# An Analysis of Household Transportation Spending during the 2007-2009 US Economic Recession

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**Abstract**

The recent economic recession in the United States led to widespread destruction of jobs, home foreclosures, credit freeze and to creditor repossessions of key assets such as personal cars. Our objective is to empirically assess transportation conditions of US households with a focus on transportation spending. The latter is examined in the context of changes in multiple metrics such as total number of household cars, zero-vehicle status, expenditures on local public transportation and gasoline, down payment and net purchase price of cars, decline in household vehicle stock, and interest rates on auto loans. Using an econometric model of repeated cross-sections of data on households from the Consumer Expenditure Survey for the period 2005 through 2011, we examine factors which affect recession-period spending.

In an effort to demonstrate the effects of the recession on specific groups, as well as to examine equity implications for vulnerable populations, our overall results are disaggregated by variations in transportation spending of minority, single mother and young households. Transportation spending declined significantly between 2005 and the recession years. A large part of this was due to lower car-ownership levels and an overall increase in zero-car households. Those households that did acquire a car needed to make higher levels of down payment. They also paid higher interest rates compared to the pre-recession period. Minorities spent significantly less than non-minorities before the recession but the difference from non-minorities was not significant during the recession. Single mothers did not spend significantly less than other households overall; however, their spending level became significantly less during the recession and they were much more likely to become zero-car households during the recession. The cost of car-ownership increased drastically for young adult households and the share of carless young households greatly increased during the recession.

Keywords: transportation spending, recession, car-ownership, vehicle interest rate, minority, single-mother, young adults, equity

## 1. Introduction

The recent economic recession in the United States has led to extensive destruction of jobs and livelihoods and to overall credit freeze, home foreclosures and creditor repossession of key assets such as personal cars. The recession started in December 2007 and ended in June 2009 (*1*). One major aspect of the downturn was record-high levels in the national unemployment levels from 5% in December 2007 to 10% in October 2009, although unemployment rates were considerably higher in specific areas within the country. Such high unemployment levels had not occurred nationally since 1983. Another aspect of the recent economic recession was the alarming rate of home foreclosures. According to private sector data, more than 2.3 million properties went into foreclosure in 2008, representing an 81% increase from the previous year (*2*). This trend in home foreclosures continued well after the recession was officially pronounced to be over, with foreclosure reports in 2009–2010 of more than 2.8 million properties in each of these years (*3*, *4*). Home foreclosures and commuting cost are also related - there were more foreclosures in areas farther away from the central business districts where households are more likely to have overextended themselves with higher commuting costs (5).

Along with the housing and financial markets, one of the hardest hit sectors during the recession was the automotive industry. Industry data show that car sales in the US dropped from over 7.6 million in 2005 to 5.4 million in 2009, with 2009 being the lowest point since 1950 (*6*). The US auto giants, Chrysler and General Motors, were pushed into bankruptcy. Chu and Su (7) noted that an estimated 276,000 jobs in the automobile and parts industry were destroyed, "a whopping 36 percent of the total employment in the sector", due to automobile sale decline, as the industry rode the three "rogue waves" of high gasoline prices, the credit crunch and the loss of jobs. The authors speculated that collapse of the auto market in turn exacerbated the economic downturn. Hamilton (*8*) argued it would be hard to defend the claim that the recession began in the fourth quarter of 2007, had it not been for the problems of the US auto industry. Generally during a recession, households spend less on auxiliary products than the necessary ones (*9*). At a structural level, the restoration of the auto industry is linked to other attributes such as housing, employment, and credit availability (*7*). Hiraide and Chakraborty (*10*) support these findings and concluded in the case of Ford that any rebound after the last economic recession will be based on factors like housing, employment, gasoline and vehicle prices. Moreover, it has been emphasized that increases in gasoline prices contributed to the last economic recession which impacted household consumption and use of transportation (*8*).

The objective of this paper is to undertake an empirical assessment of transportation conditions of US households with a focus on transportation spending. We make preliminary examination of several factors which contribute to variations in transportation spending such as total number of vehicles, zero-vehicle status, gasoline and public transportation expenditures, down payment and net purchase price of cars, loss or decline in household vehicle stock, and interest rates on auto loans. We use repeated cross-sections of household-level data from the Consumer Expenditure Survey (CEX) program of the US Bureau of Labor Statistics (collected by the U.S. Census Bureau) for the period 2005 through 2011, although the econometric models estimated consider the period 2005 through 2009, with 2005 and 2006 being the "prior" or "baseline" period and 2007 through 2009 being the recession period. Our main research question is to examine how transportation spending levels during the recession compares to levels before the recession and to understand factors which contribute to such variations.

