



# Impacts of Millennial Student Loan Debt on Transportation Choices

September 2016



U.S. Department of Transportation  
Federal Highway Administration

1. Report No. <b>FHWA-PL-17-015</b>		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle <b>Impacts of Millennial Student Loan Debt on Transportation Choices</b>				5. Report Date <b>September 2016</b>	
				6. Performing Organization Code <b>HPTS</b>	
7. Author(s) <b>Ismail Zohdy, Nathen Huang, Nathan Keegan, Josh Lukens</b>				8. Performing Organization Report No. <b>FHWA-PL-17-015</b>	
9. Performing Organization Name and Address <b>Booz Allen Hamilton 20 M. Street Suite #4 Washington, DC 20590 USA</b>				10. Work Unit No. (TRAIS)	
				11. Contract or Grant No. <b>DTFH6113D00013-5003</b>	
				13. Type of Report and Period Covered <b>White Paper, Research. September 2015 - September 2016</b>	
12. Sponsoring Agency Name and Address <b>FHWA, Office of Policy 1200 New Jersey Avenue E83-431 Washington, DC 20590 USA</b>				14. Sponsoring Agency Code <b>HPTS</b>	
15. Supplementary Notes					
16. Abstract <p>There are many perceptions about the decline in vehicle miles traveled (VMT). Some speculate that decline in VMT is related to the economy. But it was not until 2008 that gas prices rose dramatically and the recession hit the United States. It was in 2005 vehicle miles traveled began to drop. Coincidentally, 2005 was the time the millennial generation began to enter the workforce.</p> <p>Now the largest generation in America, the Millennials are not driving at the same rates of their predecessor generations, the Baby Boomers and Generation X. There have been plenty of studies about the millennial generation's lack of interest in driving. Many conclude that Millennials are fascinated by technology or urban culture. However, there may be another economic reason to the change in transportation mode choice by Millennials.</p> <p>According to AAA's findings of the 2013 'Your Driving Costs' study, annual automobile spending for an average sedan owner are \$9,122 (Based on 15,000 miles annual usage). For someone newly out of college with student loan debt, automobile ownership may feel out of reach.</p> <p>Millennial student loan debt is a widely discussed topic. Approximately 40 million Americans hold student loan debt. Currently more than 70 percent of U.S. students who graduate with a bachelor's degree leave with debt, averaging \$28,400. According to the White House Council of Economic advisors, 61% of adult millennials attended college, compared to 46% of their Baby Boomer parents. In 2014, the total outstanding student loan debt in the US surpassed \$1 trillion.</p> <p>The purpose of this study is to be a qualitative and quantitative analysis of millennial student loan debt and the relationship to transportation expenditures.</p> <p>For the purpose of this report, the millennial generation is defined as those born between the years 1981-2000. Generation X is defined as those born between the years 1962-1980. The Baby Boomers are defined as the generation born between the years 1946-1961.</p>					
17. Key Words			18. Distribution Statement		
19. Security Classif. (of this report)		20. Security Classif. (of this page)		21. No. of Pages	22. Price
				72	\$125,000

# **IMPACT OF MILLENNIAL STUDENT LOAN DEBT ON TRANSPORTATION CHOICES**

## **Notice**

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

The U.S. Government is not endorsing any manufacturers, products, or services cited herein, and any trade name that may appear in the work has been included only because it is essential to the contents of the work.

---

# TABLE OF CONTENTS

<b>EXECUTIVE SUMMARY .....</b>	<b>1</b>
Descriptive Analysis .....	2
Statistical Analysis .....	3
Limitations.....	4
Insights and Recommendations .....	4
<b>REPORT OVERVIEW .....</b>	<b>6</b>
<b>CHAPTER 1.0. INTRODUCTION .....</b>	<b>7</b>
Home Ownership and Living Arrangements .....	10
Vehicle Ownership .....	13
Mobility Preferences .....	14
Final Thoughts on Millennial Choices .....	15
<b>CHAPTER 2.0. MILLENNIAL STUDENT LOAN DEBT OVERVIEW .....</b>	<b>17</b>
Educational Attainment .....	18
Rising Tuition Costs.....	19
Millennial Debt Characteristics .....	20
Undergraduate Loans .....	22
Graduate Loans.....	22
Incomplete Degrees .....	23
Millennial Student Loan Debt Reduces Financial Stability .....	24
<b>CHAPTER 3.0. STUDENT LOAN DEBT AND TRAVEL CHOICES (DESCRIPTIVE ANALYSIS).....</b>	<b>25</b>
Sampling and Data Collection .....	25
Consumer Expenditure Survey (CE).....	26

Methodology .....	28
Analysis Assumptions .....	28
Analysis Hypothesis.....	30
Preliminary Analysis.....	31
Student Loan Debt Payment, Housing, and Transportation Relationships .....	32
Student Loan Debt Impact for Pre- and Post-Recession.....	33
Student Loan Debt and Transportation/Housing Expenses by Income Level .....	37
Summary .....	38
<b>CHAPTER 4.0. STATISTICAL MODEL ANALYSIS .....</b>	<b>40</b>
Pre-Analysis Process.....	40
Variable Assumptions.....	42
Analysis.....	42
Methodology .....	42
Survey-Weighted Generalized Linear Models.....	44
Significance Testing of Interactions of Student Loan and Income.....	48
Differences in Transportation Expenses among Income Levels and Student Loans (Two-Way Analyses of Variance) .....	49
Statistical Analysis Findings.....	50
<b>CHAPTER 5.0. KEY FINDINGS AND CONCLUSIONS .....</b>	<b>52</b>
<b>APPENDIX A. ADDITIONAL DATASETS OVERVIEW .....</b>	<b>55</b>
<b>APPENDIX B. CE DATASET HISTOGRAMS .....</b>	<b>66</b>
<b>APPENDIX C. TWO-WAY ANALYSES OF VARIANCE (ANOVA).....</b>	<b>68</b>

---

# EXECUTIVE SUMMARY

The Millennial generation (those born between the years 1981 through 2000) is unique. Their childhood was steeped in technology, they are the most educated generation to date, and their worldview and priorities differ from preceding generations. Paradoxically, while Millennials are quite mobile, a smaller proportion have driver's licenses or own vehicles – they make use of alternative transportation modes in a higher percentage than other age groups.

Smartphone applications evolution, innovative mobility services, and social networking advancements have certainly driven Millennial transportation choices to some degree. However, a host of socioeconomic motivations are also likely drivers for their distinct travel behavior – and specifically, one contributing cause: Millennial student loan debt. Student loan debt is the “dark side” of being the most educated generation. Millennials' investment in their own futures comes with a significant cost, and it is only increasing with time; tuition has been consistently rising above the rate of inflation.

As student loan debt becomes a standard fixture in the reality of many young Americans, planners and analysts must consider its effect on lifestyle and spending choices. This study investigates how student loan debt affects the housing and transportation choices of the Millennial generation, to help the Federal Highway Administration (FHWA) better anticipate and plan for this age group's transportation needs. This study addressed the research question: *Is there any relationship between student loan debt and transportation choices?* “Transportation choices” are defined in this study as the budgets allocated for travel, both private (e.g., vehicle ownership expenses, new or borrowed, and other fuel and operating expenses) and public (e.g., transit expenses).

This particular focus of study is new, and no prior studies or datasets had explored the relationship of student loan debt to Millennial transportation choice. The team identified several datasets containing input from expenditure and travel surveys, and conducted a preliminary scan to identify the most applicable data to use. The team reviewed:

1. **Financial/Expenditure Databases:** Survey of Consumer Finances (SCF) and Consumer Expenditure Survey (CE), and
2. **Travel Behavior-Related Databases:** American Community Survey (ACS), Metropolitan Travel Survey Archive (MTSA), and NREL's Transportation Secure Data Center (TSDC).

Each dataset has its own strengths and weaknesses, but we found the CE to be the most information intensive, including transportation expenses, education loans, and demographic characteristics of each household member.

The CE survey covers a large nationwide representative sample: about 7,000 households have been surveyed each quarter in recent years. To ensure consistency when using disparate datasets from CE in our models, we made the following assumptions:

- All data were evaluated at the consumer unit level.
- We worked exclusively within the years of 2003–2012.
- Since the recent recession has contributed to Millennial unemployment rates, all year-based analyses use a pre-recession (2003–2007) group and post-recession (2008–2012) group.
- We averaged quarterly values to create an “average quarterly” metric for all expenditure variables.

## Descriptive Analysis

To determine if student loan debt has a causal effect on transportation choices and residential locations of the Millennial generation, we conducted a number of descriptive, visualization-based analyses. Our descriptive analysis yielded a number of observations and identified a number of potentially valuable future research directions. In both pre- and post-recession periods, our findings indicated that:

- The majority of student loan holders in the survey are gainfully employed.
- Student loan holders in smaller cities (i.e., populations less than 330K) showed a large uptick in transportation expenses post-2008, as compared to loan holders in larger cities.
- While the percentage that Millennial household budgets spent on transportation fell considerably after the recession for those with student loans, this may be due to a steep growth in housing expenses for the same group, as well as lower fuel prices.
- Transportation spending as a percentage of income declined for low-income Millennials as student loans increased, suggesting transportation choices are being altered due to mounting student loan commitments.
- Transportation expenditures for those with and without loans, high- and low-income earners, and pre- and post-recession stayed mostly same, indicating a lack of correlation between student loans and transportation choices.

Considering transportation as a percentage of household expenditures and income, we found that the percentage of transportation and housing budgets that households devote to transportation varies by socioeconomic demographics (e.g., income level, amount of student loan, etc.). However, our analyses of transportation spending as a percentage of only household expenditures (and not income) do not reveal a connection between student debt and transportation expenditures. These preliminary findings confirm that there seems to be little convincing evidence connecting student loans with Millennial transportation choices at the descriptive level.

## Statistical Analysis

While our preliminary findings yielded potential relationships, they remain unconvincing and, at times, conflicting—emphasizing the need for additional statistical analysis. To address these limitations, we empirically assessed a student loan variable’s significance in predicting various domains of public and private transportation expenses, using a series of regression analyses and two-way Analyses of Variance (ANOVAs). Specifically we regressed our descriptive variables, such as demographics in terms of age, income, class, education, and student loan amount on vehicle ownership costs, fuel expenditure costs, vehicle maintenance costs, and public transportation costs. The analysis yielded a number of insights and potential future areas of study related to Millennial travel choice. In both pre- and post-recession periods, our findings from the statistical models indicate that:

- Student loan debt does not significantly predict fuel and maintenance expenditures due to vehicle ownership.
- Student loan debt does significantly predict total transportation expenditures as a percentage of total transportation and housing expenditures. In other words, an individual with student loan debt will have a lower percentage of his or her total transportation and housing budget dedicated solely to spending on private and public transportation than an individual with no student debt. Each increase in unit of debt will likely result in an approximately 1.2 percent decrease in amount that individuals spend on transportation as a share of total household expenditures.
- Student loan debt, when combined with income, becomes a significant predictor of private transportation expenditures. For instance, when an individual’s student loan debt and income increase conjointly, that individual can be expected to increase their transportation expenditure.
- Despite the limited significance of student loan debt as a variable in the regression models, ANOVAs reveal that Millennials with loan debt generally spend differently on private

transportation costs than those without loan debt. An individual without student loan debt, for instance, may spend more on private transportation, such as the purchase or rental of a private vehicle, than an individual with student loan debt.

Our statistical analysis yielded more concrete findings than our descriptive observations, but the analyses still failed to demonstrate student loan amount as a statistically significant predictor of private and public transportation expenditures on their own. However, the statistical analysis did demonstrate that the manner in which Millennials allocate their transportation expenses (as a share of their overall transportation and housing costs) is impacted by student loans. Of particular interest is the finding that student loans, when combined with income, become a statistically significant predictor of private transportation expenses. In other words, student loan impact may be moderated more by fluctuations in income than the mere amount of debt that Millennials owe.

## **Limitations**

While this report's critical assumptions were useful for moving the analyses forward, the existing datasets limited our ability to explicitly link the contribution of student loan values with Millennial transportation behavior (e.g., mode choice, miles travelled). Several confounding variables may have significant influence on travel behavior, in addition to student loan debt. It is also important to note that the value of the student loan and its impact on a Millennial's life style are disparate and vary from individual to individual.

## **Insights and Recommendations**

Differences in household formation, marital status, presence and number of children, location, and technological advances are several of the factors that set Millennial life decisions apart from Gen Xers and Baby Boomers. Our research is a pioneering attempt to directly link student loans with transportation choices, and our results are an important initial examination of the impact of student loans and warrant further investigation.

For further analysis of the subject matter, a more comprehensive study design could be constructed, in which qualitative surveys investigate the isolated effect of student loan itself (without influence by noise from other owed credit), and how it predicts Millennial's transportation choices. Specifically, this survey would address previous dataset limitations, including, but not limited to: 1) The student loan history

tracking (e.g., loan payment plan), 2) The transportation-related choices (e.g., preferred mode, travel distance, number of trips per day), and 3) The value added by the loan (e.g., job salary increase).

---

# REPORT OVERVIEW

The Millennial Generation—for the purposes of this report, those born between the years 1981 to 2000—is becoming the largest generation in the work-place, and preliminary research suggests a shift in their travel, housing, and transportation choices when compared to the previous generations. This report defines Generation X as those people born between 1962 and 1980, and Baby Boomers as people born between 1946 and 1961. This study investigates how student loan debt affects the housing and transportation choices of the Millennial generation and how those choices might affect the FHWA's planning for transportation needs. In this study, transportation choices are defined as expenses allocated from a Millennial's overall household budget to specific private travel choices (e.g., vehicle ownership expenses, either new or borrowed, and other fuel and operating expenses) and public travel choices (e.g., transit subscription). The report includes five chapters:

- **Chapter 1: Introduction:**
  - Outlines the background for this study.
  - Documents research scan on the travel behaviors of Millennials.
- **Chapter 2: Millennial Student Loan Debt:**
  - Documents extensive research on rising student debt patterns and the impact of this debt on millennials' home and vehicle ownership characteristics.
- **Chapter 3: Millennials' Travel Choices and Student Loan Debt Descriptive Analysis:**
  - Presents our preliminary analysis of the relationship between student loan debt and different transportation choices.
- **Chapter 4: Statistical Model Analysis:**
  - Addresses the importance of student loans (and other factors of interest) in determining transportation choices through the use of statistical models.
- **Chapter 5: Key Findings and Conclusions:**
  - Summarizes the main findings of this study.
  - Presents recommendations for moving forward.

---

# CHAPTER 1.0. INTRODUCTION

In 2015, the Millennial generation surpassed the Baby Boomer generation as the largest living generation in the US.<sup>1</sup> Comprising 83.1 million people ranging in age from 16 to 34 years old, Millennials currently represent more than 25 percent of the nation's population and more than 33 percent of the nation's labor force.<sup>2</sup>

Millennials are now entering their peak driving period; according to USDOT, 35–54 years of age is the prime age for employment, household formation, and child rearing. People in this age range drive an average of 15,291 miles per year,<sup>3</sup> and Millennials should be poised to continue the single occupancy vehicle usage trends of past generations. However, new technologies and alternative transportation methods are providing Millennials with other avenues of travel. The average Vehicle Miles Traveled (VMT) of persons aged 16 to 34 dropped 23 percent, from 10,300 miles in 2002 to just 7,900 miles in 2012.<sup>4</sup>

The shift from driving has caused surges in other areas. According to a transportation survey by the American Public Transportation Association (APTA), Millennials are more likely to combine several modes of transportation to get from point A to point B.<sup>5</sup> Additionally, they are more likely to use active modes of transportation, such as cycling and walking, to cover the first and last miles of their trips (the gap in service that any transit user experiences while accessing or leaving a bus or train terminal). Since

---

<sup>1</sup> US Census Bureau. *Millennials Outnumber Baby Boomers and Are Far More Diverse*, Census Bureau Reports. <https://www.census.gov/newsroom/press-releases/2015/cb15-113.html>. 25 June 2015.

<sup>2</sup> The Pew Research Center. *Millennials surpass Gen Xers as the largest generation in U.S. labor force*. <http://www.pewresearch.org/fact-tank/2015/05/11/millennials-surpass-gen-xers-as-the-largest-generation-in-u-s-labor-force/>. February 2015.

<sup>3</sup> Federal Highway Administration, Office of Highway Policy Information. <https://www.fhwa.dot.gov/ohim/onh00/bar8.htm>. February 2015.

<sup>4</sup> US Public Interest Research Group (PIRG) Education Fund. *Transportation and the New Generation: Why Young People Are Driving Less and What It Means for Transportation Policy*. April 2012.

<sup>5</sup> American Public Transportation Association, *Millennials & Mobility: Understanding the Millennial Mindset*. 2013.

Millennials comprise the largest age cohort of the population, it is important to understand and identify the factors that shape their transportation decisions.

Many factors contribute to Millennials' changing attitudes toward mobility, compared to those of Baby Boomers and Gen Xers, including socioeconomic shifts, lifestyle preferences, and evolving technology. But one key difference between Millennials and prior generations is their higher college tuition costs and greater student loan debt.<sup>6</sup> Millennials are on track to be the most educated generation in American history, with 33.5 percent already holding at least a bachelor's degree.<sup>7</sup> Consequently, the average Millennial with student loans carries student loan debt averaging \$28,950.<sup>8</sup> Millennials with debt spend an average of \$282 of their monthly income on student loans.<sup>9</sup> As a portion of Millennials' income is devoted to student loan debt, they presumably have less income for other household expenses like transportation. This trade-off may contribute toward Millennials' shift from car ownership to other modes of transportation.

In general, the Millennials are the first generation to grow up entirely in the technological age, having had access to both the internet and smartphones for most of their adult lives.<sup>10</sup> Several studies have examined the Millennials' choices and travel behavior and have identified several factors that affect these characteristics, most noticeably:

1. **Telecommuting** – Millennials, being an “internet-native” generation, are comfortable with the idea of telecommuting.<sup>11</sup>

---

<sup>6</sup> The Pew Research Center. *The Rising Cost of Not Going to College*. <http://www.pewsocialtrends.org/2014/02/11/the-rising-cost-of-not-going-to-college/>. February 2015.

<sup>7</sup> Ibid.

<sup>8</sup> The Institute for College Access and Success. *Student Debt and the Class of 2014*. [http://ticas.org/sites/default/files/pdf/classof2014\\_embargoed.pdf](http://ticas.org/sites/default/files/pdf/classof2014_embargoed.pdf). October 2015.

<sup>9</sup> The Brookings Institute. *The Typical Household with Student Loan Debt*. <http://www.brookings.edu/research/papers/2014/06/19-typical-student-loan-debt-akers>.

