

**Spatial, Temporal, and Economic Variation in Mobility: A Gender  
Perspective**

by

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Thesis submitted in partial fulfillment of the requirements  
for the degree of Doctor of Philosophy in Urban Planning and Policy  
in the Graduate College of the  
University of Illinois at Chicago, 2017

Chicago, Illinois

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## ACKNOWLEDGMENTS

I want to thank my committee members for their support, without their help, the completion of this thesis would not be possible.

I would like to specifically show my appreciation to my advisor, Dr. Nebiyu Tilahun, for his help through the end and for his enormous advice and guidance in completing this thesis. I would also like to thank Dr. Thakuriah, Dr. Kawamura, Dr. Parker, and Dr. Vidyarthi who are members of my committee and who provided significant input to the research.

Moreover, I thank the Department of Urban Planning and Policy (UPP) at the University of Illinois at Chicago (UIC) for its support during my PhD. Program.

Additionally, I am very grateful to my father Mamadou Keita and my mother Lalle Meriem Zouboye for always supporting and guiding me through the end. My parents are the foundation of my life and my education. Their physical, financial, and moral assistance enabled me to finish this thesis.

Finally, I am thankful to my late husband, my kids, and the rest of my family for all their patience and support.

## TABLE OF CONTENTS

<u>CHAPTER</u>		<u>PAGE</u>
<b>1</b>	<b>INTRODUCTION . . . . .</b>	<b>1</b>
1.1	Introduction . . . . .	1
1.2	Unequal Division of Household Tasks: Women's Double Duties	6
1.3	Gender Inequality in Economic Well-Being . . . . .	6
1.4	Common Gendered Travel Outcomes . . . . .	8
1.5	Contribution of this Thesis to Gender and Transport Research	9
<b>2</b>	<b>THEORIES OF JUSTICE, MOBILITY, AND TIME-SPACE GEOGRAPHY IN THE CONTEXT OF GENDER . . . . .</b>	<b>13</b>
2.1	Introduction . . . . .	13
2.2	Social Justice: Diversity and Equity . . . . .	14
2.3	Mobility . . . . .	21
2.4	Time-Space Geography . . . . .	23
2.5	Utilitarian Approaches . . . . .	26
2.6	Summary . . . . .	29
<b>3</b>	<b>LITERATURE REVIEW OF THE EMPIRICAL SCHOLARSHIP</b>	<b>30</b>
3.1	Introduction . . . . .	30
3.2	Gendered Mobility: Difference in Travel Behavior and the Use of Urban Space . . . . .	31
3.3	Temporal, Spatial, and Intra-personal Variation in Travel Research . . . . .	37
3.4	Activity Space and Travel Behavior . . . . .	39
3.5	Impacts of the Recession on Women . . . . .	40
3.6	Summary . . . . .	47
<b>4</b>	<b>GENDER AND ACTIVITY SPACES . . . . .</b>	<b>48</b>
4.1	Introduction . . . . .	48
4.2	Research Hypotheses . . . . .	49
4.3	Data . . . . .	51
4.4	Methodology . . . . .	54
4.4.1	GPS Data Approach . . . . .	56
4.4.2	Two-Day Data Approach . . . . .	57
4.5	Model Results and Discussion . . . . .	58
4.5.1	GPS Data Model . . . . .	62
4.5.2	Two-Day Travel Diary Data Model . . . . .	64
4.6	Conclusion . . . . .	74

## TABLE OF CONTENTS (Continued)

<b><u>CHAPTER</u></b>		<b><u>PAGE</u></b>
<b>5</b>	<b>HOUSEHOLD TRANSPORTATION EXPENDITURES DURING THE GREAT RECESSION . . . . .</b>	<b>77</b>
5.1	Introduction . . . . .	77
5.2	Data . . . . .	78
5.3	Research Method . . . . .	81
5.4	Model Results and Discussions . . . . .	89
5.5	Conclusion . . . . .	98
<b>6</b>	<b>EXPENDITURE TRADEOFFS BETWEEN TRANSPORTATION, HOUSING, AND FOOD IN TIMES OF CRISIS . . . . .</b>	<b>101</b>
6.1	Introduction . . . . .	101
6.2	Research Hypothesis . . . . .	102
6.3	Data & Research Methods . . . . .	104
6.4	Analysis . . . . .	105
6.5	Conclusion . . . . .	123
<b>7</b>	<b>FINDINGS AND DISCUSSIONS . . . . .</b>	<b>126</b>
7.1	Dissertation Contribution . . . . .	128
7.2	Policy Synthesis . . . . .	130
7.3	Limitation of the study . . . . .	135
7.4	Future Research . . . . .	136
<b>8</b>	<b>CONCLUSION AND POLICY IMPLICATIONS . . . . .</b>	<b>138</b>
	<b>CITED LITERATURE . . . . .</b>	<b>140</b>
	<b>VITA . . . . .</b>	<b>155</b>

## LIST OF TABLES

<b><u>TABLE</u></b>		<b><u>PAGE</u></b>
I	On-Person GPS and CMAP Region Population Characteristics . .	69
II	Sample Characteristics of Total Sample Percent by Gender . . . .	70
III	Sample Characteristics of Mean of Total Sample by Gender . . . .	71
IV	Gender Difference in Workday and Non-Workday Activity Space Areas and Contributing Factors . . . . .	72
V	GPS Data Ordered Logistic Regression Models for Ratio of Non- Workday to Workday Areas . . . . .	72
VI	Two-Day Data OLS Regression Models of Activity Areas . . . . .	73
VII	Sample Characteristics by Percentiles . . . . .	84
VIII	Transportation Spending Component Before and During the Re- cession in 2011 Dollar Values . . . . .	87
IX	Quantile and OLS Regressions of Transportation Expenditures . .	96
X	Major Expenditures Before and During the Recession by Gender	112
XI	Major Expenditures Before and During the Recession by Income Group . . . . .	114
XII	OLS Models of Proportion of Major Expenditures from Total Ex- penditures . . . . .	121
XIII	OLS Models of Expenditure Ratios . . . . .	122

## LIST OF FIGURES

<b><u>FIGURE</u></b>		<b><u>PAGE</u></b>
1	Conceptual framework for the geography of activities . . . . .	51
2	GPS Data Difference in Workday and Non-workday Activity Space Areas by Gender and Household Structure . . . . .	61
3	Quantile and OLS estimate plots of effect of covariates on natural log of transportation spending . . . . .	97
4	Major Expenditure Categories Before and During Recession for all Households . . . . .	106
5	Expenditures during the Recession as Percentage of Pre-Recession for Major Categories by Income Group . . . . .	107
6	Expenditures during the Recession as Percentage of Pre-Recession for Major Categories by Gender . . . . .	108
7	Expenditures during the Recession as Percentage of Pre-Recession Expenditures for Major Expenditures for Female-Headed Households by Income and Household Structure . . . . .	110

## SUMMARY

A study exploring gender inequality in mobility was conducted using quantitative statistical techniques. Three different analyses were done using two main secondary datasets: the CMAP Travel Tracker Survey and the Consumer Expenditure Survey. The first part of the study tests how gender inequality in household division of labor informs the workday and non-workday geographies and the reshaping of workday geographies during non-workdays. The second analysis evaluates how the lower economic status of women compare to men is associated with lower transportation spending of low, middle, and high income female-headed households with children during normal period and during economic crisis such as the great recession. The last component of the study examines how female-headed households with children compare to other households are substituting the share of their total spending allocated to transportation, housing, and food during normal period and during the recession.

The findings from the first analysis stress the gender difference between workday and non-workday geographies as well as the reshaping of the workday geographies during non-workdays. Women are likely to have larger non-workday geographies compare to their workdays. However, this difference is almost not observable when little children are present in the household because presence of small children is extra constraints during both days. Female-headed with children and no other adult in the households have also different workday and non-workday geographies than other households. More precisely, the results highlight that female-headed households with children that have longer commute and who live with no other adult have narrower workday than

## SUMMARY (Continued)

non-workday geographies also their workday geographies are smaller than their counterparts with shorter commute. The outcomes of the second analysis demonstrated that low income female-headed households with children are spending more on transportation than other low income households with children. However, low income female-headed households with children were associated with lower transportation spending compare to middle and high income female-headed households with children whose spending were also inferior to female-headed households with no children or male-headed households. No larger gender gap in transportation spending was observed during the recession compare to the before recession period.

The last analysis proved some possible gender difference in the trade-off between the proportion of total expenditures allocated to transportation, housing, and food. The results claim that female-headed households with children are most likely to have lower transportation spending but higher housing and food spending than female-headed households without children or other households. Further investigation demonstrated that those female-headed households with children are likely to decrease their transportation share in order to increase their housing and food shares of total spending. There was no association between the recession and the gender difference in substituting the proportion of total spending going toward the three spending categories considered: transportation, housing, and food.

## CHAPTER 1

### INTRODUCTION

#### 1.1 Introduction

Gender inequality is present in most societies though it is more pronounced in some than others. Issues facing women are broad and multifaceted ranging from those that arise out of the role women play within the household to their experiences in the labor market, experiences of gender based discriminatory behavior, and gender inequality with respect of violence and victimization. Some of these factors also interact with the household structure, household location, demographic and economic status of women. Women with children can have issues that are significantly different from those with no children. Race plays a factor in the experiences of women. Poor women's experiences are different than those of middle-income and wealthy women. Outside of the household, particularly within the labor market, women's experiences are demonstrably unequal to men. Women are more likely to have lower wages and tend to work in low-paid jobs than men. They are also more vulnerable to violence than men. On the other hand, the problems affecting women during some critical times (such as the great recession) are different than during normal periods. This thesis focuses on the experiences of women in the United States (U.S.) as it relates to their mobility, particularly looking at its space-time dimension and how women's experiences during the economic recession affected their expenditures in transportation.

Gender disparities in the U.S. affect women's everyday choices. As alluded to in the previous paragraph, women are still unevenly positioned in regards to things such as division of household duties, pay at work, and others. Despite their increasing entry in to the labor force, women are still mainly responsible for caring for children and elderly people on top of other household duties inside and outside of the home. The extent of their responsibilities require them to multi task and sometimes to accept lower pay than their fellow men. Undoubtedly, all of these inequalities act together to shape their travel decisions. As a result, women travel shorter distances with several stops for several different purposes. For safety reasons, they usually prefer to travel using private cars or with companions. The goal of this research is to contribute to the literature on gender and transport by exploring how unceasing and unequal division of household duties, economic inequity, as well as economic crises are fostering gendered transportation in the U.S. and to demonstrate some of the travel outcomes surging from those inequities and crisis.

The work in this manuscript looks at gendered travel at both national and local levels to show the experiences of women at many levels. It looks at the issues from the aspects of space-time variation and variation in economic conditions. The thesis helps to highlight some of the travel issues faced by women due to work, poor economic status, and the macro-economic crisis. It seeks to lay the foundation for policy interventions and other solutions to transportation problems resulting from the uneven position of women with respect to household duties, economic well-being, and economic crisis.

Some background and reasons for the importance of gender study of transportation and mobility in the U.S. are the following. Based on the last decennial census of the U.S., women

constitute 50.8 percent of the population(1). Female householders with no husband present make up 13.1 percent compare to 5.0 percent of male householders with no wife present. Additionally, the percentage of female householders with own children under 18 years is 7.2 percent compare to 2.4 for male householders with no wife present living with own children (2). Further, according to the United Department of labor, 57 percent of all women participate in the labor force while 70 percent of women with children under 18 participate in the labor force (3). Despite their high labor force participation, the poverty rates for women remains high with one in seven women living in poverty (4). Among these women, 45 percent live in extreme poverty. Moreover, the poverty rate of single mother families is 39.8 percent compare 22.0 percent of male-headed families (4).

Besides the higher percentage of women than men and the critical social and economic situation of women compare to men, national dataset demonstrates that mobility is gendered. For instance, in 2009 the percent of work trips by women is 13.8 percent compare to 17.6 percent for men. Family and personal errands make up 46.11 percent of women total trips compare to 38.67 percent for men (5). Thus, "women make about 80 percent of the number of trips men make for commuting to and from work, while men make about 80 percent of the number of trips women make for shopping and family and personal errands"(5). Moreover, men travel 10 more miles per day compare to women(5).

Given this background at the national level, the dissertation starts by first investigating how workday and non-workday geographies vary by gender. It assumes that women especially women with children are likely to have smaller workday geographies compared to non-workdays.

The narrow workday geographies are inferred to be due to their space-time constraints. More precisely, they are shaped by their double duties in and out of home, which in turn reduce their reachable opportunities. This is important because it stresses how gender inequality in household duties impacts other parts of women lives such as their travel. It also proposes some management strategies they adopt such as scheduling other nonessential activities during non-workdays.

Second, it looks beyond space-time constraints to examine how economic constraints faced by women, especially by women with children, alter their travel decisions during normal period as well as during macro-economic crisis such as the great recession. The study also claims that it is important to consider values beyond the usual average in order to paint fuller pictures of gender difference in travel related economic constraints. Thus, it determines the heterogeneous difference in gender transportation spending by evaluating gender difference in the transportation spending distribution. This involves estimating transportation spending at several quantile levels with a look at the gender components. This analysis is based on the assumption that there is a gender difference in transportation spending because of the gender inequality in economic status which could be further exacerbated by the great recession. It also highlights the difference between women themselves related to their travel decisions. This is valuable because it helps clarify how gender inequity in economic well-being impedes travel decisions.

Lastly, the dissertation expands on the travel related economic constrained decisions. This analysis compares how expenditures that are allocated to transportation, housing, and food change in times of economic crises. It inquires about possible trade-offs and substitutions that

individuals make between these three main components of total expenditures as households face increased economic risk. This work seeks to underscore gender difference in such substitution due to economic dilemmas. This is substantial because it demonstrates constrained decisions that could alter women's travels because all three elements (transportation, housing, and food) are required in anyone life.

Altogether, this dissertation tackles the following questions:

1. Is there a gender difference in workday and non-workday geographies? Do women reshape their workday activity spaces during non-workdays more than their fellow men? How and why?
2. Did the great recession impact transportation spending? Is there a gender difference in transportation spending overall and during the recession? Going beyond average impacts, what are the impacts of the recession on the expenditure distribution at different quantiles of the expenditure distribution?
3. Is there some substitutions between transportation, housing, and food during allocation of total expenditures? Is there any gender difference in such substitution? Was there any alteration in those substitutions during the last economic crisis?

The rest of this chapter briefly discusses gender inequalities around the household, in economic well being, and in travel outcomes in sections 1.2, 1.3 and 1.4, respectively. These topics are reviewed here because they lay the foundation of all the work done as part of this dissertation. This thesis believes that gender inequalities in household duties and economic status

influence travel behavior of different gender groups. These discussions build toward an identification of gaps in the existing literature and the contributions of this thesis, which is summarized in section 1.5.

## **1.2 Unequal Division of Household Tasks: Women's Double Duties**

Even though, gender inequality in household division of labor affects many women, its negative effects is more visible and obvious among women who are employed outside their home. The percentage of women entering the labor force has increased with time. However, women are still the primary caregivers of the house despite their outside employment. This often creates time poverty and causes them to multi-task, especially in single-parent households (6; 7; 8; 9; 10). Women's double burdens of paid work and household duties, also called the second shift, thus shape their everyday decisions and limit their mobility and opportunities. Uneven gender roles require women to conduct most of the household maintenance travels such as shopping and errands while conjointly transporting household children, elderly, and others under their care. These tasks in and out of the home hinder and dictate their travel to other places for opportunities or enjoyment purposes. As a result, women make mobility decisions that are affected by their gender status and role. This inequity is one of the two main gender inequalities explored in this dissertation.

## **1.3 Gender Inequality in Economic Well-Being**

In addition to unequal division of household tasks, another gender inequity that trigger this thesis is the one related to earnings and economic well-being. Women are unevenly position financially compare to men. They earn less and represent a big share of people in poverty

(11; 12; 13; 14). In the United States, women have a median earning of \$31,800 which is only 77 percent of men's earning (15). This makes them economically vulnerable and insecure. A reason for the lower economic status of women is their marginalization in the labor force (16). Women are likely to be employed in low-paid jobs with no health insurance or pension benefits than men (17).

The lower economic status is even worse for some groups of women than others. For instance, single mothers are mentioned to be among the poorest. More than a third of single mothers are confirmed to be living below poverty and numerous others live close to poverty (18; 19). Moreover, single mothers with children under 18 have more chances to be poor than other mothers (20; 21). In addition, scholars have pronounced that female-headed households living in nonmetropolitan areas are poorer than the average American households (22). Furthermore, women at childbearing age encounter even more poverty than other women (23).

It is important to note that the gender inequality in economic well-being challenges women's mobility. The relation between income and mobility is stressed in past studies (24). The growth of household income enhances their mobility while household investment in mobility can also boost incomes (24). Economic inequality between women and men can thus possibly lead to a gender differences in mobility as women are likely to make lower investments in mobility on account of unequal earnings. Likewise, the connection between economic condition and spending potential is evident in myriad of other works. A strong link exists between income and spending (25; 26; 27; 28; 24). Income is the most significant factor determining levels of various expenditures (26). Studies have shown that all spending varies by income including

transportation spending (28). Thus, gender inequality in economic well-being can obstruct women's transportation spending as well as their mobility.

#### **1.4 Common Gendered Travel Outcomes**

Various scholars have demonstrated that mobility is gendered in several ways (29; 30; 31; 32; 33; 34; 35). These research argue that women have different travel patterns than men. Some of the most common travel behaviors by women stressed in the literature include shorter commute distances but with multiple stops, reliance more on public transportation, and multiplicity of travel purposes (31; 36; 35; 9). Most of the studies attribute these differences to the socially constructed power relations that concurrently operate at both societal and individual levels of society. More precisely, they ascribed it to the household division of labor, especially to the fact that women are both responsible for most of the domestic tasks and paid employment (37; 38; 35) as well as to the lower economic status of women. Undoubtedly, many other factors act together to create gender differences in travel such as sociodemographic, household structure, economic, built environment, and crime or safety aspects.

This thesis tackles these issues by demonstrating how the mobility choices of women are affected by their uneven gender roles and lower economic status. In addition, it illustrates how elements such as the macro-economic factors, for example, the great recession, can also influence women's daily mobility decisions in ways that are different from men. The contribution of this thesis to the gender and transport research is described in the next section.

## 1.5 Contribution of this Thesis to Gender and Transport Research

In an effort to show the contribution of the thesis to the gender and transportation research, I outline three areas where there are gaps in previous studies. This discussion is followed by an explanation of how this work will add to our existing understanding of gender and mobility.

### **Gaps in the Gendered Mobility Research**

Even though there is a broad literature on gendered mobility, there are at least two gaps in this literature. First, much of the empirical evidence in these studies use observations collected over a short duration such as a single day in a week to determine every day behavior and the factors affecting behavior. They also limit their spatial dimension by incorporating only residential or/and employment location factors in the analysis. Because much analysis focuses on a snapshot of travel over the course of a day or two, data limitations have deterred researchers from painting a full picture of gendered mobility. The need for more research that incorporates the temporal and spatial variation in a person's mobility is stressed in recent studies (39; 40). In recent years, with the broad use of on-person GPS units, it has become easier to collect and analyze mobility patterns more fully. Such data allows us to study how temporal, spatial, and other personal decisions affect the same individuals from day to day as well as to study differences among individuals.

Second, few studies consider the circumstances of the macro economy, which may affect auto ownership as well as everyday travel decisions depending on its effect on household budgets, and interact with gender. The last economic recession in the United States, which started in 2007 and ended in 2009, was devastating for many families. It escalated unemployment rates, home

foreclosures, and impeded numerous individuals from keeping up with their credit payments, resulting in loss of automobiles. Though men lost more jobs during the recession than women, studies have also underlined many other ways in which the last recession impacted women. Unemployment among women was still rising even after the end of the recession was officially pronounced and after unemployment rates for men had started decreasing (41; 42; 43). In addition, the great recession increased the poverty and insecurity of women more than men (44; 43; 45). It also impacted some subgroups more than others. Black, young, and single mothers were significantly and negatively affected by the crisis (46; 42; 47) with the employment state of black women getting worse during the recovery period (41). Though the interrelationship between personal economic conditions and transportation is well established (48; 49; 50; 51; 52; 53; 54), there is a dearth of studies that looks at how economic conditions during the recession impacted the transportation decisions and conditions of people from different gender groups. Beyond understanding these phenomenon, it also means that policy can't readily respond to the unique challenges that women face in these circumstances.

### **Contributions to the Gendered Mobility Research**

Given the foregoing discussion, this thesis focuses on the following three questions: the first question explores the temporal (workdays and non-workdays) and intra-personal variations in mobility and its gendered dimensions using data over a longer period of observation of up to seven days for each individual. This work is complemented by analysis of a larger set of observations that are made over the course of two days. The next question focuses on how women's mobility is shaped by recurring economic crisis such as the great recession. This work

specifically looks at both changes in average expenditures of different types of households, and the changes to the expenditure distribution for transportation. The last question investigates the impact of the recession on two other major components of total expenditures (housing and food) beside transportation and how households adjust expenditures under broad economic crises.

I argue that it is important to first investigate variation of mobility for the same person (intra-personal variation) and to determine how these variations differ between women and men spatially and temporally. This intra-personal variation approach enhances our understanding of how travel varies from day to day and from place to place when several constraints are added together for the same individuals. Studying variation of activity spaces provides an assessment of how outside constraints shape mobility for men and women. For instance, one possibility is that activities such as work lead to different mobility demands for men and women on different days. If work and in-home responsibilities place significant constraints on women, then their workday geographies may be limited, requiring a compensating behavior when these barriers are lifted. For men, the pattern may be different. These understandings shed light on the impact of multiple constraints on personal mobility and the behavioral responses it engenders.