Whereas we are interested in all households, we are particularly interested in the effects of the recession on vulnerable households. We therefore pay particular attention to minority households,

households with single mothers with children less than 18 years of age, and households where the reference person is a young adult less than 25 years of age. As expanded in the next section, the rationale for this focus is as follows: wealth disparities between minorities and white households are noted to have greatly increased during the recession. This motivates us to examine ways in which household transportation factors may have been differentially impacted. The importance of private transportation to women has been widely documented, which motivates us to examine how female-headed households particularly single-mothers coped during the recession and the cost of transportation in their case. Recent academic and industry analysis show that young individuals are entering car ownership at different rates than earlier generations, deferring drivers licensing, vehicle purchases and by driving less. We are interested in analyzing the role, if any, of financial and credit-related factors on changes in mobility levels of young adults, as the period over which their motorized mobility have been noted to decline coincides to some extent with the recession period.

The analysis in this paper is exploratory in the sense that changes in household credit and finance-related factors discussed are potentially only one explanation for the pre- and during-recession differences in the transportation-related metrics considered. Other critical factors at play during the time period considered which are not explicitly considered include increases in active travel levels and greater awareness regarding the connections between mobility and wellbeing, and potential substitution effects with increased use of Information and Communications Technologies (ICTs), particularly in the use of social media at an unprecedented scale.

The paper is organized as follows: in Section 2, we provide background information and the conceptual underpinnings of the paper. In Section 3, we elaborate on the research approach by presenting specific research questions and the data and methods used. Results are presented in Section 4. Conclusions are drawn in Section 5.

## 2. Background

Transportation spending by households do not vary much with short-term changes in income levels and is generally fairly steady over time, as households settle into a pattern of travel behaviour that is in keeping with long-term lifestyle expectations,. For example, once a vehicle is purchased, it becomes a necessity so that manoeuvring without a car becomes much more difficult (*11*). Once a lifestyle centered around car is settled upon, it becomes difficult to change and habits form around it (*12*). This is because  many fundamental decisions become centered around the availability of a car, examples being choices regarding residential and work location, work schedule and other employment-related choices, as well as choices relating to trip chaining, scheduling itineraries or organizing social activities and household chores.

Broadly speaking, household travel behaviour can be construed as being related more closely to expectations of permanent income to keep up with lifestyles enjoyed so as to be able to maintain a constant standard of living, in contrast to fluctuating with actual annual income levels, since rapid adjustments in mobility patterns can be difficult to make in response to changes in income levels. Permanent incomes are long term expectations of earnings (*13*) and several authors (*14,12*) have used annual household expenditures as a proxy for permanent incomes to better reflect what households expect to earn over a considerable period of time.

Related to the above is asymmetry, a concept of income elasticity that has garnered attention in the car ownership literature (*15,11*). Asymmetry would arise if falling incomes reduced transportation expenditures to a different extent than rising incomes would lead to a rise in transportation

expenditures. This again relates to the idea of the permanent income hypothesis. Asymmetry can be of two types: effects of short-term, temporary income reductions, and effects of long-term reductions. It was speculated that short-run reductions in income do not generally affect transportation spending, although reductions due to, for example, retirement, moving out of the labor force or other long-term, life-changing reasons may lead to more far-reaching changes in spending. However, these studies were not based on data during extreme economic conditions such as the recent recession, which is comparable in magnitude only to the Great Depression of the 1930s, leading to unprecedented levels of cut-backs in consumption, and to previously unseen levels of adjustments in transportation consumption.

During the recent recession, the median U.S. household income (in 2011 dollars) is estimated to have dropped from $54,489 in 2007 to $52,195 in 2009, a loss of 4.2% (*16*). Hence the buying power of American households generally declined. Contemporary research has also investigated the impact of recession on car financing and car payments. For example, Hayden and Cooper (*17*) emphasized that automobile loan default rates significantly increased since the last recession. In the beginning of 2008, 11.6% of people with automobile loans failed to make on-time payments compared with 6.8% in 2007. Moreover, the number of automobiles repossessed in 2008 was 15% greater than in 2007.

As discussed previously, one result of the recent recession is a decline in the purchases of cars which is potentially not just due to purchase cost, but also due to costs involved in maintenance. Atypically high fuel costs are also likely to have played a role. For instance, Ferdous et al (*18*) indicated that increase in fuel prices instigate households to adjust their vehicular purchases as well as to reduce vehicle operating and maintenance expenses. However, the adjustment in light of gasoline price changes is different for divergent socio-economic groups (*19*). The monetary cost of purchasing and operating a vehicle dominates total transportation-related costs to households (*20*). Vehicle ownership costs include fixed and variable costs such as the cost of owning and operating a vehicle. The ownership costs consist of net outlays on vehicle purchase and vehicle finance charges notably the cost of interest paid for loans contracted for the purchase of vehicles. Costs related to operating vehicles comprise gasoline and motor oil purchases, maintenance and repairs, and vehicle insurance costs which include the premium paid for insuring vehicles. The authors noted that income levels remain the primary determinant of vehicle ownership, even though the real prices of vehicles have dropped and financing tools and credit mechanisms have become available that have greatly facilitated vehicle ownership.

