	Unweighted	Weighted	Unweighted	Weighted
Daily household trips	7.8	8.7	8.0 (10.2*)	8.7 (11.1*)
Daily person trips	3.7	3.5	3.5 (4.4*)	3.5 (4.5*)
* Adjusted with GPS correction factor				

The weighted distributions of person trip rate by purpose from the two surveys are similar (See Figure M.16). The person daily home-based work trips from CSTS are slightly greater than that of the RHTS, while the non-home, non-work based other trips from CSTS are fewer than that of the RHTS. The comparison with the GPS corrected person trip rates indicate that the respondents tend to underreport the non-home, and non-work based other trips.

Figure M.16: Person Trip Rates by Purpose Comparison between CSTS and RHTS
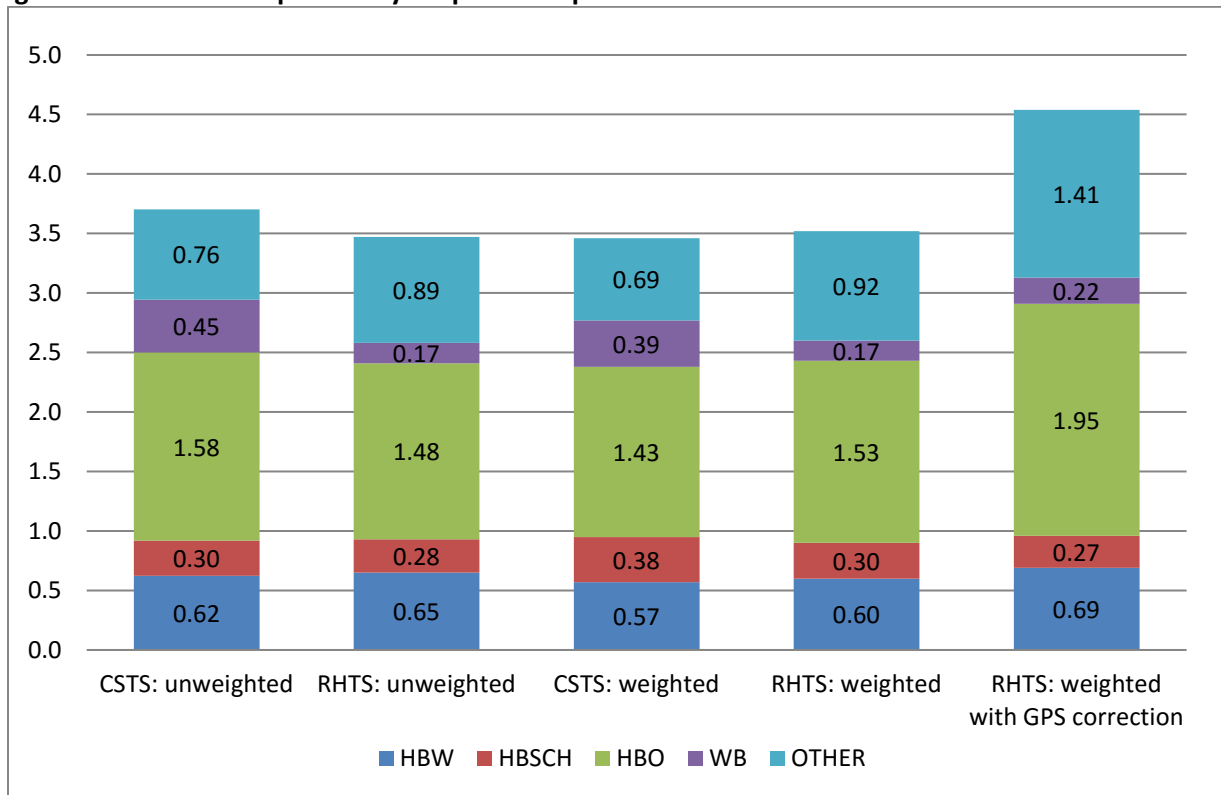

The comparison of trip length distribution shows that the weighted trip length distribution from CSTS is close to that from RHTS (See Figure M.17). The comparison with the GPS corrected trip length shows that short trips (under 5 miles) are more likely to be underreported.