Second, given the sporadic shocks the U.S. economy has experienced over the past few decades, it is necessary to evaluate how such sources of macroeconomic shocks impact women's transportation decisions and conditions differently from men and for how long. These could be beneficial for broadening our view and identifying other sources that limit women's movements on top of other constraints women face within and outside of the household. This piece of my

thesis yields new insights into gendered travel behavior and helps inform policy responses when the next economic shock happens.

The thesis also provide a synthesis of the findings of the three dimensions that I empirically explore with an eye towards policy. The policy implications section builds on the three areas of empirical exploration and recommends relevant policy interventions that could enhance mobility options.

This research contributes to existing knowledge in the following ways: i) by analyzing how the mobility patterns of workers differ between workdays to non-workdays based on gender using data that covers multiple periods, ii) by evaluating how the recession impacted the mobility expenditures of households and the differential impact that it had on minority and female-headed households, and iii) by identifying any substitutions that exist between transportation, housing, and food when it comes to allocating total expenditures and to stress any gender difference and reallocation of those expenditures during the great recession. Finally, I offer a synthesis of these three areas of investigation and their implications to policy.

## CHAPTER 2

### THEORIES OF JUSTICE, MOBILITY, AND TIME-SPACE GEOGRAPHY IN THE CONTEXT OF GENDER

#### 2.1 Introduction

The theories, concepts, and approaches that lay the foundation for this research come from the social justice, mobility, and time geography literature. The next sections discuss these theories in some detail as it applies to this research. Social justice is relevant to this work because the primarily goal of this dissertation is to identify how two main gender inequalities in household division of labor and economic well-being are shaping women mobility. Thus, the work done as part of this thesis is precursory to diagnosing social or gender injustice in order to urge appropriate policies that can help restore justice for women. As mentioned previously, enhancing women mobility is the fundamental objective of this dissertation. Hence, the term mobility is one of the key terminology through this work. Similarly, this thesis suppose that the two gender inequalities in household partition of tasks and economic welfare create space-time and economic constraints that can restrain the mobility of women. Space-time constraints also called time geography which was first demonstrated by the geographer named Hagerstrand is part of the backbone of this dissertation.

## 2.2 Social Justice: Diversity and Equity

The planning research presented in this manuscript belongs under a broad umbrella term of social justice. Social justice is essential to improve lives, neighborhoods, communities, and societies. Nonetheless, several philosophers and authors argue about what should the true definition of social justice(55; 56; 57; 58). Rawls, one of the major philosopher and promotor of social justice, argues that social justice is about equality of opportunity especially of primarily goods. He believes that any inequality should benefit the disadvantaged member of society but not the privileged(55). He stressed the importance of “equal rights and fundamental liberties... and the equitable distribution of resources, profits, and opportunities to those with greatest need...” (59).

In other words, “social justice concerns the degree to which a society contains and supports the conditions necessary for all individuals to exercise capacities, express experiences, and participate in determining actions” (60). Social justice is also viewed as fairness(55). “A just society would be an enabled and socially engaged actor who inhabited a society in which goods were fairly shared such that each individual could pursue his or her life project” (61).

Certain participants in the debate believe that social justice is more useful when used as principle to solve conflicts. They believe that it works best when it connects efficiency to equity(56) and when it considers culture(58).

On top of that, other ideologies and policies in modern societies hinder social justice. For instance, numerous authors agree and stress the incoherent nature of neoliberalism with social justice. Fainstein highlights that neoliberalism which is about capital accumulation regardless

of the social consequences seldom supports social justice. It favors instead the reassertion of masculinity(55) and disfavors women and even reinforces their burdens (62).

The relation between social justice and space is also a theme that has been discussed by theorists(63; 64). Social justice has always a spatial component to it. They consider spatial justice as a movement for the appropriate use of space and a just organization of spatial activities(63; 64). According to Lefebvre, the organization of space affects society and social relations(63). Though, in society it is a fundamental human right to have equitable allocation and access to resources and services(64). Therefore, spatial justice is primordial in all societies.

Altogether, all the ideas discussed previously show that the theory of social justice is broad and sometimes controversial. This theory is pertinent to this dissertation because the fundamental objective of this thesis is to determine few other ways gender inequalities in household division of labor and economic well-being impede women travels. This work is a starting point of the long journey in the endeavor of social or more precisely gender justice. The undertaking of social justice involves several processes and begin with problem identification which constitutes the tasks done in this manuscript. Social justice also encompasses two important concepts: diversity and equity. These notions are discussed in the following subsections.

## **Diversity**

Different scholars claim that considering diversity is essential for social justice. They believe that satisfying the needs of the majority of people is not sufficient. They urge the consideration of the pluralist nature of society. They criticize the persistent use of the universal approach and keep insisting on heterogeneity. Group differences of race, age, gender, and sexuality should

not be ignored but rather embraced. Universal approach is not ideal because it demands people or groups that are different to change their identities in order to assimilate and tremendously disfavours them in the competition of scarce positions and resources.

Group representation is the key because it can benefit both the oppressed and the privileged by guaranteeing a voice for both. It is therefore the technique that makes sure that all needs and interests of the public will be identified in democratic deliberations. Listening to group-specific needs enhances social equity and sustains different cultures. Young declares: “I believe that group differentiation is both an inevitable and a desirable aspect of modern social processes. Social justice requires not melting away of differences, but institutions that promote reproduction of and respect for group differences without oppression.” (55)

## **Equity**

In addition to diversity, equity is a vital part of social justice. In almost all definitions of social justice, the term equity is emphasized which requires the unbiased distribution of resources, rights, and responsibilities to all members of society. Embedded in the word equity are also two significant notions which are access and participation. Hence, social equity underscores the importance of every individual in society to have access to knowledge, power, resources, and services which gives them control of their lives. It highlights the necessity for everyone to have the right to participate in decisions that can impact their lives.

Equity is about creating symmetry between lived experiences of different subgroups in the community. For example, it is about recognizing cultural differences and making sure that those differences do not disfavor anybody. The necessity of equity in urban planning is also

emphasized by several authors (65; 66; 67). Equity is one of the key concepts and frameworks explored throughout this thesis. More specifically, gender equity is of particular concerns in this manuscript. Thus, gender justice and equity are discussed next.

### **Gender Justice and Equity**

Similarly to other kinds of social justice, gender justice is also an important constituent of social justice. Feminists have had a unique goal to fight for gender justice. Their main objective has been to promote social justice for women who are part of the oppressed and subordinate groups. Many scholars believe that “social justice brings to feminism a particular emphasis on fairness and transformation; it is a modification that signals change” (68). Obviously, feminists and social justice proponents share important points.

Though, many feminists had divergent perspectives of what social justice and equality should be. Some feminists believed that equality should be mainly about equal treatment and equal opportunity as men. Other feminists viewed equality as merely the elimination of gender discrimination to enter the workforce and to enable women to be part of the paid labor force. Altogether, they had common goal to edify and fight how the multiple “forms of injustice, oppression, discrimination, marginalization, social-cultural privileges adversely affect the lives of millions of people in contemporary society” (59).

Feminist movements are one of the many movements that were initiated due to social inequality and the lived experiences of socio-spatial injustices (62). “Urban material feminists connect lived experience and the everyday to multi-scalar institutions and processes, emphasizing social justice and the politics of redistribution” (62). Many feminists believe that the

social order and system in the US favor mostly white middle and upper class men and disempower others that are not part of this group. As an example, they state that the unearned benefits received by white middle and upper class men related to things such as urban design and workforce structure in this country are one source of social injustice.

Nonetheless, it is important to note that many of feminists' work, movements, and theories have contributed to multiple changes and produce much knowledge related to gender and educated societies about the existence of the oppressed and subordinate groups. Some of these changes led to a paradigm shift that allowed women to vote and led to the establishment of anti-discriminatory laws including labor reform of things such as minimum wage (68; 61).

Despite major progresses, gender inequity still persists in the workforce and in our society. For instance, women still represent the majority of the poor nowadays. Reid declared that "the poverty rate for women is higher than for men in every age group and disparity between socioeconomic groups is growing" (69). This gender trend in poverty is deeply rooted in the gender culture of our society. One determinant of this trend is that women still encounter lower wage rate than men and are more likely to work in low wage part time jobs. Moreover, they are less likely than men to climb to the top positions in a company; thus they are less likely to achieve economic mobility than men. On top of all of those, women are still the primary caregiver in our homes even though men are now participating in the caregiving activities but still to a lesser extent (61). Being the primary caregiver which is a non-paid work is partly another reason for women lower socio-economic status.

Feminists argue that a better approach and a more comprehensive way to analyze gender inequality is through the capability framework (70) which measures what each individual can do or cannot do in society (71; 72). As a tangible example, Nussbaum explains how caregiving is essential in our society by elucidating how young, children, the elderly, and disabled people have definite needs to have caregivers which are usually the tasks of women. According to Nussbaum, the function of women as the principal caregivers impact them in other ways such as paid employment, citizenship, play, and self-expression by restricting their capability (71; 72). She explains that “the time spent on this caregiving disables women from many other functions of life, even when a society has in other respects opened those functions to them” (72). She emphasizes how important considering the interaction of capability and caregiving is important for gender justice in society and the fact that women need support to live adequate lives. A just society should provide care for those in needs by not exploiting women as in the past which hinder their capabilities in other areas.

Another related reason for gender inequity explained by some feminists is embedded in the structure of our old and current cultures and policies. Thus, numerous feminists believe that the establishment of gender justice requires both change in the private domains of our homes and change in the public arenas. They believe that we should reconsider our standard dogma of things such as gender division of labor as well as our public policies. Some of them argue that our decision makers are responsible for the gender inequity. Therefore, they urge the need for social justice especially for gender justice through policy-making. They claim that women should participate in political decision making and that group-specific policies should be

adopted to facilitate social equality (60). Overall, they refer to the gender difference in things like employment, migration, and poverty and instigate new ways of studying and combatting gender inequity (61; 60).

Other feminists necessitate social justice for diverse subgroups of women by pointing to the issues of intersectionality and difference. These issues became relevant with the theory of critical race feminism which shows for example that black women compare to white women are subject to more than one type of oppressions. Overall, this theory allows the analysis of multiple oppressions (68). The notion of intersectionality not only shows that there is a difference among women but gives an opportunity to assess the different types of inequality they face beyond the gender inequality such as inequality related to race, class, and ethnicity which can also help in assessing inequality among women. This issue of intersectionality pushes feminists to change direction and to adopt a strategy that will benefit the most oppressed women such as low-income black women. This strategy seeks change from the bottom up. Besides, many feminists believe that understanding the intersections of oppressions is necessary to combat social injustice.

As a whole, the underpinned theory that motivated the research presented in this thesis is gender equity. Gender inequality is a serious problem in many fields including in mobility. This thesis has primary goal to identify gender inequality in daily and physical mobility in order to recommend important and relevant policies. The next section elaborate on daily physical mobility.

### 2.3 Mobility

Mobility is an important term that can be applied or linked to many divergent circumstances. Cresswell and Uteng (29) noted in their book that mobility is “not only geographical movement but also the potential for undertaking movements (mobility) as it is lived and experienced”. For them, “understanding mobility thus means understanding observable physical movement, the meanings that such movements are encoded with, the experience of practicing these movements, and the potential for undertaking these movements” (29). They also relate mobility to capability.

It is important to note the different types of mobility. One of them is the daily physical mobility which helps to move people around a city or region for the goal of accessing opportunities and places. This mobility can improve daily life and material well-being. Another type of mobility is the socioeconomic mobility which is the mobility that helps people to improve their socioeconomic status over time. Other dimensions of mobility encompass people’s movement or relocation over long distances such as from one country to another or from one continent to another called international migration, movement or relocation within the same country named internal migration, and people residential movement or relocation within the same city or even the same neighborhood which can also be part of the internal migration (35). The mobility concept is applied to other things such as time-space compression, globalization, movement of information, cultural study, body movement and others. The kind of mobility of interest in this thesis is the daily physical mobility. A brief discussion of daily physical mobility and the gender difference in mobility are provided in the following subsections.

## **Daily Physical Mobility**

Daily physical mobility is almost indispensable in today world because of the greater separation of different activity locations due to suburbanization. It enables people to participate in different activities and to access opportunities, services, and resources. Urry indicates five obligations that may require daily mobility which are as follow. Daily physical mobility may be important in the accomplishment of legal, familial, and economic obligations (travel to work, family events, school, hospital), social obligations (social meetings), Object obligations (meeting to sign contract, usually related to work), obligation to place (being at seaside, walking in the mountains), and event obligations (to participate in life event) (73). Thus, daily mobility is one important factor that determines the quality of life and the autonomy of a person.

Transportation and daily physical mobility are inseparable. Transportation modes and infrastructures are the main enablers of this type of mobility. However, the environment or space within which mobility is taking place can influence daily mobility as well. Additionally, different groups of people have diverse views and practices of daily mobility. Poor people may have different experiences of daily mobility than non-poor people, women may have different perspectives of mobility than men, and black people may see mobility differently than white people. The next subsection focuses on gender difference in daily mobility which is the main objective of this thesis.

## **Gender difference in Daily Mobility**

Numerous scholars have demonstrated that daily physical mobility is gendered in many ways (29; 31; 35). Many of these studies mainly show gender difference in travel patterns, behavior,

and needs and the reasons behind the divergence (29; 74; 30; 31; 75; 76; 36; 35; 77; 9). A lot of this research shows that women have different travel patterns from men with short and multiple trips which are primarily due to their double duties of caring for the home and for participating in the labor market. All of these factors constraint them spatially and temporally. Some scholars underline the car preference of women due to reason related to safety, security, and the built environment (30). Moreover, many of this scholarship show that women have different access to transportation resources because of economic reasons. They also stress that the extent of the gender issues in transportation can vary based on particular situation related to family structure, age, race, and ethnicity.

In summary, daily mobility is gendered for several different reasons. Various constraints act together to create divergence in daily mobility. Those constraints are grouped into categories by scientists. The diverse categories of constraints are discussed in the subsequent subsection.

## **2.4 Time-Space Geography**

Movements in space and time are guided by a set of constraints that are grouped by the geographer Hagerstrand (78) into three main constraints such as capability, coupling, and authority constraints. The next subsections explain each category of constraints separately.

### **Capability Constraint**

Capability constraint emphasizes the manner by which daily time limitation determines people every day spatial and distance coverage to participate in different activities from home. In other words, it is the time constraints faced by people after performing necessary daily activities of sleeping and eating (78). Capability constraint enables the creation of space-time

prism of daily activities. This prism depends not only on the locations of destinations but also on the time spent at those locations (78). Transportation enhancements, faster modes of transportation, and technology can increase an individual spatial coverage or reachable distance within the constraint time frame (78).

### **Coupling Constraint**

Coupling constraint is another type of constraint that can also affect people's daily time-space. It involves the constraint face by an individual to interact or bundle with other people (78). It comprises scheduling constraints. Connecting with other people not only demand part of a person daily time of 24 hours but it asks for the person to arrange her day schedule to fit other people time schedule. For instance, working should be done during a certain time frame during the day. To go to the shop, the bank, or the primary care doctor, people need to schedule head because each one of these places has fixed operating schedule. In other words, an individual is constrained by the numbers of interaction he or she can do in a daily schedule in time and space especially when the meeting schedules coincide. Sometimes trade-off between bundles is necessary (78). Other things can facilitate combination of different bundles such as faster transportation modes, telecommunication tools and others.

### **Authority Constraint**

The last time-space constraint is the authority constraint. This constraint shows that not all time-space domains are accessible. Some of those domains are accessible only through certain kinds of investments. Various time-space domains are accessible through immediate power and custom such as your place in a queue at a grocery store or your favorite seat. Others

are protected legally such as visiting a foreign country which requires usually acquiring Visa. Diverse domains could only be control temporarily such as a seat in the bus. Powerful people in higher domains can exercise their power to confine the act of people in inferior domains. People in the same domains do not give order to each other but use techniques like trading, negotiation, and invasion. Economic is not the only way to obtain power in a domain. As a whole, many other things can impact people daily space-time paths including laws, rules, regulations, and economic status.

### **Interaction Between Constraints**

The interaction of constraints in time-space is almost inevitable and can limit people's options. These time space constraints could be the source of many problems facing people. Most of these constraints underline the fact that the individual is indivisible and that his time is limited. Further, it should be noted that individual in dealing with space not only considers distance, but they also take into account time and other barriers of coupling and authority constraints (78). Above all, breaking down constraints into the three groups of time-space constraints (capability, coupling, and authority) could help with their management.

### **Gender Related Constraints**

The interaction of capability, coupling, and authority constraints restrict more the time-space of single working mothers than other women and all men by shrinking their time-space prisms and reducing their opportunities. Likewise, these constraints can restrict their access to resources such as money which are essential for their well-being. Kwan explains in one of her studies that women have inferior access to urban opportunities because of their time-

space constraints (33). She also highlighted that women have more spatial and temporal fixed activities (called fixity constraint) due to their gender role which constraint their travel to some other places and configure their daily activities. These fixity constraints also affect their employment status. For instance, it was demonstrated that “women with higher levels of fixity constraint are more likely to work part time” (33).

Overall, the interaction of capability, coupling, and authority constraints affect women because of their critical needs to take care of the family and to be in the labor force. Clearly, constraints are some of the main reasons for difference in daily mobility. However, an important factor that could exacerbate the issues of daily mobility is the type of decision-making endorsed by the person in face of constraints. The next section expands on decision making and the different sorts of decision-making approaches adapted by women and men.

## **2.5 Utilitarian Approaches**

Time and money are two important and scarce resources in people’s lives. They are necessary for the well-being of individuals. These resources are needed for the accomplishment of most things. For instance, the availability of time can allow one to participate in distinct activities performable in a day and money can help in reaching such goal. Thus, time and money are needed for travel to take place and for people to participate in different activities.

However, how time and money are allocated involves decision making that sometimes require trade-off (79). Trade-off is a well-known concept by economist that involves losing one thing in return of gaining another one. It is a condition that requires balancing aspects that cannot

be all satisfied at the same time given the present economic situation. It sometimes involves negotiation, bargaining, and evaluation of costs and benefits of the available alternatives (79).

Sometimes, decision making can necessitate minimizing costs and maximizing benefits (80). Though, many factors influence people's decision-making process (81) leading to multiple criteria decision-making (MCDM) (82). Several decision-making theories exist and are used by scientists, economists, and even transportation scholars such as rational choice, utility maximization, utilitarian and cost-benefit (83). The utilitarian approach is relevant to this dissertation work. The next subsections cover this theory and link it to the gender decision making process.

### **Utilitarian Theory**

Utilitarian theory initiated by the philosopher John Locke (1632-1702) focuses on overall well-being and pleasure by minimizing pain (84). Jeremy Bentham (1748-1832) and John Stewart Mill (1806-1873) also contributed to the utilitarian theory (84). Utilitarian philosophy cares about aggregate welfare (85). Its goal is to maximize utility, happiness, or well-being. It is a type of consequentialism. It evaluates alternative decisions based on their consequences and outcomes. It goes beyond satisfying the happiness of one person to satisfying the happiness of others. It is the basic for moral behavior (86). It evaluates if an action is moral by weighting good and bad consequences. Utilitarian strategy seeks for the greatest good for the greatest number. It also values how an action can affect others.

This thesis supposes that women's decision making processes is based on utility maximization. The next subsection elaborates on women's decision making process.

## **Women's Decision Making**

Decision making is part of everyday life. Multiple factors and constraints shape people's decisions. Given the multiple roles that women play in and out of home, their choices are even more constrained than men's (34). The dissertation work presented here claims that women's mobility or travel decisions even though more constrained than men can be explained with utilitarian approach. Nevertheless, women as well as men weigh the costs and benefits of their available options before making a choice. For the most part, they choose the options whose benefits outweigh the costs. However, myriad of studies have highlighted gender difference in decision making (87; 88; 89). For example, Beekun et al. (88) find that when faced with ethical decisions women tend to adopt a utilitarian approach that draws on contextual factors while men's sense of justice tends to be universal. They ascribe the utilitarian approach to potentially arise from the expectations placed on women as care givers. Empathy and emotions drive women decision processes more than men (90).

This thesis also assumes that women, when confronting with constrained decisions, are likely to prioritize the household through a utilitarian calculus. The same is true regarding their transportation decisions. They make transportation choices that favor the well-beings of the entire family. Sometimes, these choices could involve trade-offs between their individual well-being and the well-being of their families. An example of such decision making by women is when they decide to work part time in order to care for household children and elderly (34). Hence, this dissertation presumes that the outcomes of gender difference in transportation are not only shaped by multiple constraints but by the types of decisions one makes when faced with

these constraints. Based on the various knowledge on the topics, the results of gender difference in mobility could be explained by gender inequality which create gender related constraints as well as gender difference in constrained decision making.

## **2.6 Summary**

Overall, many theories inform and motivated the work done as part of this dissertation. This thesis seeks to address gender justice or more precisely gender equality in mobility. It is a beginning work that identifies gender inequity in travel by answering three main questions regarding: 1) gender difference in workday and non-workday geographies and the conditions that inform that difference, 2) gender difference in transportation spending in times of crises by comparing expenditures before and during the great recession, and 3) gender difference in substituting transportation, housing, and food expenditures before and during the last economic crisis. All three inquiries aim to determine mobility dimensions that are gendered. Thus, the notion of mobility is an important and relevant concept of this dissertation. All three questions consider that the gender differences in mobility are based on the differences in constraints faced by women and men and the approach women take to constrained decision making. Thus, the knowledge of different constraint types and gender difference in decision making is important part of this thesis.