There are a number of possible scenarios regarding how households adjusted transportation spending during economically difficult times. It is possible that households responded by delaying purchases of additional (new or used) cars leading to increases in holding time for cars, selling off cars, buying cheaper or used cars which they otherwise would not have, or by returning cars to dealers by means of voluntary repossession. They may also have deferred routine maintenance of the existing stock of cars or lowered spending on operating costs by driving less. Increased unavailability of credit led some households to resort to highly risky lending mechanisms to finance cars from fringe banking firms. One such high risk credit instrument is the auto title-loan, where a borrower typically takes out a one-month loan at a high interest rate and gives a security interest to the lender on a vehicle that has no other liens on it (*21*,*22*). The lender has the right to repossess and sell the collateral (i.e., the vehicle), if the borrower defaults on the loan. There is generally a dearth of plain disclosures of the cost of title loans and the risks of repossession and costly rollovers. Another financial factor that impacts car ownership is dealers' markup rate for automobile loans during car purchase (*23*,*24*). Customers with poor credit are more susceptible to higher markups than those with good credit (*24*). The decline in

car purchase and use may also imply increased local public transportation use; for example, Pucher (*25*) noted a resurgence of public transportation use after the recession of the early 1990 s.

The economic recession was understood to be particularly difficult for minorities and wealth disparities are noted to have increased during the recession. The increase in unemployment rate was different among different demographic groups. During the recession, blacks had a higher unemployment rate than hispanics and whites; also hispanics had higher unemployment rate than whites. Moreover, some states were more affected than others (*1*).

Taylor et al (*26*) noted black households had a median of just $5,677 in wealth (assets minus debts) in 2009; hispanic households had a median $6,325 in wealth; and white households had $113,149. Interestingly, they also noted that about a quarter of all hispanic (24%) and black (24%) households in 2009 had no assets other than a vehicle, compared with just 6% of white households which had no other assets. Furthermore, minority car buyers (African-Americans and hispanics) have been noted to be victimized to a great degree by higher markups of auto loans than white customers (*23*). Other researchers have investigated the differential impact of the economic recession on different types of automobile dealers by race and ethnicity and found (eg, *27*) that black-owned automobile dealerships were more impacted by the recession than white-owned automobile dealerships. The reasons cited are that black dealers were particularly vulnerable due to already-poor financial conditions of black dealerships, they tend to be located in lower-income areas in urban neighborhoods with residents who were worst hit by the recession, and that they sell unvaried American brands and lack diversity in their products which were increasingly facing strong competition (*27*). The net result of this phenomenon is a decline of car dealers in some African-American neighborhoods, adding one more level of difficulty for black families to access vehicles.

Women are noted to have more complex trip patterns than men resulting from the need to juggle work and family responsibilities, particularly due to the need to be able to respond promptly to child-related emergencies and child chauffeuring. These have been variously noted to keep women closer to home, child-care centers, and schools (a far from complete list of references include *28*,*29*), to greater trip frequency than men, and to greater dependence on private transportation. The importance of private transportation to women has been widely documented, which motivates us to examine how female-headed households particularly how single-mothers coped during the recession and changes in their transportation costs.

Finally, there has been considerable excitement recently about overall reductions in car dependence among young people. Thakuriah et al (*30*) found, by examining three generations of Americans from the mid-1960's to the early 2000's that each generation acquired a car at a younger age and also earlier in their worklife, compared to previous generations. However, as noted previously, recent research show that young individuals are exhibiting lower levels of car-dependence in many aspects such as acquiring drivers licenses when they are older, reducing the number of trips or distance driven by car and increased non-car mode choice (for example, *31*,*32*).We are interested in analyzing the role of finance and credit in the transportation decision-making of young adults during the economic recession, in order to identify the role that economic factors may have played in such trends recently observed among young adults.

## 3. Research Approach

Our goal is to analyze how transportation spending changed for US households over the period of the economic recession, compared to the two years prior to the recession. Although our major interest is

on transportation spending, we examine contributory factors such as local public transportation spending, gasoline expenditures, total number of cars, zero-car status, decline in the quantity of household vehicle stock, vehicle interest rates, net purchase price of vehicles, and down payment made to purchase vehicles.

We use the Consumer Expenditure Survey (CEX), a data program of the Census Bureau for the U.S. Bureau of Labor Statistics (BLS). The CEX is a household-level data set which consists of detailed information on incomes, expenditures, assets, and demographic variables. This is a rotating sample, where households are interviewed once for each of five quarters. Invalid responses and missing responses because of refusal were deleted from the sample used. An effort was made to understand whether the households retained in the final sample after case deletion were representative of all households in the sample. On the basis of variables such as income, race and other socio-demographic variables, the final sample was determined to be a representative. The final sample size for all seven years of data was 26,819.

