THE DYNAMICS OF HOUSEHOLD FOOD INSECURITY FROM 2010-2011: EVIDENCE FROM THE SURVEY OF INCOME AND PROGRAM PARTICIPATION

by

SAE ROM CHUNG

(Under the Direction of Robert B. Nielsen)

ABSTRACT

Despite numerous formal and informal food assistance programs, food insecurity threatens millions of households in the U.S. Yet, little is known about households that transition into, and out of, food insecurity. This study used the 2008 panel of the Survey of Income and Program Participation to examine how changes in household vehicle ownership, unsecured debt, and disability were related to food insecurity over 12 months. Bivariate tests identified an association between household food insecurity and vehicle ownership, unsecured debt levels, and disability status. Findings from cross sectional multivariate models were consistent with extant literature; food insecurity was positively associated with disability and negatively associated with the number of vehicles and higher unsecured debt levels. Conditional fixed effects models identified a negative relationship between changes in the number of vehicles owned and food insecurity transitions, but no association between food insecurity transitions and changes in unsecured debt levels or disability status.

INDEX WORDS: Household Food Insecurity Transition, Survey of Income and Program Participation, Vehicle Ownership, Unsecured Debt, Disability Status, Intertemporal Choice, Conditional Fixed Effects Regression Model, Surveylogistic Model with Subpopulation Analysis, Cross-Sectional Model.

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DEDICATION

To my spiritual families at Servant Korean Evangelical Church of Atlanta young adults group and Atlanta Full Gospel Church. To my lifelong friends across the states and nation. To my friends and faculties at the Department of Financial Planning, Consumer Economics, and Housing at the University of Georgia. To my parents who have passed on the greatest heritage one could ask for while living on the Earth, the heritage of faith, unto my sister, my brother, and me. To my siblings who always love and accept me just the way I am. Thank you for helping me to run this race with hope and excitement. Thank you for your encouragement, love, support, and prayers. I also dedicate this thesis to all organizations and personnel who continue to fight to reduce food insecurity and hunger in U.S. with passionate heart. Above all, to my best friend, my love, my life, my source of strength, and my good Shepherd, Jesus Christ, who died on the Cross for me, washed away all my sins with His Blood, and gave me the true freedom, true peace, and true love. I am who I am today because of God's grace. All the Glory to God. Forever. Amen.

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CHAPTER 1

INITRODUCTION

Background

Food insecurity, which describes "a household's lack of adequate resources for food, and in any given period the adequacy of those resources is affected by national economic conditions" (Nord, Coleman-Jensen, & Gregory, 2014, p. 1), is a serious policy concern in the U.S. that is identified as being one of the four major different hardship categories--along with health care, housing, and child care--that individuals tend to experience (Boushey & Gundersen, 2001). Many studies that have looked at food insecurity in the U.S. share the same concern about its rapid increase not only among specific vulnerable groups of people, but the overall population in general. The statistics show that there is an increase in percentage of all children receiving food stamps from 13% in 2007 to 22% in 2014 (U.S. Census Bureau, 2016), and 14% of the total U.S. households suffered from food insecurity in 2013 (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2015).

Certain population groups in U.S. are at greater risk of food insecurity, including school-aged children (Jyoti, Frongillo, & Jones, 2005), university students (Gallegos, Ramsey, & Ong, 2014; Hughes, Serebrayanikova, Donaldson, & Leveritt, 2011), pregnant women (Laraia, Siega-Riz, Gundersen, & Dole, 2006), U.S. Iraq and Afghanistan war veterans (Widome, Jensen, Bangerter, & Fu, 2014), seniors (Ziliak & Gundersen, 2014), low income households (Furness, Simon, Wold, & Asarian-Anderson, 2004), and households with a member with a disability

(Coleman-Jensen & Nord, 2013; Huang, Guo, & Kim, 2010; Tarasuk, Mitchel, McLaren, & McIntyre, 2013).

Each of the above studies focused on different groups, yet, regardless of age or sex, those who are at a higher risk of food insecurity tend to have lower health status than those who are food secure. As food insecurity is significantly related to poor nutrition well-being of households, a vast number of studies related to food insecurity have investigated various health outcomes. The negative health consequences of food insecurity can range from physical health to mental health, across all age groups. Some of the negative health conditions associated with food insecurity are deprived sleep (Ding, Keiley, Garza, Duffy, & Zizza, 2015), depressive symptoms (Leung, Epel, Willett, Rimm, & Laraia, 2015), hypertension and hyperlipidemia (Seligman, Laraia, & Kushel, 2010), and different chronic conditions such as heart disease, diabetes, high blood pressure, as well as food allergies (Vozoris & Tarasuk, 2003). Moreover, food insecurity was associated with growth and development outcomes among children (Cook & Frank, 2008; Nord, 2009), dysthymia symptoms in adolescents (Alaimo, Olson, & Frongillo, 2001), functional impairments among elderly (Lee & Frongillo, 2001), and overall mental health problems (Leung, Epel, Willett, Rimm, & Laraia, 2015; Whitaker, Phillips, & Orzol, 2006).