<sup>10</sup> The Pew Research Center. *Millennials will benefit and suffer due to their hyperconnected lives*. [http://www.pewinternet.org/files/old-media/Files/Reports/2012/PIP\\_Future\\_of\\_Internet\\_2012\\_Young\\_brains\\_PDF.pdf](http://www.pewinternet.org/files/old-media/Files/Reports/2012/PIP_Future_of_Internet_2012_Young_brains_PDF.pdf). October 2015.

<sup>11</sup> Jones, J.M., *In U.S., Telecommuting for Work Climbs to 37%*. <http://www.gallup.com/poll/184649/telecommuting-work-climbs.aspx>. October 2015.

2. **E-commerce** – Unlike the previous generation, the ease of using the internet to shop for goods and services has caused the new generation to be relatively more open to online shopping.
3. **Social Media** – With the evolution of social media platforms, some social gatherings have moved to online space, affecting non-recurring trips to meet family and friends. However, social media has added more social trips, owing to higher interaction between friends and families.<sup>12</sup>
4. **Shared Mobility** – Recent years have seen a surge in technology-based Transportation Network Companies (TNC) like Uber and Lyft.<sup>13</sup>
5. **Traveler Information** – Mobile applications such as Google Maps, Waze, etc., provide advanced traveler information, not just in the form of real-time route guidance, but also information about real-time traffic conditions. Research shows that Millennials are more likely to use mixed modes (part-bike, part-transit or part-walk, multiple bus transfers) for their travel needs, with real-time traveler information and travel guidance helping these transfers.<sup>14</sup>
6. **Driver's License** – Fewer young Americans are choosing to get driver's licenses. From 1983 to 2014, license applications decreased 16 percent in the 20–24 age group, and about 10 percent in the 30–34 age group.<sup>15</sup>

To adapt future policies to these changes, policymakers and transportation planners must understand the reasoning behind Millennial preferences and behaviors. A multitude of characteristics should be investigated to fully explain the changes in the travel behavior of Millennials and whether these changes will persist. We discuss some unique lifestyle and mobility characteristics of Millennials in the following subsections.

---

<sup>12</sup> Interrante, E., *The Next Generation of Travel: Research, Analysis, and Scenario Development*. Accessed at [https://www.fhwa.dot.gov/policy/otps/nextgen\\_finalreport.cfm](https://www.fhwa.dot.gov/policy/otps/nextgen_finalreport.cfm).

<sup>13</sup> Dutzik, T, Inglis, J and Baxandall, P, *Millennials in Motion - Changing Travel Habits of Young Americans and the Implications for Public Policy*, October 2014.

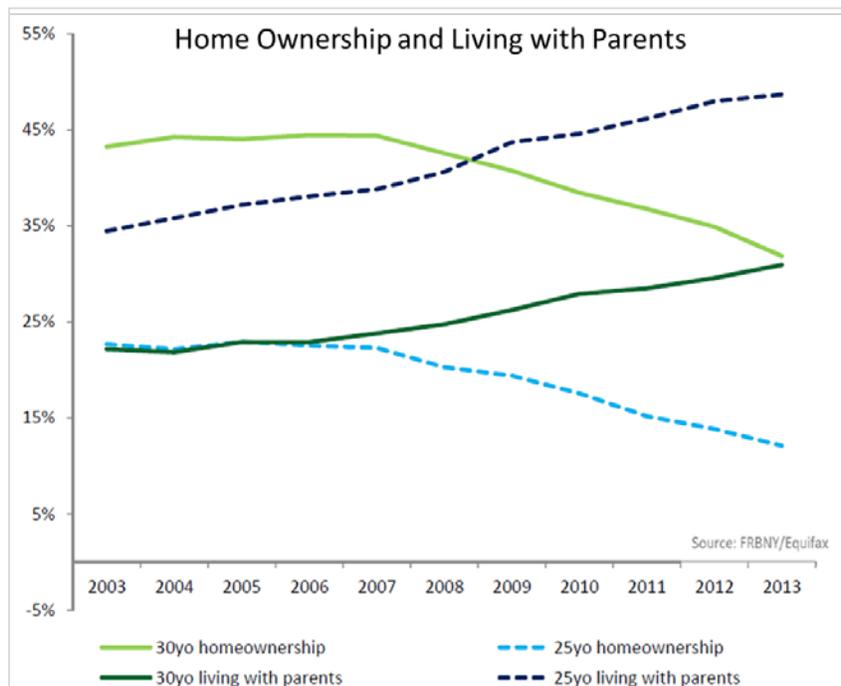
<sup>14</sup> Ibid.

<sup>15</sup> Michael Sivak and Brandon Schoettle, *Update: Percentage of Young Persons with a Driver's License Continues to Drop*. Accessed at: <http://time.com/money/4185441/Millennials-drivers-licenses-gen-x/>. 2012.

## Home Ownership and Living Arrangements

Several studies highlight that, unlike previous generations, Millennials are more likely to live with their parents – a finding that is associated with the likelihood of Millennials having student loans.<sup>16</sup>

Researchers from the Federal Reserve Bank of New York analyzed the relationship between home ownership and living with parents for 25- and 30-year-old adults between 2003 and 2013. They found that home ownership nearly halved among these young adults, while the percentage living with parents increased by around 30 percent.<sup>17</sup> This comparison is shown in Figure 1. A Wisconsin study also compared student debt characteristics of survey respondents to their home ownership status.<sup>18</sup> Their analysis stratified the responders into two groups, those who paid off their student loan and those who were still paying off their loans. This data is summarized in Figure 2.

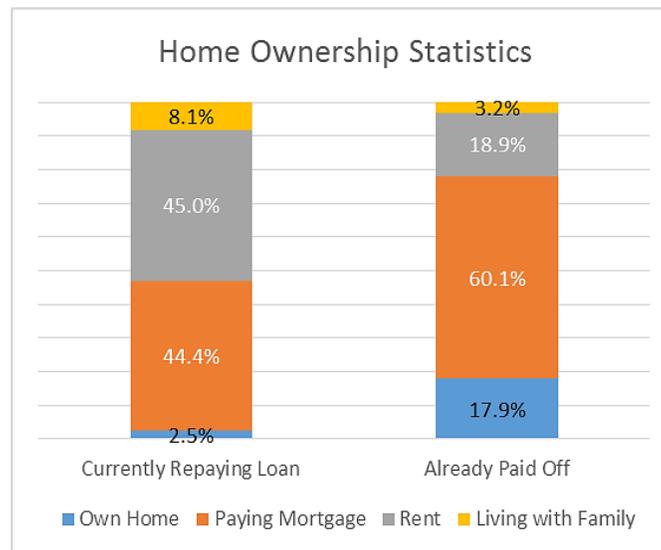


<sup>16</sup> Bleemer, Z., Brown, M., Lee, D., & Van der Klaauw, W. *Debt, Jobs, or Housing: What's Keeping Millennials at Home?* Federal Reserve Bank of New York Staff Report. 2014.

<sup>17</sup> Ibid.

<sup>18</sup> One Wisconsin Institute. *Research Note 13-2 Survey Results: Impact of Student Loan Debt on Homeownership Trends and Vehicle Purchasing.* June 2013.

**Figure 1. Home Ownership and Living with Parents Statistics of 25- and 30-Year-Olds. [Source: Federal Reserve Bank, NY]**



**Figure 2. Home Ownership Statistics of Millennials Currently Repaying Student Loans and Those Who Already Paid Off Their Student Loans. [Source: One Wisconsin Institute]**

The researchers found that young adults who are still on their loan tenure are more likely to rent a home or apartment (45 percent) than their peers who already paid off their loans (19 percent). Also, respondents who are still paying off their student loans are nearly three times as likely to live with their parents compared to respondents who already paid off their student loans.<sup>19</sup> Researchers used data from the Panel Study of Income Dynamics (PSID) to examine the effect of student loan debt on home ownership.<sup>20</sup> Their findings are summarized in Table 1. The difference in home ownership rates is significant when the subject has a student loan debt.

**Table 1. Homeownership Statistics [Source: Federal Reserve Bank, Boston]**

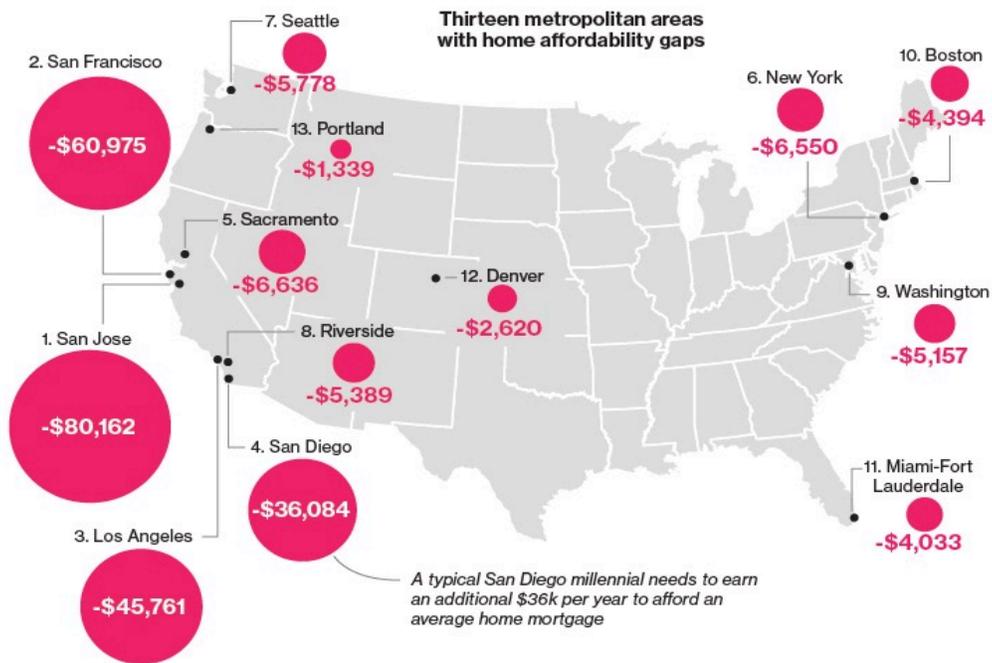
	Age Group	With Student Loan Debt	Without Student Loan Debt
At least some college experience	20–24	7.9%	17.3%
	25–29	28.7%	30.7%
	30–34	50.3%	52.7%

<sup>19</sup> Ibid

<sup>20</sup> Cooper, D, and Wang, C.J. *Student Loan Debt and Economic Outcomes*. Federal Reserve Bank of Boston Current Policy Perspectives No. 14-7.

	Age Group	With Student Loan Debt	Without Student Loan Debt
College Graduates Only	35–39	65.2%	66.3%
	20–24	8.6%	9.1%
	25–29	32.6%	31.0%
	30–34	52.7%	59.9%
	35–39	71.9%	78.3%

Several studies also examine Millennial housing location choice (urban versus suburban) in light of affordability, living standards, and transit availability.<sup>21</sup> These neighborhoods are characterized by abundant transit service and residential density which aligns with Millennials’ travel preferences. Figure 3 shows the Millennial Housing Affordability Indices of 13 large metropolitan areas (the difference between the median income for Millennials in each city and the minimum salary required to buy a home).



**Figure 3. Millennial Housing Affordability Index [Source: Bloomberg<sup>22</sup>]**

<sup>21</sup> Lachman, M.L and Brett, D.L. *Gen Y and Housing*. Urban Land Institute Report, 2015.

<sup>22</sup> Stilwell, V and Lu, W. *These are the 13 Cities Where Millennials Can’t Afford a Home*. <http://www.bloomberg.com/news/articles/2015-06-08/these-are-the-13-cities-where-millennials-can-t-afford-a-home>. October 2015.

Young generations have always been drawn toward urban areas, and Millennials are continuing this trend, with 86 percent of Americans aged 18–33 living in metropolitan areas in 2014. This is slightly higher than 83 percent of Gen Xers when they were 18–33 years old and significantly higher than 68 percent of Baby Boomers.<sup>23</sup> In comparison to older generations, Millennials report a preference for living in urban areas as well. In a recent APTA survey, nearly 35 percent of polled Millennials explained that they want to live in an urban community where transit is the best way to move about the city. While stated preferences are very different from their actual choices, Millennial preference for central-city neighborhoods seems to stem from their desire to travel on foot, by bike, or via transit. Analysis of these geographic preferences by the UCLA Institute of Transportation Studies revealed that Millennials are more likely than older generations to live in mixed-use, old urban, and urban residential neighborhoods.<sup>24</sup>

## Vehicle Ownership

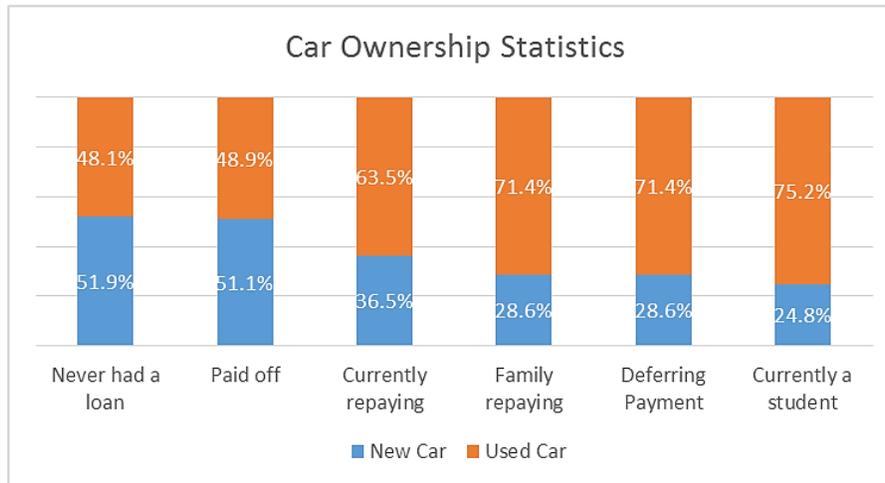
Similar to home ownership, vehicle ownership is also related to student loans. The One Wisconsin Institute survey analyzed whether respondents bought their cars new or used and the relationship between their vehicle purchase and student loan status.<sup>25</sup> As shown in **Figure 4**, a higher percentage of respondents who never had a loan or paid off their loans buy new cars, as compared to those who are currently repaying their loans. Additionally, respondents are nearly three times more likely to buy a used car than a new car if they are currently a student, deferring their loan payment, or if their family is repaying the loan.

---

<sup>23</sup> The Pew Research Center. *How Millennials today compare with their grandparents 50 years ago*. <http://www.pewresearch.org/fact-tank/2015/03/19/how-Millennials-compare-with-their-grandparents/#!1>. March 2015.

<sup>24</sup> Blumenberg, E., Taylor, B., et al. *Typecasting Neighborhoods and Travelers*. FHWA report. 2015.

<sup>25</sup> Student Loan Debt Campaign. <http://onewisconsinnow.org/studentloandebt>. Accessed on July 2016.



**Figure 4. Vehicle Ownership of Millennials [Source: One Wisconsin Institute]**

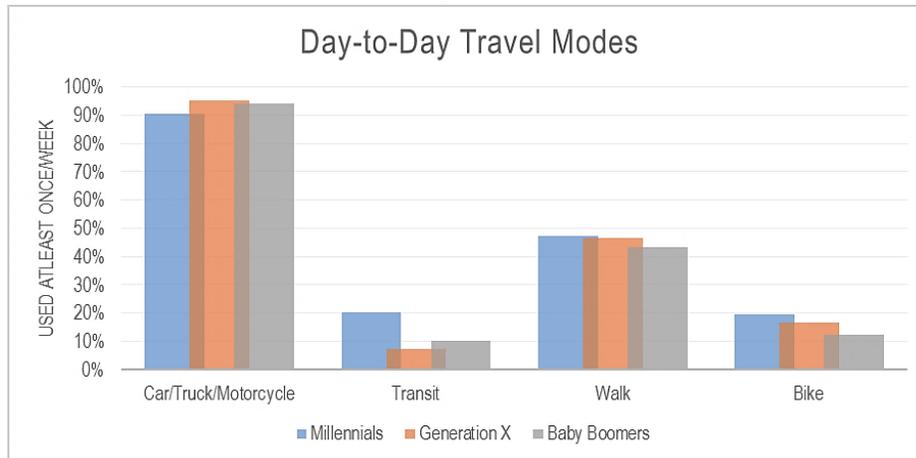
## Mobility Preferences

Young Americans are less likely than other generations to use a car, which reflects the larger trends of Millennials driving less.<sup>26</sup> UCLA’s Institute of Transportation Studies examined this trend in depth and found that conversely, 20 percent of Millennials will use either transit or biking at least once a week and almost 50 percent will walk as their primary form of transportation once a week.<sup>27</sup> As Millennials favor transit, cycling, and walking, policymakers and transportation planners should consider future strategies around these modes. Figure 5 below shows the travel mode preference.

---

<sup>26</sup> Dutzik, T, Inglis, J and Baxandall, P. *Millennials in Motion - Changing Travel Habits of Young Americans and the Implications for Public Policy*.

<sup>27</sup> Blumenberg, E., Taylor, B., Smart, M., Ralph, K., Wander, M. and Brumbaugh, S. *The Next Generation of Travel Statistical Analysis*. [http://www.fhwa.dot.gov/policy/otps/nextgen\\_stats/](http://www.fhwa.dot.gov/policy/otps/nextgen_stats/). Accessed in July 2016.



**Figure 5. Millennial Transportation Choices Compared to Other Generations [Source: US Public Interest Research Group (PIRG) Education Fund]**

## Millennial Choices Thoughts

Young generations are also typically the first to embrace new technologies. Millennials have come of age during the advent of both the internet and the smart phone, and research has shown that they are 2.5 times more likely to adopt and use these technologies than older generations.<sup>28</sup> Additionally, 56 percent of Millennials surveyed by BCG for a study say they will readily try a new technology, versus older generations who choose to wait a year or longer to try a new technology. These tendencies have a real impact during a time when technological advances are changing the transportation industry. Shared-use mobility apps, real-time navigation, transit schedules and congestion information on smartphones, and new generation taxi services like Uber and Lyft, along with ridesharing, bike sharing, and the ability to telecommute have provided Millennials with more alternatives to single occupancy vehicle travel. It is unclear whether Millennials will maintain their lower rates of driving and reliance on other options as they grow older and start families.

In addition, demographic factors shape Millennials' changing transportation preferences. For a given income, Millennials who owe more in student loan debt have less to spend on other household expenses. Simultaneously, student debt-holders are more likely to have a college education and higher income.

<sup>28</sup> Boston Consulting Group and Barkley. *American Millennials: Deciphering the Enigma Generation*. <https://barkley.s3.amazonaws.com/barkleyus/AmericanMillennials.pdf>. Accessed on July 2016.