The next chapter discusses the relevant literature particularly focusing on the empirical evidence and findings that motivated this research.

## CHAPTER 3

### LITERATURE REVIEW OF THE EMPIRICAL SCHOLARSHIP

#### 3.1 Introduction

This chapter describes four main threads in past studies that are important for this multi-dimensional research: 1) Gendered Mobility: difference in travel behavior and the use of urban space (2) temporal, spatial, intra-personal variation in travel Research 3) activity space and travel behavior 4) Recession impact on women and relation between the economy and transportation.

The first group of literature which is gendered mobility is pertinent to all three analysis done in thesis. All three questions are hypothesizing that mobility is gendered. The second piece of literature that covers temporal, spatial, and intra-personal variation in travels motivated the first question that evaluates the gender difference in workday and non-workday geographies and gender difference in the reshaping of workday geographies during non-workdays. The third part of the literature review related to activity space and travel behavior is also relevant to the first hypothesis of gender difference in workday and non-workday geographies along with the reshaping of workday geography during non-workdays. The last section of the literature review is related to questions number 2 and 3 which deal with the recession and transportation spending.

### **3.2 Gendered Mobility: Difference in Travel Behavior and the Use of Urban Space**

The gender and transport literature as well as the gender and urban space literature are growing bodies of literature as the notion of gender is becoming more and more important and apparent in policy related studies. The research in this thesis is motivated by some important parts of this growing literature which are described. Many scholars have demonstrated that mobility is gendered (29; 31; 35). Some argue that women have divergent travel patterns than men because they commute shorter distances but with multiple stops, rely more on public transportation, and have divergent travel purposes (31; 36; 35; 9). Most of them attributed the divergence to the socially constructed power relations that concurrently operate at both societal and individual levels of society. They ascribed it to the household division of labor and to the fact that women are both responsible of most of the domestic tasks and paid employment (37; 38; 35). Undoubtedly, many factors act together to create a gender difference in travels such as space-time constraints created by work and household duties, sociodemographic factors, household structures, economic constraints, built environment factors, and crime/safety.

#### **Space-Time Constraints from Work and Household Duties**

Many scholarships have illustrated the differential impacts of the work and household constraints on women and men and on their travel patterns (37). Most of those studies show the strategy used by women to balance their constraining lives which demand proper allocation and organization of their activities during workdays (37). The manners by which work configure daily activities of people in general from a gender-blind lens are explore by numerous

scholars. For most of those authors, home and work activities inform the time spent on other out of home non-work activities during workdays. For instance, Bhat and Singh (91) came up with an analytical framework by dividing travels for a typical day for workers into different segments such as before morning commute, morning commute, midday during break travel, afternoon commute, and after work trip. They determine the number of tours and stops as well as their interactions with mode choice and activity types. Other studies have emphasized the importance of distinguishing between workdays and non-workdays for identifying people activity travel patterns (92; 93). A most recent study using cellular data found out that they are more regularities in activity participation in space and time during workdays than during non-workdays (94).

Scholars interested in the gender studies elucidate some keys travel behavior emerging from workers of different gender groups. They demonstrate that women who are in charge of a lot of household duties usually work locally and then have shorter commutes (37; 31; 35; 9). In addition, women usually have higher number of spatial and temporal fixed activities than men because they juggle work and things like dropping kids to day care or school daily. Thus, they are tremendously constraint in time-space during workdays and the possibility of traveling to other non-fixed activities is limited (33; 34; 9). Pan uses only one workday activities and the space-time prism methodology to stress the gender difference in out of home non-work activities (95). Nonetheless, a study argued that the constraining and gendered mobility is not limited to working women; thus workdays only. It illustrated that women with children at home have different mobility needs as well. They are sometimes responsible of chauffeuring husband

and kids to different locations in addition to the household shopping and other errands (74). Another research states that gender difference in travel time among groups of people may not exist for all trips together (96).

### **Sociodemographic Factors and Gendered Mobility**

Besides work and household duties, other factors such as socio-demographic attributes are also highlighted in the literature to contribute to gendered travel behavior during workdays and non-workdays. Some of those studies done in the US have underlined that the shorter commute trips of women may not hold true for Black and Latino women who encounter racial segregated labor and housing markets (31; 35). Other authors declared that “statistical analysis of commuting times for a large sample of service workers in the New York metropolitan area shows that black and Hispanic women commute as far as their male counterparts and their commuting times far exceed those of white men and women”(97). Another research came up with similar finding that gender difference in commute time is higher among whites (4.5 min) than Hispanics (1.8min). They also found that gender difference in child-serving trip distance and time is less among Asians and pacific Islanders than among whites (96).

### **Household Structure and Gendered Mobility**

The effect of household structures on gendered mobility is also documented in the literature. A recent study by Fan shows that gender difference in work travel time vary by household structures but that it is apparent in households with children (98). Contrary to Fan (98) finding of no gender difference in commuting time between single-breadwinner couples and double-breadwinner couple, some scholars in the past demonstrated that women in different household

structures such as two-earner households versus single-earner households have divergent travel behavior. Women in two-earner households are likely to have shorter commute distance than the one in single-earner households (76; 99). Other scholars participated in the discussion by affirming that linking work trip and non-work trip is mostly done by women (especially by women with children) but vary based on household structure (100; 101). Mauch and Taylor study declares that “gender differences in commuting behavior extend to household-serving travel and can vary significantly by race/ethnicity in addition to income and household structure” (96).

### **Economic Constraints and Gendered Mobility**

The gender difference in economic status was obvious in the past because women were not allowed in the labor force. Despite their increase entry in the workforce nowadays, women are still less financially stable than men. “American women who work full-time, year-round are paid only 77 cents for every dollar paid to their male counterparts” (44). This gender difference in economic status evidently create a difference in constraints between the two groups (12; 13; 14) which can also lead to gendered and constrained related travels (98; 31; 36; 34; 35; 9). It has been illustrated in the literature that the gender difference in travel patterns is also related to disparate access to economic resources in addition to other resources such as time and social (35; 9). Thus, the lack of money limits women’s daily physical mobility (35). Likewise, the effect of divergent socio-economic status can be seen even among the women groups. Women from different occupational statuses are said to have divergent commuting distances. Women that are well educated travel longer than women that are less educated (29).

### **Built Environment and Gendered Mobility**

Likewise, the influence of the built environment on gendered mobility has also been underlined by scholars (30; 38; 35). The built environment factors of their neighborhoods can impact women travel behavior and then the choice of the walking mode to satisfy their daily recommended level of physical exercise (30). It has been affirmed that particular types of community design induce women to travel longer distance to satisfy their needs and the needs of their families by adding to their travel costs and time. However, other community designs exist that allow shorter distance trips by women and trips by other modes other than automobile which diminish their trip costs by a great amount. For example, suburban settings is found to increase women driving responsibility than urban areas. Women in urban areas were identified to walk twice as many times as women in suburban places (30).

### **Crime/Safety and Gendered Mobility**

Spatiality of fear and effect on behavior is stressed by Pain (102). Fear of violent crime in public space is generally linked to lack of integration in an area, isolation, lack of social acceptance, people having little control over resources, marginalized and powerless people (102). Fear of violent crime affect deeply people mobility, lifestyle and behavior. It also restricts people independent mobility. It varies with places as well as with time and depends more on gender, life-cycle, and race (103). Many gender studies have demonstrated how women fear of violence affect their use of urban space in numerous circumstances (104; 105). For instance, Koskela declares that “experiences and attempts at violence, and incidents of sexual harassment produce a space from which women are excluded on account of their gender” (104). Women fear more at

night than during the day (102). Thus, the spatiality and temporality of fear of violent crime is evident as women avoid dark and feel differently during summer and winter as well as during the day and night.

Other research delineate the relationship between women's daily physical mobility, their mode choice, and safety and security factors. A handful of those studies affirm that sometimes women uniquely choose one transportation mode (car, transit, bike, and walk) versus another due to safety and security (30; 31; 36; 35). For protecting themselves from sexual violence, women travel with companions and avoid certain areas especially after dark (30; 35). A related literature highlights that women choice of car as the preferred mode of travel is also associated with safety reasons. Women feel safe in cars than walking or riding transit (30). Moreover, research found that women viewing their neighborhoods dangerous are classified as not physically active (walk less) than women recognizing their neighborhood as safe (30). For biking, women were also more risk averse to perceived un-safety of certain bicycle facilities (36).

Overall, multiple factors on top of work and household responsibilities can act together to create a gendered travel behavior. Some of those constraints go beyond the household division of labor to things such as sociodemographic, household structures, economic constraints, built environment, and crime/safety reasons. Other factors can aggravate these constraints such as transportation supply and demand aspect as well as working hours of diverse stores and services (106). As Law mentioned "gendered norms of domestic responsibility, overlaid on temporal rhythms of childcare and domestic work, and on the spatial patterns of segregated land-uses, and combined with inflexible service hours, and minimal public transport, generate

time-space constraints that restrict the mobility of those responsible for this work (mainly wives and mothers)” (35). The proposed research has a primarily goal to add to the gender and mobility literature by adding lacking pieces of intra-personal variation as well as temporal and spatial variation which will be described next.

### **3.3 Temporal, Spatial, and Intra-personal Variation in Travel Research**

Contemporary inquiries are beginning to demonstrate the usefulness of incorporating temporal and spatial as well as intra-personal variation in studying people’s movements in part because of the evolution of tracking technologies such as location-aware technologies (LATs) which enable the collection of multiple days of data for the same individual in real time at all locations visited (107; 108; 40; 106; 109). Other scholars point to the lack of studies in this arena despite its importance. For instance, Buliung et al. (107) note that while a set of various factors influencing individual activity travel behavior has been explored, less effort has been directed towards the study of temporal variation in activity travel behavior. Though, time omissions in mobility research is declared to provide erroneous results especially when the goal is to prove social difference (40). Likewise, the necessity to include spatial variability in people activity travel behavior is stressed in recent scholarship (39; 40). They underline the importance to move from static analysis of residential or employment locations to dynamic analysis in mobility study that incorporate all other places in people lives as well as the temporal aspect.

As part of the beginning efforts, the day to day variation of individuals’ space-time constraints and temporal rhythms was proved (106). The unique circumstances of each day regarding mobility and necessary activities dictate variation in daily constraints (106). This is also

substantiated in other work (107; 106). Further, some authors demonstrated less variability in day to day activity travel behavior during the week and greater variability during the weekend (110; 111; 112; 113) while others argued for the opposite (107; 114).

Other temporal variations in transport is illustrated in past studies. For instance, Thakuriah et al.(115) demonstrate the difference in time of car acquisition among young adults in past generations. They affirm that young adults in the past own a car early in their adulthoods than nowadays (115). Contemporary studies also discover that people start to acquire driver licenses at later stage of their lives (116; 117).

As a whole, considering temporal, spatial, and interpersonal variation in people's mobility is informative and can yield important details that are not possible otherwise. Besides, a study done during a fixed point in time or a fixed place can be informative when data is a limitation despite the fact they are more likely to provide erroneous results (40). Recent research has started to prove the importance of temporal dynamics in space-time constraints and other aspect of lives (107; 108; 40; 106; 109). The evolution of data collection method nowadays and the increased availability of free and rich data empowered by things like new open government policy is enabling the incorporation of temporal variability in constraining travel research and the consideration of other places beyond the residential and employment locations and other factors such as the great recession. The propose research not only aim to contribute to the gendered mobility literature but also to the temporal, spatial, and intra-personal dynamism body of literature. Literature related to the novel concept of activity space that will be used in the planned research is discussed next.

### 3.4 Activity Space and Travel Behavior

The activity space is a graph containing all activities undertaken by a person under the temporal constraints (118). It is an emerging and informative concept that can elucidate further people travel behavior based on a very realistic framework of time-space constraints (78; 34; 119). It is an extension of time-space prism showing the movement of people in space and time under three different constraints of capacity, coupling, and authorities which was first laid out by Hagerstrand in his seminal work in 1970 (78). It is defined by others as the set of all locations within which the individual has direct contact as a result of his day-to-day activities. It is the area that shows the space in which a person frequently participates in activities daily (120; 121).

The concept of activity spaces is used to measure different outcomes in the literature. Some scholars use activity spaces to measure accessibility to important locations such as health care facilities (122). Other scholars linked activity spaces to safety (123). Likewise, Kwan argued how activity space can be powerful tools for understanding constrained and flexible travel patterns for different gender groups (34). Different factors that can influence activity spaces are home location and household size (118), the number of places visited by the individuals (124), as well as some built environment factors notably urban form (125). Residential locations and employment status also impact individual activity space areas (106). Studies have also stressed that individual activity space is not constant and can vary daily as well as monthly (108).

Overall, an activity space is very helpful for measuring the extent and ability of mobility of a person given all the temporal and other constraints in life such as crime. Smaller activity spaces

could be the results of constraints and mobility limitation from things like work and household tasks while large activity spaces show flexibility and ability to move. The knowledge of how crime vary in people's activity space could elucidate more their travel behavior. The proposed research will use this innovative approach to identify some differences in travel behavior of women and men. The subsequent literature will talk about the recession impacts on women and the relation between the economy and transportation.

### **3.5 Impacts of the Recession on Women**

The recent economic recession negatively impacted the financial conditions of many individuals across the countries and alter many of their regular behaviors. Well-known outcomes from the crisis include an increase in unemployment rates, home foreclosures, and credit issues related to things like auto loan. In addition to the housing industry, one of the most affected business is the automobile industry. Moreover, the dilemmas of the recession differed across sociodemographic groups. Part of the fact is that men lost more jobs during the recession than women. However, there are many other ways in which the last crisis was tragic for women than men particularly for specific groups of women. The negative outcomes of the recession on women can be classify in two main groups 1) the aggravation of women unemployment during the recovery period and difference between subgroups of women, 2) the intensification of women's poverty, insecurity, and hardship. These two damaging effects of the recession for women will be discussed in the coming sections.

### **Unemployment among women during the recovery period**

Since the end of the recession women's unemployment rate was on the rise while men were catching up (126; 42; 43). The unemployment rate for women increased from 7.7 percent in 2009 to 8.0 percent in 2011 contrary to the decrease for men from 9.9 percent to 9.1 percent for the same period (126). This increase in women's unemployment was more pronounced for some groups of women than others even during the recession (46; 42; 47). For instance, during the recession the poverty of old women of 65 and up was 10.7 percent compare to 6.6 percent for men of the same age (44). Moreover, household headed by women along with other vulnerable groups were severely impacted and more impacted than men headed households during recession. Female-headed households faced more unemployment during the crisis than male-headed households. For instance, single mothers nationally had the highest rate of unemployment than other women and men which reached its peak in 25 years during the crisis to 13 percent (45). Similarly, the employment state of black women got worse during the recovery period than for others (41). On top of the increase in women's unemployment during the recovery period and to the difference between subgroups of women, the crisis affect women in other ways which are explained next.

### **Intensification of women's hardship**

A different gender related issue of the crisis is the increase of the poverty and insecurity of women more than men (44; 43; 45). Even though poverty rates have also raised for men, women from all groups face more poverty than their male counterparts (127). "Poverty among women rose to 13.9 percent, up from 13.0 percent in 2008 the highest rate in 15 years and the

largest single-year increase since 1980. More than 16.4 million women were living in poverty in 2009, the largest number since the Census began collecting this data in 1966.” (44)

In addition, the last recession brought more insecurity and hardship on single mothers. Thirty eight percent of single mothers could not pay for medical expenses for themselves or family members, 80 percent of this group reduce their family spending while 72 percent of all women and 57 percent of all men cut down expenses. In addition, among single mothers, 43 percent could not satisfy their children financial needs while 42 percent of married mothers failed to do so. Moreover, 38 percent of single mothers compared to 42 percent of married mothers cut down their retirement savings to meet immediate needs. More critically, 16 percent of single mothers experience famine at some point during the recession while only 9 percent married mothers face such challenge. Single mothers experience less work flexibility than others. One half of single mothers assert that at least one person was unemployed in their households during the last recession (43).

After the last recession, the poverty rates for women and children were at the peak during 17 years. Despite the official end of the last economic recession, its negative impact is still ongoing for female-headed households. Households headed by women with children experience increase in poverty between 2009 and 2010, from 38.5 percent to 40.7 percent. This escalation of poverty rate is higher for different groups of female-headed households. Black female-headed households experience 3 percent increase in poverty rate from 2009 to 2010. Hispanic households headed by mothers also experience about 4 percent increase in poverty rate during the same period. Likewise, Asian households headed by mothers 2010 poverty rate was about 8 percent higher

than in 2009 (126). As of 2011, the poverty rates had become more stable for almost all groups except single mothers. The 2011 poverty rate for single mothers was still the highest with 40.9 percent compared to 21.9 percent for single fathers and 8.8 percent for married couples. Over 600,000 (13.3 percent) of single mothers that are fulltime workers in 2011 were poor (128)

Overall, considering all those negative outcomes of the recession on women is alarming to any researcher whose primary goal is to improve the lives of people especially to improve the lives of women. Three main reasons why the recent economic crisis brought the need for more research in the field of gender equity in transport especially in the gender difference in transportation spending are: 1) the link between the economy and transportation, 2) inferior economy status of women before the recession, and 3) gender difference in spending.

### **Link between the economy and transportation**

The first one is the obvious link between the economy and transportation (48; 49; 50; 51; 52; 53; 54). Thakuria and Liao (54) demonstrated that increase in income helps in enhancing one's mobility. They also illustrate that investment in mobility (which is only possible when money is available) helps to increase people's income (54). Similarly, the importance of owning a vehicle and of the number of accessible jobs by private vehicle or public transportation within acceptable travel time on employment retention is also documented in the literature (129; 52). For instance, women in female-headed households possessing a car are more likely to have income above 100 percent of federal poverty threshold (129). Also, lack of proper transportation (or poor job accessibility) limits young women job search to smaller geography or strictly to

neighborhood jobs (53) which in turn affect their labor market outcomes (51). Access to decent transportation also determine women especially female heads' economic outcomes (129).

### **Inferior economy status of women before the recession**

The second reason why the gender related impacts of the recession should be troublesome to researchers interested in gender equity in transport is the inferior economic status of women compare to men long before the recession. Women have always earn less and represent a big share of people in poverty (12; 13; 130; 14). In the United States, women have a median earning of 31, 800 dollars which is still only 77.0 percent of men's earning (15). The poor economic status of women that has already existed is even worse for some group of women than others. For instance, single mothers are mentioned to be among the poorest (18; 19). The poverty for single mothers with children under 18 and the ones living in non-metro areas is worse than for others (11; 22; 20; 21; 131).

Some reasons for women higher poverty are their marginalization in the labor force (16). Hennessy emphasized that "Jobs with low wages and no health insurance or pension benefits are more likely to be filled by women and may inflict considerable hardship on workers and their families, especially in single earner households" (17). Another study supported that argument and highlighted that about 62 percent of women householders with children are employed in such depressed jobs (132).

Though, it should be noted that other factors act together to create the poor economic status of single mothers such as race, age, education, employment status, employment sectors. Poor single mothers are usually Black, then Hispanic or White. Also, low income single mothers

are usually in certain age range with no marriage experience with lower education and no employment. About 50 percent of poor single mothers are below 34 years old which is more than 10 percent higher than the percentage of middle and high income female householders with children that are below 34. Three-fifths of poor single mothers have not reached college level as compared to two-fifths of higher income single mothers. Forty-three percent of poor single mothers are unemployed, which is more than double the number of higher income single mothers that are unemployed (16 percent). Also, the number of low-income female householders with children that work in service oriented jobs is double of that of middle and higher income ones (132).

Thus, the poor economic status of single mothers is one reason why they are likely to encounter issues related to housing affordability and to have members in deprived health (22). Similarly, it leads to the fact that more single mothers are likely to live in public housing (16). Other than the fact that the majority of female householders are poor, most children living in female-headed families are also poor notably seven in ten compared to less than a third of children in other households (132). Thus, children in female-headed households account for well over half of all poor children in the United States. Not only children from families headed by women are poor, they are also asset poor (60 percent of children) (133). For these reasons, single female-headed households remain a particular concern to policymakers (134). With all of these issues, access to job training centers and post-secondary education facilities is essential for their prosperities (19).

### **Gender differences in spending**

The last reason why further gendered behavior and issues created by the recession should be evaluated includes the impact of the crisis on labor markets, income, spending and the gender difference in spending documented in past work. Women and men's income are spent differently. Increase in women's income is related to increase in things such as child care while increase in men's income is not (135). Studies have as well demonstrated the relationship between women labor force participation, their occupational status, their income, and their spending on different services, products, and goods such as housekeeping services, prepared food, prepared food at home, meals out, and others (136; 137). "Families in which women have more relative power, as reflected in their income and occupational status, consume more housekeeping services and spend more of their food dollars on meals out" (136). The relationship between factors of wife's employment and family's spending on time saving services was also identified by others (138). "When a wife becomes a second earner, husband-wife families spend more on work-related and timesaving items such as child care and food away from home, according to the Consumer Expenditure Survey." (139). Not only women use more health care services they also spend more on health care than men. The difference in health care spending between women and men is more apparent for age group of 45 to 64 (140). Some others have argued that poor economic status of women decreases their spending potential on different goods - notably their transportation spending and thus affecting their mobility (54). Multifarious researches have demonstrated a strong link between income and spending (25; 26; 27; 28; 54). Since the

recession altered people transportation spending (141), it is important to take in depth view of women transportation conditions during the recession as well as for diverse groups of women.