While the above studies looked at the way food insecurity affects health outcomes, Tarasuk, Mitchell, McLaren, and McIntyee (2013) investigated the other way around and found that respondents who had chronic conditions (either physical or mental) were more likely to be food insecure than respondents without any such condition. Noonan, Corman, and Reichman (2013) also found that health conditions, such as depression, could also be a significant predictor for household and children food insecurity. Moreover, households that have one or more family members with a disability tend to be more exposed to food insecurity (Huang, Guo, & Kim,

2010) as well as other hardships (She & Livermore, 2007), due to medical-related expenses and decreased income (Coleman-Jensen & Nord, 2013). Such medical expenses may lead to high levels of unsecured debt and limit future health care access (Doty, Edwards, & Holmgren, 2005), and may decrease and limit employment opportunities for those with a disability (Brault, 2012).

From a larger context, just as diverse groups of people are affected by food insecurity, it cannot be solved by one specific sector of the society, and thus is often discussed from interdisciplinary perspective including human nutrition and health (Nord, 2009; Alaimo, Olson, Fongillo, & Briefel, 2001), environmental sustainability in terms of food production (Fish, Winter, & Lobley, 2013), as well as economics and social well-being of households (Gundersen et al., 2011). Moreover, it is a great interest from the point of view of sustainability of food systems. According to a report by the High Level Panel of Experts on Food Security and Nutrition (2014), a sustainable food system is "a food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised" (p.12). While important, this study delves into the economic side of food insecurity phenomenon from a household's point of view, as food insecurity is often weighed more towards an accessibility and distribution problem (economic or physical) than a supply matter (production) (Gustavsson, Cederberg, Sonesson, Otterdijk, & Meybeck, 2011). In doing so, this study contributes to what is known about household accessibility (both financial and physical) by investigating the roles vehicles, unsecured debt, and disability status play in household transitions into and out of food insecurity over the course of 12 months.

Two recent studies looked at food insecurity and household assets specifically considering vehicle ownership as one of the assets (Chang, Chatterjee, & Kim, 2014; Guo,

2011), and found household assets to be a better measure for the household food insecurity than household income alone. Households with few assets are not only more likely to experience difficulties in meeting a range of basic needs (McKerman & Ratcliffe, 2008), but also are more likely to experience food insecurity (Chang et al., 2014). Furthermore, having reliable transportation is not only critical for accessibility to food resources, but also for employment (Bird, Dolan, & Seiling, 2011). It is important, therefore, to examine the association between vehicle ownership and household food insecurity as vehicle ownership is significantly associated with employment. For example, Sullivan (2008) found that both housing and food consumption fell more for households with a head who is unemployed than for households with a head who is employed.

As household assets have a significant association with food insecurity directly or indirectly through employment, there needs to consideration of a household's other financial status, such as unsecured debt status and its association with food insecurity. The reason for this is because consumers' outstanding debt balances have been increasing since late 1990s (Federal Reserve System, 2016), and high debt levels put financial strains on households that are not well understood. Toward this goal, recent work by Gundersen and Garasky (2012) found a significant association between a household's financial management skills and food insecurity. However, there is no study that has examined households' unsecured debt and any association with transitions into and out of food insecurity. Moreover, in terms of economic resources and financial management, people with a disability, when compared to people without a disability, were more likely to have fewer resources (Parish, Grinstein-Weiss, Yeo, Rose, & Rimmerman, 2010), and greater probability of entering into poverty (Ribar & Hamrick, 2003). This, coupled with evidence from Coleman-Jensen and Nord's (2013) study that identified a significant

Table 1.1 Household Food Security Categories

Group	2010	2011	Definition
1	Food Secure	Food Insecure	Household transitioned into food insecurity
2	Food Insecure	Food Secure	Household transitioned into food security
3	Food Secure	Food Secure	Household always food secure
4	Food Insecure	Food Insecure	Household always food insecure

association between disability and household food insecurity, suggests that it is important to further examine disability status and its possible correlation with household food insecurity. Notably, the research outlined in this thesis improves upon these largely cross-sectional analyses by examining each in the context of household transitions into, and out of, food insecurity over the course of 12 months data from the Survey of Income and Program Participation (SIPP).

Statement of Problem

Through extensive research on food insecurity, it is well known that low income is one of the main determinants for household food insecurity status (Gundersen & Gruber, 2001). Because there also are other correlates of a household's food insecurity status, it is important to look into multiple dimensions of related factors. As shown in Table 1.1, there are different household groups when it comes to food insecurity status over the course of 12 months – those households that are food insecure/secure throughout the entire study period, and those households that make some transition from food insecure/secure to food secure/insecure. The objective of this study is, therefore, to identify the factors that contribute to a household transitioning into, and out of, food insecurity over the course of a 12 month study period (from 2010 to 2011). Of particular interest is whether changes in vehicle ownership, specific types of

debt obligations, and disability status are related to the household's transitions into and out of food insecurity.

A few notable studies have examined household transitions into and out of different economic circumstances, including food assistance program transitions (Wilde & Nord, 2005), changes in household banking status (Rhine & Greene, 2013), and food insecurity status (Hofferth, 2004; Ribar & Hamrick, 2003). Indeed, in their studies, Hofferth (2004) and Ribar and Hamrick (2003) sought to understand the dynamics related to household food insecurity in a manner similar to the current research. Ribar and Hamrick utilized the 1993 panel of the SIPP data and Survey of Program Dynamics, whereas Hofferth used the Panel Study of Income Dynamics (PSID). Although their studies offer insights into household food insecurity, this research offers unique insights by using the first SIPP panel to include more than just one food insecurity assessment.