Housing, transportation, and food account for 64 percent of the average American family's yearly expenditures in 2013.<sup>29</sup>

Millennials spend their income differently than past generations, which affects transportation trends. According to an analysis of a Consumer Expenditure survey, saving money was the most prevalent reason that Millennials choose to take multiple modes of transportation options to reach a destination, with 42 percent of respondents agreeing.<sup>30</sup> However, it is important to note that many studies point to shared-based options and community connections as strong influencers of Millennial travel behavior as well.

Economic factors also contribute to Millennial behavior. An increasing number of Millennials graduate with student loans as compared to members of the previous generation. This report looks into factors such as the loan amount, education level, housing expenses, and the impact of Millennial behavior pre- and post-recession in terms of private travel choices (i.e., vehicle ownership expenses, new and borrowed, and other fuel and operating expenses) and public travel choices (e.g., transit subscription, ridesharing, and bike sharing expenses). In the following chapters, we investigate the impact of student loans on Millennials in general and its relationship to Millennial travel choices.

---

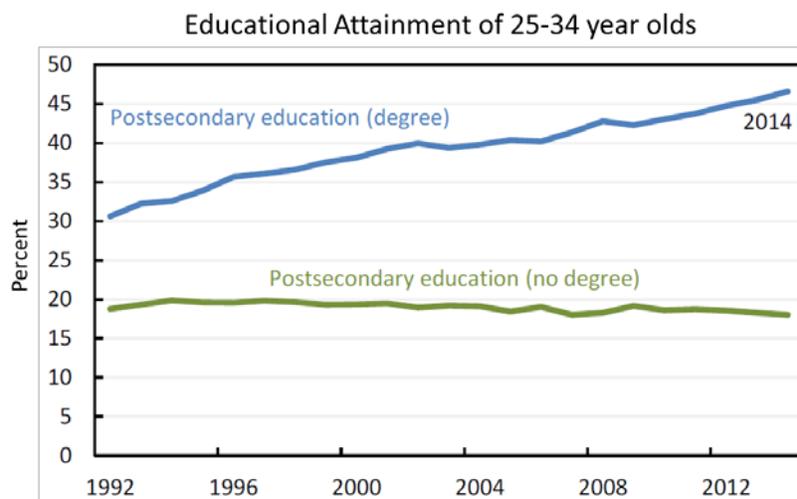
<sup>29</sup> Bureau of Labor Statistics, *Consumer Expenditures in 2013*. <http://www.bls.gov/cex/csxann13.pdf>. Accessed in February 2015.

<sup>30</sup> American Public Transportation Association. *Millennials & Mobility: Understanding the Millennial Mindset*. 2013.

---

## CHAPTER 2.0. MILLENNIAL STUDENT LOAN DEBT OVERVIEW

This chapter addresses and summarizes the research on the greater student loan debt burden for the Millennial generation, specifically when compared to the Baby Boomers and Generation X. According to the Federal Reserve Bank of New York, there are nearly 37 million student loan borrowers in the United States. This accumulated debt amounts to more than \$1.1 trillion, with the average outstanding debt per borrower over \$27,000. Millennials are also considered the most educated generation in the history of the United States, according to the White House report<sup>31</sup>. A higher percentage of Millennials have a college degree than in any other previous generation.<sup>32</sup> In 2013, 47 percent of 25- to 34 year-olds received a postsecondary degree (associates, bachelor's, or graduate degree) and an additional 18 percent completed some postsecondary education, as shown in Figure 6.<sup>33</sup>



**Figure 6. Educational Attainment of 25–34-Year-Olds across Time. [Source: White House Report]**

---

<sup>31</sup> Executive Office of the President of the United States, The Council of Economic Advisors. *15 Economic Facts About Millennials*, [https://www.whitehouse.gov/sites/default/files/docs/millennials\\_report.pdf](https://www.whitehouse.gov/sites/default/files/docs/millennials_report.pdf). Accessed in October 2015.

<sup>32</sup> Ibid

<sup>33</sup> Ibid.

Over the past 35 years, tuition and required fees at public universities have risen from \$2,249 to \$9,410 in 2015 dollars -which helps account for the student loan debt that Millennials are burdened with during their young working years.<sup>34</sup> The level of Millennial debt continues to rise; from 2007 to 2012, the number of student loan borrowers rose at a rate of 31 percent.

## Educational Attainment

As previously mentioned, the Millennial Generation is fast becoming the most educated generation in U.S. history, with 33.5 percent of young adults ages 25 to 29 already obtaining at least a bachelor’s degree. This compares to 24.7 percent of Gen Xers and 21.9 percent of Baby Boomers at the same age.<sup>35</sup> Furthermore, research from the Pew Research Center suggests that educational attainment will continue to rise as the remainder of the Millennial cohort completes its education.<sup>36</sup> Table 2 on the following pages illustrates the current level of educational attainment in the US.

**Table 2. Educational Attainment in the U.S. (in 2014)**

	Total Population (in thousands)	Millennials	Percentage of Degree Holders who are Millennials
<b>Bachelor’s Degree</b>	45,176	13,476	29.83%
<b>Master’s Degree</b>	17,960	3,585	19.96%
<b>Professional Degree<sup>37</sup></b>	3,174	560	17.64%
<b>Doctoral Degree</b>	3,719	524	14.09%

Table created by Booz Allen Hamilton and the data acquired by US Census Bureau educational attainment in the US: 2014 detailed tables

<sup>34</sup> Fry, R. Pew Research Center. *For Millennials, a bachelor’s degree continues to pay off, but a master’s earns even more.* <http://www.pewresearch.org/fact-tank/2014/02/28/for-millennials-a-bachelors-degree-continues-to-pay-off-but-a-masters-earns-even-more/>. Accessed in October 2015.

<sup>35</sup> National Center for Education Statistics. *Data Reveal a Rise in College Degrees Among Americans.* <http://www.nytimes.com/2013/06/13/education/a-sharp-rise-in-americans-with-college-degrees.html>. Accessed in June 2013.

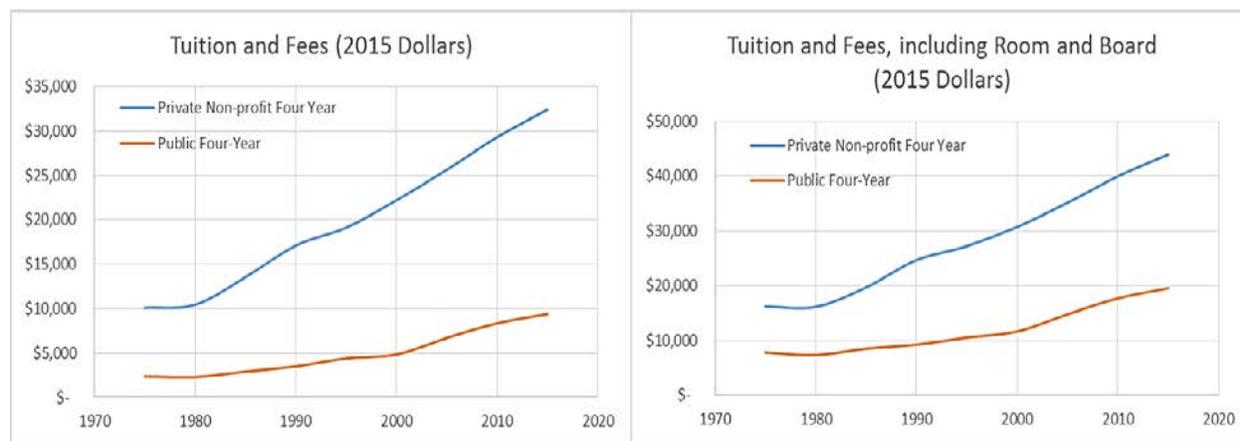
<sup>36</sup> Fry, R. Pew Research Center. *For Millennials, a bachelor’s degree continues to pay off, but a master’s earns even more.* <http://www.pewresearch.org/fact-tank/2014/02/28/for-millennials-a-bachelors-degree-continues-to-pay-off-but-a-masters-earns-even-more/>. Accessed in July 2016.

<sup>37</sup> “Professional Degree” refers to Master’s programs that are comprised of advanced studies in professional or vocational fields.

As of 2014, Millennials made up nearly 30 percent of the population who hold at least a bachelor's degree. This number does not include the 2015 graduating class, nor does it account for other Millennials still completing their education.

## Rising Tuition Costs

Record numbers of young people are choosing to further their education past high school diplomas; however, the cost of educational attainment for the Millennial Generation is significantly higher than that of past generations. As shown in Figure 7, the average cost of tuition in 2015 for a four-year degree at public, in-state universities was \$9,410 and \$23,893 for out-of-state public universities<sup>38</sup>. The costs are even higher for four-year degrees at private universities (on average \$32,405).<sup>39</sup> By comparison, Gen Xers attending a public college paid an average of \$4,399 while Boomers paid an average of \$2,387 (figures adjusted for inflation). These figures show that public tuition has increased by 294 percent in real terms. Salaries for nonsupervisory workers, in comparison, have only risen by a mere 10 percent since 1978.<sup>40</sup>



**Figure 7. Tuition, Fees, and Room over Time [Source: College Board]**

<sup>38</sup> The Economist. *Creative Destruction*. <http://www.economist.com/news/leaders/21605906-cost-crisis-changing-labour-markets-and-new-technology-will-turn-old-institution-its>. June 2014.

<sup>39</sup> College Board. *Trends in Higher Education*. <http://trends.collegeboard.org/college-pricing/figures-tables/tuition-and-fees-and-room-and-board-over-time-1975-76-2015-16-selected-years>. Accessed in October 2015.

<sup>40</sup> Economic Policy Institute. *CEO Pay Continues to Rise as Typical Workers Are Paid Less*. <http://www.epi.org/publication/ceo-pay-continues-to-rise/>. Accessed in October 2015.

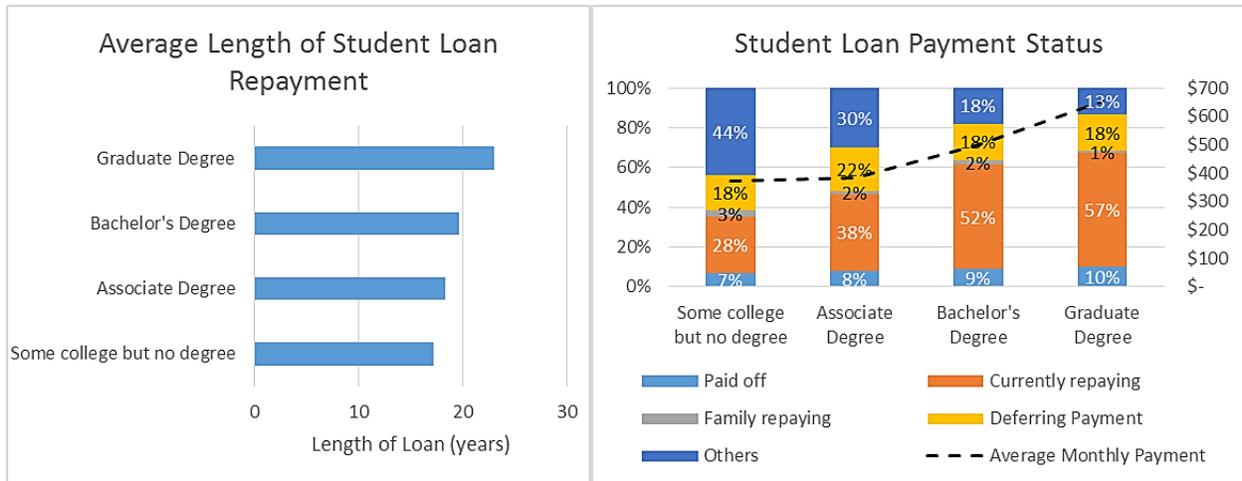
The rising costs of tuition and fees, room and board, and associated expenses (such as books and transportation) have increased the need for students and their families to finance their education using loans. This trend has resulted in a record high number of Americans with student loan debt, as will be discussed in the next section.

## **Millennial Debt Characteristics**

In May 2013, One Wisconsin Institute conducted a targeted survey of 61,762 individuals to assess the impact of student loan debt on home ownership trends and vehicle purchasing.<sup>41</sup> The survey analyzed respondents' education levels, student loan status, home ownership status, and vehicle ownership status. Figure 8 below shows the Wisconsin study's average student loan repayment duration surveyed among different degree levels. The average loan payment amount varied drastically across education levels, with respondents having some college education but no degree paying an average of \$371 per month, as compared to graduate degree holders, who pay an average of \$653 per month. It is important to note as well that individuals in these two groups will also have very different earnings/ incomes.

---

<sup>41</sup> One Wisconsin Institute. *Research Note 13-2 Survey Results: Impact of Student Loan Debt on Homeownership Trends and Vehicle Purchasing*. June 2013.



**Figure 8. Wisconsin Survey Results on Loan Repayment Duration and Status [Source: One Wisconsin Institute]**

The figure shows that the percentage of respondents who currently repay loans is more than 50 percent after earning a bachelor's or graduate degree. Additionally, the amount of debt and the proportion of young adults with debt are also rising substantially. For example, in a study conducted by the Federal Reserve Bank of New York, researchers found that the proportion of 25-year olds with student loans rose from 25 percent in 2003 to 45 percent in 2013, with the mean debt among the borrowers rising from \$11,000 in 2003 to \$21,000 in 2013 (a nearly 90 percent increase, after adjusting for inflation).

In addition, the recent recession and other economic factors have increased Millennial unemployment rates. The unemployment rates of recent college graduates increased from 7.7 percent in 2007 to 13.3 percent in 2012.<sup>42</sup> The unemployment rate for workers with at least a bachelor's degree was 2.4 percent, and their participation rate was 74.3 percent.<sup>43</sup> This is a lower unemployment rate and higher participation rate than the general population. This data suggests that it is more difficult for recent graduates to find their first jobs; however, on average, Millennial generation college graduates are more likely to be employed and have higher lifetime earnings than Millennial generation non-college graduates.

<sup>42</sup> Bureau of Labor Statistics. *Consumer Expenditures in 2013*. <http://www.bls.gov/cex/csxann13.pdf>. February 2015.

<sup>43</sup> Associated Press. *High school dropouts show difficulty finding or keeping jobs*. <http://www.cnsnews.com/news/article/high-school-dropouts-show-difficulty-finding-or-keeping-jobs>. February 2015.

## Undergraduate Loans

In 2014, total undergraduate and graduate U.S. student loan debt reached \$1.2 trillion, surpassing what is owed in credit card debt, mortgages, and auto loans.<sup>44</sup> Undergraduate debt comprises nearly 60 percent of the \$1.2 trillion. Currently, the average Millennial owes \$28,950 in student loans just for an undergraduate degree. With that level of debt, the average monthly payment is \$282.

Not only has the amount of loans that students must take to complete their undergraduate education increased, but also the number of students taking out loans has increased. In 2014, 71 percent of undergraduate students took out student loans to finance their undergraduate education. This is compared to 64 percent of Gen Xers and less than 50 percent of Baby Boomers.<sup>45</sup> While people with bachelor's degrees earn \$17,500 more annually than those without a degree,<sup>46</sup> undergraduate student loans still constitute a significant portion of monthly household income.

## Graduate Loans

Undergraduate loans alone are not causing the shift in household expenses. Nearly 40 percent of all student loan debt arises from Millennials pursuing graduate and professional degrees. This is because graduate and professional students borrow almost three times more a year than undergraduate students.<sup>47</sup> As with undergraduate degrees, more students are taking loans and are taking higher loan amounts. As of 2012, nearly 20 percent of students obtaining master's degrees borrowed \$80,000 or more. This number jumps to 70 percent for those obtaining a professional or doctoral degree.

Because the amount of debt owed on graduate degrees is significantly higher than that of undergraduate loans, the repayment plan is often income-based. For example, a person making \$70,000 with graduate

---

<sup>44</sup> *Wall Street Journal*. "Congratulations, Class of 2015. You're the Most Indebted Ever (For Now)." <http://blogs.wsj.com/economics/2015/05/08/congratulations-class-of-2015-youre-the-most-indebted-ever-for-now/>. May 2015.

<sup>45</sup> *Ibid.*

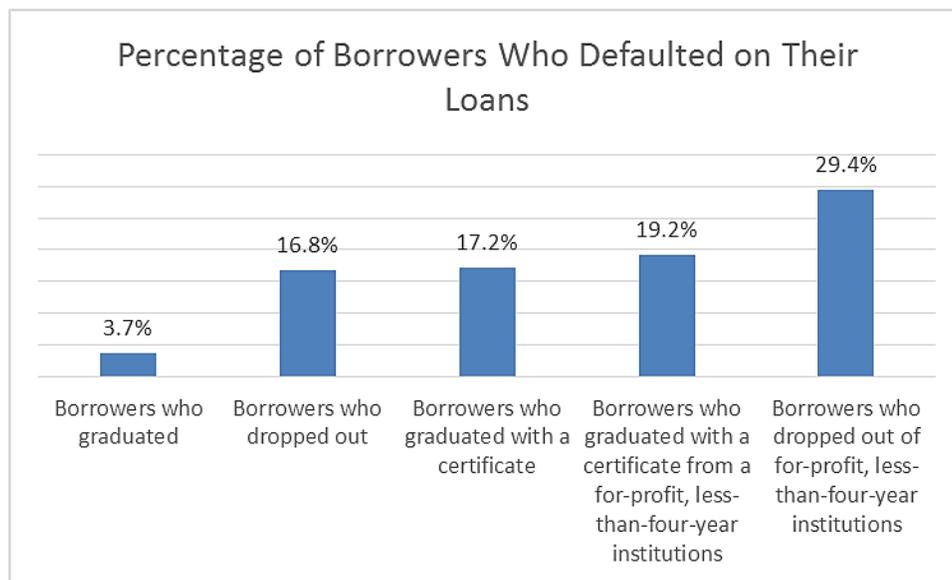
<sup>46</sup> The Pew Research Center. *The Rising Cost of Not Going to College*. <http://www.pewsocialtrends.org/2014/02/11/the-rising-cost-of-not-going-to-college/>.

<sup>47</sup> College Board. *Trends in Higher Education*. <https://trends.collegeboard.org/student-aid/figures-tables/cumulative-debt-undergraduate-graduate-studies-time>.

degree debt of \$57,600 would pay approximately \$600 a month. Monthly payments increase as income increases. This would also differ based on the interest rate of the loans.

## Incomplete Degrees

A large number of student loan borrowers do not complete their degrees, across all levels of education. According to the Education Policy Center at the American Institutes for Research, 29 percent of borrowers dropped out of college in 2009.<sup>48</sup> The economic burden of dropping out comes as borrowers do not have the financial benefits of higher income that are associated with a completed degree and, therefore, have difficulty repaying their debt. Of those taking out student loans, dropouts were more than four times as likely to default on their student loans, as shown in Figure 9.