### **3.6 Summary**

On the whole, this dissertation research is inspired by all the highlighted bodies of literature. It evaluates the intra-personal, temporal, and spatial variation in gendered limited travel behavior using three main constraining factors of work, the great recession, and crime. In other words, it shows how the use of urban space or mobility in urban areas can be gendered, but also varies temporally and spatially even for the same individual. This dissertation research elaborates on these arenas in order to yield new insights and to explore new methods on how the different constraints (spatiotemporal and economic) faced by different gender groups can impact their mobility and explain the persistent gender gap in travel. The study goes beyond gender difference to consider subgroups of women. The importance of studying sub-groups of women is stressed in past work (115; 142). The following three chapters demonstrate the analyses and results of the research. Three independent quantitative analyses are done: 1) Gendered Mobility in Reshaping the Geography of Workdays during Non-Workdays, 2) A Gendered Analysis of the Impact of the Great Recession on Transportation Spending Distribution of Poor and Middle Income Households, 3) Gender Differences in the Use of Urban Space for Safety Reasons. These three are lay out next.

## CHAPTER 4

### GENDER AND ACTIVITY SPACES

#### 4.1 Introduction

The past century has witnessed a dramatic increase in workforce participation among women in the U.S. Despite this increase, women are still the primary care givers in charge of household maintenance and child-serving travel (38; 143). Many studies stress the fact that women struggle to balance work and household duties which constrain them in space-time leading to shorter commutes (37; 31; 34; 35; 9). Work places particularly shape daily geographies for workers because of their fixity and time-consuming characteristic.

Even though several transportation and gender studies emphasize that work influences people's activity travel patterns and that workday travel behavior may be different from non-workdays such as weekend (125; 92), few studies have tried to evaluate how activity spaces change for the same individuals during their workdays and non-workdays and across gender groups. By combining information on workdays and non-workdays for the same individual and using the concept of activity spaces(78), I propose an approach for measuring the impact of different constraints (including gendered household responsibilities) play in shaping every day geographies. In the next section, I discuss the hypothesis and approach, followed by the data used for the analysis.

## 4.2 Research Hypotheses

In this chapter, I hypothesize that the activity spaces of women is shaped differently from men as a result of the different roles and responsibilities they take on within the household. As past research has shown, for women, the activity spaces tend to be smaller. In this research, I investigate how a relaxation of one of the main constraints, work responsibilities, allows women to reshape their geographies in relation to men. I anticipate that during non-work days, women's geographies will tend to be larger relative to their workday geographies because of the multiple roles they play within the household. On the other hand, I anticipate that for men, non-work day geographies will be similar or smaller relative to work days. I hypothesize that gender roles notably gender division of household duties inform these geographies in geographically and statistically apparent ways.

To test these hypothesis, I start with a two dimensional space on which all activity locations for an individual are located with their corresponding coordinates. I imagine a loose rubber band that is gradually tightened around the set of all points until it is tightly anchored delimiting an outer boundary of an individual's activity space. The polygon that emerges is the minimum area convex hull (144). One can think of this as a general outline of the person's activity space. This space is however too general and likely defines an area much larger than how a person may conceive their activity space on any given day. Everyday geographies are likely narrower. A time limit over the course of a day, a technology limit (including costs of transport), limits imposed by long term choices of home and work, and personal/household constraints shape and reshape these activity spaces on a daily basis. More practically, a person creates a dichotomy

of spaces influenced by activities that anchor any given day. Work for example places one such structure. Because work activities require that a person spend a significant amount of their daily time in this one activity, it is less likely that any given person would visit the larger convex hull geography in any given day. Given the limits of time and technology, they are therefore likely to make locational decisions that are narrower than the larger outlined geography. On different types of days then, we expect that people likely have an activity space that is overlapping but with alternative areas of emphasis based on the most important activities (anchors) of the day.

I illustrate these ideas in Figure 1 which shows the activity locations of a hypothetical agent and the convex hulls associated with different geographies: Figure 1a shows the workday activity locations, Figure 1b shows non-work day locations, Figure 1c shows all locations, and Figure 1d shows the overlapping convex hulls shown in Figure 1a and Figure 1b. I imagine the person takes into consideration the constraints of the day (or absence of constraints) and reshapes the geography into subset areas in Figure 1c. Extending the rubber-band analogy, I think of this as a reshaping of geographies influenced by the constraints of the day (time commitments, technology, work, children, etc.) stretching the non-work geography in some directions and being squeezed in others. The extent to which the geographies can be stretched depend on the flexibility of the person's constraints.

I then investigate how not having a work activity during a given day changes the activity space for different gender groups by looking at the ratio of workday and non-workday activity space areas built out of the activity locations of individuals. These average area ratios are categorized and regressed against individual gender, household, and residential built environment

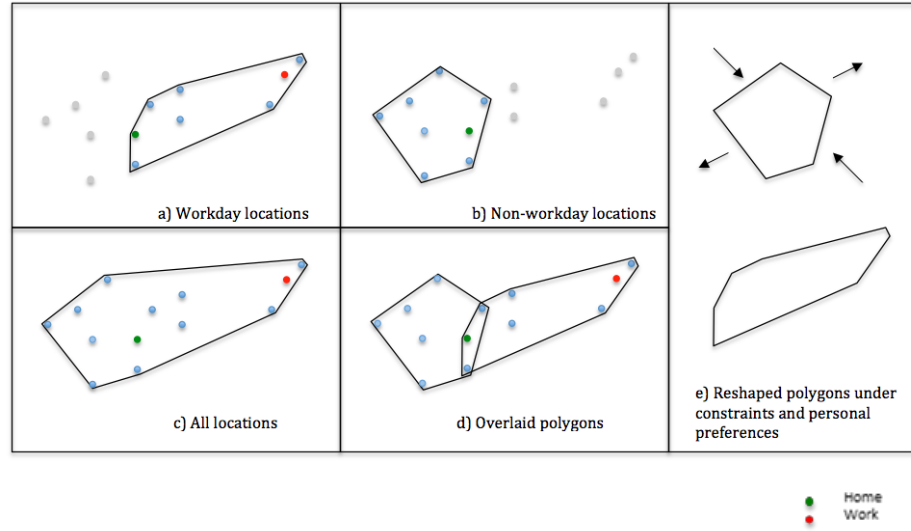


Figure 1: Conceptual framework for the geography of activities

factors to understand how these variables inform the changes that occur as work constraints are relaxed. More specific descriptions of the activity space measure are given after discussing the data used for this analysis.

### 4.3 Data

The 2007 CMAP travel tracker survey data is used for these analyses. Thus, the study area of this chapter is limited to the Chicago Metropolitan Area. The CMAP survey had two main parts. The traditional survey for which they interviewed 10,552 households during one or two days. And the GPS survey for which subset from the traditional survey are selected and

volunteered to participate in the GPS portion. Like the traditional survey, the GPS part had also two sections: in-vehicle GPS and on-person GPS.

The analyses in this chapter focused on the traditional two-day data and the on-person GPS data. These two are chosen from the four parts of the CMAP survey because they enable the estimation of intra-personal variation in geographies which is the primary goal of this chapter. These data include workday and non-workday information of the same participants. The on-person subgroup was selected instead of in-vehicle one because their travel modes were not limited to automobile and I could correctly identified the person who is traveling. Even though the on-person GPS data was of primary interest because it has up to seven days of travel data per person, its sample size is limited and did not give me a lot of flexibility when modeling. Another issue with the on person GPS data is the fact that it is not random and most participants volunteered to the survey. This matter makes the results from the GPS data not generalizable to a bigger population. All these problems led me to also consider the two-day traditional survey which sample size was adequate for statistical analyses and included participants with one workday and one non-workday that made up their two-day of survey.

After all the data cleaning, the subset of the CMAP on person GPS dataset used has 112 individuals among which 53 people are women and 59 are men. These 112 people were used because those are the individuals with on-person GPS data who are workers and whose workplace and workday information could be properly distinguished. Among the 112 workers, 14 people work from home and 90 people have both workdays and non-workdays. Each person has up to seven days of data. The daily data has a total record of 3452 with 966 records

for women during workdays and 639 during non-workdays and 1193 records for men during workdays and 654 records during non-workdays. To demonstrate the limitation of GPS data, some of its characteristics are compared against those of the CMAP Region Population based on the census data in Table I.

On the other hand, the two-day survey data has 1770 individuals with one workday and one non-workday which consist of 897 women and 873 men. In addition, I use the American Community Survey (ACS) data to get the home area characteristics of each participant. The on-person GPS and two-day survey data sample characteristics by gender are presented in Table II and Table III.

By first considering the GPS Data statistics in Table II and Table III, the results highlight that women and men in that sample are similar in many ways. Most of them are educated, have other adults in the households, and are home owners with driver license. The gender difference considering the previous characteristics is minimal. Half of the sample is white with 21% women and 26% men. Women with children under 18 make up around 30% of the data. Though, more women in the GPS sample tend to be students and part-time workers than men. On the other hand, men are likely to use transit to work than women. The mean age for both gender groups for the GPS sample is in the 40s and the average income for both gender groups is around \$90,000. One gender difference is that the average number of household licensed drivers are fewer for the women group (1.849) compared to men's (2.085). Additionally, the mean number of vehicles is higher in men's households (1.932) than in women's (1.623). Moreover, women in the sample work on average fewer days (4.566) than men's (4.983).

On the other hand, a look at the two-day survey data statistics demonstrate that participants in that survey are more educated than the GPS data participants with no apparent gender difference. Similar to the GPS sample, most of them are educated, home owners and driver license holders. Half of the sample is white 25 and 21% for women and men. The percentage of all women with children under 18 in their households are around 17% while women with children under 18 and no other adult in the household are just 2% in this sample. In the two day sample too, more women are part-time workers than men. With a gender difference of less than 5%, women and men of the two day survey are more likely to drive to work and less likely to ride transit to work than participants of the GPS survey. The mean age of the two-day sample is around the 50's where women tend to be older than men. The average household income of the traditional survey is lower compare to the GPS one and is around \$60,000. Men live in households with more people, more vehicles, more license holders, more children than women in the sample. Though on average, women are likely to work less days during the week than men. Overall, the two samples from the GPS and traditional surveys are similar in some ways but clearly the GPS sample participants are much richer than the two-day participants.

#### **4.4 Methodology**

A lot of studies have demonstrated how the framework of time geography is very informative in evaluating people time-space constraints (78; 34; 33). The analyses in this chapter use this framework to draw minimum convex hulls (activity spaces which are extension of time geography) for daily activities for each traveler. While there are different ways of estimating an activity space including convex polygon, standard deviation ellipses, potential path area,

kernel densities, and network based measure—I chose to use the convex polygon over ellipses after exploring both because it is a more conservative measure of area. The convex polygon method tends to not overstate the geography over which people engage in activities.

Given the frameworks describe earlier at the beginning, I investigate how not having a work activity during a given day changes the activity space of different gender groups. My objective is to understand how the geography of workdays is different from the geography of non-workdays for different gender groups and household structures. Then, I seek to understand which mobility and household factors are contributing to such reshaping of geography for an individual.

Therefore, the ratios of non-workday to workday activity space areas are used to measure the extent to which these spaces are reshaped. Thorough this chapter, I assume that smaller geographies reflect some constraints while larger mean a relaxation of such constraints. One limitation of the study is that I was not able to incorporate people choices and preferences. The limited sample size of the GPS data and its lack of randomization created some modeling issues that led to a more complicated model. To further validate the results obtained using the GPS data, I also estimated some simpler models using the two-day survey data as mentioned previously because it has adequate random sample size and allow for testing intra-personal variation in geographies with single workday and non-workday for each person. The different approaches considered depending on the dataset used are described next.

#### 4.4.1 GPS Data Approach

For the GPS data the average daily workday areas are obtained separately from the average daily non-workday areas for each worker. Then, the ratio ( $R$ ) of these two measures (i.e.  $R = \frac{\text{Average Non-Workday Area}}{\text{Average Workday Area}}$ ) is acquired for each individual. Once the ratio is obtained, an ordered logistic regression model is estimated which describes how the non-work day area compares to work-day areas (expanded, stayed the same, or shrunk) as a function of the person's household composition and gender while also taking into consideration the locations in which they live (e.g. home distance to downtown) to determine the contributing variables that play important roles in the reshaping of activity spaces as the work constraint is relaxed. Three levels for the ordered logit model are considered: a decrease, no change, or an expansion of the work-day area based on the ratio. These are coded as follows:

- a decrease: non-work day areas are significantly smaller than workday areas ( between 0-75% of the work day area)
- no change: non-work day areas are more or less similar to work day areas (75% to 125% of work day areas)
- an expansion: non-work day areas are significantly larger than work day areas (greater than 125% of workday areas)

These categories are used as the dependent variables in an ordered logit model. The ordered logit model is utilized because it is more capable of providing detailed information on the factors affecting the scale of the change since there is a significant difference in the scale of activity

spaces among the participants. The general formula of the ordered logit regression model is as follows with specific retained variables and results given in Table V.

$$Y = 0, \text{ if } R < 0.75; \quad Y = 1, \text{ if } 0.75 \leq R \leq 1.25; \quad Y = 2, \text{ if } R > 1.25$$

An ordered multinomial logit model is estimated as:

$$Pr(Y_i = j) = f(S, I, T, A, N)$$

with:

- Y= Area ratio category (can take on value j where j can be 0, 1, or 2 as defined above)
- S = Gender and household variables including household structure and income
- T = Transportation related variables
- A = Activity related variables
- N = Neighborhood/Home area characteristics

#### **4.4.2 Two-Day Data Approach**

To complement the analysis with the longer GPS data, models were also estimated using the two-day survey data because of its larger sample size. Three different ordinary least square (OLS) models were estimated with the following dependent variables: 1) natural log of ratio of non-workday to workday areas, 2) natural log of workday area, and 3) natural log of non-workday area. The log transformation was used because it provided a better fit. Altogether,

they enable a better understanding of the contributing factors of the intra-personal variation in workday and non-workday geographies. The general formula of the OLS models is as follow and retained variables are available in Table VI:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \dots + \beta_n x_n + \epsilon$$

where

- $y$  is the dependent variable in each instance taking the value of 1) natural log of ratio of non-workday to workday areas, 2) natural log of workday area, and 3) natural log of non-workday area
- $x_1 - x_n$  are the covariates
- $\beta_0 - \beta_n$  are the parameters to be estimated
- $\epsilon$  is the error term assumed to be distributed i.i.d. Normal with mean zero

#### 4.5 Model Results and Discussion

The results obtained from both GPS and two-day data supported the hypothesis that there is a difference between women and men in the reshaping of activity spaces due to personal, household, and work constraints. The GPS results suggest that there is a higher likelihood for women to have larger or similarly sized non-workday geographies compared to their workdays than men while women with children under 12 are less likely to have larger or similar sized geographies than women with no children. Similarly, the two day survey data conveys the gender difference in activity spaces and states that women with children in their households and no other adults to help are likely to have smaller workday geography than their counterparts

when they have longer commute than their counterparts that travel shorter distance to work. Other factors influence the reshaping of workday geographies during non-workdays in both models.

This dissertation considers larger areas during non-workdays compare to workdays to imply more flexibility when work constraints are removed. However, this may not necessary be true for all cases. Even though large areas show that the individual is able to travel longer distances or to visit several places, they may also result when less nearby opportunities exist. Thus, it is important to note that people with more nearby opportunities who have smaller geographies may be less constrained than the ones with less nearby opportunities with larger areas. Additionally, some other special cases exist where people travel longer distances but have smaller areas or where they travel shorter distances and have larger areas than people who travel longer but straight distances.

Based on my assumption that larger non-workday to work-day area ratios imply more flexibility, my dissertation finds that having little children in the household obstructs women from participating in many other activities during both workdays and non-workdays. Additionally, the results suggest that longer commutes interfere with the social life of female-heads with children who are the only adults in their households. The long journey to work impedes them from conducting several other activities during work days and lead them to postpone most other activities to non-workdays.

### **Exploratory Analyses from the GPS and the Two-Day Survey Data**

The results of the GPS and two-day survey data exploratory analysis in Table IV demonstrate that there is a gender difference in travel behavior notably activity space areas. Women have significantly smaller activity spaces during workdays than men. Some of the reasons supported by the data highlighted in Table IV is the fact that women spend more time in the home during workdays than men and commute shorter distances than men. This summary statistics demonstrate that women have smaller activity spaces than men during workdays and they also spend more time in their home than men during workdays. Therefore, it can be implied that the time spent inside home apart from the time they spend at work all restrict their mobility to other places during workdays and lead to narrower geographies for them during those days.

In addition, the GPS data supported the hypothesis and shows that household constraints related to household structures such as households with children and age of children in the household also create a difference between women and men's travels. Figure 2 shows this gender difference based on household structures from my analysis. It highlights that in addition to women being constrained during workdays that having children under 5 in the household restrict women geographies both during workdays and non-workdays. Similarly, having children under 12 limit women geographies during workdays and non-workdays but women with no children under 12 have larger geographies during non-workdays than men while they are constrained during workdays.

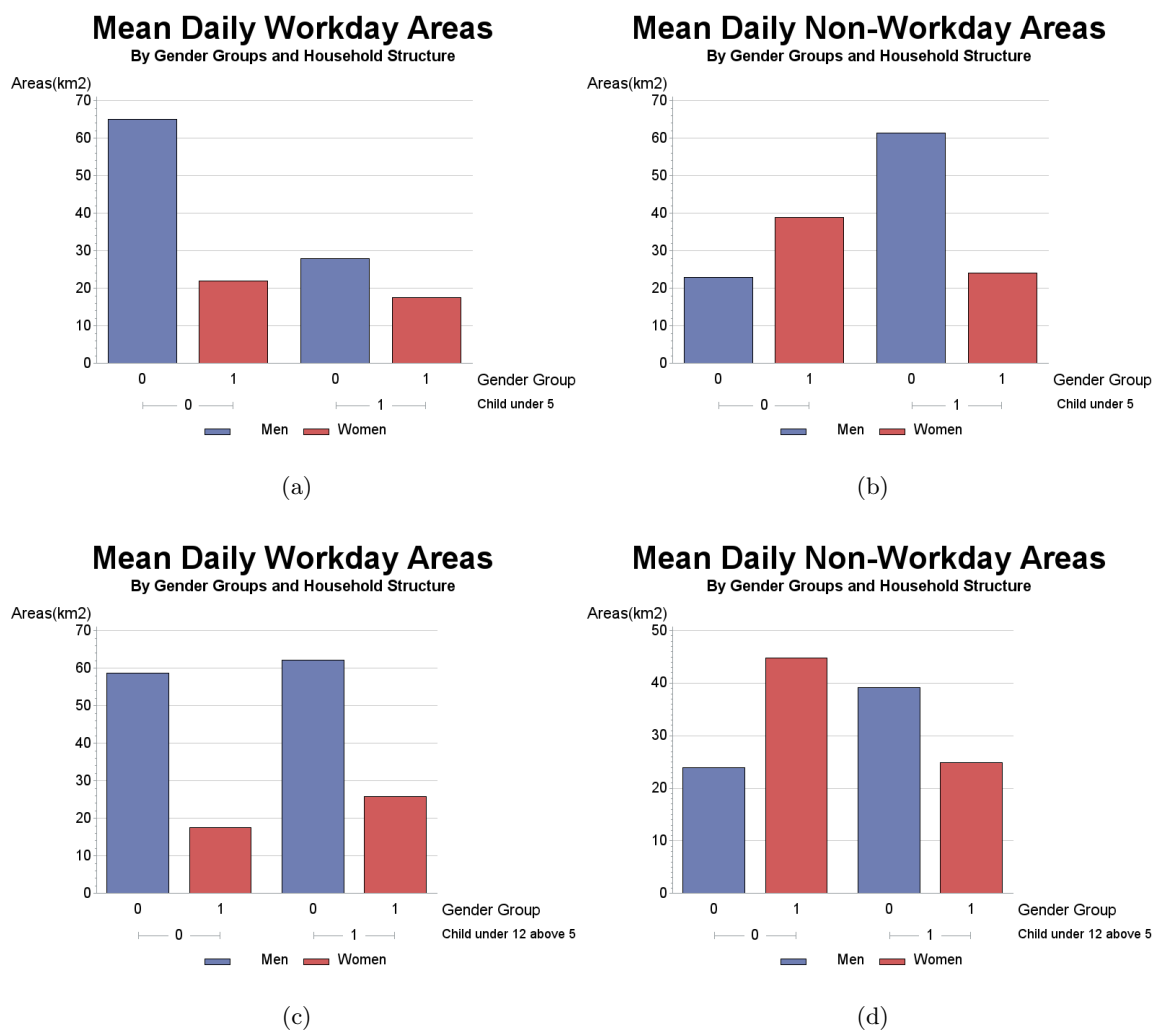


Figure 2: GPS Data Difference in Workday and Non-workday Activity Space Areas by Gender and Household Structure

#### 4.5.1 GPS Data Model

The modeling results of the GPS data are illustrated in Table V. The modeling efforts suggest that on average, the non-workday geographies for women with no children is similar to or larger than their workday geographies as compared to women with children in the 12-18 year old group (like 30 times more likely). Similarly, women with children under 12 are also (3 times) more likely to have equally sized or larger non-workday geographies. Thus, there is also a higher likelihood (30 vs 3 times) for women with no children to have larger or similarly sized non-workday geographies as compared to women with children under 12. This can be explained by the fact that women with children in their households are more constrained than women with no children even during non-workdays which limits their geographies during those days as well.

The modeling effort shows no difference between men in households without children and men in the households with children. This finding may be due to the fact that men have more flexibility during workdays to participate in other activities reducing the need to travel more during non-workdays. This flexibility is enabled by the fact that they are probably not the main person in charge of the care giving duties. The results indicate that women are more constrained than men during workdays maybe because of the fact that they interweave work and in-house tasks during those days leading them to postpone some out of home activities to non-workdays.