Contribution of This Study

There are several points where my study contributes to, and expands, the findings from Ribar and Hamrick (2003) and Hofferth (2004). First, I am using newly published 2008 panel of the SIPP data to examine changes in each household's vehicle ownership, unsecured debt (e.g. credit card debt), and disability status. These transitions into and out of food insecurity are identified in the same households over the course of 12 months. Both Ribar and Hamrick and Hofferth examined the changes in disability status in their studies, so I anticipate that the results will be somewhat similar, but updated. However, neither Ribar and Hamrick or Hofferth considered household changes in vehicle ownership nor the role of credit card debt. Moreover, I am also focusing on households with and without children whereas Hofferth's study focused on households with children under the age of 13. Second, in the 2008 panel of the SIPP data, the

food security assessment appears two times (in waves 6 and 9) in one panel for the first time. Hence, using the 2008 panel of SIPP data will be beneficial in this study of examining the change in household disability, asset, and debt status as correlates of food insecurity status over time. Furthermore, Coleman-Jensen and Nord (2013) suggested and recommended using SIPP data for answering research question related to household disability, asset accumulation, and food insecurity. The data will allow me to examine each of the three factors in one study. Since SIPP data are panel data, I may capture how such factors correlate with transitions of household food insecurity status (McIntyre, Pow, & Emery, 2015).

Because the U.S. economy experienced the Great Recession from 2007 to 2009, which ended in 2010, using the 2008 SIPP panel also may be insightful in understanding a household's changing behaviors in food insecurity status that happened during a period of such economic hardship. Mass media and reports (Krzyzek, 2011; Labonte, 2010) now describe the Great Recession as the longest and most destructive economic financial crisis since the Great Depression of 1929.[1] From late 2008 to beginning of 2009 even before the recession was over, as many as 740,000 jobs were cut each month (Mishel, Bivens, Gould, & Shierholz, 2012). Households that became unemployed reduced spending, including about 5.5% decreased spending on food eaten at home and even more on food eaten outside of home. Households also reduced credit card ownership by 2.8%, and increased the level of credit card debt (Hurd & Rohwedder, 2010). Furthermore, compared to year 2008, there were 1.9 million fewer vehicles registered in 2009 (USDT, 2014), and a study considered a possible and yet important reason for such reduction in vehicles in U.S. was the economic crisis that occurred in 2008 (Sivak, 2013). In that sense, the recession alone cannot explain the reasoning behind a household's transition

[1] National Bureau of Economic Research (NBER) reported that the Great Recession lasted for 18 months from December 2007 to June 2009. For more information: http://www.nber.org/cycles/sept2010.html.

into food insecurity between 2010 and 2011, but still it can be helpful in understanding why some changes had to happen to vehicle ownership, credit card debt, and disability which possibly affect household food insecurity transitions.

The Great Recession was so severe that Congress passed the 2009 American Recovery and Reinvestment Act to restore U.S. economy that was hit by the major recession (Mishel et al., 2012). This recessionary period also saw dramatic changes in federal food assistance programs, especially Supplemental Nutrition Assistance Program (SNAP, formally known as food stamp)[2], because of increased need for food assistance and many people became poor and thus eligible for the food assistance due to economic shocks (Oliveira, Tiehen, & Ver Ploeg, 2014). According to Oliveira, Tiehen, and Ver Ploeg's (2014) report, there was a dramatic increase in the participation of SNAP from 2007 to 2010, 26.3 million and 40.3 million, respectively. Such increase was the largest since the program started in the 1960s. On the bright side, however, the U.S. economy started to see the growth beginning early 2010 and about 1.8 million private sector jobs were created (Krzyzek, 2011). Since the SIPP data utilized here include survey responses from earlier months of 2009 and 2010 where the recession was still visible, it would be appropriate to discuss findings from economic and policy point of view.

Research Questions

The purpose of this study is to investigate the effect of dynamic economic resource factors on household's food insecurity transition. Since I am interested in looking at household's food insecurity transitions, I use the 2008 panel of the SIPP data where the food insecurity assessment appears two times in one panel. This allows me to identify such transitioning moves,

[2] There are other federal food assistance programs, such as School Breakfast Program (SBP), Special Supplemental Nutrition for Women, Infants, and Children (WIC), and so on. Such program participations are related to changes in economic conditions, however, the SNAP program participation is the most sensitively affected by the variation in the economic conditions (Oliveira, Tiehen, & Ver Ploeg, 2014)

and other resources that may have changed in ways that affect their food security status. I employ a neoclassical economic framework where individual households are presumed to maximize their utility over time, subject to their constraints. This framework is only slightly adapted for use in a two time period conditional fixed effects model to model changes that occur in non-static factors that may change over time.