## 4. Results

We started with an exploratory analysis of the seven transportation metrics described above and given in Table 1. These are: total transportation expenditures (TOTTRAN), local public transportation expenditures (LOPUBTRAN), total gasoline expenditures (TOTGAS), total number of vehicles owned or leased (TOTVEH), decline in household stock calculated by comparing the number of household cars in the last quarter that the household was in the sample to the number of cars in the first quarter that the household entered the sample (VEHLOSS), percent down payment for car purchases if any (DDPERCENT), and average vehicle interest rates (VINTRATE). We then model TOTTRAN against a set of explanatory variables, using Tobit regression, to see how transportation spending changed during the recession period, for all households, as well as for the three household groups of interest, controlling for a variety of factors.

**Place Table 1 here**

**TABLE 1 Transportation Metrics Considered with Summary Statistics**

Transportation-related expenses accounted for about 18% of annual household expenditures throughout 2005 to 2010, with an average of about $13,900 (in 2011 USD) spent each year. Transportation spending declined significantly from the pre-recession years considered to the during-recession period, by more than $1,900 on the average. It should be noted that roughly 1 percent of households reported making zero expenditures on transportation. Personal vehicles dominate transportation expenditures with spending on fixed and variable vehicle costs amounting to about 95% of the total budget allocated to transportation.

**Place Table 2 here**

**TABLE 2 Tukey-Kramer Tests of Difference in Means**

Table 2 shows the Tukey-Kramer tests of difference in least squares means between a base year estimate of a transportation-related metric of interest (given in the first column) and a comparison year (second column), adjusted for unequal variances. This table shows only those variables which were found to have statistically significant differences between the pre- and during-recession years. The third column shows the estimated differences in total spending between the base year and the

comparison year. Households in 2005 incurred significantly higher levels of transportation expenses compared to 2008, 2009, and 2010. This showed that although the recession was officially determined to have started in the last quarter of 2007, declines in spending were evident (statistically significant) after a lag of a year, ie, 2008. Transportation spending in 2006 and 2007 were significantly higher than in 2010, although at the 10% level of significance.

The bottom panel of Table 2 shows significant differences between subgroups considered and the baseline group, for all years considered, 2006-2007 and during the recession, 2007-2009. The results show that the differences in transportation spending among minority households is significantly lower at the .01 level for all years considered and that although these differences existed in the before period, the differences during the recession are not significant at any reasonable level. The gap between transportation spending for minority and non-minority groups appear to have *narrowed* during the recession, stemming primarily from much lowered levels of spending by non-minority group during the recession.

For single mothers, differences which are not statistically significant in the before period appears to have magnified during the recession, relative to the households without single-mothers. Young households were statistically no different in transportation spending than other households.

### 4.1 Summary Analysis of Contributors to Transportation Spending Decline

We consider the indicators described below in order to have an understanding of the differences in TOTTRAN before and during the recession.

*Local Public Transportation (LOPUBTRAN):* No statistically significant difference overall was found between the pre-recession period and the recession period for local public transportation even though LOPUBTRAN levels decreased as well overall. The lack of significant differences persist when only large metro areas which are well-served by transit are considered indicating that potential declines in auto-related spending and use are not necessarily related strongly to increased public transportation availability, potentially due to lack of destination accessibility or schedule matching, or due to difficulties in accessing transit facilities. Minority, single mother and young adult household spending on public transportation were also found to be not significantly different from baseline households during all years, pre-recession and during-recession time periods.

*Total Expenditures on Gasoline for Vehicles (TOTGAS):* Statistically significant difference was found between the pre-recession period and the recession pending on gasoline. Spending on gasoline was higher during the recession than before the recession. This supports Hamilton (*8*) finding that states that high gas prices contributed to the recession; additionally, changes in the other variables examined here could also be a response to higher gasoline prices. Households spent more on gasoline in 2006, 2007, 2008, and 2009 than in 2005. Their spending was also higher in 2007, 2008, 2009, 2010, compared to 2006.

*Total Number of Vehicles (TOTVEH):* Since personal car-related expenses account for a large share of transportation spending, we next examine trends in TOTVEH, or the total number of vehicles owned or leased by households during a year. The average number of vehicles per household declined from 2.95 in 2005-2006 to 2.87 in 2007-2009, with a statistically significant difference at the .01 level. Table 2 shows that minority households differed significantly from non-minority households on total household vehicles both before and during the recession. The average number of vehicles per household in 2008 is estimated to be significantly lower than in 2005, 2006 and 2007. Vehicle ownership levels were also significantly higher in 2007 than in 2008 and 2010.

As noted previously, industry data shows that car sales in the US dropped from over 7.6 million in 2005 to 5.4 million in 2009, with 2009 being the lowest point since 1950. This trend is recovering, with 2012 estimates at 7.2 million, which is about the level of the pre-recession years. The reversal in the trend has been attributed to various factors, ranging from increased consumer confidence, pent-up demand and low interest rates.