Figure M.17: Trip Length Distribution Comparison between CSTS and RHTS
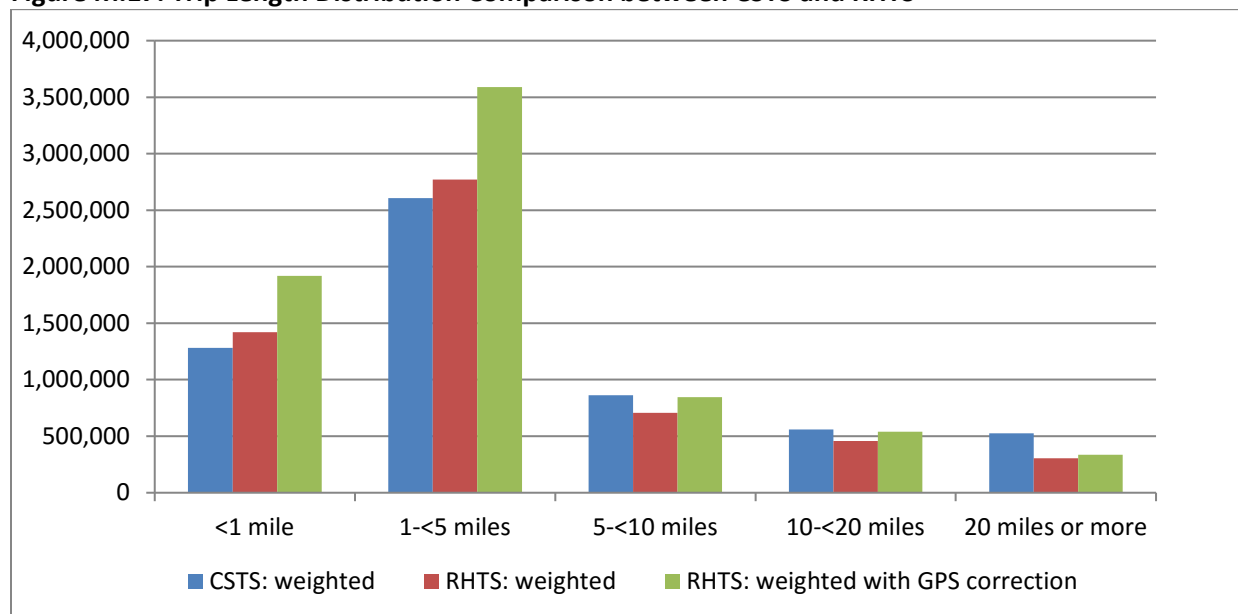
The weighted travel mode distribution comparison shows that CSTS has more walk, bike and transit trips, while fewer SOV and carpool trips when compared with the weighted distribution from RHTS (see Figure M.18). The GPS corrected travel mode distribution indicates that SOV and carpool trips turn out to be underreported.

Figure M.18: Travel Mode Distribution Comparison between CSTS and RHTS
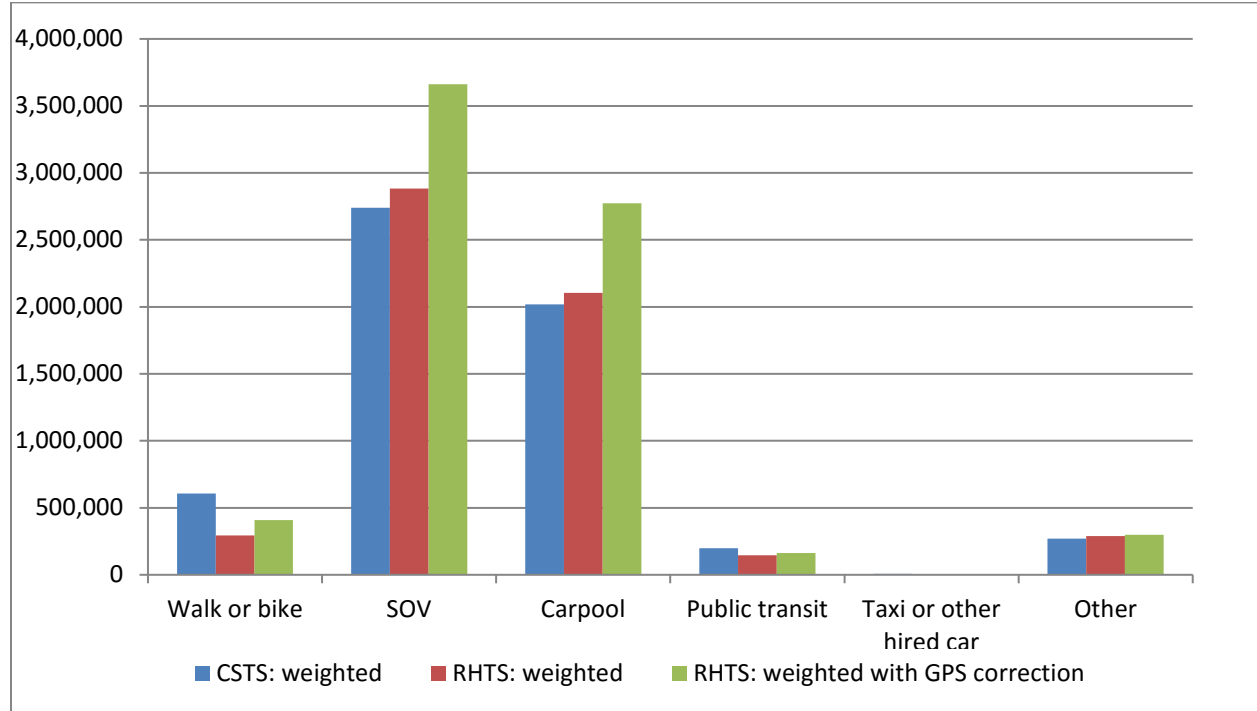
Summary of Findings

Findings from the validation analysis are summarized in Section 3.8.5.