**Figure 9. Percentage of Loan Defaulters [Source: Education Policy Center]**

While dropouts occur at all institutions, they are most common at for-profit universities. In 2009, 54 percent of students who borrowed money to pursue a bachelor's degree at a for-profit, four-year

---

<sup>48</sup> Mary Nguyen. American Research Institute. *Degreeless in Debt: What Happens to Borrowers Who Drop Out*. [http://educationpolicy.air.org/sites/default/files/publications/DegreelessDebt\\_CYCT\\_RELEASE.pdf](http://educationpolicy.air.org/sites/default/files/publications/DegreelessDebt_CYCT_RELEASE.pdf).

institution dropped out.<sup>49</sup> Additionally, more than 40 percent of borrowers at for-profit, two-year institutions have dropped out. Again, the financial burden already caused by debt is exacerbated by the fact these borrowers do not receive the financial benefit of having a college degree.

## **Millennial Student Loan Debt Reduces Financial Stability**

Many studies showed that Millennials have more debt than earlier generations, including credit card bills, student loans, mortgages, and car payments. Some of these studies have shown that the rising cost of student debt has slowly grown to be both a social and an economic barrier: the latest numbers suggest that seven of 10 college seniors in 2015 graduated in debt,<sup>50</sup> and student debt now comprises 69 percent of Millennials' owed debt.<sup>51</sup> Consequently, student loan debt has greatly reduced the financial stability of Millennials, compared to other generations. This finding suggests that debt is a statistically significant influencer of Millennial lifestyle decisions to delay marriage, own a home (or even a stable rental), or choose alternate forms of transportation, along with many other decisions. The subsequent chapters will focus on the relationship between student loan and travel choices.

---

<sup>49</sup> College Board. *Trends in Higher Education: Tuition and Fees and Room and Board over Time, 1975-76 to 2015-16, Selected Years*. <http://trends.collegeboard.org/college-pricing/figures-tables/tuition-and-fees-and-room-and-board-over-time-1975-76-2015-16-selected-years>. Accessed in October 2015.

<sup>50</sup> The Institute for College Access and Success. Project on Student Debt: State by State Data <http://ticas.org/posd/map-state-data-2015>.

<sup>51</sup> Lane., A. *Beyond the Headlines: Is Student Debt Strangling Millennials' Chances for Success?* <http://www.bentley.edu/impact/articles/beyond-headlines-student-debt-strangling-Millennials-chances-success#sthash.xFCx8fSK.dpuf>. Accessed July 2016.

---

# CHAPTER 3.0. STUDENT LOAN DEBT AND TRAVEL CHOICES (DESCRIPTIVE ANALYSIS)

While many have considered student loans' effects on big-ticket items, like starting a family or buying a house,<sup>52</sup> researchers have not yet examined the effect of these loans on more proximate purchases, such as household expenses or transportation choices. This chapter leverages data from the Community Expenditure Survey (CES) from the Bureau of Labor Statistics to examine the relationship between student loans and transportation choices for Millennials. Figure 10 depicts the content flow of Chapter 3.

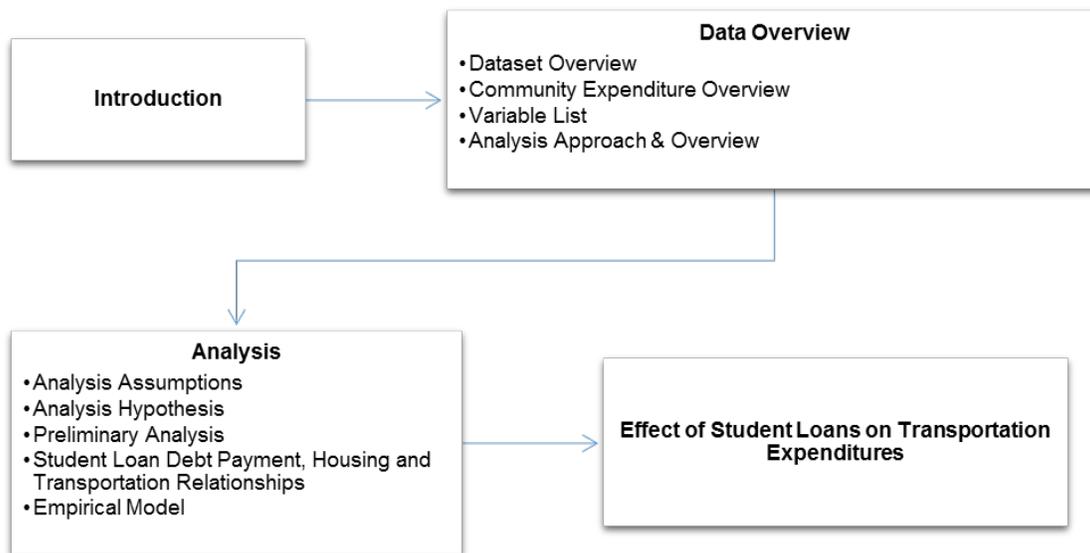


Figure 10. Content Flow of Chapter 3

## Sampling and Data Collection

The research team sought to directly assess the impact of student loan debt on Millennials' transportation choices, but no existing dataset to our knowledge has focused on this relationship. As a result, the

---

<sup>52</sup> Zetlin, M, How Student Debt Is Ruining Millennial Lives, Accessed at <http://www.inc.com/minda-zetlin/the-dark-side-of-being-a-Millennial-student-debt.html>

research team conducted a preliminary scan of multiple expenditure and travel surveys to identify the best data for a quantitative analysis of student debt and transportation behavior. The team reviewed two types of databases:

1. **Financial/Expenditure Databases:** Survey of Consumer Finances (SCF) and Consumer Expenditure Survey (CE), and
2. **Travel Behavior-Related Databases:** American Community Survey (ACS), Metropolitan Travel Survey Archive (MTSA), and NREL’s Transportation Secure Data Center (TSDC).

Each dataset has its own strengths and weaknesses, but we found the CE to be the most information intensive, including transportation expenses, education loans, and demographic characteristics of each household member. Consequently, this chapter focuses on the CE overview and findings, while Appendix A summarizes the findings of the remaining datasets scan.

## Consumer Expenditure Survey (CE)

The Consumer Expenditure Survey<sup>53</sup> consists of two surveys, the Quarterly Interview Survey and the Diary Survey, which gather information about the buying habits of American consumers in terms of their expenditures, income, and consumer unit characteristics. The survey covers a large nationwide representative sample: about 7,000 households have been surveyed each quarter in recent years. The microdata of the CE is rich and has been available on a yearly basis for the last 20 years.

The CE survey is the only federal survey to provide information about the complete range of consumers' expenditures and incomes, as well as the characteristics of those consumers. Also, it provides a continuous and comprehensive flow of data on the buying habits of American consumers. Our initial analysis reduced the original number of variables in the dataset from more than 1,500 to 49 (listed in Table 3) for further analysis.

**Table 3. CE Selected Variables for the Analysis**

ID	Variable Name	Description
Reference person(s) (survey respondent's) demographics		
1	AGE_REF	Age of reference person

<sup>53</sup> Bureau of Labor Statistics. *Consumer Expenditures in 2013*. <http://www.bls.gov/cex/> February 2015.

ID	Variable Name	Description
2	EDUC_REF	Education of reference person
3	SEX_REF	Sex of reference person
4	MARITAL1	Marital status of reference person
5	CUID	Consumer Unit ID of reference person
6	YEAR	Year in which reference person completed interview
7	BLS_URBN	Urban or rural
8	INCLASS	Income class (imputed)
9	POPSIZE	Population size of city of inhabitation
10	PSU	Primary sampling unit (city of inhabitation)
11	REGION	Region of inhabitation
12	SMSASTAT	Does inhabitant live in metropolitan area?
13	STATE	State of inhabitation
14	BIRTH_YEAR	Year of birth
15	HISP_REF	Hispanic nature of reference person
16	VEHQL	Number of autos, trucks, vans
17	EARNCOMP	Composition of earners in household
18	OCCUCOD1	Job of reference person
19	INCOMEY1	Nature of employer (private, public, etc.)
20	INC_HRS1	Number of hours worked weekly
21	CUTENURE	Housing tenure
22	REF_RACE	Race of reference person
23	NUM_AUTO	Number of owned automobiles
<b>Spouse/ other house-member(s) demographics:</b>		
24	AGE	Member's age
25	AGE2	Age of spouse
26	CHILDAGE	Age of children of reference person
27	HISP2	Hispanic origin of spouse?
28	SEX2	Sex of spouse
29	RACE2	Race of spouse
30	PERSLT18	Number of children under 18 in CU
31	FAM_TYPE	Type of family (composition of children)
32	FAM_SIZE	Size of family
33	OCCUCOD2	Job of spouse
34	INCOMEY2	Nature of spouse's employer (private, public, etc.)
35	INC_HRS2	Hours spouse worked per week
<b>Expenditure Metrics</b>		
36	AVGGASMOPQ	Gas expenses in the past quarter
37	AVGHOUSPQ	Housing expenses in the past quarter
38	AVGTRANSPQ	Transportation expenses in the past quarter
39	AVGVEHFINPQ	Vehicle finance charges in the past quarter
40	CREDITX5/1	Approximated student loan values
41	AVGTOTEXPPQ	Average total expenditures, past quarter
42	AVGEDUCAPQ	Average educational expenditures, past quarter
43	AVGPUBTRAPQ	Average public transit expenditures, past quarter
44	AVGVRNTLOPQ	Average vehicle rental expenditures, past quarter
45	AVGVEHINSQP	Average vehicle insurance expenditures, past quarter
46	AVGMAINRPPQ	Average maintenance and repairs past quarter
47	AVGOTHVEHPQ	Average other vehicle costs last quarter
48	CARTKUPQ	Net outlay of used cars and trucks, past quarter

ID	Variable Name	Description
49	CARTKNPQ	Net outlay of new cars and trucks, past quarter

Appendix B summarizes the different distributions of the variables identified in Table 3.

## Methodology

Working with CE data is difficult due to the number of data points, the inconsistency of available data, the extent of the data, and the almost yearly changes to the interview structure. Our team thoroughly researched the issues, developed a list of critical analysis assumptions, wrote custom scripts to collect, clean, and harmonize the data, and finally, used the data to inform a number of descriptive, visualization-based analyses.

## Analysis Assumptions

To work with such a complex dataset, we made a number of assumptions to move our analysis forward.

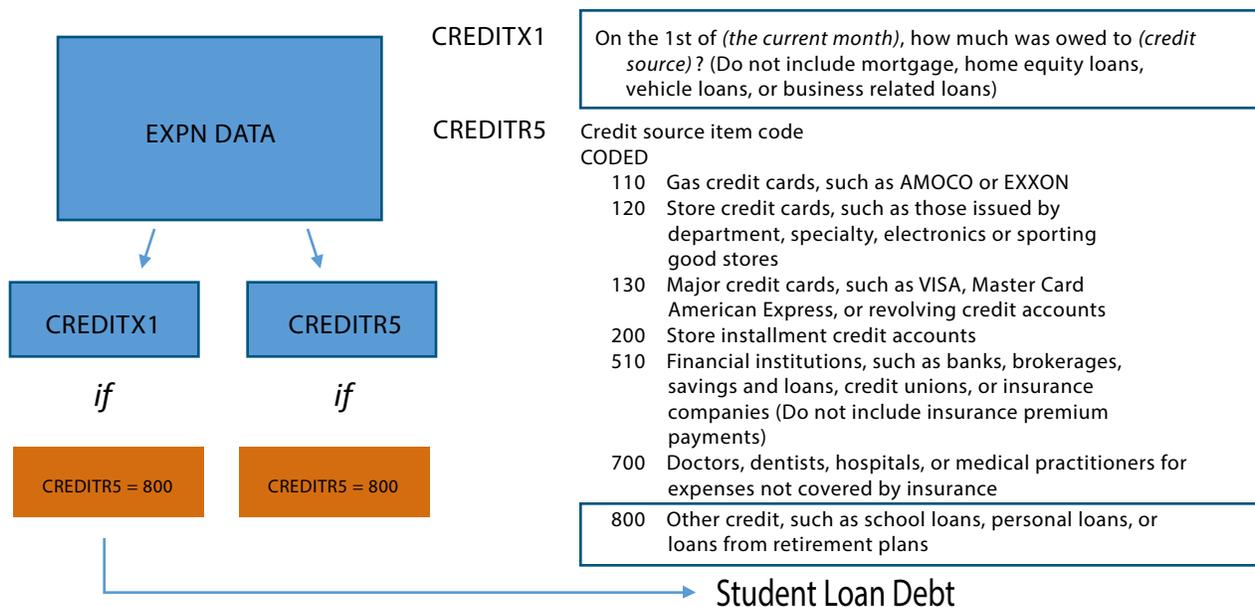
- **All data were evaluated at the consumer unit level** – the size of the dataset and the complexity of different types of families made splitting consumer units into different groups unfeasible for our analyses.
- **We worked exclusively within the years of 2003–2012** – We did not have much data for Millennial heads of household before 2003, since most Millennials had not yet graduated college. In addition, the CE dataset changed its tracking question for student loans in the second quarter (Q2) of 2013. Consequently, we only focus on the range of years 2003–2012 for consistency.
- **All year-based analyses use a pre-recession group (2003–2007) and post-recession group (2008–2012)** – As the dataset has relatively small sample size (n=4,400 with student loans across 10 years of data), analyses that favor yearly divisions are often compromised by noise related to sample size issues. In addition, this division helps us to understand the changes pre- and post-2008, an important dividing line for economic decisions, given the Great Recession.

- **We used Kurz and Li’s (2015) method for approximating student loan data as combined balances of total household debts.** Christopher Kurz and Geng Li of the Federal Reserve<sup>54</sup> pioneered a method for approximating student loan data in their 2015 paper on light vehicle purchases. Prior to the release of 2013 CE (the latest release), student loan balance information was lumped with several other types of household credit, such as personal loans and pension plan loans. Therefore, we use the combined loan balances as an approximation of student loan balances. Figure 11 summarizes the process. We worked exclusively within the ages of 20–40 throughout the dataset to exclude other types of personal loans (e.g., retirement loans), more relative to other demographics.
- **We averaged quarterly values to create an “average quarterly” metric for all expenditure variables** – The interview data is variable; some families might complete four interviews per year, while others may only complete two or three. This happens not only because the CE has a staggered-interview approach, but also because of participant nonresponse. As a result, we investigated this issue with the Bureau of Labor and Statistics, and they suggested the following: *“Limiting research to households who actually complete four interviews will introduce bias to their estimates. Studies show that those who complete all four interviews tend to have common characteristics. Thus, averaging the quarterly values for all expenditure variables is the recommended process.”*

---

<sup>54</sup> Kurz, C and Li, G. *How Does Student Loan Debt Affect Light Vehicle Purchases?*

<http://www.federalreserve.gov/econresdata/notes/feds-notes/2015/how-does-student-loan-debt-affect-light-vehicle-purchases-20150202.html>.



**Figure 11. Methodology for Approximating Student Debt**

## Analysis Hypothesis

As student debt is rapidly rising,<sup>55</sup> we tested whether there is a relationship between student debt commitments and transportation choices. Intuitively, we posit that the relationship has a negative correlation; i.e., the burden of student debt constrains household choices in other areas, including transportation. Student loan debt also may affect credit ratings, which can, in turn, make it more difficult for Millennials to secure auto loans. Indeed, automobile purchases and operating expenses are a large component of total transportation expenses.

Nonetheless, the relationship between student loans and transportation expenditures could also be either positive or nonexistent. A positive relationship would suggest that student debt acts as a proxy for economic opportunity. A 2014 study by the New York Federal Reserve,<sup>56</sup> for example, finds that despite

<sup>55</sup> Puzanghera, J. *Los Angeles Times*, "Soaring student loan debt poses risk to nation's future economic growth." <http://www.latimes.com/business/la-fi-student-debt-20150906-story.html>. Accessed in October 2015.

<sup>56</sup> Paretla, K. *U.S. News and World Report*: "Benefits of College Still Outweigh Costs, Fed Study Says." <http://www.usnews.com/news/articles/2014/06/24/benefits-of-college-still-outweigh-costs-fed-study-says>. Accessed in October 2015.

mounting student loan burdens, returns on college education still outweigh the costs. Furthermore, there might be no clear relationship — households might simply cut back on other expenditures, instead. A 2016 Yellowbrick study<sup>57</sup> found that 75 percent of Millennials report that student-loan debt has affected their decision to buy a house, and 43 percent say it has caused them to delay starting a family.

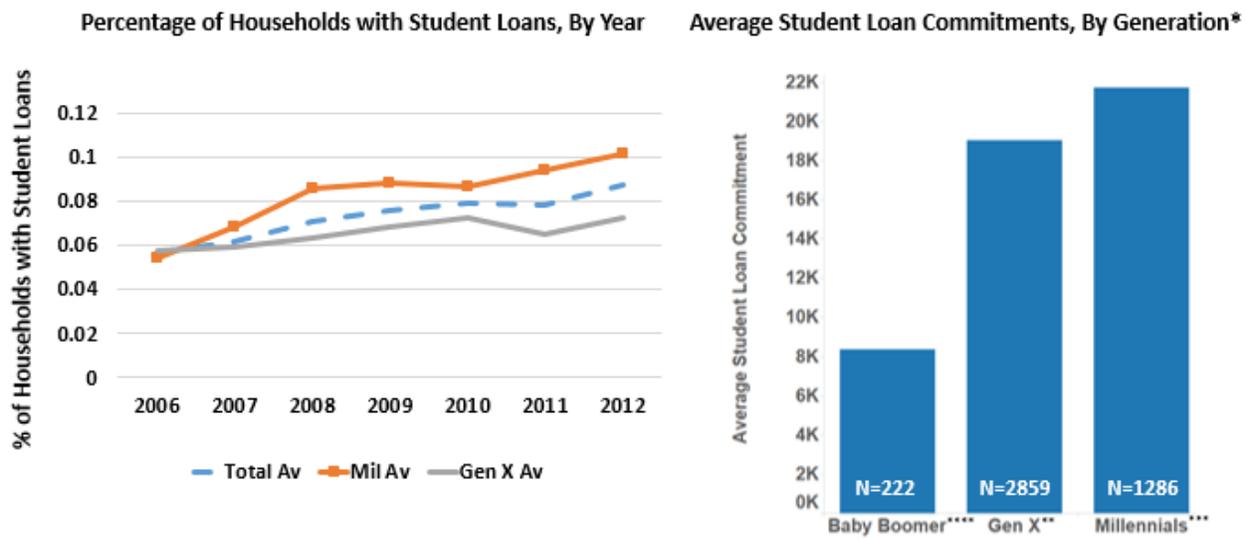
Households may be disproportionately cutting back on other big-ticket items. We hypothesize that there is a negative relationship: as student loan burdens rise, we expect loan holders to spend more conservatively, affecting expenditures not only on big-ticket, down-the-road items, but on day-to-day purchases and transportation decisions as well.