The dynamics of vehicle transactions also changed during the study period. Based on our analysis, fewer households acquired a new or used car in 2009 compared to 2005; however, the levels of net increase in numbers of cars per household as a result of such acquisition changed as well. In 2005, approximately 71 percent of households that acquired a car did so for the purpose of replacing one of the existing stock of household cars and for the remainder, it was an additional car or net increase in household car stock. In 2009, however, over 84% of those who acquired a car did so for the purpose of replacing an existing car, without adding to household car stock.

*Vehicle Loss (VEHLOSS):* Another aspect pertaining to the overall stock of cars per household is loss of one or more cars, without addition to household vehicle stock. One or more cars may have been simply sold and not replaced. Additionally, involuntary and voluntary repossessions of cars during the recession years have certainly been highlighted in the media, and at least by one account, 2 million automobiles were repossessed in 2008 (*24*). The CEX survey does not query the details of how a car was disposed of, except in broad terms such as “sold”, “traded in”, “given away or donated to someone outside the Consumer Unit (CU), including students away at school”, “damaged beyond repair”, “stolen” and “other”. Since our data is repeated cross sections of households over years, we do not have the ability to observe total household cars over multiple years for the same household.

We created a proxy VEHDIFF_LASTFIRST_QTR, which is the difference in the count of cars between the last quarter that the household was in the CEX sample, and the quarter in which they entered the sample; hence, may be considered to be an “year-end” net gain in total household cars. Based on the value of VEHDIFF_LASTFIRST_QTR, we create a dummy variable VEHLOSS, which takes a value of 1 when VEHDIFF_LASTFIRST_QTR is negative, and zero when VEHDIFF_LASTFIRST_QTR is non-negative. VEHLOSS thus identifies households in which the total stock of cars declined during the survey year. Vehicle stock declined for 2.3 percent of the sample during the study period. Interestingly, vehicle loss was higher before the recession (2.6 percent of households reduced vehicle stock without replenishing) compared to during the recession (2.2 percent), although this difference is not significant at any reasonable level.

*Percent Down Payment (DPPERCENT):* Car-acquiring households paid a median of 11.85 percent on down payment. However, the mean amount is close to 17 percent in down payment for the car during the study period since the distribution is extremely long-tailed with 25 percent of households paying more than 23 percent.

During the recession years, the highest amount put in down payment for cars was in 2008, with a median of 12.73 percent. This level is not too different from 2005, when the median was 11.05 percent and the top 25 percent of households paid close to 22 percent. Car down payments have remained high post-recession, with households paying a median of 13.79 percent. The relative lack of volatility is indicated by the Tukey-Kramer statistics (not shown), where there is no evidence of significant difference in average down payments between any of the year-pairs considered. This is likely due to the fact that the percent of households which could get to the car transaction stage was already a selected subset of all households, with better financial credentials to be able to afford stable, pre-recession levels of down payment to acquire a car. Households with single mothers differed

significantly from other households on the amount of down payment throughout the period considered. Such differences were not discerned for the other households, relative to comparison households.

*Average Vehicle Interest Rates (VINTRATE):* Many factors affect the interest rate of a car loan; however, a higher level of down payment generally assists in lowering auto interest rates. The reverse is also true – that a car can potentially be purchased for a lower down payment, but with a higher interest rate on the loan. The median interest rate paid was 5.75 percent in 2005, peaking in 2008 at 6.9 percent, and then declining to 6 percent by 2011. The distribution of vehicle interest rate, like down payments, is very long-tailed, with 25 percent of households paying having an interest rate of over 8.50 in 2008.

There are statistically significant differences between several year-pairs on vehicle interest rates for car-acquiring households. Table 2 shows that interest rates were significantly lower in 2005 compared to 2006 through 2010, while they were significantly higher in 2007 and 2008 compared to 2011. This latter trend may have been stimulated by the ultra-low federal funds rate set in 2008 at 0 to 0.25 percent. Minority households acquired cars with statistically higher interest rates throughout the study period, as was the case with young households

**4.2 Tobit Model of Transportation Spending**

It may be noted from the above discussion that univariate statistics by subgroup on the indicators of interest do not immediately show marked trends. One reason for this is that each subgroup exhibits large variations in terms of income levels, credit conditions, family employment situation, location and other factors that also affect the transportation outcomes of interest.

To explore the situation experienced by the three subgroups of interest in greater detail, we develop regression models of TOTTRAN, controlling for additional important factors. The general form of the model is as follows:

$$y = f(\textit{subgroup}, \textit{recession indicator \& interactions with subgroups}, \textit{household demographic, employment, financial \& housing characteristics, location factors})$$

Specific variables used on the right-hand side are given in Table 3. The subgroups considered are, as before, minority, single-family and young households. By introducing interactions between subgroup status and recession indicator (a dummy with 1 for the "during recession" period of 2007-2009), we are able to explore the relative experience of subgroups regarding transportation spending during the recession, compared to the 2-year period before). Not all control variables were retained in the final model; the final selection depends on what is suggested in the literature and due to considerations of model fit and parsimony. For example, TOTGAS was not included since it was not significant and did not improve model fit. TOTTRAN is modeled as a Tobit function of the exploratory factors since it is continuous and censored at 0.