A study that applied a similar economic framework was conducted by Rhine and Greene (2006), where they used an intertemporal framework to look at household transitioning behavior in banking status in two periods. As Rhine and Greene mentioned, a household's 'switching behavior (a term Rhine and Greene used in their study to represent household's transition into and out of banking status)' is affected by changes in a household's characteristics or circumstances, specifically socioeconomic or demographic. In their study, they also proposed that there are other important resources as well besides only income, and I adopt a similar approach.

In addition to this framework, I utilize Campbell's (1991) use of risk factors related to food insecurity. Campbell defined risk factors as any factors that limit household economic related resources, such as money, time, information, and health. She further reasoned that such risk factors could be anything that would reduce or hinder a household's employment status, as well as increase in nonfood expenditures such as medical expenses. Therefore, this study defines household changes in vehicle ownership, unsecured debt obligation (credit card), and disability status as main risk factors that may affect household's switching behavior in food insecurity status in a two-time period model.

Studies that have examined determinants for household food insecurity have often used neoclassical static single period model (Rose, Gundersen & Oliveira, 1998). However, it is not

sufficient for multi-period questions, especially when investigating transitioning behaviors in two different time periods. One of the well explained estimation strategies for two-period fixed effects model is done by Allison (2005) in his work. Considering two different time frames for household's food insecurity status, Allison's fixed effects regression model estimation will be appropriate and needed in this proposed study. Detailed theoretical framework will be discussed in Chapter 2 Literature Review section.

Based on the neoclassical framework and existing empirical evidence from the research literature, these research questions are investigated:

1. What percentage of households transition from food secure to food insecure over a 12 month period (from 2010 to 2011)?
2. Does a change in vehicle ownership contribute to households transitioning into, or out of, food insecurity over a 12-month period (from 2010 to 2011)?
3. Does a change in households' credit card debt contribute to households transitioning into, or out of, food insecurity over a 12-month period (from 2010 to 2011)?
4. Does a change in a household member disability status contribute to households transitioning into, or out of, food insecurity over a 12 month period (from 2010 to 2011)?

Justification of Research Questions

When developing the research questions and hypotheses I utilized a pyramid approach. That is, I started with the broad question that was refined into a statement about what I anticipate will contribute the most to the present literature of the correlates of food insecurity. Based on the literature, I expect disability status to be the most serious economic related factor among those three factors that would have higher probability of affecting household's food insecurity status

simply because its rates are high (Meyer & Mok, 2009), disability is a significant element of different types of hardships (She & Livermore, 2007), and it often affects one's employment. Since a person with disability may lack in both human and social capital compared to a non-disabled person (Palmer, 2011), it would reduce the likelihood of gaining desirable skills and thus lead to higher rates of unemployment (Potts, 2005) and lower accumulated net worth than a person without a disability (Parish et al., 2010). Therefore, disabled individual's limited physical and material resources may severely affect employment. Even though a person owns a vehicle and does not have much unsecured debt, if that person has daily activity limitations such as difficulty driving (Cohen, 2006) and managing money due to disability, then he/she may have a higher probability of becoming food insecure.

Moreover, the reason behind setting vehicle factor prior to credit card debt is because there are studies that have looked at how a lack of reliable transportation affects household food insecurity – especially food accessibility (Azuma, Gilliland, Vallianatos, & Gottlieb, 2010; Heflin, Corcoran, & Siefert, 2007; Walker, Keane, & Burke, 2010), and relationship between vehicle ownership as asset and food insecurity (Chang, Chatterjee, & Kim, 2014; Guo, 2011); however, little is known about whether unsecured debt affects households' food insecurity transitions. The above explanation is not to conclude that disability, in general, is the biggest challenge and economic factor that affects households' financial lifestyle, because the hardship level would be different by the types and severity level of disability. Thus, it is simply a function of how the literature review will be introduced in the next chapter with more detailed information.

From a household's economic resource point of view, having a vehicle is crucial because it is related to employment or earned income per se and provides accessibility to food for

households; yet, owning a vehicle would require different expenses – such as repairing cost, insurance cost, traveling cost, management cost, etc. Therefore, owning a vehicle would not directly or may not help a household to make a transition from being food insecure to food secure. However, in this study I assume that a household's earned income through employment by owning a vehicle would be greatly beneficial and weigh more in terms of importance compared to such household's loss of income due to different costs associated with owning and maintaining a car.

Since food insecurity is not a static but instead a dynamic phenomenon, it might be hard to see the true impact of dynamic attributes on household's food insecurity transition over just one year period; for example, a household might have owned a vehicle in the beginning of the study, but still might be unemployed due to a short time period of looking for a job and thus would still be in food insecure status at the end of study period.

Summary

The next chapter provides a literature review on food insecurity in general, its history, as well as detailed literature on three specific factors that I am interested in investigating. It will also present theoretical framework, hypotheses, and the reasoning for those hypotheses. Chapter 3 discusses the methodology used in this study. In this section I present the dataset used for this research, explain dependent and independent variables, as well as the theoretical framework to support my research question and hypotheses. Furthermore, I describe the economic model I used for this study. In Chapter 4, I present the results of the analysis, whereas in Chapter 5 I present conclusions, any possible limitations of this research, and recommendations for future research related to food insecurity transitions among U.S. households.