## **Preliminary Analysis**

Our analysis begins with an overview of student loans within our dataset. As mentioned above, the percentage of households in our dataset with student loan commitments is on the rise, with the percentage of Millennials with student loan debt nearly doubling over the six-year period from 2006–2012. Among those with loans, Millennials also showcased the highest average student loan commitment, compared to members of other generations: over \$22,000 in debt. While many Millennials had not yet graduated college or attended graduate school within the scope of our dataset, we nevertheless saw rising trends in student loan commitment on an annual basis across both graphs of Figure 12.

---

<sup>57</sup> Michael Sivak and Brandon Schoettle. *Why There's Been a Huge Decline in Drivers' Licenses for Millennials and Gen X*. <http://time.com/money/4185441/Millennials-drivers-licenses-gen-x>. 2012.



**Figure 12. Student Loan Overview Annually**

\* N= 4400.

\*\* Generation X is defined as any CU head born between the years of 1965 and 1980

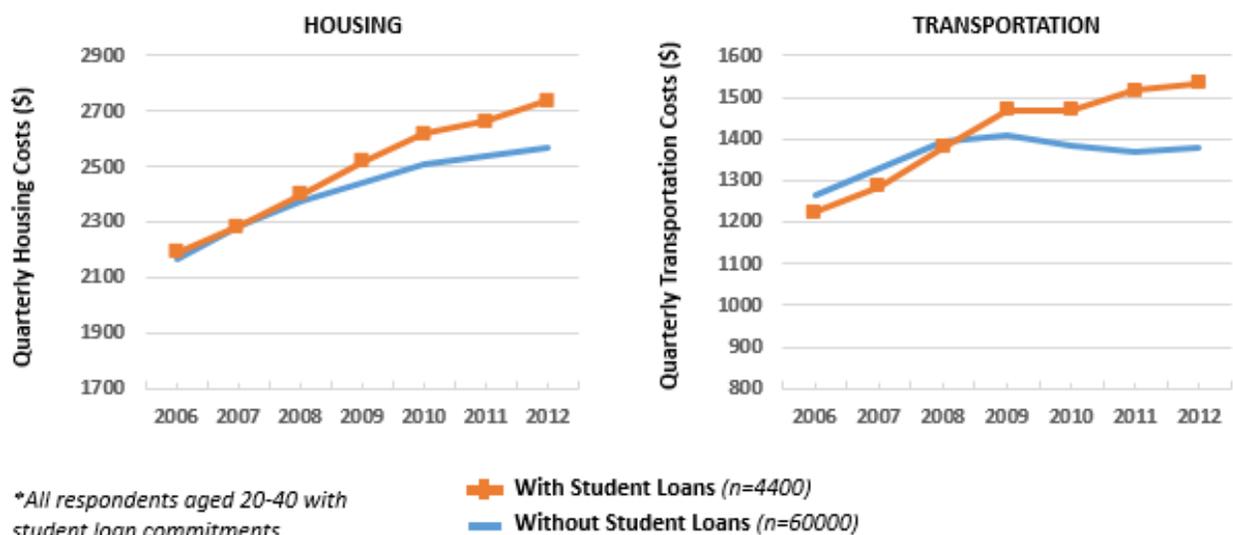
\*\*\*Millennial defined as any college-aged (22 or older) head of household born after 1980

\*\*\*\*Baby Boomer defined as any person born before 1965. Note: N is small for baby boomer, as most are out of our age range of 20–40

In the following section, we explore the relationship between these rising student loans and transportation expenses in-depth.

## Student Loan Debt Payment, Housing, and Transportation Relationships

To accurately understand the relationship between student loans and household expenses, we first examined how these expenses have been affected by student loan growth, as outlined in the graphs above. Over this period, housing and transportation costs were rising at a slightly faster rate for those with student loan commitments than for those without student loan commitments, indicating a potential correlation between the student loans and household expenses. Figure 13 shows the distribution of housing and transportation expenses for Millennials with and without student loan debts.

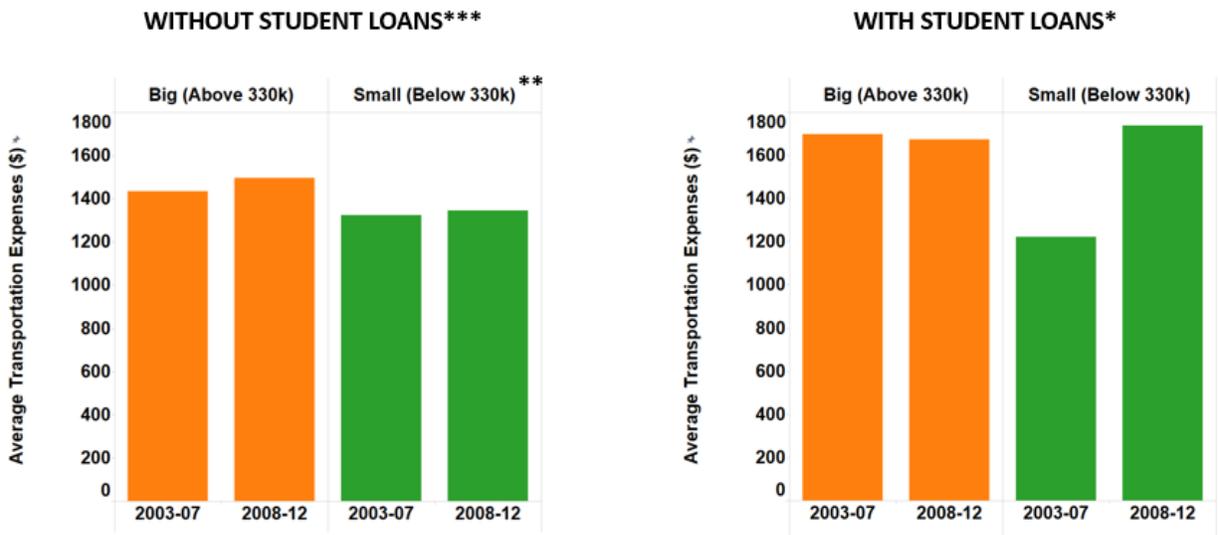


**Figure 13. Housing and Transportation Costs Adjusted for Inflation, 2006–2012**

### Student Loan Debt Impact for Pre- and Post-Recession

The theory was that student debt holders should have lower transportation expenses, especially given the recession that began in 2008. In a 2011 study, 67 percent of respondents admitted to cutting back on expenses throughout the recession.<sup>58</sup> In such a situation, we might expect student loan holders, with existing debt commitments, to cut back more than non-student loan holders. However, as we investigate below, this has not been the case. The following figure demonstrates that Millennials with student loan debt spent significantly less on transport during the recession.

<sup>58</sup> Rix, E. AARP Public Policy Institute. *Recovering from the Great Recession: Long Struggle Ahead for Older Americans*. [http://assets.aarp.org/rgcenter/ppi/econ-sec/insight50\\_recovering.pdf](http://assets.aarp.org/rgcenter/ppi/econ-sec/insight50_recovering.pdf). Accessed in July 2016.



\*All respondents aged 20-40 with student loan commitments

\*\*330k divide determined by POPSIZE variable in CE

\*\*\*N = 15,000

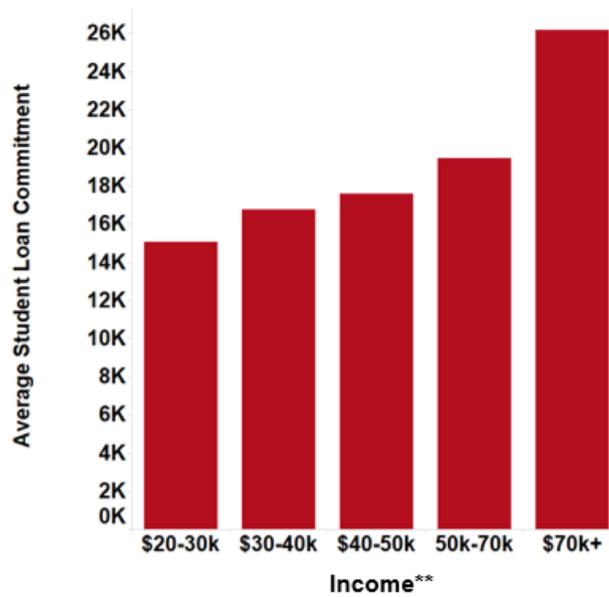
1:

**Figure 14. Transportation Expenses Before and After Recession for Big (> 330,000) and Small (<330,000) Populations**

Figure 14 suggests that the slight uptick in transportation expenses throughout a recession may be partially caused by small city dwellers' inability to cut back in their transportation costs. Despite rising gas costs, the wider population in smaller cities' transportation expenses stayed relatively steady. Among those with student loans, expenses rose much more rapidly. While their loan-bearing big-city counterparts were able to cut back on transportation expenses despite rising transportation costs, small-city dwellers with student loans did not show that tendency.

Therefore, we potentially attribute some of the increase in overall transportation spending to rising transportation costs in smaller urban and rural areas. This could be due to the lack of alternative transportation options amidst rising transportation costs in general. Smaller-town inhabitants often do not have an option to take the subway or the bus instead of driving a car, and those with student loan commitments may have less economic mobility that might allow them to take a job closer to home or move to a larger city with alternative transportation options.

In general, cutting back on transportation expenses may not be a central priority for those with student loans, as their job earnings enable such individuals to handle rising transportation costs. Indeed, the data shows a positive relationship between income and student loan value (Figure 15).



*\*\*Income imputed from pre-tax income using imputation methodology outlined in CE documentation*

**Figure 15. Student Loan Commitment by Income Class**

Taking into account all student loan holders, the relationship between student loans and transportation expenses appears unclear. While some analyses suggest a slightly positive relationship (i.e., the uptick in transportation expenses for loan-holders), many of the other trends can be explained by Figure 15. Student loan holders in our data are generally well-off, which would contribute to higher transportation expenses. Given the murkiness of absolute-spending-based analyses over our entire dataset, it is imperative to a) confine our investigation to the Millennial generation, and b) consider transportation as a percentage of household expenses in place of absolute spending data.

Across the board, people spent less on transportation as a percentage of household expenditures post-2008, but Millennials showed a particularly large difference between loan-holders (Figure 16, right) and those without loans (Figure 16, left). While we might consider this drop to be connected to student loan commitments, a number of analyses seem to refute this idea. The housing and transportation expenses definitely differ from one region to another in the U.S. Subsequently, we analyzed the total transport expenses on a region-by-region basis as shown in Figure 17. The region-by-region analysis proved ineffective at connecting regions of higher growth in student debt with higher declines in transportation

expenses. The west region, for example, showed the lowest increase in student debts among Millennials over this period, while showcasing the highest decline in the transportation expenditure burden.

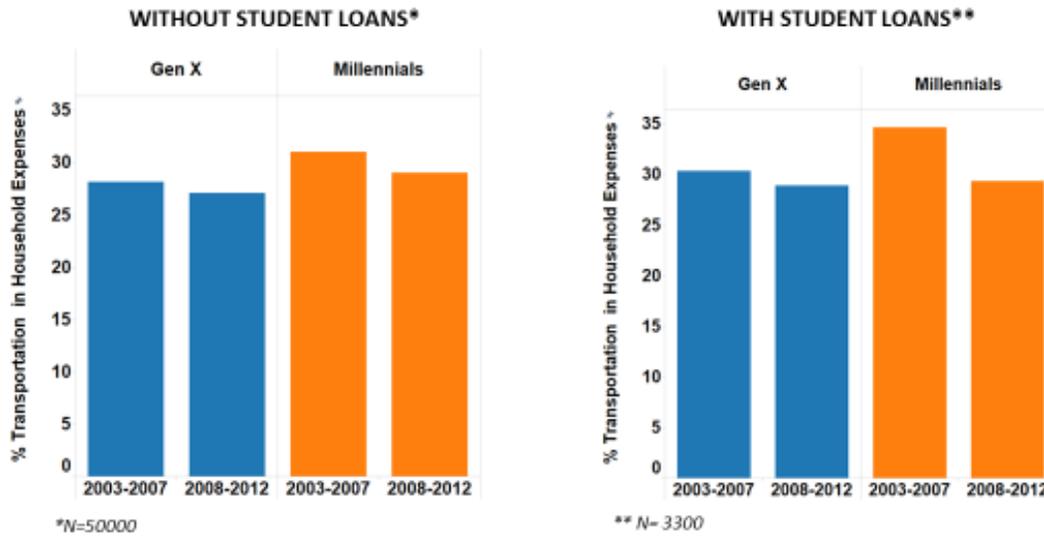


Figure 16. Transportation as a Percentage of Household Expenses

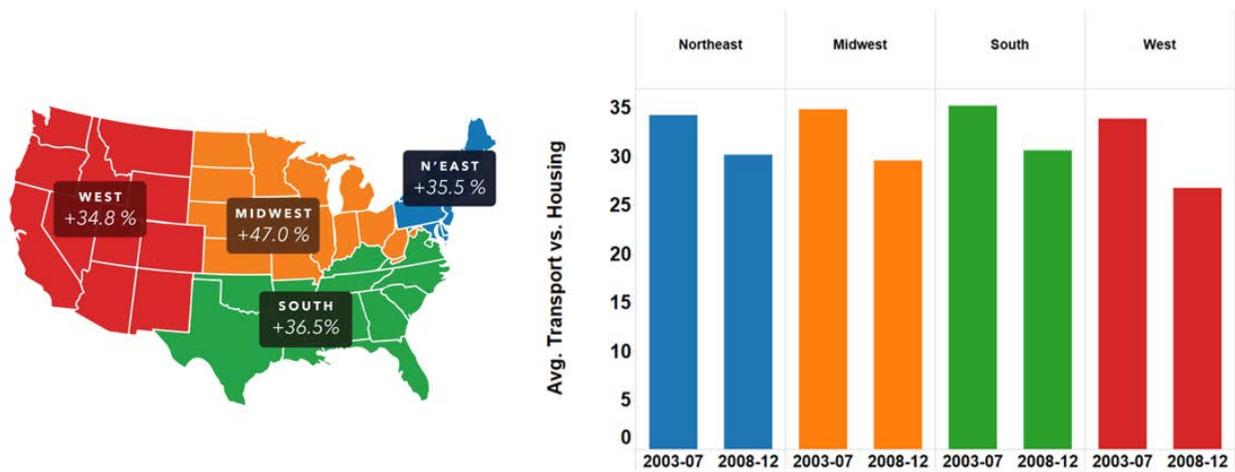


Figure 17. Transportation as a Share of Household Expenditure Before and After Recession (2003–2007 vs. 2008–2012)

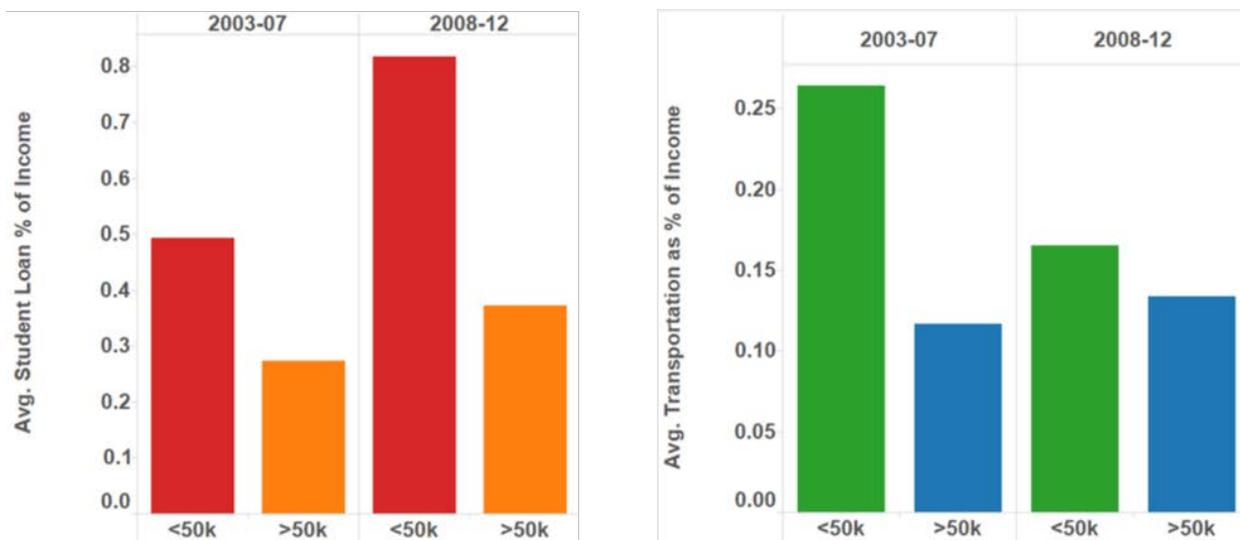
\*Millennial defined as any college-aged (22 or older) head of household born after 1980

\*\*Map shows growth in average Millennial student loan commitment for that region. Note: not longitudinal, so following the same respondents, year-over-year. N = 1249 for both graphs.

## Student Loan Debt and Transportation/Housing Expenses by Income Level

Our analysis shows that the housing expenses for Millennials with student debt nearly doubled over that time period, taking up a larger share of household expenditures and possibly affecting transportation decisions. On the other hand, housing costs for Gen Xers with student debt did not rise as quickly. Additionally, homeownership among Millennials is roughly 34 percent, compared to that of Gen Xers, which is roughly 59 percent. Consequently, we decided to further investigate the transportation expenses and their relationships to the income level of Millennials' total transportation and housing costs.

On the left of Figure 18, we see the growing chunk of yearly income represented by the average student loan; lower-income respondents are hit particularly hard in this regard. The right of Figure 18 measures transportation expenditures as a percentage of income, and we see opposing trends. While lower-income respondents show a massive decrease in transportation expenditures, their higher-income counterparts do not. This likely indicates that student loan holders with low salaries are cutting back on transportation spending as student loan values skyrocket. Nonetheless, as we have previously seen, those who are gainfully employed do not seem to be altering their transportation choices.



## Figure 18. Transportation and Loan Payment as Percentage of Income

\*  $N = 4400$ .

Given the general inability of our descriptive analyses to connect growth in student loan commitments to changes in transportation spending, it is critical to explore the data through a statistical model. Statistical models can help account for important vagaries in the data—unobserved predictors like family structure, other spending habits, and demographics—all of which are difficult to assess using cross-tabulations with many variables and associated values. While creating a descriptive analysis that accounts for differing income levels, for example, would be impossible, the statistical model developed in the next section helps account for these variances.