The non-workday geographies for workers that live in household with more than one adult are said to be 4 times more likely than their counterparts that have only one adult in their house-

holds to have similar to or larger than their workday geographies. Households with more than one adult might probably be sharing in-home household tasks during non-workdays enabling to visit larger geographies during those days.

As household income increases, the likelihood to have larger or similarly sized non-workday geographies decreases by (0.17 times). This may be explained by the fact that richer people have more flexibility during workdays which enable them to cover larger geographies during those days. During workdays, they are even able to hire nanny or maids to help them with in-home tasks.

### **Transportation variables**

The model also proposes that after controlling for other variables in the model, on average getting to work by transit than by other modes decreases the likelihood to have larger or similarly sized non-workday geographies ( by 0.44 times). That result may be because people who use transit to work may have no vehicle which limit their mobility even during non-workdays.

### **Activity and work variables**

After controlling for many other variables in the model, the model suggests that one unit increases in the average in-home activity duration during workdays has no effect on the interdependence of non-workday and workday geographies. This may be due to the limited sample size.

## Location and other variables

The modeling work shows no relation between home to work distance and the interconnection between non-workday and workday areas.

Other variables that were also included in the model are age, education levels, home area population density and home tract transit accessibility. None of them was significant or improves the model, or they correlate with other variables. Thus they were dropped from the model.

### 4.5.2 Two-Day Travel Diary Data Model

The modeling efforts using the two-day CMAP survey data tested how work constraints affect the geography of workday and non-workday for different gender groups and other subgroups. The main goal is to assess the intra-personal variation in the workday and non-workday geographies caused by the work constraint using a larger data set than the GPS data. Three models are estimated for that purpose: 1) the natural log of the ratio of non-workday to workday areas for the same worker, 2) the natural log of workday area, and 3) the natural log of non-workday area. The  $R^2$  values of the three models are 0.141, 0.181, and 0.215 respectively. The results are available in Table VI

## Gender

The results suggest that women with children under 18 with other adults in the household are not different from their counterparts related to workday, non-workday, and ratio of non-workday to workday areas. However, women with children under 18 with no other adult in the household (defined as female headed with children in model) are likely to have larger workday

area and smaller non-workday area than their counterparts when other factors are held constant. The same individuals are also likely to have larger workday area compare to their non-workday area. It is possible that workday geographies are larger for a number of reasons. First many workdays may coincide with school days, and there may be slightly more flexibility for these women to under take other mandatory household tasks that may expand the area. On non-workdays, demands of care taking of children may limit larger geographies. The model also indicates that the larger geographies for this group is not a result of longer commutes. In fact for those among the female heads with longer commutes, workday areas get smaller with increasing distance. This seems to support the idea that multitasking during workdays may be the reason for the larger geographies on average. These results imply that women with children and no other adult in the household are likely to have a little more flexibility during workdays when they have shorter commutes but are likely to be constrained when they commute are longer.

### **Home to Work Distance**

Overall and contrary to women with children and no other adult in the household, an increase in the home to work distance is associated with an increase in the workday area. More precisely, individuals that commute longer distance are likely to have larger workday area compare to their non-workdays.

### **Individual and household Characteristics**

Race appears to be associated with the geographies measured. On average, white respondents have larger workday and non-workday geographies than non-whites. This may reflect

differing settlement patterns for Whites relative to places of work from non-whites on workdays and a propensity to cover larger areas or undertake more travel on non-workdays. Using the geography size as a measure of constraints, this suggests white respondents are less constrained than non-whites during both work and non-work days. People in low income households are likely to have smaller workday area than middle and high income household individuals. As a result, the ratio of their non-workday areas to workday areas is also larger as compared to other groups. This may reflect a number of constraints on poor households on finding jobs from a wider geography, including constraints on mobility options, travel expenses, and time constraints to undertake long commutes when household pressures that demand proximity may be present. Workers living in household with more than one adult are likely to have smaller non-workday area than worker living in one adult-household. These households are likely to have larger workday area compare to their non-workday area. This finding suggests that having other adults in the households that can help give more flexibility to those people during workdays and probably reduce their travel needs during non-workdays. However, the modeling efforts also propose that no matter if there are other adults in the households to help that longer commute can be constraining and limit the reachable opportunities during workdays. For instance, as home to work distance increases these workers with other adults in the households are likely to have smaller geographies during workday compared to their non-workdays.

## **Employment**

People with flexible work are most likely to have larger workday and smaller non-workday geographies than people who have non-flexible work schedule. They are also probably going to

have larger workday area compare to their non-workday area. Though, workers with flexible work schedule that live with other adults are likely to have bigger non-workday area than the ones living with no other adults. In addition, those workers are likely to have larger non-workday area compare to workday area than the workers living with no other adults. These results denote that having flexible work schedule reduces workday constraints. It also stress that work flexibility and the help of other adults can reduce constraints during both work and non-work days.

### **Activity Duration**

A surprising result is that the time spent inside home during workday is associated with decrease in non-workday area but not workday area. This may insinuate that those people may also be busy inside their home during non-workdays. Or alternatively, that they have a preference for spending time at home when the opportunity is present. The models also propose that people living with more than one adult are likely to have larger non-workday area with increase in time spent inside the home during workday than workers who are the only adults in their houses. These workers have larger non-workday area than workday area. One explanation of these findings is that people who are called to spend more time inside their home during workdays which limit the time they can spend on other outside activities during those days can some flexibility during non-workdays with the help of other adults. Time spent inside home during non-workday is linked to decrease in workday and non-workday areas. As the time spent inside home during non-workday increases, the non-workday area is likely to be smaller than the workday area. This result is as expected. Those people that are constrained to stay home

during non-workdays for a long duration of time are likely bounded to in home tasks during their workdays as well that confined the geographies of both days with greater effects on the geography of non-workday.

### **Transportation**

The availability of vehicle for work is associated with larger workday area. When vehicle is available for work the person is likely to have larger workday geography compare to her non-workday geography. This not unexpected because the greater flexibility given by the private mode can partly help with the time-space constraints and enable access to other opportunities during workday. Workers with flexible work schedule that have vehicle available for work are likely to have bigger workday area than non-workday area than the workers that do not have flexible work and no access to vehicle for work. Vehicle availability and flexible work both increase flexibility and reduce people's space-time constraints. People with license are likely to have larger non-workday area than the ones that do not have license. Their non-workday area are also larger than their workday area in relative terms when compared to others. Workday geographies do not appear to be affected by having a license as both those with and without a license find ways to reach their places of employment. However, on non-workdays, those with licenses may be able to travel further if an automobile is available to them. It suggests that the lack of a driving license may constraint travel to other activities during non-workdays.

TABLE I: On-Person GPS and CMAP Region Population Characteristics

	On-Person GPS Data	CMAP Region Census Data
<b>Household Size</b>		
1	16.9%	26.4%
2	24.7%	28.7%
3	20.8%	16.2%
4+	37.6%	28.9%
<b>Household Vehicles</b>		
0	10.4%	14.3%
1	31.2%	36.3%
2	44.2%	36.1%
3+	14.2%	13.3%
<b>Household Income</b>		
<\$20K	9.5%	16.9%
\$20K-<\$35K	5.4%	15.7%
\$35K-<\$50K	2.7%	15.3%
\$50K-<\$75K	21.6%	20.9%
\$75K-<\$100K	24.3%	12.9%
\$100K+	36.5%	18.3%
<b>Race &amp; Ethnicity</b>		
White	81.8%	65.5%
Black/African American	11.7%	18.9%
Other race	6.5%	15.6%
Hispanic	3.9%	17.2%
<b>Age</b>		
<20-24	40.4%	36.2%
25-54	50.0%	45.1%
55-64	8.7%	8.0%
65+	0.9%	10.7%

TABLE II: Sample Characteristics of Total Sample Percent by Gender

Variable	GPS Data		Two-Day Data	
	Women	Men	Women	Men
Sample Size	47.3%	52.7%	50.7%	49.3%
White	21.4%	25.9%	25.2%	20.7%
Women with Children under 18	29.5%	NA	16.9%	NA
Women with Children under 18 and no other Adult	0.0%	NA	1.6%	NA
Household with more than one Adult	37.5%	49.1%	40.3%	42.8%
Low Income Household	2.7%	2.7%	2.5%	1.8%
Education Level:High School	4.5%	2.7%	6.7%	5.7%
Education Level: Some College	2.7%	7.1%	6.4%	6.2%
Education Level: Any Degree	40.2%	42.9%	48.2%	46.6%
Student	5.4%	0.9%	4.5%	2.9%
Part Time Worker	12.5%	2.7%	13.5%	6.0%
Multiple Job Holder	7.1%	6.3%	6.0%	3.9%
Works at Home	6.3%	6.3%	3.8%	4.4%
Telework	8.0%	15.2%	6.4%	8.5%
No Flexibility at Work	13.4%	12.5%	16.3%	15.2%
Very Flexible Work	8.9%	11.6%	12.1%	10.6%
Home Owner	38.4%	47.3%	44.4%	41.6%
Driver License Holder	45.5%	51.8%	48.0%	47.2%
Vehicle Available for Work	8.9%	14.3%	10.7%	12.8%
Use Auto for Work	25.0%	25.9%	35.9%	32.7%
Use Transit for Work	14.3%	18.8%	6.3%	8.9%
NA = Not Applicable				

TABLE III: Sample Characteristics of Mean of Total Sample by Gender

	<b>Women</b>	<b>Men</b>	<b>Difference</b>	
<b>GPS Data</b>				
Age	43.7	44.6	-1.0	
Household Income	\$88,333	\$91,071	-\$2,738	
Household Vehicles	1.6	1.9	-0.3	*
Household Size	3.2	3.2	0.0	
Household Workers	1.9	1.9	-0.1	
Household Student	1.4	1.2	0.2	
Number of Household licensed drivers	1.8	2.1	-0.2	**
Household Children Under 18	1.3	1.1	0.2	
Household Children Under 12	0.8	0.6	0.2	
Work Days	4.6	5.0	-0.4	**
<b>Two-Day Data</b>				
Age	49.0	47.3	1.7	**
Household Income	\$56,729	\$57,329	-\$600	
Household Vehicles	1.9	2.0	-0.1	*
Household Size	2.6	2.9	-0.2	***
Household Workers	1.9	1.8	0.0	
Household Student	0.7	0.8	-0.1	
Number of Household licensed drivers	2.0	2.0	-0.1	*
Household Children Under 18	0.6	0.7	-0.1	***
Household Children Under 12	0.4	0.5	-0.1	***
Work Days	4.2	4.6	-0.4	***
*** significant at 0.01 level, ** significant at 0.05 level, * significant at 0.1 level				

TABLE IV: Gender Difference in Workday and Non-Workday Activity Space Areas and Contributing Factors

	Workdays				Non-Workdays		
Variable	Women	Men	Difference		Women	Men	Difference
<b>GPS Data</b>							
Average Daily Areas	21.3	60.0	-38.7	***	36.7	29.3	7.4
In-Home Activity Duration	865.5	682.7	182.8	*	738.9	676.2	62.7
Home to Work Distance	7.1	12.1	-5.0	***	NA	NA	NA
<b>Two-Day Data</b>							
Average Daily Areas	14.5	21.9	-7.4	***	14.3	15.0	-0.7
In-Home Activity Duration	839.4	777.9	61.5	***	1122.7	1132.3	-9.6
Home to Work Distance	7.5	10.2	-2.7	***	NA	NA	NA
*** significant at 0.01 level, ** significant at 0.05 level, * significant at 0.1 level, NA not applicable							

TABLE V: GPS Data Ordered Logistic Regression Models for Ratio of Non-Workday to Workday Areas

Variable	Estimate	Exp	
Intercept 1	-0.410	0.664	
Intercept 2	-1.372	0.253	
women no children	3.413	30.356	***
women with children under 12	1.122	3.072	*
men no children	0.371	1.449	
men with children under 12	0.935	2.548	
household with more than one adult	1.443	4.234	*
household income	-1.753	0.173	**
use transit to work	-0.812	0.444	*
home activity duration during workdays	0.229	1.257	
home distance to downtown	-0.158	0.854	
R-Square	0.273		
Max-rescaled R-Square	0.315		
*** p≤0.01; ** p≤0.05; *p≤0.1			

TABLE VI: Two-Day Data OLS Regression Models of Activity Areas

[illegible]

#### 4.6 Conclusion

The primary purpose of this part of the dissertation is to update gender related policies on gendered travel behavior beyond gender difference in commute distances. The objective is to separate non-workday from workday geographies and to determine the interdependence between the two for the same individuals. The reshaping of geography framework is used to figure out how geographies are gendered when work and in-home tasks are intertwined. For this analysis, I assume larger non-workday compare to workday geographies signifies more flexibility when work constraints are removed. The results suggest that women are more likely than men to have similar or larger non-workday geographies compared to workday geographies because they are more constraints during workdays due to the fact that they have to be both at work and at home to perform in home tasks, a reason why they probably work close to home. Longer commute is proved to add to women constraints and to restrict their workday geographies. Thus, to balance their work, in-home, and all other out of home activities during the week, they probably postpone most of their out of home activities that can wait until non-workdays. Women with children under 12 years old (or women with children above 12 years old) are less likely to have similar or larger geographies during non-workdays compare to workdays than others because they are also constraints during those days taking care of the kids and doing in-home tasks. Thus, women with children under and above age 12 have probably less flexibility both during workdays and non-workdays.

People with higher household income are less likely to have similar or larger non-workday geographies maybe because they are less constrained during workdays after work to conduct

some other activities. They probably have more flexibility because they can even hire people to help them in their homes. They do not need to travel a lot during non-workdays unless they choose to. People who get to work by transit are less likely to have similar or larger non-workday geographies compare to workdays because they may have not have automobile, a more flexible mode, hindering their mobility and limiting their movements during non-workdays when they are not require to engage in activities such as work.

People with higher average in-home activity duration during workdays have probably also more in-home tasks during non-workdays limiting their movement during those days as well. People living close to downtown are less likely to have larger or similar size non-workday geographies probably because they many opportunities close to their home reducing the need for travel during non-workdays.

Overall, gender sensitive policies are still needed that can give more flexibility to women especially to women who work and have children under 12 years old in their households. This can help them balance work, in-home tasks, and other activities during the week. Making sure that they have vehicle available for work and for all out of home activities may be helpful. Giving them more flexibility at work may also be useful. Making sure that they are sharing household tasks with other adults may be promising in enhancing their lives and their work-life balance.

It is important to note that these results are not generalizable to the population of the metropolitan Chicago because the CMAP GPS dataset was not a random sample both in its targeting and the final profile of participants. Moreover, weights were not used to address the

sampling limitation in this analysis. The analysis highlights the types of day to day variations in geography that participants, given their socio-demographic characteristics and constraints, made over the period of observation.

## CHAPTER 5

### HOUSEHOLD TRANSPORTATION EXPENDITURES DURING THE GREAT RECESSION

#### 5.1 Introduction

The last economic recession in the United States began in 2007 and lasted through 2009 (145). Its effects were disastrous for many families leading to unemployment, home foreclosures, and the fact that it dragged many people into a credit dilemma that caused them to lose many of their assets. Nationally, the unemployment rate rose to 10 percent while the home foreclosures reached over 2.3 million in 2008 (81 percent more than in 2007) and to 2.8 million in 2009 and 2010 (146; 147; 148).

Even though the recession impacted nearly everyone, its impact on female householders (e.g. single mothers) related to unemployment, insecurity and hardship has been significant. During the great recession, 80 percent of single mothers reduced their family spending while 72 percent of all women and 57 percent of all men cut down expenses (43). In addition, one half of single mothers assert that at least one person was unemployed in their household during the last recession (43).

The great recession also impacted the sale of vehicles and people's ability to make their monthly car payments (149). Car sales decreased by almost 2 million units (150). The number of car repossessed in 2008 was fifteen percent higher than in 2007 (149). These impacts might

also have been felt in overall transportation spending, which besides vehicle purchasing, also include significant ownership, and operating costs (24).

The objective of this chapter is to undertake an empirical assessment of the impacts of the recession on the transportation spending distribution of households during the great recession with a special focus on female-headed households. I also examine the different factors which contribute to variations in transportation spending such as vehicle purchases, ownership and operating costs, public transportation costs, age, family size, race, education level, income, employment, housing tenure, and gasoline prices. It looks beyond the average spending to assess more robust measures of transportation spending at different quartiles. The goal of this work is to contribute to the gender and transport research by conducting an in-depth economic analysis of travel before and during the recession.

## **5.2   Data**

Data for this work comes from the Consumer Expenditure Survey (CEX) conducted by the U.S. Bureau of Labor Statistics (BLS). The CEX survey collects detailed information on household income, expenditures, assets, and demographic variables over 5 successive quarters. In addition, retail gasoline prices (151) along with data on gasoline taxes (152) are merged to the CEX data by state. While aggregated state gasoline prices may often differ from the prices at lower geographies such as city or neighborhood, such data are not readily available. Further details of the CEX survey is given next.

## **Description of CEX Survey Design and Limitation**

This analysis uses the consumer expenditures survey (CEX) data for the interview years of 2005 to 2015. It includes data obtained from interviewing households from the first quarter of 2005 to the first quarter of 2015. Normally in the CEX, each household is interviewed during 5 consecutive quarters but the first quarter is just to obtain socio-demographic and socio-economic information for the households and the last 4 quarters ask them to report their diverse expenditures and updated their socio-demographic and socio-economic status. Due to imperfection in the data collection as in any other survey, some households have less than 4 quarters of data due to skipping interviews or due to the fact they moved from the sampling locations. The CEX survey is designed in a way that new households enter the survey process every month for 5 consecutive quarters. Therefore, depending on which month the households enter the survey process, their year worth of data may spanned two calendar years. During each of their last 4 quarters of interview, households are asked to report on their expenditures for the last three months prior to the month of their interview. By gathering information over four quarters, a year's worth of expenditure data for the household is collected.

Depending on the month the household enter the interview process, the four quarters of reported expenditure time frame may not correspond (and would not usually be the same) as the calendar year (January to December of Year X). The time frame for the four quarters of reported expenditures of households may span two calendar years. To adopt the rotating sample design with different expenditure time frame of households to the traditional calendar period, the Bureau of Labor Statistics (BLS) divided each quarter of expenditure reported

by the household among two variables they created to facilitate the allocation of household expenditures to calendar period. The first variable starts with the expenditure name and ends with (PQ) for previous calendar quarter. The second variable also starts with the expenditure name and ends with (CQ) for current calendar quarter. Thus, adding the PQ and CQ of each expenditure category yields the quarterly expenditure of the household.

With the CEX survey design in mind and thorough understanding of its limitation, the PQ and CQ expenditure categories were added to yield the quarterly expenditure of the household for each category. Average monthly expenditures were then computed by dividing by three. Based on the month of their interviews, we assigned the monthly expenditures to the exact calendar month and year they occur. Each row (record) in the initial dataset corresponded to a month of expenditure data for a specific household. Thus, each household had initially 12 records (12 months) of expenditure data with known calendar month and year when they happened. All monthly expenditures were adjusted to 2011 dollar values based on the calendar year the expenditures occurred. Due to the nature of the survey design and the goal of our analysis, we identify in the dataset the monthly expenditure data that happened before recession, during recession, and after recession. We considered the recession to have started on December 2007 and ended in June 2009. Monthly expenditures that happened prior to 2005 up to November 2007 are assigned to pre-recession monthly expenditures. Monthly expenditures that happened from December 2007 to June 2009 are considered recession period monthly expenditures. Monthly expenditures that happened from July 2009 to 2015 are post-

recession expenditures. In addition, the number of months of data per households in each period (pre-recession, recession, and post-recession) are determined.

Considering each period (pre-recession, recession, and post-recession) separately, the adjusted monthly expenditures were then averaged per household to get the average expenditures per household per period (with one row of expenditures per household). The same household may have average monthly adjusted expenditures in two periods (pre-recession and recession) or (recession and post-recession). The average monthly adjusted expenditures were converted to yearly adjusted expenditures by multiplying them by 12. Further, a subset of the data is obtained that considers only households whose yearly adjusted expenditures were obtained from the average of 6 months or more of expenditure data in each period. This subset gives more confidence about the yearly adjusted expenditures and reduced the possibility of households appearing twice in the final data. The other variables that were not expenditure variables such as yearly income, age, number of vehicles were averaged per household and merged to the yearly adjusted expenditures. The most probable status of the categorical variables along with other fixed categorical variables such as marital status and urban/rural reported during the 4 quarterly interviews are also chosen and merged with the yearly adjusted expenditure data. Households with negative expenditures and income are deleted from the final subset. Households with zero total expenditures are also eliminated.

### **5.3 Research Method**

As mentioned previously, the goal of this chapter is to analyze the heterogeneous effects of the great recession on transportation spending distribution and to assess any difference between

women and men. This is done by comparing the magnitude of the change in transportation spending during the recession at higher tail (50th, 75th, 90th percentiles) to lower tail (10th and 25th percentiles) of the distribution with a focus on female-headed households. This research is a household level study. Even though all types of households are included, the households of interest are female-headed households which are defined as households with at least two members that are maintained by a female householder (153). The major contributing factors on the distribution of transportation spending are examined such as purchasing, owning, and operating a vehicle, age, family size, number of children, race, ethnicity, education level, housing tenure, income status, receiving welfare, employment, household locations, and gasoline prices.