CHAPTER 2

LITERATURE REVIEW

The purpose of this study is to examine the transitions in household food insecurity status over the one year study period using the 2008 Survey of Income and Program Participation (SIPP) panel data, and I specifically wanted to investigate three factors that might influence such transitions – vehicle ownership as household asset, debt obligation like credit card debt, as well as disability status. The literature review will begin with a background of food insecurity in U.S., the characteristics of those vulnerable households that are more likely to be in food insecure, previous literature about transition into and out of food assistance programs, as well as the factors that may significantly affect household transitions into and out of food insecurity. Following identifying such factors, there will be a discussion of literature focusing on the role that assets such as vehicles play directly or indirectly into household food insecurity status, specific types of unsecured debt obligations, as well as the relationship between household disability status and food insecurity.

Background of food insecurity in U.S.

Even before the term food insecurity arose in United States, it was an obvious issue in poor countries due to a lack of food production that would meet the needs of entire population, and the term and idea of 'hunger' was first introduced in U.S. before food insecurity (Wunderlich, Norwood, & National Research Council, 2006). According to Wunderlich et al. (2006), during 1960s, hunger became an issue in America, which have concerned President Reagan and led him to create what was called the 'President's Task Force on Food Assistance' in

the 1980s. The development of task force report then impacted researchers as well as government agencies to come up with hunger measures in U.S., and in the late 1980s food security question was included in the National Health and Nutrition Examination Survey (NHANES). During the 1990s, different studies examined the validity of food insecurity measurements (Carlson, Amdrews, & Bickel, 1999; Frongillo, 1999; Frongillo, Rauschenbach, Olson, Kendall, & Colmenares, 1997; Hamilton et al., 1997), and in 1995, food security data were first collected among U.S. households in the Current Population Survey (Andrews, Nord, Bickel, & Carlson, 1999). Since then, researchers have investigated the trends, prevalence, as well as severity of food insecurity among U.S. households.

From the Coleman-Jensen, Nord, and Singh's report (2013), *food secure households* are defined as those who have both economical and physical access to enough food for healthy and active lifestyle. Since the concept of food insecurity arose in U.S., there has been a lot of investigation to define the term *food security*, *food insecurity*, and *hunger*, as well as to adequately measure household food insecurity (Wunderlich et al., 2006). Clearly, there are differences in between the term 'food insecurity' and 'hunger'. According to Food and Agriculture Organization (FAO) of the United Nations, the term 'hunger' is related to 'painful sensation' that individuals feel due to a lack of nutritious food energy consumption, whereas 'food insecurity' is related to different factors, such as physical and economic accessibility and availability to nutritious food (FAO, 2008). In acknowledging this, the Committee on National Statistics of the National Academics, at the USDA's request, gathered a panel of experts in 2006 and recommended that there should be a clear distinction between the two terms. Hence, USDA changed "food insecurity without hunger" to "low food security" and "food insecurity with hunger" to "very low food security" (Coleman-Jensen, 2015).

From looking at the definition of 'food insecurity' defined by FAO, one may easily recognize the impact of a household's economic status on food security status. There is some research that has looked at food insecurity status among low income households and found that majority of the food insecure households tend to have low income (Coleman-Jensen, 2011; Ribar & Hamrick, 2003). Thus, household income seems to contribute a large part in explaining a household's experience with food insecurity, yet, as other studies have found, household income alone might not be a significant predictor of a household becoming food insecure (Chang et al., 2014; Guo, 2011). Other than income, literature found a significant association between food assistance program participation and food insecurity. However, the finding is inconsistent throughout the literature. DePolt, Moffitt, and Ribar (2009) found an association between food stamp participation and fewer food hardship, whereas Wilde and Nord (2005) found that households that participate in food stamp program were more likely to enter food insecurity. Furthermore, Nord (2013) and Mayer, Hillier, Bachhuber, and Long (2014) found that compared to those who do not receive any food assistance, those who receive SNAP, benefits experienced worsened food insecurity and were more likely to be food insecure.

Moreover, in predicting food insufficiency, Rose, Gundersen, and Oliveira's (1998) study found that the effects of race were ambiguous across models, yet, different studies found that those who are Black or Hispanic (Cook & Frank, 2008; Mammen, Bauer, & Richards, 2009) were more likely to be food insecure. Education was also significantly associated with household food insecurity (Ribar & Hamrick, 2003). High school graduates (Alaimo, Briefel, Frongillo, & Olson, 1998; Gundersen & Garasky, 2012; Rose et al., 1998) and households with an adult who is a college graduate (Nord, Coleman-Jensen, & Gregory, 2014) were less likely to be food insecure. In terms of household type, those never married, cohabiting, divorced or separated

(Hanson, Sobal, & Frongillo, 2007) and female-headed households (Coleman-Jensen, 2011) were more likely to be food insecure. Moreover, homeowners were found less likely to be food insecure (Bartfield, Dunifon, Nord, & Carlson, 2006; Chang et al., 2014; Gundersen & Gruber, 2001; Guo, 2011; Rose et al., 1998). In terms of age, Strickhouser, Wright, and Donley (2014) found that as age increases the rate of food insecurity decreases, and thus, seniors were less likely to be food insecure (Bartfield et al., 2006; Rose et al., 1998).