### Summary

Given this analysis of descriptive data, we come to the following preliminary conclusions:

- Transportation and housing expenses were slightly higher (a one percent higher total expenditure burden, to be precise, which may be due to variance and may not be a statistically significant difference) on average for those individuals with student loans, which may seem counterintuitive.
- The majority of student loan holders in the survey are gainfully employed, which explains their ability to absorb slightly higher expenditures.
- Student loan holders in smaller cities (>330K population) showed a large uptick in transportation expenses post-2008, possibly related to a lack of alternative transportation choices in smaller cities.
- The percentage of the Millennial household budget spent on transportation fell considerably after the recession for those with student loans. This was likely due to a steep growth in housing expenses for the same group.
- Transportation spending as a percentage of income declined for low-income Millennials, while student loans increased, suggesting that transportation choices are being altered due to mounting student loan commitments.

Overall, there seems to be little evidence connecting student loans with transportation choices, at least at the descriptive level. The data suggests some potential relationships; however, they remain unconvincing

and, at times, conflicting, emphasizing the need for additional empirical/statistical analysis as presented in the following chapter.

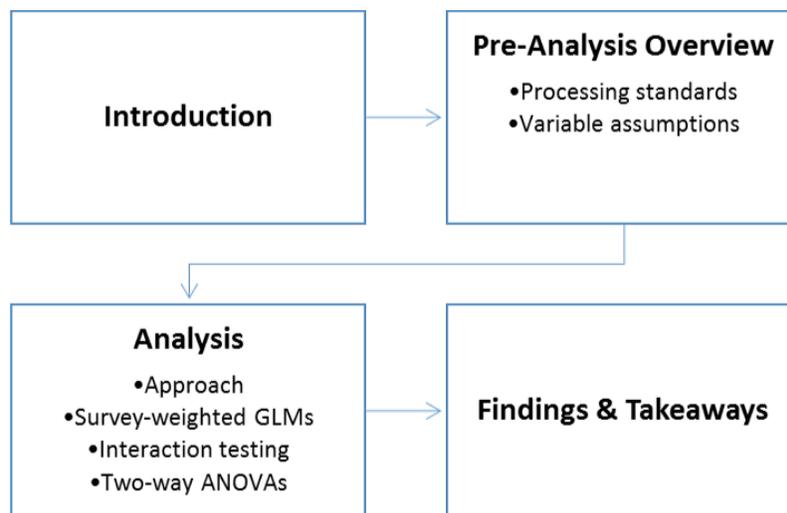
---

# CHAPTER 4.0. STATISTICAL MODEL ANALYSIS

To address the limitations of the preliminary (descriptive) analyses, we *directly* assessed the importance of student loans (and other factors of interest) in determining transportation choices by constructing more statistical analysis. The team used a series of regression models to test the hypothesis that student loans significantly predict transportation choices across different modes of transportation.

The analyses in this chapter once more draw upon the CE Survey data from the Bureau of Labor Statistics to test the statistical significance of student loans in predicting transportation choices of Millennials.

Figure 19 represents the content flow of processes undertaken in this chapter.



**Figure 19. Content Flow of Chapter 4**

## Pre-Analysis Process

As mentioned in Chapter 3, the CE is composed of two surveys, the Quarterly Interview Survey (“Interview” data) and the Diary survey (“Diary” data), which track the buying habits of American consumers and includes data on the characteristics of these consumers. For the analyses in this chapter, we use only Interview data.

For each quarter in which the CE survey is administered, approximately 20 percent of survey respondents drop out of the survey and are replaced by a new cohort of respondents. When considering a year’s worth of data (five quarters in a year), the rotating cohort structure of the survey will cause some survey respondents to be represented more (up to five times, if respondents enter the survey in the first quarter of the new year, such as Cohort 1 as seen in Figure 20) than others who enter the survey later. To account for disproportionate representation by certain CUs in the dataset, only distinct CU IDs were taken across five quarters to form a dataset representing the year from which the CUs were drawn.

	2012				2013
	Q1	Q2	Q3	Q4	Q1
Cohort 1	1	2	3	4	5
Cohort 2	2	3	4	5	
Cohort 3	3	4	5		
Cohort 4	4	5			
Cohort 5	5				
Cohort 6		1	2	3	4
Cohort 7			1	2	3
Cohort 8				1	2
Cohort 9					1

**Figure 20. Rotation of Cohorts Throughout a Year**

To isolate people who pay student loans, we further narrowed the data to respondents who indicated (for the question on owed credit, CREDITR1) that the source of their owed amount was “other credit” such as school loans, personal loans, or loans from retirement plans. This question served as the student loans filter. After filtering the data through these assumptions and expectations, two datasets were produced for analysis: 3,153 observations for the 2002–2007 dataset and 3,365 observations for the 2008–2012 dataset (serving as pre- and post-recession analyses, as seen in the preliminary analyses).<sup>59</sup>

---

<sup>59</sup> The CE datasets also contain survey weights. Calculated using the balanced repeated replication (BRR) method, the 44 replicate weights correctly compute the standard errors of point estimates for survey data analysis. These replicate weights are calculated on information not provided to the user in order to further anonymize the results. There is also one total replicate weight, finlwt21, calculated from the 44 replicate weights, and this serves as an alternative to the probability weight used to weight the sample back to the population from which the sample was drawn from.

## Variable Assumptions

### Student Loan

As described in the previous chapter, we used the Kurz and Li method of approximating student loan data (Figure 11), employing a proxy variable for capturing student loans. Since it is impossible to parse student loan expenditures from the owed “Other credit,” we assumed that anyone younger than 45 years old that paid any amount of owed credit to “school loans, personal loans, or loans from retirement plans” was paying such amounts as school loans. While this is not a direct measurement of student loans, it is the closest available proxy included in the dataset.

### Income

Additionally, to use continuous-value variables, all INCLASS values were recoded to be the midpoint value of the class ranges they represent. For example, if a CU’s income class was recorded as “06” (which represents an income range of \$30,000 to \$39,999), their recoded income value was simply \$35,000. For those individuals having an income class of “01” (or less than \$5,000), their income was recorded as \$2,500; likewise, individuals with the highest income class of \$70,000 and over were simply recorded to have incomes of \$70,000 (since it was unclear how much higher one’s income could be than \$70,000). In light of this coding scheme, the minimum income that any individual could have in these analyses was \$2,500, while the maximum income that an individual could have was \$70,000.

## Analysis

### Methodology

To assess whether determinants of interest are significantly related to transportation expenditures, we ran regressions consistently using the same predictors of interest:

1. Age (of CU respondent),
2. Education level,
3. Student loan amount,
4. Income (midpoint value), and
5. Amount spent on housing in the previous quarter.

Studying how these attributes shaped consumer units' transportation choices, we regressed these variables to three components of previous-quarter private transportation expenses, along with public transportation cost:

1. **Vehicle ownership costs** (sum of the following):
  - a. Vehicle finance charges last quarter
  - b. Cars and trucks, new (net outlay) last quarter
  - c. Cars and trucks, used (net outlay) last quarter
  - d. Other vehicles last quarter
  - e. Vehicle rental, leases, licenses, and other charges last quarter
2. **Fuel expenditure costs:**
  - a. Gas charges last quarter
3. **Vehicle maintenance costs** (sum of the following):
  - a. Maintenance and repairs last quarter
  - b. Vehicle insurance last quarter
4. **Public transportation expenditures:** Private transportation costs were of greater interest in these analyses since only a portion (approximately 20 percent each year) of CU respondents spent any money in a quarter on public transportation expenditures.

Additionally, we examined a fifth component: in case transportation expenditures themselves were not changed, but rather the overall *share* of how much people spend on transportation, the model was regressed by taking the total transportation expenditures (sum of values for all three private transportation categories plus public transportation expenses) divided by the sum of total transportation expenditures and housing expenditures. Housing and transportation expenses were considered a denominator, in light of the documented research exploring how housing and transportation expenditures may be affected by student debt. Other expenditures incorporated in the previous quarter total expenditures variables (food, education, and tobacco) were beyond the scope of our analyses and could introduce variance when studying the relationship between debt and transportation/living choices, so housing and transportation were taken as their own denominator.

With our variables of interest, we then ran regression analyses using the survey-weighted generalized linear model function found in the “survey” package in R. By first specifying a complex survey design object with the 44 replicate weights and 1 total replicate weight, we are then able to feed the design object

into the survey-weighted Generalized Linear Model (GLM) to run weighted regression analyses. For ease of interpretation, log-log transformations of the predictor and outcome variables were taken so that coefficients of the results could be interpreted as elasticities (i.e., each percent changes in  $x$  leads to [coefficient] percent changes in  $y$ ).<sup>60</sup>

## Survey-Weighted Generalized Linear Models

### 1. Vehicle Ownership Costs

*=significant (p < 5%)	2002–2007 Model	2008–2012 Model
<b>Dependent Variable</b>	<b>log(Vehicle Ownership Costs)</b>	
(Intercept)	<b>-11.51073 *</b>	<b>-14.54911 *</b>
<b>log(Respondent Age)</b>	<b>-1.24443 *</b>	-0.67838
<b>log(Student Loans)</b>	-0.03416	-0.01844
<b>log(Income)</b>	<b>1.41156 *</b>	<b>1.56391 *</b>
<b>log(Educational Level)</b>	0.26064	0.06085
<b>log(Housing Expenses)</b>	<b>0.45172 *</b>	<b>0.38124 *</b>
McFadden's R <sup>2</sup>	0.140	0.127

**Figure 21. Results of Survey-Weighted GLM to Vehicle Ownership Costs**

For both the 2002–2007 and 2008–2012 models, income and housing predictors are consistently demonstrated to be statistically significant predictors of vehicle ownership costs in both time periods. This is reasonable: the more income individuals have, the more that they are expected to spend on vehicle ownership costs. In the 2002–2007 model, age of the respondent is also a significant predictor of vehicle ownership costs. Pursuant to the research question, however, student loan amount is not a statistically significant predictor of the amount spent on vehicle ownership costs.

***In both pre- and post-recession periods, student loan does not significantly predict vehicle ownership expenditures.***

<sup>60</sup> Survey-weighted GLM results were tabulated under assumptions of constant error variance. Many of the GLMs are in violation of this assumption; while significances of these variables may not change much even after correcting for error variance violations, these variables may no longer be significant under other conditions.

## 2. Fuel Expenditure Costs

*=significant (p < 5%)	2002–2007 Model	2008–2012 Model
<b>Dependent Variable</b>	<b>log(Fuel Expenditures)</b>	
(Intercept)	<b>-3.59287 *</b>	-2.68934
<b>log(Respondent Age)</b>	-0.59387	-0.35367
<b>log(Student Loans)</b>	-0.01784	-0.01476
<b>log(Income)</b>	<b>0.83346 *</b>	<b>0.75728 *</b>
<b>log(Educational Level)</b>	0.01913	<b>-0.35643 *</b>
<b>log(Housing Expenses)</b>	<b>0.28096 *</b>	<b>0.26833 *</b>
McFadden's R <sup>2</sup>	0.180	0.128

**Figure 22. Results of Survey-Weighted GLM to Fuel Expenditures**

Similar to the models regressed to vehicle ownership costs, income and housing expenses in the previous quarter both continue to be significant predictors of fuel expenditures in 2002–2007 and 2008–2012. In the 2008–2012 model, increasing educational level of a CU respondent is shown to significantly contribute to lower expenditures on fuel and gas.

*In both pre- and post-recession periods, student loan does not significantly predict the size of fuel expenditures.*

## 3. Vehicle Maintenance Expenditure

Running the survey-weighted generalized linear model on the predictors of interest to vehicle ownership costs, we produce the following results:

*=significant (p < 5%)	2002–2007 Model	2008–2012 Model
<b>Dependent Variable</b>	<b>log(Vehicle Maintenance Costs)</b>	
(Intercept)	<b>-12.628182 *</b>	<b>-6.63448 *</b>
<b>log(Respondent Age)</b>	0.469447	<b>-1.07371 *</b>
<b>log(Student Loans)</b>	0.001393	<b>-0.08226 *</b>
<b>log(Income)</b>	<b>0.830474 *</b>	<b>0.74960 *</b>
<b>log(Educational Level)</b>	0.002697	<b>-0.74402 *</b>
<b>log(Housing Expenses)</b>	<b>0.624242 *</b>	<b>0.87498 *</b>
McFadden's R <sup>2</sup>	0.115	0.113

**Figure 23. Results of Survey-Weighted GLM to Vehicle Maintenance Costs**

We observe an interesting difference between 2002–2007 and 2008–2012 results. Whereas income and housing expenditures are significant in 2002–2007, as we have observed in the previous two models, all of the predictors appear to be statistically significant in predicting vehicle maintenance fees in 2008–2012, even student loan amount. However, the 2008–2012 model is in violation of the constant variance of errors assumption of a linear model; after correcting for the model violation by using White Standard Errors (Robust Standard Errors) with the regular linear model (absent of weights), student loan amount is no longer statistically significant.

*In both pre- and post-recession periods, student loans do not significantly predict the size of vehicle maintenance expenditures.*

#### 4. Public Transportation Expenditures

*=significant (p < 5%)	2002–2007 Model	2008–2012 Model
<b>Dependent Variable</b>	<b>log(Public Transportation Expenditure)</b>	
(Intercept)	<b>-3.92467 *</b>	<b>-5.35867 *</b>
<b>log(Respondent Age)</b>	-0.41735	-0.81187
<b>log(Student Loans)</b>	-0.02317	-0.03036
<b>log(Income)</b>	-0.12260	0.01183
<b>log(Educational Level)</b>	<b>1.51679 *</b>	<b>1.92927 *</b>
<b>log(Housing Expenses)</b>	<b>0.22916 *</b>	<b>0.33072 *</b>
McFadden's R <sup>2</sup>	0.020	0.033

**Figure 24. Results of Survey-Weighted GLM to Public Transportation Expenditure**

For both 2002–2007 and 2008–2012, the results of the regression analyses are consistent. In predicting public transportation expenditures, educational level and previous-quarter housing expenses of the CU respondent were significant. Income is a noticeably non-significant predictor of public transportation expenses, in contrast with previous regression models. While a majority of respondents do not spend any money on public transportation, the ones that do may not be spending more money on public transportation simply out of a desire to conserve money; in areas in which public transportation is the most cost-effective method of commuting, individuals, regardless of their income, may spend money on public transportation.

*In both pre- and post-recession periods, student loans do not significantly predict the size of public transportation expenditures.*

## 5. Transportation Share

Though we have observed that student loan was non-significant for each of the different forms of private transportation, we are interested in seeing if perhaps student loan significantly predicts transportation spending (both public and private) as a share of expenditures for both transportation and housing. Student loans may ultimately affect how much people spend of their overall housing and transportation budget, rather than simply how much they spend on transportation alone.

*=significant (p < 5%)	2002–2007 Model	2008–2012 Model
<b>Dependent Variable</b>	<b>log(Transportation/ (Transportation + Housing))</b>	
(Intercept)	-1.5516539 *	-1.425874 *
log(Respondent Age)	-0.3328972 *	-0.266482 *
log(Student Loans)	-0.0109017 *	-0.012635 *
log(Income)	0.2532480 *	0.257667 *
log(Educational Level)	-0.0568640	-0.184684 *
log(Housing Expenses)	-0.1684596 *	-0.186522 *
McFadden's R <sup>2</sup>	Adjusted R <sup>2</sup> : 0.082	0.105

\*\* Results of OLS

**Figure 25. Results of Regression (OLS for 2002–2007, Survey-Weighted GLM for 2008–2012) for Transportation Share**

After running the first survey-weighted GLM for 2002–2007 data, the p-value of the student loan coefficient amount was slightly above statistical significance. For this model, we ran a non-weighted Ordinary Least Squares (OLS) regression.<sup>61</sup> *The model shows that student loan amount is a statistically significant predictor of transportation share.* Likewise, the survey-weighted GLM for the 2008–2012 data demonstrated statistical significance of all model predictors, including student loan amount.

***In both pre- and post-recession periods, student loans do significantly predict how much of one's transportation expenditures are spent in relation to total transportation and housing expenditures. The model specifies that each increase in unit of debt results in an approximately 1.2 percent decrease***

<sup>61</sup> Given the linear model's violation of error variance, we ran a non-weighted Ordinary Least Squares (OLS) regression with a White Standard Errors correction to determine if student loan was even statistically significant after correcting for non-constant variance in the errors.

*in the amount that individuals spend on transportation as a share of a sum of transportation and housing costs.*

## Significance Testing of Interactions of Student Loan and Income

In light of the limited impact of student loans with other variables in the model, we then ran interactions with the variables of interest to see if student loan amount was a statistically significant predictor of transportation choices when considered with other predictors of interest.

	2002–2007 Model	2008–2012 Model
*=significant, p < 5%		
<b>Dependent Variable</b>	<b>log(Private Transportation)</b>	<b>log(Private Transportation)</b>
(Intercept)	-7.47296 *	-6.297253 *
log(Respondent Age)	-0.30312	-0.378267
log(Student Loans)	0.38922 *	0.454289 *
log(Income)	1.12155 *	1.141982 *
log(Educational Level)	0.13073	-0.330655 *
log(Housing Expenses)	0.34845 *	0.312429 *
log(Income):log(Student Loan)	-0.03728 *	-0.043726 *
McFadden's R <sup>2</sup>	0.214	Adjusted R <sup>2</sup> : 0.1637
		** Results of OLS

**Figure 26. Student Loan/Income Interactions in Fuel Expenditure and Private Transportation Models**

When running a regression with an interaction of Student Loan Amount and Income, both the interaction of these variables and student loan amount are statistically significant predictors of total private transportation expenditures as a whole in 2002–2007. In 2008–2012, the survey-weighted GLM revealed that student loan amount was only slightly significant; after using an OLS and correcting for the model's non-constant variance of errors, student loan was a significant predictor of private transportation expenses. This indicates while student loan and income both increase expenditures, after considering that, the product of student loan and income decreases expenditure – suggesting that individuals with given incomes and student loans spend less than individuals with that income without loans. We explore this in the next section.

*In both pre- and post-recession periods, when an individual's student loan debt and income increase conjointly, that individual can be expected to increase their transportation expenditure, revealing a*

*unique effect of student loan amounts with a person's income class on private transportation expenditures.*

## Differences in Transportation Expenses among Income Levels and Student Loans (Two-Way Analyses of Variance)

Given our limited success in detecting significance from the amount that people owe in student loans in predicting transportation choices, we turn to two-way analyses of variance (ANOVAs) to compare significance of differences between high- and low-income individuals with and without student loans in how much they spend on private and public transportation. This approach limits the ability to draw relational interpretations of the results (as regression analysis enables us to do) but is still helpful to understand whether people with student loans spend significantly differently from those without student loans. The ANOVA results are presented in Appendix C.