All dollar values used in this work are expressed in 2011 values. The final sample size is 34,478 households where 6.5% are female-headed households, 4.0% are female-headed households with children, 20.7% are low income households with income below or at 150% of poverty line, 12.3% are Hispanic Households, 22.5% have householders with education at the high school level, 65.1% have householders with greater than high school, 40.0% lost at least a worker, 8.0% purchase a vehicle during their reporting period, and 10.8% are zero vehicle households. In contrast, female-headed households with children are poorer, have lower education levels, and more likely to have no vehicles. For instance, 45.6% are low income households with income below or at 150% of poverty line, 16.9% are Hispanic Households, 27.6% have householders with high school, 58.7% have householders with greater than high school, 43.3% lost at least a worker, 12.1% purchase a vehicle during their reporting period, and 16.0% are zero vehicle households. These and other statistics are summarized in Table VII below.

Additional sample characteristics provided in Table VII show the 10th, 25th, 50th, 75th, and 90th percentile values for income, transportation expenditures for all households, transportation expenditures for zero vehicle households, transportation expenditures for non-zero vehicle households, gas prices, age of householders, number of children, and number of vehicles for all households as well as separated by female-headed households and female-headed households with children. The values demonstrate the variability in the data as well as the lower economic status of female-headed households, especially female-headed households with children. It also shows how owning a vehicle has a significant effect on transportation spending.

TABLE VII: Sample Characteristics by Percentiles

	All Household Percentile					Female-Headed Household Percentile					Female-Headed Household with Children Percentile				
Variable	10th	25th	50th	75th	90th	10th	25th	50th	75th	90th	10th	25th	50th	75th	90th
Yearly income (2011 dollar)	13852.474	27009.712	51672.200	90687.340	143228.415	14202.010	23409.826	37957.488	62170.867	94735.212	12226.251	19404.749	30682.345	48227.590	76482.001
Total transportation expenditures (2011 dollar)	1015.969	2719.343	5464.053	10359.227	23269.103	1232.705	2702.525	4593.128	8373.501	17831.819	864.566	2258.439	4024.924	7039.693	14600.413
Zero vehicle household total transportation expenditures (2011 dollar)	0.000	0.000	363.374	1323.178	3052.381	0.000	281.746	742.421	1425.136	3417.671	0.000	274.702	742.421	1396.204	3273.229
Non-zero vehicle household total transportation expenditures (2011 dollar)	2002.954	3424.334	6167.704	11355.671	25542.259	2162.224	3269.771	5225.094	9146.759	19387.100	2032.223	3013.111	4592.704	7852.268	16798.685
Gas prices (2011 dollar)	2.560	2.719	2.957	3.245	3.445	2.560	2.714	2.957	3.200	3.445	2.560	2.714	2.957	3.200	3.445
Age of the householders	27.000	36.000	48.000	61.250	74.500	28.000	34.250	44.583	57.750	65.750	26.333	31.000	37.250	44.250	50.500
Number of Children	0.000	0.000	0.000	1.000	2.000	0.000	0.000	1.000	2.000	3.000	1.000	1.000	1.750	2.000	3.000
Number of vehicles	0.000	1.000	2.000	2.500	4.000	0.000	1.000	1.000	2.000	3.000	0.000	1.000	1.000	1.500	2.000
Variable	All Percentiles														
Percent of female-headed households	6.540														
Percent of female-headed households with children	4.000					61.080					100.000				
Percent of householders with income $\leq$ 150% of poverty line	20.650					31.470					45.570				
Percent of Hispanic householders	12.260					13.740					16.910				
Percent of households with education level at (High school = 1)	22.510					25.840					27.580				
Percent of households with education level at (Abv. high school = 1)	65.140					62.810					58.710				
Percent of households who lost at least one worker	40.010					39.670					43.250				
Percent of households that purchase at least a vehicle during their reporting year	8.030					9.800					12.050				
Percent of zero vehicle households	10.800					11.570					16.040				

As mentioned previously, the recession exacerbated the poor economic conditions of families managed by women (43). Further, transportation and the economy are interrelated (49; 54) and impacts on transportation spending may indicate reduced mobility and activity participation with consequences on quality of life. The importance of car ownership for women and women with children as well as the gender difference in spending is widely known in the gender literature (138; 136; 30; 139; 35; 137; 135).

The summary statistics of transportation spending and its components (purchasing and ownership, operating, and public transportation spending) at 10th, 25th, 50th, 75th, and 90th for the before recession period separate from during recession period are obtained. This summary is highlighted in Table VIII. These statistics help assess the major transportation components that contributed to the change in transportation spending.

Summaries of transportation spending for different population subgroups before and during the recession are provided in Table Table VIII. These summary statistics demonstrate a decrease in transportation spending at higher percentiles (75th and 90th) by \$548.3 and \$4181.0 while it increased slightly at lower percentiles (10th, 25th, and 50th) by \$93.6, \$120.6, \$62.9. Further summaries in Table Table VIII show that the decline at higher percentiles can be explained by a decline in vehicle purchasing and ownership costs. Vehicle purchasing and ownership expenditures dropped by \$571.9 and \$5710.2 for the 75th and 90th percentiles while they were constant with a difference of \$0, decreased by \$14.4 and \$95.5 at the 10th, 25th, and 50th percentiles respectively. On the other hand, vehicle operating and public transportation either increase during the recession or their reduction were minimal. Similar patterns are ob-

served when considering female-headed household and female-headed household with children subgroups. However, female-headed households are spending less than for their counterparts. Female-headed households with children were spending less than other female-headed households.

TABLE VIII: Transportation Spending Component Before and During the Recession in 2011 Dollar Values

Spending Component	All Household Percentile					Female-Headed Household Percentile					Female-Headed Household with Children Percentile				
	10th	25th	50th	75th	90th	10th	25th	50th	75th	90th	10th	25th	50th	75th	90th
<b>Total Transportation</b>															
Before Recession	980.514	2669.284	5441.166	10548.909	24725.893	1189.693	2655.956	4498.886	8573.661	18977.964	810.020	2148.874	3905.007	6770.563	15833.111
During Recession	1074.156	2789.916	5504.024	10000.612	20544.927	1431.227	2734.326	4794.872	8117.619	14756.281	998.462	2500.706	4278.112	7409.016	13441.996
Difference	<b>93.642</b>	<b>120.632</b>	<b>62.858</b>	<b>-548.297</b>	<b>-4180.966</b>	<b>241.534</b>	<b>78.371</b>	<b>295.985</b>	<b>-456.042</b>	<b>-4221.683</b>	<b>188.442</b>	<b>351.832</b>	<b>373.104</b>	<b>638.454</b>	<b>-2391.116</b>
<b>Vehicle Purchasing and Ownership</b>															
Before Recession	0.000	505.342	1600.662	4112.144	18591.461	0.000	425.121	1438.972	3224.780	14432.648	0.000	208.020	1174.449	2700.803	11308.754
During Recession	0.000	490.972	1505.194	3540.251	12881.274	0.000	421.785	1352.069	3001.964	7463.774	0.000	182.886	1088.171	2879.679	7152.382
Difference	<b>0.000</b>	<b>-14.370</b>	<b>-95.468</b>	<b>-571.894</b>	<b>-5710.188</b>	<b>0.000</b>	<b>-3.337</b>	<b>-86.903</b>	<b>-222.816</b>	<b>-6968.873</b>	<b>0.000</b>	<b>-25.134</b>	<b>-86.278</b>	<b>178.877</b>	<b>-4156.372</b>
<b>Vehicle Operating</b>															
Before Recession	383.073	1462.036	2791.251	4596.565	6784.415	632.580	1471.948	2447.277	3746.377	5656.098	40.450	1257.201	2110.440	3227.953	4611.074
During Recession	472.944	1544.885	2973.676	4898.746	7123.818	787.031	1670.767	2695.449	4083.708	6246.199	647.158	1493.097	2408.926	3808.920	5282.464
Difference	<b>89.870</b>	<b>82.849</b>	<b>182.425</b>	<b>302.180</b>	<b>339.402</b>	<b>154.452</b>	<b>198.819</b>	<b>248.172</b>	<b>337.331</b>	<b>590.101</b>	<b>606.708</b>	<b>235.896</b>	<b>298.486</b>	<b>580.967</b>	<b>671.390</b>
<b>Public Transportation</b>															
Before Recession	0.000	0.000	0.000	439.631	1831.792	0.000	0.000	0.000	281.746	1344.163	0.000	0.000	0.000	137.131	913.326
During Recession	0.000	0.000	0.000	396.705	1784.996	0.000	0.000	0.000	260.640	1476.959	0.000	0.000	0.000	97.740	1303.199
Difference	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>-42.926</b>	<b>-46.796</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>-21.106</b>	<b>132.796</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>-39.391</b>	<b>389.872</b>

After obtaining the sample characteristics and summary statistics, quantile regression models are estimated for the conditional value of transportation spending at the 10th, 25th, 50th, 75th, and 90th percentiles. For the gender component, poor female-headed household with children and non-poor female-headed household with children dummies are kept because their better fits than other gender dummies that were tested. These effects are tested while also controlling for race, economic status, age, household children, education level, employment status, vehicle purchasing during period under consideration, and vehicle ownership. The general formula of the multivariate quantile regressions is as follows:

$$Q_{yi} < \tau / X = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \cdots + \beta_k X_{ki} + F_u^{-1}(\tau) \text{ With}$$

$Q_{yi}$  = conditional value of transportation spending given where represents the quantile value of interest (in this case the 10th, 25th, 50th, 75th, and 90th percentiles)

$\beta_0$  = intercept

$\beta_0 - \beta_k$  = parameters to be estimated

$X_1 - X_k$  = variables (subgroups, recession, interaction with subgroups, household characteristics, employment, housing, location, and transportation)

$F_u$  = common distribution function of the error given  $\tau$

An OLS model (multivariate linear regression model) is also estimated using the same predictive variables as in the quantile regressions. Model results are shown in Table IX. The effect of different covariates on the log of transportation expenditures is shown in Figure 3.

## 5.4 Model Results and Discussions

Overall, the results from the model support the hypothesis that there exists gender differences in transportation spending over all period. However, the modeling efforts show no evidence of a larger gender gap in transportation spending during the recession. The transportation spending of other subgroups such as low income and Hispanic households were also significantly different than their counterparts. In addition, the findings suggest that the great recession significantly impacted the transportation spending distribution for all households. The analysis approach illustrates the strength of using quantile regressions to show the magnitude of the difference and impact along the spending distribution on both sides of the mean. Overall, the models have a reasonable goodness of fit with r square of 0.555 for the OLS model and pseudo- $r^2$  values of 0.285, 0.155, 0.276, 0.253, 0.233 at the 10th, 25th, 50th, 75th, and 90th percentiles respectively for the quantile models. The findings from the quantile and OLS regression separated for different variable groups are summarized below.

### **All Households during the Recession**

The quantile regression model results in Table IX and the quantile plots in Figure 3 demonstrate support for the hypothesis that the great recession was associated with a more pronounced reduction in the transportation spending at the higher percentiles than at the lower percentiles which is not observable from the traditional OLS model. The recession was significantly associated with lower transportation spending for all percentiles but the association was progressively more robust at the higher percentiles. For instance, during the recession transportation spending is reduced by 5.4% ( $p < 0.001$ ), 3.7% ( $p < 0.05$ ), 6.5% ( $p < 0.001$ ), 9.7% ( $p < 0.001$ ), and 15.3%

( $p < 0.001$ ) for the 10th, 25th, 50th, 75th, and 90th percentiles respectively. On the other hand, the OLS model propose a reduction by 9.5% ( $p < 0.001$ ). The quantile regression results show the heterogeneous effects of the great recession along the transportation spending distribution which is also evident in Figure 3. While one interpretation of these results may suggest that the economic downturns may have altered spending of households with high level of transportation expenditures than the ones with low transportation expenditures, it is possible that much of these reduction were a result of limiting discretionary transportation spending. At the lower tail on the other hand, it is possible that even in the absence of the recession, spending levels might have been severely constrained to essential expenditures alone.

#### **Low, Middle and High Income Female-Headed Households with Children**

The modeling efforts highlighted in Table IX propose that low income female-headed households with children were spending 37.3% (OLS), 17.2% Q(25th), and 15.3% Q(50th) more on transportation than other low income households. These results show the importance of transportation for low income female-headed households because despite their low economic status they spent more on transportation than their poor counterparts. A comparison of low income female-headed households with middle/high income female-headed households shows lower spending levels of the former compare to the latter. Middle and high income female-headed households were also spending less than other households as demonstrated in the same Table IX for all models except the 90th percentile. Clearly, the quantile regressions help demonstrate the heterogeneity in transportation spending by gender along the spending distribution.

The effect of the recession on low, middle and high income female-headed households with children was tested in other models not presented in this manuscript. Interaction terms of low income female-headed household with children, middle and high income female-headed household with children and the recession term was insignificant. Thus, the gap between female-headed households with children and their counterparts was not wider during the recession than in normal time. This may be explained by the fact that female-headed households with children were already spending on mandatory transportation and had no possibility to cut down spending during the recession.

### **Low-Income Households**

Households with income at and below 150 percent of poverty threshold were spending less in transportation than their counterparts for all percentiles. However, this disproportion was intense at the 90 percentile than other percentiles of the transportation spending distribution which is even graphically visible in Figure 3. Low income households spent 42.0-45.1% less than their counterparts based on the quantile regressions. This difference was even higher based on the OLS model (50.7%). In other models not presented in this thesis, the interaction between low income households and the recession was not significant. Therefore, the economic downturn did not accentuate the discrepancies between low-income households and their counterparts related to transportation spending. This may be because those households were already spending only on mandatory transportation spending and no opportunity to cut down spending.

## **Hispanic Households**

The modeling results suggest that Hispanic households spent significantly more than their counterparts at lower tail than higher tail of the transportation spending distribution from 20.1-8.0%. The OLS model proposes that Hispanics were spending 25.6% more than non-Hispanic in transportation overall. The impact of the recession was tested for this subgroup in other models not illustrated here by adding the interaction of recession and Hispanic. Though, that interaction was insignificant. The fact that Hispanic were spending more than non-Hispanic was a surprising result but stressed the importance of mobility for them.

## **Householder or Household Characteristics**

The quantile regressions suggest that as the age of the householder increases transportation spending increased for all percentiles by 3.8-1.5% up to peak ages of 44-31. After the peak age, a unit increase in age is associated with a decrease in transportation spending. The OLS results argue that a unit increase in age is associated with 4.1% increase in transportation spending up to the peak age of 39 after which a unit increase in age is associated with a decrease in spending. This implies that people are willing to spend on transportation up age 44 after which the need or willingness to invest in transportation decreases.

A unit increase in the number of children is associated with 7.9-9.2% increase in transportation spending at the different percentiles. The OLS model suggests that a unit increase in the number of children is linked 7.6% increase in transportation spending. According to this finding, the presence of kids in the household is likely to create a demand for more flexible

and expensive transportation. The travel needs of family become higher with kids and reliable transportation become more important.

The effect of education was to increase expenditures at the different quantiles observed. As compared to those with no high school degrees, high school graduates had expenditures that were between 7.1-16.0% higher, and those with more than a high school degree had expenditures that were in the range of 27.1-42.8% higher, depending on the quantile being observed. Figure 3 shows a visual of these results. The OLS model states that householders with high school and above high school spent 22.3% and 54.5% more in transportation spending than their counterparts. These results may be related to the fact higher educated people can for the most part afford to pay for flexible transportation than people that are not educated or with lower education.

### **Welfare Recipients**

Households that receive welfare spend less on transportation considerably (17.1% to 9.7% at different quantiles) than the ones that do not receive welfare. The OLS regression suggests a difference of 15.3%. The findings suggest that households that receive government subsidies need further transportation subsidies. However, the findings may in part be a reflection of significant curtailment of activities by these households.

### **Employment**

Households that lost at least a worker spent less on transportation than the ones that did not for all percentiles except the 90th percentile but to a greater degree at lower tail of the spending distribution. A graphical representation of these findings is available in Figure 3. The

OLS model supported the quantile regression findings. One explanation of these results may be that being unemployed reduce the need for travel to work and eventually reduce the daily travel costs. It is important to note that this type of expenditure reduction is not desired. Individuals would likely be better off having a job and having to spend more on transportation than losing a job resulting in spending less on transportation. Another justification may be that those households confined their travel to necessary only due to the lack of income sources and financial uncertainty. The worse case scenario may be that those households lose their leased and financed vehicles which cut down their transportation spending.

### **Transportation**

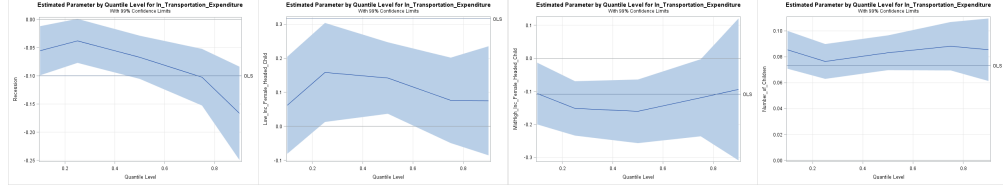
Households who purchase a vehicle during their reporting year have higher transportation costs than their counterparts for all percentiles but the differences are larger at higher percentiles than lower percentiles by 19.3-56.9% depending on the percentiles. On the other hand, households with no vehicle were paying a lot less in transportation than households with at least a vehicle for all percentiles but to a greater extent at the lower tail than the higher tail of the distribution by 99.9-55.0%. A unit increase in the number of vehicles increases transportation spending by 33.0-49.4%. Moreover, as gasoline prices increase by a unit transportation costs increase for all percentiles by 9.5-12.0%. All these patterns are also easily seen in Figure 3.

Similarly, the OLS model suggests that household who purchased a vehicle during their reporting year spent 28.1% more in transportation than the ones that did not. It also proposes that households with no vehicle are spending 93.6% less than households with at least a vehicle. A unit increase in the number of vehicles increases transportation spending by 37.8% based on

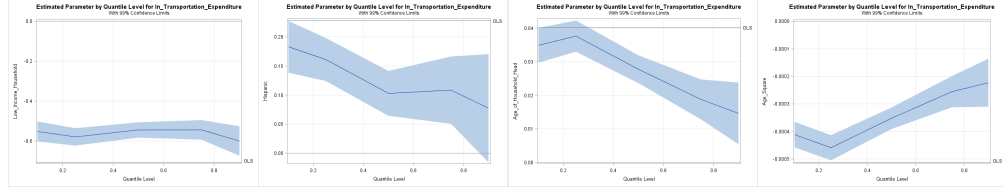
the OLS model. A unit increase in gas prices increases transportation spending by 15.2% ( $p < 0.001$ ) according to the OLS model. Clearly, all these vehicle ownership and operating variables demonstrate that vehicle ownership and operating make the bulk of transportation spending.

TABLE IX: Quantile and OLS Regressions of Transportation Expenditures

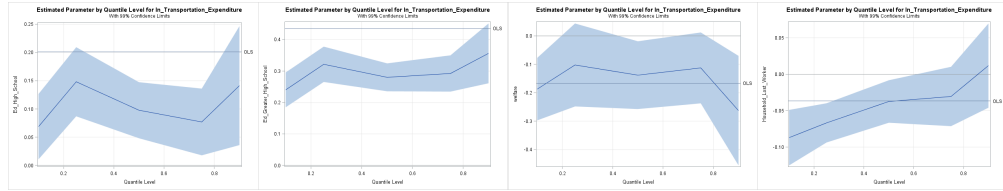
[illegible]



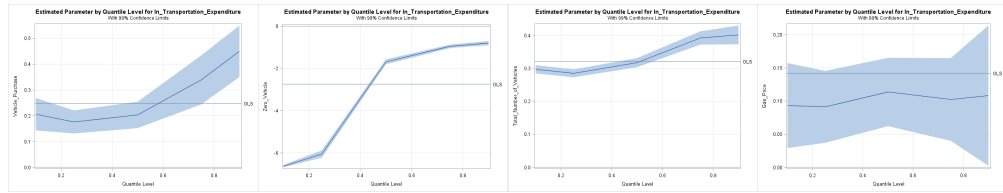
(a) Recession (b) Poor single mother (c) Non poor single mother (d) Number of children



(e) Low income hh (f) Hispanic (g) Age of householder (h) Age square



(i) High school (j) Greater high school (k) Welfare (l) Lost worker



(m) Vehicle purchase (n) Zero vehicle (o) Number of vehicles (p) Gas price

Figure 3: Quantile and OLS estimate plots of effect of covariates on natural log of transportation spending

## 5.5 Conclusion

Overall, the modeling efforts show that there is a gender difference in transportation spending for all periods considered and this difference is not constant along the transportation spending distribution. Low income female-headed households with children seem to invest more on their mobility than other low income households. However, they spent less than middle and high income female householders on transportation. Given that transportation demand is derived from other personal and household needs for activity engagement, these results indicate the extent to which low income female headed households have to endure higher expenditures to satisfy their mobility needs relative to other poor households. On the other hand, middle and high income female-headed households with children were spending less than other households over all periods considered. Altogether, all these gender related results entail a more financial constrained mobility of female householders with children compare to other households.

The great recession significantly impacted transportation expenditures for all households. I found that its negative impact is not constant thorough the spending distribution. Transportation spending decreased by a lot more at the higher tail (75th and 90th percentiles) than at the lower tail and middle (10th, 25th, and 50th percentiles) of the distribution during the recession. Some of the possible contributing factors of the decline at the higher tail are the decrease in vehicle purchasing and ownership costs by households. Additionally, the results suggest that there is no apparent effects of the recession on the gender gap in transportation spending. However, the hypothesis that the recession may have exacerbated the gender difference in transportation spending was not supported by the data used for this chapter.