In addition, children present in the household (Furness, Simon, Wold, & Asarian-Anderson, 2004; Ziliak, Gundersen, & Haist, 2008), households without health insurance (Gundersen & Garasky, 2012), households with heads who are unemployed (Coleman-Jensen, 2011), those who report poor health conditions (Vozoris & Tarasuk, 2003), and households with incomes at or below the poverty line (Coleman-Jensen, Nord, & Singh, 2013) were also more likely to be food insecure than their counterparts.

Household Transitions Various Circumstances

According to the report of FAO (2008), there are two types of food insecurity – chronic and transitory food insecurity. The latter one is temporary where a household transition into or out of food insecurity in short-term period. As the definition itself tells, such transitions occur when there is a sudden reduction of accessibility to sufficient and nutritious food, and it may result from economic related factors, such as change in food prices as well as an unexpected change in income. Furthermore, what they have suggested to alleviate the risk of transitory food insecurity was to better utilize safety net programs, such as SNAP and other assistance programs that would help households and provide them with resources to and means of economic opportunity to access to food needs. However, there are debates and contradictory findings of measuring such programs' influence on household food security status (Gundersen & Oliveira,

2001). It seems to be an ongoing challenge to policy makers. Previously, Gundersen and Oliveira (2001) and Wilde and Nord (2005) investigated the impact of household food stamp participation on food security status. Wilde and Nord's study specifically focused on controlling for variables which are not observed but may have effect on household's decision on program participation and their food security status. Gundersen and Garasky defined such an 'unobserved variable' in a simpler way in their study. They defined it as the variable that may play an important role in explaining household's food insecurity but are not available in data sets.

In Wilde and Nord's (2005) paper, using the Consumer Population Survey (CPS) data, they found that those who were food secure in the first year tend to be food secure in the second year; however, only less than half of those households that were food insecure in the first year became food secure the next year. Interestingly, the authors found a strong association between food security transitions and food stamp transitions, which means that a household's transition into the food stamp participation was associated with the increase in the likelihood of entering into food insecurity. To investigate the impact of such safety net programs on household food security, the study examined household food stamp participation status transition and food security status transition, and measured their association at the same time. Importantly, they concluded that those unobserved factors that might affect households transitioning into and out of food security as well as food stamp participation are likely to be dynamic and affected by time, such as unanticipated economic hardships that happen to households from one time to another. However, they only looked in between two years, and there might be a probability that those households that left the program and stayed food secure the next year may have rejoined the program a few years after. Therefore, it would be insightful to examine such transition in a longer period of time.

Another study by Nord and Coleman-Jensen (2010) investigated the reasons food insecure households exit from the SNAP even when they still do not meet the food needs. One thing to consider when it comes to food insecurity among SNAP participants or "leavers" would be that even though they have SNAP benefits, most of them might not know how to eat healthy and thus might lean towards unhealthy food choices. Realizing such issues and to help SNAP participants to get the most out of the benefits, Fair Food Network organization came up with a program called, 'Double Up Food Bucks', where they help SNAP recipient families to access to fresh produce, and get the doubled amount of fresh vegetables and fruits (Double Up Food Bucks, 2015). Their creative strategies are to help both low income families, local farmers, as well as local economies through the program, and ultimately, to bring sustainable food systems into communities. Almost always preparing for healthy food needs time, money, resource, and transportation to get ingredients and cook, which would then require households to have market accessibility, knowledge for cooking, as well as ingredients and utensils to cook. In addition to answering the question of what factors affect households to exit the program, Nord and Coleman-Jensen's (2010) main contribution to the literature was to look at the difference in the severity of food insecurity condition among the households that left, came back, and stayed in the program during the study period. The authors wanted to look at the groups that made the transitions in program participation in between the study years. They looked at factors such as change of income, employment, as well as demographic and economic characteristics, as possible determinants of a household's decision to exit the program. As a result, they found that better income and employment, as well as higher SNAP benefits were positively associated with households leaving SNAP.

Changes in economic characteristics, such as increase in income and getting improved employment status were also found to have a positive impact on coming out from hunger condition (McIntyre, Walsh, & Connor, 2001). However, in contrast to previous study, Nord and Coleman-Jensen (2010) looked at longer time period and found that for those households that once exited the program and stayed off of the program in the future, their food security status seemed to continue to improve. Yet, they did not specifically consider those time varying unobserved factors and therefore did not take into account of using fixed effects model. Another study by Heflin, Corcoran, and Siefert (2007) looked at the transition in food insecurity status over the study period using Michigan welfare recipients, and they specifically wanted to examine the factors that might have influenced such change. The study also investigated why some households are still food insecure even when they transition from relying on social welfare benefits to gaining employment, while other households become food secure. They took into consideration of including health, transportation expenses, childcare expenses, as well as net income, and found an association between mental health problem, available financial resources, and food insufficiency.

Furthermore, there is a study that has looked at the transition into and out of disability between two years, and examined a household's probability of becoming food insecurity (Huang, Guo, & Kim, 2010), which will be further explored in later part of the literature review. Another study, on the other hand, investigated how the changes in families' different circumstances and factors affect their transitions in bank status from banked to unbanked (Rhine & Greene, 2013). Rhine and Greene (2013) specifically focused on changes in circumstances, such as decline in income, loss of employment, loss of health care coverage, and homeownership and found all those factors significantly affect the likelihood of households becoming unbanked. Even though

they found income to be a significant influence on transitioning into unbanked, income may not be the sole significant determinant of a household's transition into and out of food insecurity as previous studies used household assets instead of income (Chang et al., 2014; Guo, 2011).