Confirming the earlier regression analyses, the results of the ANOVAs are summarized as follows:

- **Vehicle Ownership Costs:** Confirming the earlier regression analyses, the results of the test demonstrate that being high- or low-income results in a (statistically) *significant difference* in how much an individual spends on vehicle ownership costs. Additionally, the test demonstrates that people with student loans do spend a significantly different amount on vehicle ownership costs compared to those without student loans. Finally, the test reveals that income and student loan interact to produce a significant difference in how much people of these class/loan combinations spend on vehicle ownership costs.
- **Fuel Expenditure Costs:** In addition to differences in high- and low-income individuals, the test shows that people who have student loans compared to those who do not are *significantly different* in how much they spend on fuel. Even if this relationship is not directly observed in the earlier regression analyses, these results indicate that the mere presence of student loans is a significant differentiator of what people end up paying in fuel costs.
- **Vehicle Maintenance Costs:** Confirming the results of the regressions (and previous ANOVAs), being high income vs. low income is no doubt an important differentiator of how much people spend on vehicle maintenance costs. However, the ANOVA also reveals that people with student loans have *statistically significant* differences in their vehicle maintenance spending costs than those without student loans.

## Statistical Analysis Findings

Chapter 4.0 entailed a statistical assessment of a student loan variable's significance in predicting various domains of private transportation expenses, using a series of regression analyses and two-way ANOVAs. This chapter primarily tested different statistical model combinations in an attempt to answer this research question: Does student loan debt significantly affect the various transportation expenses for Millennials? The analyses failed to demonstrate student loan amount as a significant predictor of private and public transportation expenditures on their own, though it was significant in predicting transportation expenses as a share of a sum of housing and transportation expenses.

Some of the key findings from the statistical analysis conducted in this chapter include:

- While people's spending on transportation itself may not have been affected by their student loan debt, the analyses demonstrates that at least how people allocate their transportation expenses (with their overall transportation and housing costs) is *significantly* affected by student loans.
- Income, however, is consistently a statistically significant predictor, often accompanied by housing expenditures in significance. The significance of housing expenditures is likely directly tied to income or wealth: the more that an individual can spend on housing, the more likely they will be able to spend on transportation.
- Student loans, when combined with income, become a significant predictor of private transportation expenses. The interaction of the two components itself also becomes significant. These results reveal that student loan's impact may be moderated by one's income, rather than the mere amount that people owe. On the other hand, perhaps the instances in which student loan amount is significant in the models in which it interacts with income (and the interaction being significant itself) is picking up on a unique effect of whatever the student loan proxy actually measures.
- Although we do not determine student loan to be a statistically significant predictor of private transportation expenses on its own, the two-way ANOVAs we conducted nevertheless demonstrate that at least some significant difference exists in private transportation expenditures between people who have student loans compared to people that do not.

To conduct the analysis, we found that working with CE data is challenging due to the inconsistency of available data, the extent of the data, and the almost yearly changes to the interview structure. Although

the CE is considered the most comprehensive financial type survey, transportation-related questions are still lacking. Additional challenges for CE dataset include:

- In the CE dataset survey, the loan data (e.g., student loan) record is captured only for the current and previous quarters of the survey year and does not provide the history information of the loan. For example, the dataset does not tell whether the participant with no loan value s/he had a fully paid loan before or not.
- There is no way to identify whether the student loan value belongs to the head of household or to his/her children. In addition, it can be more challenging if the children do not live with their parents, since they would not even have been interviewed in the survey.
- Similarly, the quarter loan value for participant A might be less than participant B, but we will not be able to identify whether the overall owed-loan value is lower or higher.

All these missing information and more definitely affect the analysis results. At the end, the value of the student loan and its impact on lifestyle are disparate and vary from individual to individual. For example, student loan debt from Harvard Law is very different from student loan debt from an online college degree. Another example, a student loan to get a doctoral degree in engineering will secure a different job/income level from a loan of the same amount taken to get a Master of Fine Arts. These scenarios will not be captured using the existing datasets.

Overall, better data sources should be employed to study student debt as it directly affects measures of travel. Additionally, further analyses should be performed to consider other potential external variables of interest and determine the success that they have in predicting transportation choices.

---

## CHAPTER 5.0. KEY FINDINGS AND CONCLUSIONS

From the research scan (Chapter 1.0 and Chapter 2.0), the Millennial generation (~1981–2000), compared with the previous two generations (Baby Boomers, ~1946–1961, and Generation X, ~1962–1980) is:

- The most educated, in terms of degree attainment.
- Holds the largest amount of student loan per person, as well as for the longest duration.
- Has lowest licensure rate for driving as well as lowest home ownership and vehicle ownership.
- Uses automobiles less and internet-based means, such as telecommuting, online shopping and online social networking, more.

The descriptive analysis (Chapter 3.0) investigated, in depth, whether these trends are consequences of student loan and how the loan impacts the monthly dollars spend on transportation, and found that they are not necessarily related. In addition, transportation and housing expenses were slightly higher (around one percent higher total expenditure burden) on average for those with student loans, which may seem counterintuitive.

- Nonetheless, the majority of student loan holders in our survey are gainfully employed, which explains some ability to absorb slightly higher expenditures.
- Student loan holders in smaller cities (less than 330K population) showed a large uptick in transportation expenses post-2008, possibly related to a lack of alternative transportation choices in smaller cities.
- At the Millennial level, while percentage of household budget spent on transportation fell considerably post-recession for those with student loans, this was likely due to steep growth in housing expenses for the same group.
- Transportation spending as a percentage of income dropped for low-income Millennials with student loans, providing a slight indication that transportation choices are being altered due to mounting student loan commitments. For Millennials with student loan debt, transportation expenditures themselves were not changed, but rather the overall share of how much people spend on transportation with respect to income level had dropped.

- Apart from this, however, transportation expenditures for those with and without loans, high- and low-income earners, and pre- and post-recession stayed mostly same—indicating a lack of correlation between student loans and transportation choices.

In response to the limitations of the descriptive analyses, we conducted statistical analysis (Chapter 4.0) for both 2002–2007 and 2008–2012 data to test the significance of student loans as a predictor of transportation choices. After running survey-weighted generalized linear models on different transportation outcomes, we tested the significance of student loans as a predictor for either *private* (e.g., vehicle ownership costs, fuel expenditure costs, and vehicle maintenance cost) or *public* (e.g., transit subscription/tickets) transportation. The findings were as follows:

- After controlling for income, student loans were **not** a significant predictor for
  - Vehicle ownership expenditures,
  - Fuel expenditures,
  - Vehicle maintenance expenditures, or
  - Public transportation expenditures.
- We found that student loan amount is a significant predictor of total transportation expenditures as a share/percentage of total transportation and housing expenditure costs. In other words, an individual with student loan debt will have a lower percentage of his or her total transportation and housing budget dedicated solely to spending on private and public transportation than an individual with no student debt.
- Running interactions of student loan and income, we found that student loan (and the interaction of student loan with income) is a statistically significant predictor of private transportation. In both pre- and post-recession periods, when the interaction of an individual's student loan debt and income increase conjointly, that individual can be expected to increase their transportation expenditure. The models indicate that while student loan itself may not be a significant predictor of transportation expenditures, student loan's impact may be moderated by income level.
- Even despite the limited significance of student loan as a variable in the regression models, analyses of variance reveal that people who have student loans generally spend differently on private transportation costs than people without student loans. For example, an individual without student loan debt may spend more on private transportation, such as the purchase or rental of a private vehicle, than an individual with student loan debt.

Given the difficulties that the team experienced in searching for datasets that enabled direct assessment of the role of student loans in predicting transportation choices, it is understandable that the student loan proxy was predictably limited in its significant relationship with Millennial transportation choices. **The analyses demonstrate that to date, student loans have a very limited effect, if any, on travel choices. However, when combined with an increase in income, student loans have a significant effect on travel spending.**

To further understand the effect of student loans (or in fact, any type of debt), we recommend that surveys parsimoniously investigate how student loan itself (without influence by noise from other owed credit) predicts people's transportation choices. This survey should be able to overcome some of the limitations in the available datasets, including, but not limited to:

1. The student loan history tracking (e.g., loan payment plan),
2. The transportation related choices (e.g., preferred mode), and
3. The value added by the loan (e.g., job salary increase).

While people's spending on transportation itself may not have been affected by their student loan debt, the analyses demonstrate that the way people allocate their transportation expense share/percentage (out of their overall transportation and housing costs) is significantly impacted by student loans. A Millennial free of student debt will be more likely have different transportation spending habits compared to a Millennial under the burden of student debt.

Our research is a pioneering attempt to directly link student loans with transportation choices, and the results that we have generated serve as important initial examination of the impact of student loans and warrant further investigation.

---

# APPENDIX A. ADDITIONAL DATASETS OVERVIEW

The team conducted a preliminary analysis (as presented in this document) of multiple expenditure and travel surveys to develop a down-selected list for the quantitative and qualitative analysis. The team reviewed:

1. **Financial/Expenditure Databases:** Survey of Consumer Finances (SCF) and Consumer Expenditure (CE) Survey, and
2. **Travel Behavior-Related Databases:** American Community Survey (ACS), Metropolitan Travel Survey Archive (MTSA), NREL's Transportation Secure Data Center (TSDC).

Each dataset has its own strengths and weaknesses, but the CE survey was found to be the most information intensive in the financial category, as it can provide more insights into the transportation expenses, education loans, and demographic characteristics for each household member. However, there is still a need to retrieve more travel behavior insights, so the team will expand the analysis by considering the TSDC data archive.

Upon conclusion of our research, we will portray the key decision-making factors found among multiple financial and transportation data source compilations. Exploring what is known about the socioeconomic portrait of Millennials and its influence on transportation mode choice in a world of constantly evolving technology will allow us to speculate upon what is in store for the future of transportation. Finally, our studies will conclude with the key contributing factors of transportation mode choice behavior change and how they belong to certain financial decisions made by Millennials, ultimately illustrating the potential to improve and identify gaps and nuances in transportation innovations for future generations by addressing multiple statistical and data-rich resources.

This section of the report illustrates the data scan effort on the additional datasets to be considered along with the CE dataset.

## Data Sources Scan

The team conducted a preliminary analysis for the following datasets:

1. Survey of Consumer Finances (SCF)
2. Consumer Credit Panel (CCP)
3. NREL's Transportation Secure Data Center (TSDC)
4. Metropolitan Travel Survey Archive (MTSA)
5. American Community Survey (ACS)

## Survey of Consumer Finances (SCF)

The Survey of Consumer Finances<sup>62</sup> is normally a triennial (every three years) cross-sectional survey of U.S. families. The survey data includes information on families' balance sheets, pensions, income, and demographic characteristics. Information is also included from related surveys of pension providers and earlier such surveys conducted by the Federal Reserve Board. No other study for the country collects comparable macro-economic information.

Participation in the study is strictly voluntary. The data was collected for the following years: 1989, 1992, 1995, 1998, 2001, 2004, 2007, 2010, and 2013. The 2013 survey contains data from 6,026 families. The majority of the variables are consistent among the years from each survey. *Throughout our initial analysis we have confined the original number variables offered by the dataset of 295 to 16 parameters (listed in Table 4).*

**Table 4. SCF Selected Variables for Further Consideration**

ID	Variable	Description
Primary Keys (Head of Household Anonymous-Identifier)		
1	CASEID	Key provided to distinguish number of reference person(s) represented
2	YY1	Key provided to distinguish amongst reference persons(s)
Demographics		
3	AGE	Age of head of household
4	HHSEX	Male or female
5	EDUC	Highest completed grade by head of household
6	KIDS	Includes natural children, step-children, and foster children of household head or spouse/partner
7	MARRIED	Marital status of head of household
Vehicle Ownership		
8	NVEHIC	Total number of vehicles (owned and leased)
9	NEWCAR1	Number of car/ truck/ SUV with model year no older than two years

<sup>62</sup> Accessible at <http://www.federalreserve.gov/econresdata/scf/scfindex.htm>.

ID	Variable	Description
10	NEWCAR2	Number of car/ truck/ SUV with model year no older than one year
Debt & Loan Amount (byType)		
11	DEBT	Total value of debt held by household, 2013 dollars
12	EDN_INST	Total value of education loans held by household, 2013 dollars
13	VEH_INST	Total value of vehicle loans held by household, 2013 dollars
Income		
14	PIRTOTAL	Ratio of monthly debt payments to monthly income
15	DEBT2INC	Ratio of total debt to total income
16	INCOME	Household income for previous calendar year

The identified parameters can be divided into five categories:

1. Primary Key for Family Identification
2. Demographic Information
3. Vehicle Ownership
4. Debt and Loan Type
5. Income Information.

As per any dataset, SCF data has some strengths and weaknesses. In general, the SCF dataset offers big-picture macro-economic-type financial data for comparative purposes. It also allows a user to fact-check with other micro-data (micro-economic) rich sources to implement best-practice statistical inferences throughout research. It can be relied upon to provide information on household-wide financial measures; however, only on a three-year basis and with non-individual limitations. The SCF has some limitations in this study, to the extent it can only be used as a reference or ground truth for trends, not as a main source of analysis; some of these limitations/assumptions include the following:

- Per SCF data dictionary, “head of household” is the single core individual in a PEU without a core couple; in a PEU with a central couple, the head is taken to be either the male in a mixed-sex couple or the older individual in the case of a same-sex couple. The great majority of the time, the PEU and the household are identical.
  - In other words, we can only capture head of household information, and we cannot retrieve any information regarding the spouse/partner.
- The demographic characteristics are only provided for the head of household, but the income and expenses are for the entire household. Consequently, it will be challenging to connect the student

loan debt to a specific age group, especially if we have a mix of age groups in the same household.

- No geographic information is provided in the SCF dataset, so we would not be able to explore the impact of urban/suburban/rural split in the analysis.

Accordingly, if we decide to filter the data based on the Millennial age group (age 17–34), we should consider the following:

- We will only be able to capture the Millennial age group representative if he or she is the head of household.
- For this study, we will only consider the household structure of “unmarried, no kids, and only one person in family” structure to avoid impact by other age groups in the household.

The aforementioned limitations of the SCF data diminish its potential to be used for this study. It does not include travel data.

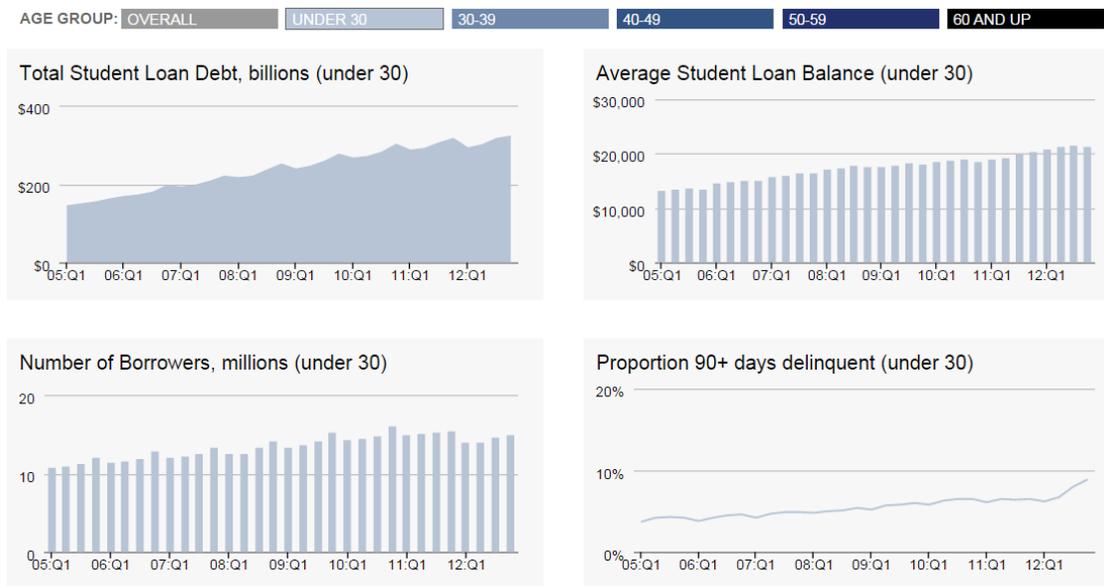
## **Consumer Credit Panel (CCP)**

The Consumer Credit Panel<sup>63</sup> (CCP) provides detailed quarterly data on a panel of US consumers from 1999 through the present. The unique sampling design provides a random, nationally representative five percent sample of U.S. consumers as well as the members of their households who have a credit report. The dataset can be used to calculate national and regional aggregate measures of individual- and household-level credit balances and delinquencies by product type. In addition to housing-related debts (mortgages, home equity lines of credit), this source includes credit card, auto, and student loans.

The main usage of the CCP is to acquire graphical representations for dynamic data feeds related to many aspects of finances (mortgage, student loan debt, inflation/income indicators, etc.). Graphical representations are defined by survey offering and are all dynamic when the user hovers over each survey dashboard with their mouse. This data visualization capability allows a tertiary source to confirm the inferences created from the other detailed data sources (e.g., SCF data). Figure 27 shows an example for the graphical interface of the CCP dataset.

---

<sup>63</sup> Accessible at <https://www.newyorkfed.org/microeconomics/ccp.html>.



Source: FRBNY Consumer Credit Panel/Equifax

**Figure 27: Student Loan Debt by Age Group for 2012**

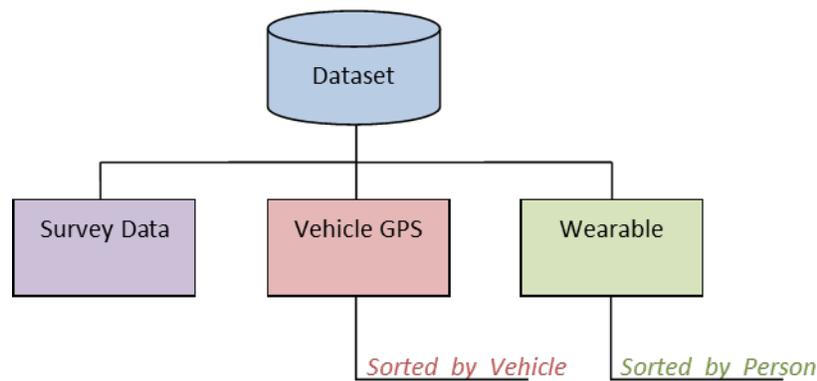
In general, the team can use this data source to capture the trends of student loan debt history, change in home prices, school finances in the region and so forth. Although the CCP data is lacking the micro-economic and individually scoped data points, it still can provide aggregated data trends which will help us to validate our analysis using other datasets. It does not include travel data.

### **NREL’s Transportation Secure Data Center (TSDC)**

The TSDC<sup>64</sup> provides free access to detailed transportation data from a variety of travel surveys and studies. The TSDC features second-by-second GPS readings from millions of miles of travel, along with vehicle characteristics and survey participant demographics. NREL screens the initial data for quality control purposes, translating each dataset into a consistent format, and interprets the data for spatial analysis. In terms of transportation data, The TSDC features second-by-second GPS readings for millions of miles of travel, along with vehicle characteristics and survey participant demographics. Typically, the data provided to NREL are organized into a standard structure. Tables are divided into three sample

<sup>64</sup> Accessible at [http://www.nrel.gov/transportation/secure\\_transportation\\_data.html](http://www.nrel.gov/transportation/secure_transportation_data.html).

groups and are named according to the type of data they contain within each group. The sample groups contained within NREL-processed datasets are survey, vehicle GPS, wearable GPS, and unfiltered GPS point and trip data (sorted by vehicle and/or person respectively), as summarized in Figure 28 . It does not include loan data.