Income level is found to be an important determinant of transportation spending. In general, low income households spent less in transportation than middle and high income households. Further expenditure levels were associated with different socio-demographic variables. As the age of the householder's increased, transportation spending increased up to peak age and then declined. An increase in household children causes an increase in transportation spending. Householders with high school and greater than high school spent more on transportation than householders with no high school. Further, I observe that losing a worker is likely to decrease the household transportation costs. Vehicle purchases as well as owning a vehicle is highly related to high transportation expenditures. Finally, an increase in gasoline prices is likely to increase household transportation spending. Its impacts were particularly high at the lower quantile of the expenditure as compared to other quantiles.

The findings in this chapter demonstrate the importance of using quantile regressions instead of OLS regression in understanding the impact of gender and the recession on transportation spending. They illustrate the disproportionate changes in the difference in spending between female-headed households with children and their counterparts as well as between other subgroups such as low income even prior to the recession. In addition, they show the heterogeneous effects of the recession across the transportation spending distribution.

In particular, at the lower end of the expenditure distribution, they show that transportation expenditures are relatively inelastic at the lower end of the distribution to external shocks than at the higher end of the expenditure distribution. The fact that transportation expenditures did not move significantly at the lower end is suggestive of the highly constrained mobility

experienced by those at this tail of the distribution even in good times. At the top tail of the distribution, the significant cuts in expenditures can in part be explained by changes in new vehicle ownership decisions which can be suggested based on summary statistics results of the transportation components.

Lastly, the results show that expenditures are sensitive to gasoline prices. Abundant availability and access of other energy sources for vehicles in the future could help reduce the effects of gasoline price on transportation spending or allow more for more mobility without raising expenditures. For instance, policies that subsidize the use of clean energy sources for motor vehicles can be a good starting point. The results call for policy interventions that help female-headed households with children as well as low income households to have improved mobility options as their counterparts at all times.

## CHAPTER 6

### EXPENDITURE TRADEOFFS BETWEEN TRANSPORTATION, HOUSING, AND FOOD IN TIMES OF CRISIS

#### 6.1 Introduction

The capability of households to afford a decent life-style is of increasing concern to policy makers. Most household have to make expenditure decisions within a limited budget and this decision-makings often involves trade-offs and substitution between different goods, products, and services. Research has demonstrated that several factors can affect household budgets such as household composition, socio-economic and demographic characteristics, and household location (154; 155; 156). Income is the major determinant of household budget allocation(157). Additionally, savings for the future (e.g. retirement) and unexpected shocks (i.e. the macroeconomic shocks of the great recession) can influence family budgetary allocations (158). For instance, households changed their shopping behavior during the last recession(159). Household budgetary decisions may also impact their activity participation and travel behavior (160).

This chapter has a the goal of comparing changes to expenditures allocated to transportation, housing, and food as a result of the recession from a gender lens. The analysis focuses on transportation, housing, and food expenditures as these are the three main expenditure categories that constitute the bulk of the total expenditures(161). Moreover, housing, trans-

portation, and food are the main drivers of household budgets with housing being the largest followed by transportation and food (161).

Even though studies exist on household budget allocation (156), they do not focus on the recession. In general, past research has demonstrated that women's spending patterns are different from men (140; 135). Women, for example, spend more on health care than men; an increase in women's income is related to increase in things such as child care while increase in men's income is not (140; 135).

The evaluation of the budget allocations to these three consumption categories (transportation, housing, and food) will help to show the kinds of trade-offs or substitutions households, particularly those headed by women, made as the great recession impacted or threatened their economic wellbeing. As the preceding chapter showed, female-headed households, particularly those with children, can face multiple challenges, including living near or under poverty and the lack of a personal vehicle, placing them at greater risk in times of economic crisis. Their budget allocations to the three main consumption categories (transportation, housing, and food) may be different than for other households and their ability to reallocate budgets may be limited. Overall, this chapter aims to contribute to the gender, transport, and economics literature by underlining some of the constrained monetary decisions that households make which could affect their well-being with a particular focus on female-headed households.

## **6.2    Research Hypothesis**

The basis of this analysis is that household monetary budget involves trade-offs or substitution between transportation, housing, and food expenditures particularly among households

whose incomes are limited. The recession places either directly impacts or increases the risk of loss/reduction of income, and as a result forces households to make different budget allocation choices with the aim of self preservation. These budgetary allocations may affect travel, food, and housing in different ways depending on the household. While factors such as income, age, education, number of children, employment status, vehicle purchase and ownership, gas prices, and housing tenure are likely to play a role in these tradeoffs, I anticipate that female-headed households will pursue different budgetary decisions than other households. In particular, I expect female-headed households more than other households to curb the share of their total spending that goes toward transportation and reallocate it to housing and food because of the severity of their financial constraints that are well documented in the literature.

Given the fact that housing and food are fundamental to the survival of any individual, I claim that reallocation disfavors transportation. However, this may subsequently female-headed households mobility and their well-beings. This would further reinforce past findings that documented the negative effect of the great recession on single mothers, highlighting one of the ways in which the last recession may have negatively affected women that are head of households as they sought to satisfy their needs for food or to be able to have a roof over their heads. A reason for such trade-offs may also include the payment of their residential rent without penalties or their mortgages without foreclosure. Knowing that housing and transportation decisions are mostly interrelated and habits formed around car ownership is hard to break (162; 54), I suspect these trade-offs to be detrimental for women headed and

their families. This chapter aims to test these claims using the CEX data in order to call for appropriate policies to address any gender inequities that emerge from the findings.

### **6.3 Data & Research Methods**

The data used in this analysis is the same as what is in the preceding chapter. Details regarding the data are available in the previous chapter's section 5.2. The goal of this research is to evaluate the share of three main consumption categories (transportation, housing, and food) from household total expenditures for all period and during the recession. This evaluation will allow an assessment of household budgetary allocations during normal times and in the presence of external economic shocks. A special focus is on female-headed households.

The analysis starts by looking at how average expenditures changes in the period prior to and during the recession. Then explanatory models are estimated to understand how the share of expenditures to the three categories have changed during the recession. I analyze the reallocation decision by closely studying before-recession and recession-period expenditure shares, specifically looking at: 1) share of transportation from total expenditures, 2) share of housing from total expenditures, 3) share of food from total expenditures, 4) ratio of transportation expenditures to housing expenditures, and 5) ratio of transportation expenditures to food expenditures . Five models are estimated with theses dependent variables and using the same covariates across all models. These models enable the assessment of households expenditures allocation among these three important expenditure categories and allow us to determine how the expenditure allocation among transportation, housing, and food depends on socio-demographic characteristics, household structure, transportation and housing factors. The last three models

of ratios evaluate how transportation expenditures fared relative to housing and food during the periods under consideration. These metrics permit the inference of any substitutions among the three main expenditure categories over the period considered.

All five models have the same covariates to enable easy comparison. Dummies for recession, female-headed households with children, and Hispanic were added to the models for macroeconomic shock and subgroups estimation. Other variables such as household composition and characteristics, employment, income, vehicle purchase and ownership, and housing tenure that can influence transportation, housing, and food allocations are controlled for in the models. Prior to modeling, summary statistics of the percentages of total expenditures allocated to transportation, housing and food before and during the recession are estimated for all households and then separated by female-headed households and by female-headed households with children. Other summary statistics for the allocations of the three main consumption categories are obtained by income groups.

#### **6.4 Analysis**

An analysis of the average expenditures shows that combined average expenditures on the three categories fell by approximately \$550 from \$34,228 during the pre-recession period to \$33,680 during the recession. As can be seen from Figure 4, average transportation expenditures fell by approximately \$1,000, while average housing expenditures rose slightly (0.8%) and food expenditures rose by approximately 4.4%.

This aggregate analysis however hides the ways in which low income households and high income households changed expenditure patterns. Patterns of change for female-headed house-

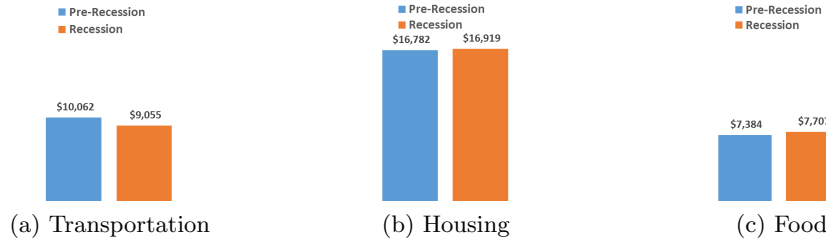


Figure 4: Major Expenditure Categories Before and During Recession for all Households

holds were also markedly different. Figure 5 and Figure 6 compare the ratio of pre-recession expenditures to recession expenditures for these groups. Figure 5 demonstrates that the drop in transportation expenditures for low income households was very small as compared to that of middle and high income households (below 2% drop vs just over 10% drop, respectively). Thus, the decline of transportation expenditures during the crisis for all households indicated in Figure 4 can be primarily explained by the downward shifts of middle and high income household transportation expenditures during the recession. The fact that low income households didn't see a large drop in expenditures suggests that they were already curtailing their transportation spending even prior to the recession and that there was likely no room for large cuts during the recession. This is even more striking since both housing and food expenditures rose by 4% and 8% respectively for low income households, likely straining budgets even further. That average transportation expenditures didn't fall for this group despite rises in food and housing expenditures further supports the claim that transportation expenditures were at the bare minimum to begin with.

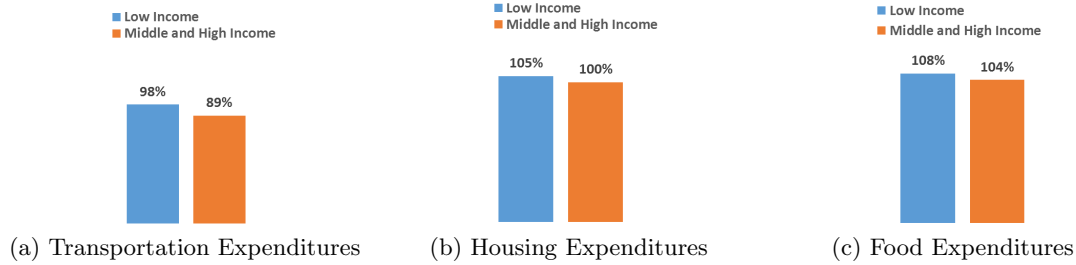


Figure 5: Expenditures during the Recession as Percentage of Pre-Recession for Major Categories by Income Group

Figure 6 shows the patterns of change for female-headed households as compared to their counterparts. Here we observe that average transportation expenditures for female-headed households decreased substantially (approximately 15%) during the recession, while housing and food expenditures rose by 4% and almost 11% respectively. Further investigation revealed that the 15% drop in transportation expenditures for female-headed households can be attributed to a smaller percentage of them purchasing vehicle during the recession compare to the before recession period. Female-headed households that purchased a vehicle during their survey year dropped from 69% (N=334) to 31% (N=150) during the recession. Other potential reasons for such drop such as losing vehicle or switching to the zero vehicle family or shifting from using private car to transit were not supported by the data to drive their 15% decrease.

As discussed in chapter 2, the intersectionality of gender and other factors such as poverty can exacerbate gender inequality for some women than others by creating differences between women themselves. Many other elements beyond gender and income levels are determinants

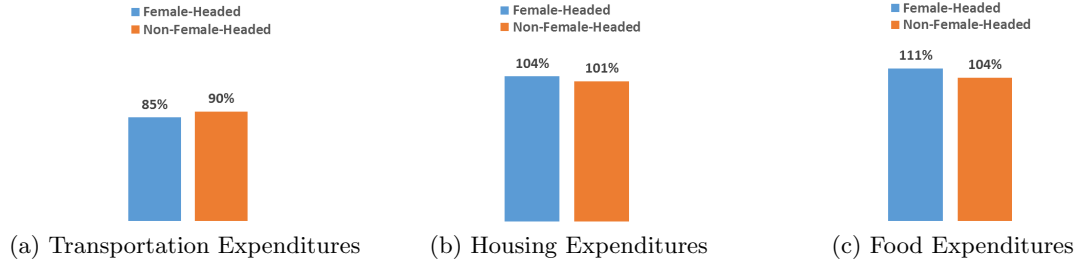


Figure 6: Expenditures during the Recession as Percentage of Pre-Recession for Major Categories by Gender

of gender inequity such as household structure. Figure 7 supports that argument and demonstrates that the effects of the recession vary across diverse types of women headed households. Considering income level and presence of children in the household, Figure 7 shows that middle and high income female-headed households with no children reduced their transportation spending by 22% during the last economic crisis while low income female-headed household with and without children and middle to high income female-headed households with children reduction were less than 10%. This finding can be classified under needs and capability categories. Middle to high income female-headed households without children were capable to reduce their transportation spending to the merest because they had some room for cut and no children to increase their absolute needs for more reliable and faster transportation. The other types of female-headed households were either already at their minimal spending even prior to the recession or the presence of children create desperate mobility needs for them that leave them with little choices than slight reduction.

Regarding housing costs, middle and high income female-headed households with no children were able to reduced their housing costs by 4% while the other three types of female-headed household increased their housing costs by 2-16%. While low income female-headed households with and without children increases were minimal from 2-4%, middle to high income female-headed households with children increase their housing cost substantially more by 16 %. The same justification regarding their differences in transportation spending is valid for their housing expenditure patterns. The availability for room for cut for middle to high income female-headed households allows for spending reduction while the presence of children counteract that aspect and escalate the commitment for housing and increase the housing spending for those households with children.

A look at food expenditures for the four types of female-headed households (low income female-headed households with and without children and middle to high income female-headed households with and without children) indicates that all four types of women headed households increased their spending on food. Though middle to high income female-headed households with children and low income female-headed households without children increases were considerable compare to the other two, 22-25% versus 4-6%. The higher increase in food spending for low income female-headed households without children than the other three women headed households was surprising and should be examined closely in future studies. Most of the exploratory analyses demonstrate the association between the great recession and the increase in food spending.

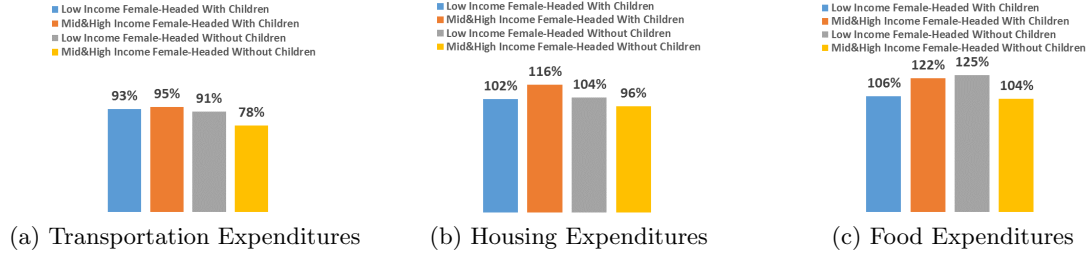


Figure 7: Expenditures during the Recession as Percentage of Pre-Recession Expenditures for Major Expenditures for Female-Headed Households by Income and Household Structure

This chapter also considers the proportions of total expenditures spent on transportation, housing, and food before recession and during recession as another way to evaluate the impact of the recession on the spending levels of all households and subgroups. The exploratory statistics based on that approach are available in Table X. The results show a significant drop in transportation share of total expenditures by 0.8% ( $p \leq 0.01$ ) while the share of food increased during the recession by 0.7% ( $p \leq 0.01$ ). The increase in housing share of total expenditures was not significant when all household are considered.

Similar pattern is seen for female-headed households in the same Table X with a decrease in transportation proportion during the recession by 1.2% ( $p \leq 0.05$ ) and increase in food proportion by 1.2% ( $p \leq 0.01$ ). The rise in housing proportion was not significant for female-headed households too.

The results in Table X indicate no change in the share of transportation and housing for female-headed households with children during the last economic crisis. However, a 1.0% ( $p \leq 0.05$ ) increase in their food share was observed during the recession.

TABLE X: Major Expenditures Before and During the Recession by Gender

Proportion of Total Expenditures	Entire Dataset					Female-headed Household					Female headed Household with children				
	All	PR	R	D		All	PR	R	D		All	PR	R	D	
Transportation	16.4%	16.7%	15.9%	<b>-0.8%</b>	<b>***</b>	16.4%	16.8%	15.6%	<b>-1.2%</b>	<b>**</b>	15.5%	15.7%	15.0%	<b>-0.7%</b>	
Housing	34.5%	34.4%	34.6%	<b>0.2%</b>		36.3%	36.1%	36.5%	<b>0.4%</b>		38.9%	38.8%	39.1%	<b>0.3%</b>	
Food	17.1%	16.9%	17.6%	<b>0.7%</b>	<b>***</b>	18.8%	18.4%	19.6%	<b>1.2%</b>	<b>***</b>	20.2%	19.9%	20.9%	<b>1.0%</b>	<b>**</b>
N	34478					2256					1378				
*** $p \leq 0.01$ ; ** $p \leq 0.05$ ; * $p \leq 0.1$ ;															
All= all dataset; PR= Pre-Recession; R=Recession; D=Difference between Recession and Pre-Recession															

After dividing the sample into different income categories as in Table XI, it can be seen that the budget of total expenditures allocated to transportation, housing, and food vary based on the income categories. The transportation proportion of total expenditures decreased during the recession for all income categories by 0.1-1.5% depending on the income groups. The housing share decreased during the recession by 0.2% and 0.8% for income group of 0-25k and over 200k but increase by 0.2-0.7% for other income groups. The food proportion increased for all income groups by 0.4-0.9% depending on the group.

TABLE XI: Major Expenditures Before and During the Recession by Income Group

[illegible]

## Model & Results

The shares of transportation, housing, food, and the ratios of transportation to housing and transportation to food are the models that are estimated to inform of the type of expenditure substitutions done by diverse households particularly by female-headed households with children over all period and during the last economic crisis after controlling for other variables. The ratios of expenditures categories are important models that are well suited to demonstrate the trade-offs. They estimate the effects of the unit increase in the share of transportation on housing and food when other variables are controlled for. The first three models even though can help with the inference because of the use of the same covariates they are unable to directly specify by what amount. The results of all models are shown in Table XII and Table XIII. The estimated models have reasonable goodness of fits with  $R^2$  values ranging between 0.131 to 0.286.

### Female-Headed Households with Children

The modeling results suggest that transportation spending of Female-headed households with children was 1.0% lower while their housing and food spending increased by 2.9% and 0.3% respectively compare to other households. The models of log of ratios of transportation to housing and transportation to food indicate that female-headed households with children spent more on housing and food than transportation compare to their counterparts by 13.4% and 5.2% subsequently.

These results prove that female-headed households with children when faced with financial decision-making concerning transportation, housing, and food are likely to prioritize housing

and food in detriment of their mobility. This is an issue that need attention from policy makers. Constrained mobility can negatively impact other aspects of their lives that are not considered in this chapter such as their social well-being or their health.

### **Hispanic Households**

The results state that Hispanic households are spending more on transportation, housing, and food than non-Hispanic. These results were surprising but show the importance of transportation, housing, and food for them. Further results suggest no difference between Hispanic and non-Hispanic related to the ratios of transportation to housing and transportation to food.

### **Recession**

The first three models indicate that the great recession was associated with the reduction of transportation and housing spending by 0.5% and 0.8% and an increase in food spending by 0.4% than in normal period. The ratio models highlight that during the recession that households spent 3.4% more on food than transportation than prior to the recession. This is alarming because such substitution between transportation and food during the recession can be detrimental to household mobility which can also affect other aspects of their lives. On the other hand, the modeling efforts show no link between the recession and transportation to housing ratio.

### **Age**

Increase in age is associated with a decrease in transportation share and almost zero effects on housing and food shares. The modeling results propose that increase in age by a unit is associated with the reduction of the values of ratios of transportation to housing and trans-

portation to food by 0.7%. These findings imply that as the age of householder increases that household are likely to spend 0.7% more on housing and food than transportation. This may indicate that as people become older they tend to prioritize home ownership and food than enhancing their mobility. Another explanation is that at certain ages such as retirement ages the needs for mobility get diminished.

### **Income**

An increase in income is associate with 0.4% increase in transportation spending and 2.9% and 2.3% decrease in housing and food spending. The interpretation of the log ratio models is that a unit increase in income is likely to increase transportation spending more than housing and food spending by 11.4% and 18.2%. Although transportation and housing are interrelated and habit formed around car ownership is hard to break (162; 54), these results are likely due to the fact that housing and food expenditures do not vary substantially in a short term due to lease commitment or the hardship of moving. However, new investment on transportation is always possible with increase in income such as the purchase of additional cars for more flexibility or for luxury purposes.

### **Number of Children**

As the number of children increases transportation spending is likely to decreases by 0.2% while housing and food spending are likely to increase by 0.3% and 1.1%. An increase in the number of children is associated with the reduction in the amount of the ratios of transportation to housing and transportation to food by 2.7%, and 8.1%. This finding highlight that households with children prioritize housing and food than transportation.

## **Education**

Householder with greater than high school are likely to have lower transportation and food expenditures than their counterparts by 0.8% and 1.6% respectively. The models of the ratios of expenditures show that householders with greater than high school are likely to reduce the ratio of transportation to housing by 2.4% while they are likely to increase their ratio of transportation to food by 6.4% than their counterparts. In other words, these results argue that householders with greater than high school are likely to have greater spending on housing than transportation and greater spending on transportation than food compare to householders with less than high school or householders with just high school degrees.

## **House Owner with Mortgage**

Obviously, households who own their house with mortgage allocate 0.6% less share of their total expenditures on transportation, 4.8% more on housing, and 1.8% less on food than their counterparts. Further modeling demonstrates decrease in the ratio of transportation to housing by 17.0%. Households who own their houses with mortgage increase the ratio of their transportation to food by 7.7%. These findings suggest that when owning a house with mortgage that a greater portion to the total spending is most likely to go toward paying mortgage and other housing costs than toward transportation. Though these households are likely to spend more on transportation than food.