**Place Table 3 here**

**TABLE 3 Tobit Model Transportation Expenditure Estimates**

The results are given in Table 3, indicating that controlling for total household expenditure, during the recession, households spent significantly less on transportation than prior to the recession – about $1,357.

### 4.2.1 Subgroup-Level Analysis

Holding other factors constant, minority and young households spend less than comparison groups, while there is no evidence that households with single mothers spend significantly less. As can be expected, households below the poverty line also spend less than households above the poverty level.

*Minority Households:* The results also show that minorities spent significantly less on total transportation than non-minorities but further increases in this reduction during the recession was not significant, as indicated by the small magnitude of the interaction term. One reason for this could be that a car tends to be the only asset left for a much larger share of minority households in distress compared to non-minority households (it may recalled that that about a quarter of all Hispanic (24%) and Black (24%) households in 2009 had no assets other than a vehicle, compared with just 6% of white households). While not significant, minority households spent more on local public transportation than non-minority overall. However, during the recession, they spent less than the non-minority group. A greater share of minority households became zero-car households in the recession (from 19% in 2005 to 20.78% in 2007, a decline of 1.78% – this may be contrasted with a decline of 1.29% among non-minority households). The percentage loss in total number of cars owned was greater between 2005 and 2007, for example, for non-minority households than for minorities, although the number of cars owned by minority families in the pre-recession years was much lower than for non-minorities, which could explain why the differential accrued during the recession was not large.

*Single-mother Households:* Single mothers did not spend significantly less on total transportation than other households overall; however, their spending level became significantly less during the recession. The local public transportation spending for this group was higher than for the comparison group during the study period but became lower during the recession but not significantlty. Single mothers were much more likely to become zero-car households during the recession (from 18.79 percent of single mother households in 2005 to 26.76 percent in 2007). Although the total number of cars did not decline by much, the number of workers declined significantly in these households from 1.96 before the recession to 1.94, indicating the level of use of cars may have declined for the households. Overall, the decline in single-mother household income was greater than other households in aggregate.

*Younger Households:* Young households spent significantly less on total transportation than non-young households; however, we find that controlling for total number of household vehicles and total expenditures, young households were likely to spend significantly *more* during the recession. This means that the cost of car-ownership increased drastically for these households. Overall, these households were the most likely of the three groups examined to become carless – the share of carless young households effectively doubled from before the recession to after – from 15 percent to over 30 percent. For local public transportation, this group spent less before and during the recession; however, the results were not significant. The number of workers in young households declined from 1.77 to 1.72, and there was an overall decline in average household incomes. About 25% of young households paid 9% or more on vehicle interest rates. One interesting fact is that the decline in car-ownership among these households may have been a response to the high cost of car ownership to them before the recession (during 2005 to 2007) in terms of interest charges and down payment required. There is, of course, as discussed earlier, the potential impact of social media and overall interest in an active and sustainable lifestyle that may be contributed to reductions in current ownership and use of local public transportation.

*Other households including households in poverty and home-owners:* It should be noted that an increase in vehicle finance charges contributes to a significant increase in transportation spending and the loss of a vehicle leads to a decrease of over $800. Households in poverty spend significantly less than households which are not in poverty; however, controlling for total expenditures and total number of vehicles, households in poverty experienced increases in total transportation spending during the recession. Households in poverty also spend significantly less on local public transportation than households that are not in poverty but they spend more on local public transportation during the recession but not significantly. Apartment dwellers spend less than those who reside in houses, while urban dwellers spend significantly less, even controlling for total number of vehicles, perhaps due to more restricted use of available cars. Keeping total expenditures constant, homeowners, both with or without a mortgage on their homes, spend less on total transportation and spend more on local public transportation, possibly due to lower finance charges. Renters are also probably penalized for the purchase price of a car.

## 5. Summary and Conclusions

The recent economic downturn significantly affected many aspects of the economic behavior of households. We found that transportation spending declined significantly between 2005 and the recession years. A large part of this was due to lower car-ownership levels overall and an increase in zero-car households. Those households that did acquire a car needed a higher amount for down payment and paid a higher interest rate. Households responded to higher car-ownership costs and adjusted to lower incomes by delaying purchases of additional (new or used) cars when selling, trading or otherwise giving up cars in the household stock, thereby leading to increases in holding time for cars.

Declines in auto-related spending were not offset by statistically significant increases in spending on other aspects of transportation such as public transportation, including in metro areas well-served by transit, potentially due to overall reductions in number of workers (and work-related trips), lack of destination or schedule matching, or difficulties in accessing transit facilities that existed before the recession. Additionally, even though there was a decline in transportation spending, expenditures on gasoline increased probably due to the fact that household did not just stop driving and also due to high gas prices during the recession period.