Factors Possibly Affecting Transitions

There are four different dimensions of food security: food availability, food accessibility, food utilization, and food stabilization (FAO, 2008). Based on the literature, households with a member with disability tend to be at a higher risk of food insecurity. Disability status may also affect employment status and therefore, a household might not be able to satisfy all those four dimensions of food security. In terms of food accessibility, it is a matter of how individuals can access food. Without their own vehicle or other transportation, households cannot easily access to food market (Azuma, Gilliland, Vallianatos, & Gottlieb, 2010) because they might be living in a neighborhood far from a market. Also, households would need reliable transportation because access to transportation is either directly or indirectly related to other economic activities such as employment (Bird, Dolan, & Seiling, 2011). Furthermore, there is not a single study that has looked at whether credit card debt puts households into food insecurity or not, but due to paying off different types of debt and bills, households might not be able to consume enough food (Tarasuk, 2001). This would imply a lack of economic accessibility and stability of food. For further support on this phenomenon, considering paying off bills as one of the financial management skills or behaviors, Gundersen and Garasky (2012) found a significant relationship between a household's financial management practices and food insecurity status. This shows that there is a need to further investigate the correlation between any household debt obligations and food insecurity transition.

Generally, in order to consume appropriate food for a day, households would need time, money, and resource to cook and shop for ingredients, as McLaughlin, Tarasuk, and Krieger (2003) found an association between the number of home food preparation and nutrient consumption among food insecure women. As food insecure households tend to experience different material hardships and give up services (Loopstra & Tarasuk, 2013), those households with a member with a disability, with accumulated debt to pay for, or without a reliable transportation may have to make a relatively larger portion of tradeoffs between food and other services necessary for daily life. Moreover, treating time as one of the costs as a theory of the allocation of time assumes (Becker, 1965), such households with the above conditions may not have enough time to produce food as commodity or might have to spend more time to access to food than other households, and thus may be more exposed to food insecurity.

There are studies that have looked at the factors that affect household food security transitions, relationship between health outcomes and food insecurity (Seligman, Laraia, & Kushel, 2010; Stuff et al., 2004; Vozoris & Tarasuk, 2003), as well as factors associated with households' exits from food assistance programs (Zedlewski & Gruber, 2001; Jolliffe & Ziliak, 2008; Nord & Coleman-Jensen, 2010). However, there is no study that has looked specifically at whether household changes in vehicle ownership as well as credit card or other unsecured debt significantly and to what extent affect household transitions into and/or out of food insecurity. As mentioned earlier, both of Ribar and Hamrick's (2003) and Hofferth's (2004) studies investigated which factors are significantly associated with entry and exit of food insufficiency and they also looked at the changes in disability status in between two years. In this study, however, I would like to expand from their studies and update on the association between disability and food insecurity transition, because the rate of work limiting disability rate has

increased from 2003 to 2014, from 7.4% to 8.4% (Disability Statistics, 2013). Those specific three main factors might be interrelated; and there might have endogenous problems between each of those factors and food insecurity, which then may be difficult to fully understand and investigate the direction of the effect. Therefore, this study will examine possible correlation between the changes in three main factors and household food insecurity status transitions.

Primary Variables of Interest

I. Role that assets/vehicles/transportation resources play

Previous studies that have looked at the association between household assets and food security status focused on household assets instead of income, and also used vehicle ownership as one of the household assets (Chang et al., 2014; Guo, 2011). It is especially critical to look at a household's asset status, because low income households tend to have low assets compared to high income households, and such low asset holdings bring households difficulties in meeting basic needs as well as getting economic opportunities (McKernan & Ratcliffe, 2008). A study by Guo (2011) investigated whether household assets help alleviate food insecurity condition and provide security for households where they can have stable food consumption. Along with other assets such as savings and mutual fund or stocks, he found vehicle ownership as a significant determinant to household food insecurity status rather than income among low income households.

Furthermore, as Gundersen and Gruber (2001) found, Guo's (2011) finding on the importance of different buffering effects of household assets on food insecurity shows savings as an asset that provides a means of available economic resources to spend on food and thus secure consumption, but his findings did not fully explain whether vehicle ownership as an asset acts as a protective factor towards household food insecurity. It may be the fact that households could

easily pay for foods with their saved money and savings play an important role in protecting the household's food consumption when they experience income loss, whereas a household's vehicle ownership as assets may provide a means of physical accessibility to food but not immediate available money. In terms of accessibility to food, households would need both economical and physical access to food (FAO, 2008), and so both savings and vehicle would be critical and necessary in acquiring food. However, in Guo's (2011) study, savings seemed to be more important factor than vehicle ownership in times of economic hardship that households face due to economic resource shocks. Still, vehicle ownership as an asset is a significant determinant of household food insecurity (Chang et al., 2014). Overall, these above studies have emphasized on the importance of using household assets when looking at the relationship between household economic resources and food insecurity (Guo, 2011).