## **Urban Area**

Households living in urban areas allocate 2.8% and 0.3% less of their household budget to transportation and food and 5.9% more of their total budget to housing than household

living in rural areas. The models of the ratios propose that households living in urban places reduced their ratios of transportation to housing and transportation to food by 31.0% and 15.2% respectively more than fellow rural dwellers. Thus, households that live in the urban areas allocate less of their total spending to transportation than housing or food or housing and food combined. These results may imply the better public transportation system and expenses rent and housing cost in the urban areas versus rural places.

### **Transportation**

Households who purchased vehicle during their reporting period allocate 4.4% more on transportation, 1.5% less on housing, and 1.1% less on food than households that did not purchase a vehicle. The models of the ratios of transportation to housing and transportation to food provide further evidence and show that households that purchased a vehicle during their reporting year allocate 27.8% and 30.3% more of their total expenditures to transportation than housing or food than households than did not purchase a vehicle.

Evidently, households with zero vehicle have 12.3% lower transportation spending, 10.6% and 3.3% higher housing and food spending than households with at least a vehicle. The modeling efforts of the ratios of transportation to housing and transportation to food demonstrate that zero-vehicle households are likely to spend 81.8% and 80.5% less on transportation than housing and food. Hence, they allot smaller percentages of their total expenditures to transportation than housing, food, and housing and food combined.

A unit increase in gas prices decrease the proportion allocated to transportation by 0.7% and increase the amount allocated to housing and food by 2.4% and 0.7% respectively. The

models of the ratios of transportation to housing and transportation to food affirm that a unit increase in gas prices decrease the amount allocated to transportation compare to the amount allocated to housing and food by 10.6%, and 8.0%. Therefore, as gas prices increase households are likely to focus more on housing and food and to curtailed their spending on transportation or to look for alternative cheaper mode that do not require the purchase of gasoline.

### **Employment**

Households that lost workers during their survey year allot 0.3% and 0.2% less of their total expenditures to transportation and food and allot 0.8% more of their total expenditures to housing than households that did not loose workers. The models of the ratios of expenditures confirm that households that lost at least a worker allocate 4.2% less of their total expenditures to transportation than housing. This may be explained in one way by the fact being unemployed that they have less need to be very mobile since there is no need for work trips.

### **Welfare Recipients**

Households that receive welfare during their survey year allot 1.0% and 2.3% more of their total expenditures on housing and food than households that do not receive welfare. The models of the ratios of expenditures confirm that households that receive welfare allocate 10.3% and 11.2% of their total expenditures on housing and food than transportation respectively. These households seem to prioritize their lodging and food needs than their mobility.





## 6.5 Conclusion

Transportation, housing, and food are three important components of total expenditures for any household as well as for female-headed households with children. Depending on the circumstances, households sometimes have to trade-off between allocating their monetary resources to transportation, housing, and food. The modeling efforts suggest that female-headed households with children allocate a smaller amount of their budgets to transportation but a greater amount to housing and food than their counterparts. An increase in housing and food spending is related to a decrease in spending in transportation. This suggests that when faced with financial constrained decision regarding transportation, housing, and food, female-headed households with children are likely to prioritize housing and food in detriment of their transportation. This calls for mediation for these households and shows the needs for policies that could help them with their mobility needs at all times.

Considering all households the great recession was association with decrease in the proportions allocated to transportation but increase in the proportions allocated to food. This may be due to the fact that the price of food escalated during the economic downturn. There was no recession effect on the difference in allocation of transportation, housing, and food for female-headed households with children compare to other households.

Further, the models show that a variety of socio-demographic variables are associated with the shifting expenditures during the recession. Increase in age is associated with household prioritizing housing and food than transportation. This may indicate the fact that people in their retirement have less need to be mobile to go to work but a greater need for better

settlement. A surprising finding is that increase in income is linked to larger share of the expenditure going toward transportation and smaller going to housing and food. This may be due to the fact that housing cost is unlikely to change during a short duration even with increase income probably because of lease commitments or moving burdens while transportation share can escalate with the purchase of additional cars that do not alter habits form around car ownership and household location decisions. Households with children prioritize housing and food than transportation. Having a roof over their head and food to survive are most likely primordial for them. However, poor mobility can hinder many other aspects of their lives even the process to obtain good and healthy food, to access health care, and many others. Households living in urban areas attribute less proportions of their total expenditures to transportation and food and more to housing. One explanation of that result may be the quality of public transportation in urban areas and the higher housing costs there than rural places.

As expected, vehicle purchase and ownership escalate household transportation share compare to housing and food. Though, increase in gas prices is associated with households attributing less to transportation and more to housing and food. In some ways, gas prices can also impact food prices and therefore increases in food costs where a positive association was noted. For the household, an increase in gas prices may also affect households mobility and cause them to drive less or switch cheaper transportation modes reducing share of expenditures. Households that lost a worker attribute less of their total expenditures to transportation and food and more to housing. These households may have no more needs to travel to work.

These results call for policy interventions that enable households to have adequate mobility and accessibility when faced with financial constraints. The findings show that diverse households for the most part prioritize housing and food in detriment of transportation. Policies are needed that give access to reliable, safe, and affordable transportation that enables to participate in different activities even under budget constraints that often requires the reduction of the proportion of total expenditure allocated to transportation. Greater needs for policy intervention exist when the lack of adequate mobility intersect with different issues such as cycles of evictions or living in neighborhoods with food desert issues.

## CHAPTER 7

### FINDINGS AND DISCUSSIONS

The findings from this dissertation show that there are geographic and economic dimensions that distinguish women's mobility from that of men. Further, these differences vary based on household structure among women. Women with children experience more constraints than women with no children or men. In addition to the presence of children, the age of children seems to also be an important influential factor on women's travel and creates gender inequality in mobility. Mothers with little children are less mobile during both workdays and non-workdays while other mothers, women, and men seem to be more mobile during non-workdays. Additionally, the absence of other adults in the household and longer commutes tend to limit women's workday geographies and lead to different geographies on workdays and non-workdays.

The findings also show that the workday areas of low income households are more restricted than their non-workday areas and than the workday and non-workday areas of middle and high income households. However, low income White people have less restricted workday geographies than other low income households. The presence of other adults in the household can increase flexibility during workdays for both women and men. On the other hand, commute distance can reduce the time available for other activities during workdays. Work flexibility is another key element that can reduce constraints during workdays. Individuals with flexible work and help of other adults have more flexibility during both workdays and non-workdays that enable them to reach more opportunities. Time spent inside home restrict movement to other places

during workdays and non-workdays. The availability of vehicle for work and having a license for driving decrease pressure during workdays and non-workdays. Altogether, gender, family structure, income, race, work flexibility, availability of private vehicle, and having driver license all inform activity space areas during workdays and non-workdays and contribute to intra-personal variation in geographies.

Additionally, the findings of the second analysis confirm that more robust methodologies on top of the usual average method should be embraced because together they are more capable of giving further details about gender inequality in transportation spending as well as to access the impact of the economic crises on all households. The results stressed a more pronounced transportation spending inequality for low income female-headed households with children than other female-headed households with children or other households. The findings also highlight that low income female-headed households with children spend more on transportation than other low income households with children. This finding implies that low income female-headed households with children are investing a greater amount of their income on transportation than their counterparts that are low income. In another way, it shows that mobility needs place expenditure pressures despite low earnings. Moreover, the results show no association between the recession and increase in the gender gap in transportation spending. This may be explained by the fact that low income female-headed households with children were already had little discretionary mobility which gives no room to cut during the crisis. Similar results were seen for other subgroups considered. Other factors that affect transportation spending are number of children, income, age, education, number of vehicles, vehicle purchase, and gas prices.

Finally, the findings of the third analysis point to the fact that female-headed households with children are more likely to reduce their transportation spending in order to be able to allocate more money to housing and food. Hence, despite the importance of housing and food, restricted mobility can hinder those women and families well-beings and their access to opportunities and other things such as health care. Having children in the households no matter of the gender of the household head lead to possible trading of transportation share for enhanced expenditures on housing and food. In addition, the great recession was associated with households allocating less share of their total spending to transportation and more to food. Transportation and housing expenditures both decreased during the recession while food expenditures escalated during the same period. Age, education, household ownership with mortgage, vehicle ownership and purchase, and gas prices influence the allocation of total expenditures among these three important spending categories (transportation, housing, and food). Another important finding is that living in urban areas reduced transportation and food spending while it increased housing costs. Those households living in urban areas are likely to trade-off their transportation and food shares for greater housing share probably due to quality of public transportation there. Enhanced and working public transportation system is likely to reduce the transportation costs of those urban residents.

## **7.1 Dissertation Contribution**

Numerous former studies have demonstrated that mobility is gendered(29; 30; 31; 32; 33; 34; 35) due to women's double duties, their caregiving duties, and the unequal economic status of women compare to men. Nussbaum(72; 71) stressed the fact that women caregiving duties

is the main obstacle to gender justice in many domains including mobility. My dissertation work supported the fact that caregiving by women is one main source of gender divergent experiences in mobility. One related finding from my research is that women in household with children under 12 have smaller geographies during both workdays and non-workdays. The smaller geographies are considered to be the result of constraints that arise from caregiving duties. My work contribute to the gender and transportation body of knowledge by showing the interdependence between period when women have double duties at work and at home and periods when they just have caregiving duties. In addition, my research helps to show some weekly activity management strategies that women adopt to overcome the constraints that their double duties at home and work impose on them.

This dissertation also advances our knowledge of how economic capability is linked to mobility. The discrimination of women in the labor market and the lower economic status of women are well known from past studies(11; 12; 13; 14). My research adds to this body of work by showing that lower economic status reduces the spending potential of women in transportation. An important insight is the non-uniform impact of gender on transportation spending at different quantiles of the transportation expenditure distribution. Additionally, my work contributes to the literature by validating gender difference in budget allocation concerning transportation, housing, and food. A valuable finding from thesis is the fact that women heads of households are likely to prioritize housing and food in contrast of transportation. This kind of budget allocation is not evident in the literature of gender and transportation.

The dissertation also proposes ways in which these disadvantages that women experience in geographic mobility and in their transportation expenditures can be overcome. These proposals are provided in the proceeding section.

## **7.2 Policy Synthesis**

The findings of the work done in this thesis compel no single policy solution to gender inequality in mobility. Rather, the results call for multi-dimensional policy initiatives that look at all aspects of the issues. Policies should look beyond transportation to consider the interrelation between transportation and other factors such as employment, housing and food. Even though several policy decisions were made in the past regarding improving transportation for low income households, few are specifically targeted to women with children or low income mothers. Recent programs based on transportation policies for low income families include welfare to work program and more specifically Job Access and Reverse Commute (JARC) program. Even though these programs are beneficial they tend to be targeted to low income households without regard to gender. And although women make the majority of poor people, without considering the gender aspect, these programs may be missing the contour of the issues.

Further, these programs are often funded based on a single issue such as spatial mismatch of jobs and people or poor people living in cities (163). However, women with children and low income mothers need policy intervention that look at their transportation issues outside of work. Many working women are also primary caregivers. Thus, they need programs that are targeted to their unique needs.

I therefore recommend several different policies to address the gender inequality in mobility. First of all, I recommend transportation policies that could lead to programs similar to JARC but reformulated to focus on women needs. These programs should subsidize multi-modal transportation options and solutions. The subsidized transportation options should include but not restricted to expanded fixed route public transit, improved paratransit services, door to door transit services, taxi and automobile access. The subsidization can be done in forms of vouchers for mothers and low income mothers. The values of the vouchers could depend on the unique circumstances of the mothers. For instance, it could depend on the age of their children or their family structure. More specifically, this kind of policy can help address the gender issue identified in Chapter 4 by expanding the workday and non-workday geographies of mothers that are living with no other adults or with little children. Faster and more reliable transportation can reduce their time-space constraint by reducing their travel time to different locations especially when the home to work distance is long. In addition, this policy can be useful for improving the mobility of mothers that are financially trading-off the quality of their mobility for housing and food as in Chapter 6.

Second, even though I encourage multi-modal solutions to the gender issues in transportation. I believe a focus should also be based on private transportation such as the automobile. One important motive for the necessity of policies that enable car ownership by women is that it is sometimes difficult for mothers especially mothers with infants in car seat to navigate the complex public transportation system with possible transfers and stairs at transit stops. Another reason for the importance of cars for women especially mothers is the fact they usually

juggle multiple errands and do more trip chaining which are the kinds of travels that are not amenable via our current public transit system in the U.S. These trips may be easier when living in big metropolitan areas such as New York but can be burdensome when living in other places. Thus, it makes sense to push for policies that reduce car ownership costs for mothers especially for low income mothers with infants and toddlers.

Government should adopt a policy that will prioritize car ownership for mothers. This kind of policy could be of types '“of secured loan programs, leasing schemes, or revolving credit arrangements” (164). Similarly, auto loan program as the one of the JARC program designated for women and single working mothers could be helpful. Owning a car is not the end of the problem, car ownership can be expensive. Therefore, transportation policy should be endorsed that help women especially single working mothers with maintenance, registration, even parking (when they live in metropolitan areas).

Though the recession analyses did not show a difference between the gender gap before the recession compare to during the recession, it stressed the facts that losing a worker is likely to reduce transportation spending. Hence, I recommend policy interventions that ensure that both men and women have continual access to transportation related economic and credit instruments both before and during the recession that facilitate their mobility and possibly empower women car ownership for all period. Again, I advise policies that protect consumers (women and men) when buying (financing or leasing) automobiles especially female buyers with children during critical period such as the great recession. These kinds of policies can hinder dealers to easily repossess leased and financed cars of women and men especially of mothers

with babies and toddlers during difficult time. This policy can assist with the fact that the recession was associated with decrease in transportation spending for all households in Chapter 5. Some of the reductions of transportation spending during the crisis are probably due to the fact that some households lost their leased vehicles during the recession as highlighted by other recession studies or were unable to purchase new ones as a result of limited credit as outlined in Chapter 6.

Third, I press for policy initiatives that will make use of the technology development to improve women mobility and decrease gender inequality in transportation. These policies can initiate programs that enable car sharing and carpooling by women and mothers to approximate destinations. They can include giving smart phones to mothers and low income mothers with monthly subsidized budgets to use transportation applications such as Uber or Lyft or similar to satisfy their daily mobility needs. These kinds of programs could demand public-private partnerships. These policies would be beneficial to address gender issues in Chapter 4-6 by enhancing women's mobility and decreasing their workday and non-workday constraints that were partly linked to non-reliable transportation and poor economic status.

Fourth, policies and programs linking land use and transportation should be encouraged. For examples, programs instigating increased population density solutions such as transit-oriented-development (TOD) or specific urban design such as new urbanism should be endorsed to a greater extent possible. These policies can be valuable and probably reduce the stresses of female-headed households with children living alone and traveling far to go to work such as the

ones identified in Chapter 4. Such policies can help in getting a job nearby and reduce their commute distance or they could have easy access to their other needs outside of work.

Fifth, economic policies could also be helpful. For instance, a policy that ensures the economic mobility of women and especially of single working mothers by discouraging gender discrimination in the workplace could assist them in climbing the economic ladder by getting better occupational types and increasing their wage rate. This type of policy could help mothers to access superior domains and then reduce their constraints. It could also help women and mothers in many other ways such as improving their daily physical mobility; thus enlarge their daily prisms for more opportunities. These policies are relevant to the outcomes of all three analyses in Chapter 4-6. Low income status of women is one important source of their constraints. It gives them less flexibility to access fast and flexible transportation mode under financial constraints or it hinders their possibility to seek for paid assistance.

Sixth, there are several programs that are policies based that provide monthly food and housing vouchers for low income households; however, few such policies and programs related to local transportation for people in needs exist such as for single mothers with infants and toddlers outside of work. Thus, I recommend two things. First, since transportation subsidies may be difficult to pass, policy makers should focus on strengthening food subsidies particularly to low income mothers. I believe by making food subsidies readily available, this may help households to reallocate expenditures to transportation and housing as needed. This policy can help address the issue of expenditure allocation in Chapter 6. Second, policies that give greater flexibility and mobility to mothers such as local transportation vouchers will be helpful.

These vouchers could be favorable for improving the mobility of low income mothers that are spending a bigger share of their income on transportation than other low income households and who are spending less than other female-headed or male-headed households as the ones recognized in Chapter 5.

Lastly, I recommend policies that will enable access to technological innovations such autonomous vehicles for women. Even though this and other new technologies may not be soon readily available for most low income households including low income women with children because of their economic status, subsidizing it for those women who drive can be helpful. This can enable them to use their travel time for other things such as scheduling other activities or reading, and others.

Overall, a diverse set of policies and programs are necessary to provide a broad range of personal, public, shared motorized and non-motorized transportation solutions which could help reduce the gender inequality in transportation. In addition, coordination of divergent policies such as transportation and land use policies or transportation, housing, food, employment, and day care policies could be favorable.

### **7.3 Limitation of the study**

As with other studies, this research has several limitations. The datasets used for this research constitute one of the major limitations of this research. Perfect data does not exist. Thus, both of the datasets used in this thesis are limited in some ways.

First, despite the richness of the CMAP GPS dataset, its sample size is very small which can create some issues when modeling. The small sample size makes it difficult to detect variability

in the dataset. Further, the CMAP GPS data is not a random sample. The on-person CMAP GPS participants were mostly volunteers, white, and high income. Therefore, I understand that the sample is not representative of neither the Chicago metropolitan area population nor the entire US population. In addition, the CMAP GPS data is a passive data that required identification of the activity types which was a challenge. Although, CMAP GPS dataset has up to seven days per person, some of the participants skipped days.

The CEX data is a large data but a cross sectional dataset which makes the assessment of intra-personal variation impossible. A longitudinal dataset would be helpful to conduct such analyses. Else, the CEX dataset contains missing values due to some households skipping interviews or due the fact they moved from the sampling locations. To conduct statistical analyses, households with who miss several interviews were deleted from the final retained sample. Other households were deleted from the sample because of negative or zero expenditures or income. Households were also deleted when their expenditures did not make sense. Moreover, the rotating survey design of the CEX makes it harder to designate the specific calendar year of household expenditures since it usually spanned two calendar years. As a result, issues rose when allocating household expenditures to either before or during the recession period. To address the problem, households were allocated to a year, pre-recession, and recession period based on the year of the first month of expenditures.

#### **7.4 Future Research**

Future research could use a larger GPS dataset with a random sample to conduct the analysis of gender difference in time-space. The combination of larger dataset and the GPS data could

allow variability in the dataset and yield more accurate results for a broader population and can be generalizable. Furthermore, future studies should include the effects of E-commerce in evaluating activity geographies of women and men because of its greater prevalence. Future studies could also look at transportation expenditures after the recession to evaluate any gender difference during the recovery period since some recession findings stressed the fact that some subgroups were more affected during the recovery period than during the actual recession period. Additionally, evaluation of expenditure substitution patterns of transportation and other consumption categories other than housing and food could be studied in the future.

## CHAPTER 8

### CONCLUSION AND POLICY IMPLICATIONS

The work done as part of this thesis supported past work done on gender inequality in mobility. The new insights from this research is that the mobility of some mothers are not only constrained during workdays but also during non-workdays. It highlights the impact of family structure, the presence of children, and the age of children on women's transportation. Moreover, the findings stress that longer home to work distance exacerbate the workday constraint of women who are living alone with children.

The results also add to the gender and transport literature by demonstrating that usual analysis of average should be augmented with more robust methodologies for a fuller picture of gender inequality with respect to transportation. They show preference for techniques such as the quantile regressions or others that can provide more details understanding of the gender transportation inequity of mothers and low income mothers. The findings clarify the impact of the recession on all households and highlight no increase in the gender gap in transportation during the recession. This may be due to the fact that mothers were already spending on mandatory transportation prior to the recession and that there was no room for additional cut-off during the crisis.

The findings also point to the fact that female-headed with children are more likely to decrease their transportation expenditures in order to put roof over their heads and to be able

to survive famines. Likewise, the great recession was associated with decrease in transportation spending and increase in food spending.

Overall, policy interventions are need to protect mothers, female-headed households with children and low income female-headed households from restricted mobility in order to decrease gender inequality in mobility. These policies could range from a wide variety of policies resulting in programs based on transportation, land use, housing, food, economic, and day care. They could include policies that reduce automobile costs and access by mothers with or without credit instruments. They could incorporate policies that give transportation vouchers for private, public, on-demand, and shared transportation. The solutions could also involve things such as Transit Oriented-Development (TOD), new urbanism, economic, and day care related interventions. Technology intervention through subsidizing of smart phone and transportation applications for mothers and low income mothers could also be part of the solutions.

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## **PUBLICATIONS:**

1. Tilahun, N., Thakuriah, P., Li, M., and Keita, Y.: Transit use and the work commute: analyzing the role of last mile issues. *Journal of Transport Geography*, 54:359-368, 2016.
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2. Tilahun, N., Li, M., Thakuriah, P., and Keita, Y. M.: Transit Use and the Work Commute: An empirical analysis of the role of urban densities, last mile problems,

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3. Thakuriah, P., and Keita, Y. M.: An Analysis of Household Transportation Spending during the 2007-2009 US Economic Recession. Presented at the 93th Annual Meeting of the Transportation Research Board, Washington, D.C., 2014.
  4. Thakuriah, P., Dirks, L., and Keita, Y. M.: An Analysis of Emerging Urban Digital Infomediaries in an Era of Big Data and Open Data Initiatives. Presented at the Association of Collegiate Schools of Planning (ACSP) Annual Meeting, 2013.
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