Minorities spent significantly less than non-minorities before the recession but the difference from non-minorities was not significant during the recession, as the greatest decreases in transportation spending was among non-minority households. Overall, the percentage loss in total number of cars owned between 2005 and 2007 was greater for non-minority households than for minorities. Cars tend to be the only asset left for a much larger share of minority households in distress compared to non-minority households. A greater share of minority households became zero-car households in the recession which may be part of the reason why their spending on gasoline was not significant overall, before or during the recession period. Minority households acquired cars with statistically higher interest rates throughout the study period.

Single mothers did not spend significantly less than other households overall; however, their spending level became significantly less during the recession. Single mothers were much more likely to become zero-car households during the recession. Although the total number of cars did not decline by much, household income declined more steeply compared to other households, and the number of workers declined significantly in these households compared to other households, indicating the level of use of

cars or public transportation may have declined for such households as well, with resultant lower commuting cost.

Young households spent significantly less than non-young households on transportation during the entire study period. However, we find that controlling for total number of household vehicles and total expenditures, young households were likely to spend significantly more during the recession. The cost of car-ownership increased drastically for these households. About 25 percent of young households paid 9% or more on vehicle interest rates. The share of carless young households effectively doubled from before the recession to after. This could be due to a variety of factors including changes in personal preferences and increased use of active travel modes or ICT, in addition to a desire to lower financial burden.

The analysis showed that although transportation spending behavior of households is relatively stable over time, in keeping with expectations of particular lifestyle and the permanent income hypothesis, disruptions can occur in spending as a result of significant external interventions (in this case, the recession), such that households rather abruptly change established, long-term behaviors. While our data does not allow us to understand the level of discomfort and inconvenience caused by such disruptions, it is possible that such an intervention may provide fertile ground and "raw material for steering behavior change" (*33*) at least in some households, to become accustomed to lower levels of automobility and to look to alternative modes of transportation such as public transportation and active travel.

The study has several limitations: first, we did not control for a variety of exogenous factors that were at play during the study period, including potentially changing preferences due to active travel messaging and increased ICT use. Secondly, although we made an effort to ensure that item non-response and missing values did not result in the use of an unrepresentative sample out of the total CEX sample at least in key demographic variables, it is possible that in some aspects missing data in financial variables may have been affected by our case deletion approach. Finally, the "base" period used – 2005 and 2006 – has been noted to be a part of the US housing bubble, marked by extraordinarily high home values and easy credit, which was considered to be unusual and unsustainable; future research should consider a longer, more typical "before" period, but in our case that was difficult due to data limitations.

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**TABLE 1 Transportation Metrics Considered with Summary Statistics**

| Variable | Type | Full Sample Mean (2005 to 2011) | Recession Status | | Difference |
|---|---|---|---|---|---|
| | | | Before (2005-2006) | During (2007-2009) | |
| **Main Policy Variable** | | | | | |
| Total Transportation Expenditures (TOTTRAN) | Total Transportation spending (2011 USD) | $13,889.16 | $14,960.20 | $13,025.30 | -$1,934.90 * |
| **Contextual Transportation Variables** | | | | | |
| Local Public Transportation Expenditures (LOPUBTRAN) | Local Public Transportation spending (2011 USD) | $38.15 | $38.91 | $35.56 | -$3.35 |
| Gasoline Expenditures (TOTGAS) | Total Spending on Gasoline for Vehicles (2011 USD) | $3,221.03 | $3,044.70 | $3,357.60 | $312.90 * |
| Total Number of Vehicles Owned/Leased (TOTVEH) | Total number of (owned or leased) vehicles | 2.91 | 2.95 | 2.87 | -0.08 * |
| Vehicle Loss during Survey Window (VEHLOSS) | Dummy: 1 if household had fewer vehicles in last quarter of survey versus first quarter | 0.023 | 0.026 | 0.022 | -0.004 |
| Percent Down Payment (DPPERCENT) | Percent down payment for net vehicle purchase price of vehicle | 16.86 | 16.74 | 16.92 | 0.18 |
| Average Vehicle Interest Rates (VINTRATE) | Average of all car loan interest rates | 0.069 | 0.069 | 0.071 | 0.002 ** |

* before-and-after difference is significant at .01 level ** difference is significant at .05 level