**Figure 28: NREL’s Data Components**

**Survey Data:** The survey questionnaire provides demographic information for the households who participated in the study, including household size, and number of household members with a driver’s license.

**Wearable Data:** A sub-sample of unique households was issued a portable GPS unit to record all of their trips information, including trip origin/destination, mode, and travel time.

**GPS Data:** A second-by-second GPS reading for tracked vehicles.

The TSDC is a rich, and the most updated, dataset source for travel surveys and covers many regions in the U.S. for last 15 years, as listed below:

- Regional Transportation Commission of Southern Nevada — 2014 Southern Nevada Household Travel Survey (Las Vegas area)
- Mid-Region Council of Governments — 2013 Mid-Region Travel Survey (Albuquerque area)
- Delaware Valley Regional Planning Commission — 2012–2013 Household Travel Survey (Philadelphia area)
- California Department of Transportation — 2010–2012 California Household Travel Survey
- U.S. Department of Transportation — 2011 Tolling Impact Survey (Atlanta and Seattle areas)
- Atlanta Regional Commission — 2011 Regional Travel Survey

- Texas Department of Transportation — 2002–2011 Regional Travel Surveys
- Metropolitan Council — 2010 Travel Behavior Inventory (Minneapolis and St. Paul areas)
- Chicago Metropolitan Agency for Planning — 2007 Regional Household Travel Inventory
- Puget Sound Regional Council — 2004–2006 Traffic Choices Study (Seattle area)
- Mid-America Regional Council — 2004 Regional Travel Study (Kansas City area)
- Southern California Association of Governments — 2001–2002 Regional Travel Survey.

## Metropolitan Travel Survey Archive (MTSA)

The MTSA<sup>65</sup> presents a data-dashboard full of geographically (city/state/ region) specific information and its corresponding travel behavior data. It provides a hub of links that allows us to collect commuting, demographic, and other transportation data specific to given localities. Table 5 shows a summary of the listed cities/regions stored at MTSA. Some of these datasets are from 1990s (e.g., Chicago) and others are more recent (e.g., California). Table 6 shows an example of the listed variables that can be found at the MTSA data.

**Table 5. List of Cities/Regions Covered by the MTSA**

Midwest datasets:
Champaign-Urbana-Savoy, Chicago, Cincinnati, Cleveland, Detroit, Indiana – Northwestern, Michigan, Ohio (Statewide Household Travel Survey), Minneapolis & St Paul
Northeast datasets:
Boston, Evansville, New York, Philadelphia, Wilmington
South datasets:
Atlanta, Baltimore, Columbia, SC, Daytona Beach, <b>Florida</b> – Northeast, Fort Lauderdale, Greater Triangle Area, Kentuckiana, Knoxville, TN, Spokane & Kootenai County, Tampa Bay, Washington, DC
West datasets:
Anchorage, California, Colorado – North Front Range, Idaho, Los Angeles, Oahu, Phoenix, Portland, Sacramento, Salt Lack City, San Diego, San Francisco, Seattle, Tahoe, Laredo & Longview, Thurston County, WA, Tucson, Washoe County, NV, Yakima County

**Table 6. An Example for Data Components/Variables – Minneapolis & St. Paul**

ID	Variable	Description
		Geographical characteristics
1	RESIDENCE_GEOG_UNIT_ID	Residence Identifier (Longitude and Latitude)

<sup>65</sup> Accessible at <http://www.surveyarchive.org/>.

ID	Variable	Description
	*microdata offered	
2	RESIDENCE_GEOG_DESC *microdata offered	Residence Location (Longitude and Latitude)
3	COCTU	11 digit identifier for the combination of county and city, township or unorganized territory
4	ST	State
5	STCO	5 digit identifier for the combination of state and county
<b>Workplace characteristics</b>		
6	WORKPLACE_GEOG_UNIT_ID	Workplace identifier
7	WORKPLACE_GEOG_DESC	Workplace location
8	WORKPLACE_GEOG_LEVEL_ID	Level of geography for workplace
9	YEAR	The year of the data
10	WORKERS	Number of workers
<b>Demographics</b>		
11	AGE15_30	Workers 15-29 years old
12	AGE31_54	Workers 30-54 years old

The MTSA is considered an easy-to-use dashboard data interface; it is sorted according to region and year, and all datasets are hyperlinked and can all be found in same common area. One of the limitations is the lack of more recent data collections and demographic data. The surveys lack loan data.

## American Community Survey (ACS)

The ACS<sup>66</sup> is a nationwide survey that collects and produces information on demographic, social, economic, and housing characteristics about our nation’s population every year. The 1960 census was the first survey to be mailed out to every household. In 1960 every household was given what was called the Short Form version of the survey, collecting limited amounts of data. Data includes age, sex, race, and relationship to the survey-taker. A subsample of households was given a Long Form.

In the early 2000s the Census Bureau altered the survey given to what was called the Long Form, which asked additional questions from each member of the household. Approximately one in six households received this particular survey type. The additional questions ranged from marital status, education, and earnings information to “journey to work” information. This data can be used to discover statistical findings from demographic data, as well as average household income and a variety of other statistics.

---

<sup>66</sup> Accessible at <https://www.census.gov/programs-surveys/acs/>.

In 2006 the United States Census Bureau created the American Community Survey. This new survey type was designed to replace the Long Form, which collected data for the census every 10 years. Since 2006 the current ACS format collects data annually, including population estimates, education statistics, income and poverty statistics, and economy statistics, as well as many others. This data is formatted into two different datasets: summary data, and Public Use Microdata Samples (PUMS).

The ACS data has already been tabulated by specific geographic areas and can be broken down as far as block groups or by city, county, census tracts and congressional district (Table 7 shows an example). The PUMS data contains information on responses to all of the survey questions from each individual. This data is available in a non-restricted form to the general public, with the personally identifiable information (PII) removed.

**Table 7. A Summary for the Considered Data Variables at the ACS Dataset**

<b>ID</b>	<b>Variable</b>	<b>Description</b>
<i>According to Household</i>		
Data Characteristics (Unique Identifiers):		
1	RT	Housing record type or Group Quarters Unit
2	SERIALNO	Housing unit (unique identifier)
Geographic Characteristics:		
3	DIVISION	Division code: Puerto Rico, New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain and Pacific
4	PUMA	Public use microdata area code based on 2010 Census definition
5	REGION	Region code: Northeast, Midwest, South, West, and Puerto Rico
6	ST	State code (All 50 states and Puerto Rico)
Household Characteristics		
7	NP	Number of person records following this housing record
8	ACR	Housing lot size
9	BLD	Units in structure (i.e., mobile home or trailer, one-family house detached, two apartments, 50 or more apartments, boat, RV, van, etc.)
10	MRGP	First mortgage payment (monthly amount)
11	RNTP	Monthly rent
12	ADJHSG	Used to adjust RNTP to constant dollars
13	SMP	Total payment on all second and junior mortgages and home equity loans (monthly amount)
14	TEN	Tenure (i.e., owned with mortgage or loan, owned free and clear, rented, occupied without payment of rent)
15	VALP	Property value
16	YBL	When structure first built
17	GRNTP	Gross rent (monthly amount)
17i	ADJHSG	Used to adjust GRNTP to constant dollars
18	MV	When moved into this house or apartment
19	TAXP	Property taxes (increase by \$50 ranges)
20	WKEXREL	Work experience of householder and spouse

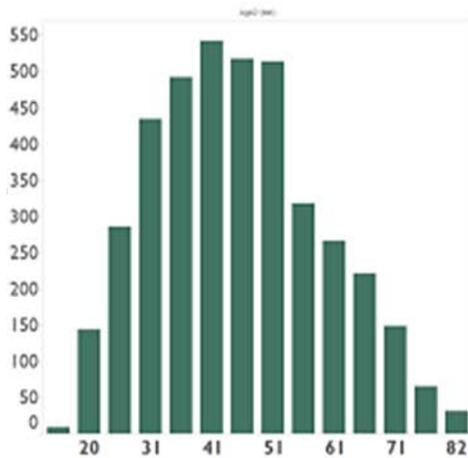
<b>ID</b>	<b>Variable</b>	<b>Description</b>
21	WORKSTAT	Work status of householder or spouse in family households
Technological Characteristics:		
22	ACCESS	Access to the internet
23	BROADBND	Mobile broadband plan
24	HANDHELD	Handheld computer
25	RESMODE	Response mode (i.e., N/A, Mail, CATI, Internet)
Quality-of-Life Characteristics:		
26	FS	Yearly food stamp/ supplemental nutrition assistance program reciprocity
Vehicle Characteristics:		
27	VEH	Vehicles (one ton or less) available
Family Characteristics:		
28	FES	Family type and employment status
29	FINCP	Family income (past 12 months)
30	FPARC	Family presence and age of related children
31	NPF	Number of person in family
32	NOC	Number of own children in household (unweighted)
33	SSMC	Same-sex married couple households
34	WIF	Workers in family during the past 12 months
Household Demographics:		
35	HHL	Household language
36	HHT	Household/ family type (i.e., N/A, married couple household, other family household: male householder, no wife present, nonfamily household: female householder: living alone, etc.)
37	HUGCL	Household with grandparent living with grandchildren
38	HUPAC	Household presence and age of children (N/A, with children under six years only)
39	HUPAOC	Household presence and age of own children
40	LNGI	Limited English speaking household
41	MULTG	Multigenerational household
42	NPP	Grandparent-headed household with no parent present
43	NR	Presence of nonrelative in household
44	PSF	Presence of subfamilies in household
45	R18	Presence of persons under 18 years in household (unweighted)
46	R60	Presence of persons 60 years and over in household (unweighted)
<i>According to Person Record (*Same Variables as Above/Person, also Available)</i>		
Individual Demographics:		
47	SPORDER	Person number
48	PWGTP	Person's weight
49	AGEP	Age of person
50	CIT	Citizenship status
51	MAR	Marital status
52	MARHD	Divorced in the past 12 months
53	MARHT	Number of times married
54	REL	Relationship (i.e., Reference person, husband/ wife, etc.)
55	SEX	Male or female
58	MSP	Married, spouse present/ spouse absent
Employment/Earnings Characteristics:		
59	COW	Class of worker (employee of a private for-profit company, self-employed in own not incorporated business, etc.)
60	NWAV	Available for work

<b>ID</b>	<b>Variable</b>	<b>Description</b>
61	NWLA	On layoff from work
62	NWLK	Looking for work
63	WAGP	Wages or salary income past 12 months
64	WKHP	Usual hours worked per week past 12 months
65	YOEP	Year of entry
66	PERNP	Total person's earnings
67	POWSP 3	Place of work – state or foreign country recode
<b>Disability Characteristics:</b>		
68	DEYE	Vision difficulty
69	DPHY	Ambulatory difficulty
70	DREM	Cognitive difficulty
<b>Family Characteristics:</b>		
71	FER	Gave birth to child within the past 12 months
<b>Transportation Characteristics:</b>		
75	JWMNP	Travel time to work (in minutes)
76	JWRIP	Vehicle occupancy
77	JWTR	Means of transportation to work (car, truck or van, subway or elevated, walked, worked at home, etc.)
78	DRIVESP	Number of vehicles calculated from JWRI (vehicle occupancy)
79	JWAP	Time of arrival at work – hour and minute
80	JWDP	Time of departure for work – hour and minute
<b>Educational Characteristics:</b>		
81	SCH	School enrollment
82	SCHG	Grade level attending (N/A, college undergraduate years, etc.)
83	SCHL	Educational attainment (kindergarten, bachelor's degree, doctorate degree, etc.)
84	FOD1P	Recoded field of degree – first entry

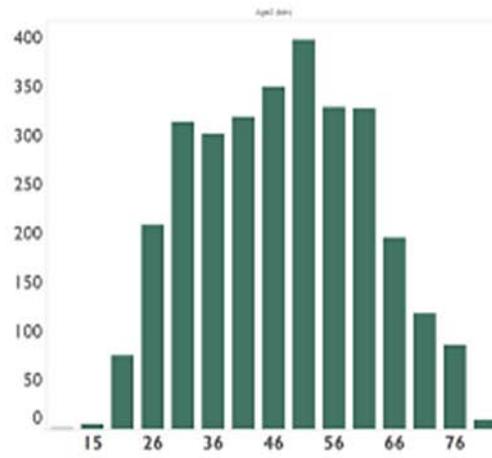
While the ACS survey collects much information and is not limited to transportation or travel behavior, it provides information that is of significant value for understanding and modeling travel behavior and planning transportation systems. However, for this study, the ACS data usage is limited as it only captures the commute travel (home-work trip) and no other forms of travel. Also, the dataset does not enable detailed origin-destination analyses, due to omission of the exact surveyed address for privacy concerns and the limitation of commute travel information. The ACS does not include loan data.

# APPENDIX B. CE DATASET HISTOGRAMS

## Age of Spouse Histograms

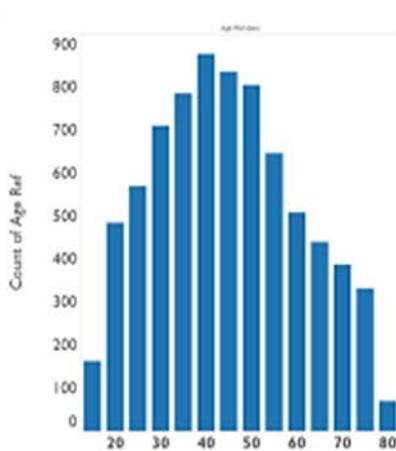


2004

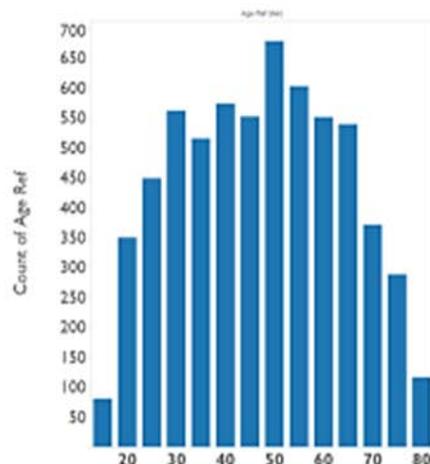


2014

## Age of Reference Person Histograms



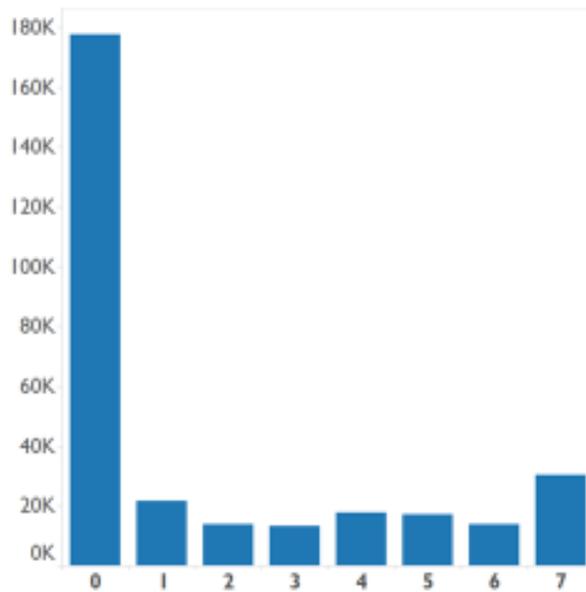
2004



2014

Figure 29: Histogram Distributions for the CE Raw Data

## Family Composition Histogram



- **0** No children
- **1** All children less than 6
- **2** Oldest child between 6 and 11 and at least one child less than 6
- **3** All children between 6 and 11
- **4** Oldest child between 12 and 17 and at least one child less than 12
- **5** All children between 12 and 17
- **6** Oldest child greater than 17 and at least one child less than 17
- **7** All children greater than 17

7

Figure 30: Family Composition Data

---

# APPENDIX C. TWO-WAY ANALYSES OF VARIANCE (ANOVA)

## 1. Vehicle Ownership Costs

Variable	DF	F-value
<b>Income (High or Low Income) *</b>	1	46.993
<b>Student Loan (Student Loan or No Loan) *</b>	1	4.364
<b>Income: Student Loan *</b>	1	9.472

ANOVA of Vehicle Ownership Costs, 2002–2007

Confirming the earlier regression analyses, the results of the ANOVAs for vehicle ownership costs demonstrate that being high- or low-income results in a (statistically) significant difference in how much an individual spends on vehicle ownership costs. Additionally, the ANOVA demonstrates that people with student loans do spend a significantly different amount on vehicle ownership costs compared to those without. Finally, ANOVA reveals that income and student loan interact to produce a significant difference in how much people of these class/loan combinations spend on vehicle ownership costs.

## 2. Fuel Expenditures

Variable	DF	F-value
<b>Income (High or Low Income) *</b>	1	297.837
<b>Student Loan (Student Loan or No Loan) *</b>	1	9.447
Income: Student Loan	1	0.783

ANOVA of Fuel Expenditure Costs, 2008-2012

Once again, in addition to differences in high- and low-income individuals, people who have student loans compared to those who do not are significantly different in how much they spend on fuel. Even if this relationship is not directly observed in the earlier regression analyses, these results indicate that the mere presence of student loans is a significant differentiator of what people end up paying in fuel costs.

### 3. Vehicle Maintenance Costs

#### a. 2002–2007

Variable	DF	F-value
Income (High or Low Income) *	1	147.663
Student Loan (Student Loan or No Loan) *	1	20.649
Income: Student Loan	1	1.679

ANOVA of Vehicle Maintenance Expenditures, 2002–2007

Confirming the results of the regressions (and previous ANOVAs), being high income vs. low income is no doubt an important differentiator of how much people spend on vehicle maintenance costs. However, the ANOVA also reveals that people with student loans have statistically significant differences in their vehicle maintenance spending costs than those without student loans.

#### b. 2008–2012

Variable	DF	F-value
Income (High or Low Income) *	1	141.253
Student Loan (Student Loan or No Loan) *	1	27.357
Income: Student Loan *	1	4.433

ANOVA of Vehicle Maintenance Expenditures, 2008–2012

In 2008–2012, income, student loan, and their interaction were statistically significant differentiators of people's vehicle maintenance costs. While it is interesting to see that people who have student loans (compared to those who do not have student loans) have different spending behaviors, the ANOVAs are limited in their explanation of the relationship of student debt with private transportation expenses.







U.S. Department  
of Transportation

**Federal Highway  
Administration**

FHWA-PL-17-015