**TABLE 2 Tukey-Kramer Tests of Difference in Means**

| | | Least Squares Differences of Means | | | |
|---|---|---|---|---|---|
| Base Year | Comparison Year | Total Transportation Expenditures (TOTTRAN) | Total Expenditures on Gasoline for Vehicles (TOTGAS) | Average Number of Vehicles (Owned/Leased) (TOTVEH) | Vehicle Interest Rates (VINTRATE) |
| 2005 | 2006 | 1475.3 | -222.71 * | 0.016 | -1.1546 * |
| 2005 | 2007 | 1918.87 | -537.91 * | -0.004 | -1.2666 * |
| 2005 | 2008 | 2649.74 *** | -1034.3 * | 0.146 ** | -1.2552 * |
| 2005 | 2009 | 3311.87 * | -464.48 * | 0.049 | -0.9252 * |
| 2005 | 2010 | 3592.78 * | -30.5789 | 0.1 | -1.1252 * |
| 2005 | 2011 | 3667.36 * | -270.38 *** | 0.052 | -0.4314 |
| 2006 | 2007 | 443.57 | -315.2 * | -0.021 | -0.1121 |
| 2006 | 2008 | 1174.44 | -811.59 * | 0.129 ** | -0.1006 |
| 2006 | 2009 | 1836.56 | -241.77 * | 0.033 | 0.2294 |
| 2006 | 2010 | 2117.48 *** | 192.13 * | 0.084 | 0.02941 |
| 2006 | 2011 | 2192.06 | -47.669 | 0.036 | 0.7232 |
| 2007 | 2008 | 730.87 | -496.39 * | 0.15 *** | 0.01144 |
| 2007 | 2009 | 1393 | 73.4268 | 0.053 | 0.3414 |
| 2007 | 2010 | 1673.91 *** | 507.33 * | 0.105 * | 0.1415 |
| 2007 | 2011 | 1748.49 | 267.53 *** | 0.057 | 0.8353 ** |
| 2008 | 2009 | 662.13 | 569.82 * | -0.097 | 0.33 |
| 2008 | 2010 | 943.04 | 1003.72 * | -0.045 | 0.13 |
| 2008 | 2011 | 1017.63 | 763.92 * | -0.094 | 0.8238 ** |
| 2009 | 2010 | 280.91 | 433.9 * | 0.051 | -0.1999 |
| 2009 | 2011 | 355.5 | 194.1 | 0.003 | 0.4939 |
| 2010 | 2011 | 74.5839 | -239.8 *** | -0.048 | 0.6938 |
| **Subgroup Differences** | | | | | |
| *Minority* (1 versus 0) All | | * | | ** | ** |
| Before | | *** | | ** | |
| During | | | | *** | |
| *Single Mother* (1 vs 0) All | | ** | | | |
| Before | | | * | | |
| During | | ** | * | | |
| *Young* (1 vs 0) All | | | ** | | ** |
| Before | | | | | ** |
| During | | | *** | | ** |

*significant at .01 level ** significant at .05 level *** significant at .1 level

**TABLE 3 Tobit Model Transportation Expenditure Estimates**

| Variable | Description | Estimate | |
|---|---|---|---|
| Intercept | | 2982.166 | * |
| ***Subgroup*** | | | |
| blackhisp | dummy: 1 if reference person is Black of Hispanic | -1332.53 | * |
| single_mother | dummy: 1 if reference person is single woman with children less than 18 years of age | -137.196 | |
| young | dummy: 1 if age of reference person is less than 25 years | -1655.78 | * |
| ***Recession Indicator*** | | | |
| newrecessdef | dummy: 1 if year=(2007, 2008, 2009); 0 if year=(2005, 2006) | -1357.49 | * |
| ***Interactions*** | | | |
| newrecess X blackhisp | | -47.3264 | |
| newrecess X single_mother | | -564.545 | *** |
| newrecess X young | | 2338.398 | * |
| ***Demographic*** | | | |
| age_ref | age of reference person | 7.508371 | |
| d_lesshs | dummy: 1 if education of reference person is less than high school | -721.404 | |
| fam_size | total number of household members | -419.008 | * |
| poverty | dummy: 1 if household is categorized as being below poverty level | -1388.45 | * |
| recesspoverty | Interaction: Recession status and poverty status | 813.5514 | ** |
| ***Employment*** | | | |
| no_earnr2 | total number of workers in household | 83.68085 | |
| ***Financial*** | | | |
| totexp_in_thousands | Total annual household expenditures (in thousand 2011 USD) | 337.7478 | * |
| ownedwithmortgage | dummy: 1 if homeowner with mortgage | -3691.8 | * |
| ownednomortgage | dummy: 1 if homeowner with no mortgage | -2116.46 | * |
| vehfinancechargeper | percent vehicle finance charges paid of total before tax income | 1726.528 | * |
| ***Housing*** | | | |
| d_apt | dummy: 1 if residence is an apartment | -281.108 | |
| ***Location*** | | | |
| d_urban | dummy: 1 if household resides in urban area | -3807.15 | * |
| ***Transportation*** | | | |
| tot_vehicles | total number of vehicles owned or leased | -899.291 | * |
| veh_loss_during_yr | dummy: 1 if household had fewer vehicles in last quarter of survey versus first quarter | -806.922 | * |
| _Sigma | | 20118 | * |
| Log Likelihood: -181449<br>AIC: 362944<br>SC: 363121 | | | |

* significant at .01 level ** significant at .05 level *** significant at .1 level