Likewise, although a household's returning to food insecurity state was found to be affected by persistently low income (McIntyre, Pow, & Emery, 2015), the fact that income is not a perfect measure or determinant for household's food insecurity status has been known since the late 1990's. Alaimo, Briefel, Frongillo, and Olson's (1998) as well as Rose, Gundersen, and Oliveira's (1998) study found that food insecure households tend to be in the lower income group, yet, some households in upper income groups were also found to be food insecure. Food insecurity hardship does not appear in only low income groups, because food insecurity phenomenon is dynamic (Rose, 1999) and tends to be affected by changes in economic situations that could happen to any household. Andrews, Nord, Bickel, and Carlson's (1999) research also supports this by finding that even though low income households were more likely to experience food insecurity and hunger, there were still some low income households that were food secure – meaning that some of the time varying economic related factors that could affect a household's

economic resource availability such as food security condition, could not be accurately captured by the household's annual income measure.

Furthermore, in their study of considering different dynamic financial events and resources and its effect on household food insecurity, Gundersen and Gruber (2001) did not find a correlation between household income and food insecurity. Therefore, by looking at the literature and considering what they suggest about household asset ownership as being a more accurate measure than income when studying household food insecurity phenomena, this study will look at the effect of vehicle ownership as a household asset. I will also include a household's homeownership as one of the variables in looking at transitions into and out of food insecurity as other studies have found a significant association between homeownership and food insecurity status (Chang et al., 2014; Guo, 2011; Marco & Thorburn, 2008; Rose et al., 1998). However, I put more importance on vehicle since it provides physical accessibility to food stores or food sources for households. Since household assets can be liquidated in the times of need and used to mitigate the unexpected loss of family economic resources, the role vehicle ownership plays in a household's food insecurity transition will be important to consider. Moreover, since both direct and indirect effects of household assets on food insecurity is significant, it would be appropriate to include vehicle ownership as possible significant predictor for household food insecurity transitions.

Studies that have looked at the transportation access for low income families highlight that those families tend to live in a disadvantaged environment, which could be define as a place with a lack of public transportation and that many of the families may not have their own reliable vehicle (Azuma et al., 2010; Bird et al., 2011; Fletcher, Garasky, Jensen, & Nielsen, 2010; Walker, Keane, & Burke, 2010). In some rural places, low income residents without a reliable

transportation choose to walk to stores. Even though the neighborhood stores offer variety of food products, residents' purchasing decisions are heavily affected by high prices of the food available in the stores (Hendrickson, Smith, & Eikenberry, 2006). Having their own vehicle tends to have a significantly negative association towards food insecurity (Chang et al., 2014; Guo, 2011), as well as accessibility to food services among low income households in Montreal city, Canada, as Paez, Mercado, Farber, Morency, and Roorda (2010) found in their study. Generally, it may be the case that because households have transportation they can access food sources which could possibly reduce an accessibility portion of food insecurity, but also that having a vehicle would allow households to shop for and access lower priced food items (Fitzpatrick & Ver Ploeg, 2010), which could then result in reduction to some burdens of the total household food expenditures.

Moreover, even as early as late 90s in America, some households experienced food insecurity due to a lack of access to a vehicle. In the 90s, Alaimo, Briefel, Frongillo, and Olson (1998) found that among the responses to a question asking the households about the reasons they experienced food insecurity, not having a reliable transportation was the second most common response that they answered. Yet, even if they do have their own vehicle(s), it might be costly for them to own a car due to repairing and maintaining the vehicle and furthermore, a household's accessibility to a reliable transportation is especially significant for employment (Bird et al., 2011). Similarly, having a reliable vehicle and/or access to transportation is critical, because it may improve the household's economic outcomes, especially that of low income households (Fletcher et al., 2010). Moreover, Raphael and Rice (2002) found that there is a strong relationship between vehicle ownership and probability of labor force participation, and

also found that the probability of engage in employment and working hours differed significantly depends on the study respondents' vehicle ownership response.

Also, a study by Fletcher, Garasky, Jensen, and Nielsen (2010) investigated a relationship between transportation barrier and access, and economic outcomes, especially employment, that rural low income families tend to face. By combining three studies conducted in Iowa, they found that a major key to improve economic conditions were to reduce transportation barriers as well as to increase transportation access. This result seems to be critical, especially to rural low income households. As the study emphasized the importance of having accessibility to a reliable transportation, without such access the rural families tend to experience more hardships than families who live in urban area (Bird et al., 2011). A study by Bird, Dolan, and Seiling (2011) provided two different possible results of having an asset, especially a vehicle. They suggested that having a reliable transportation is vital for improving family's overall economic status, but on the other hand, having assets such as vehicle may put rural low income families into more hardships due to the fact that it may decrease their eligibility for government supportive programs (Gundersen & Gruber, 2001). Hence, it is critical to look at the asset, especially vehicle and transportation, from two sides – whether owning a vehicle indirectly affects household food insecurity through employment, or directly through accessibility to markets or food.

There is also an association between food consumption, the head of the household's work status, and the household's food insecurity status (Coleman-Jensen, 2011). A study by Sullivan (2008) showed the association between employment and food and housing, in that food and housing consumption fell more for households with head who is unemployed than for households with head who is employed. As transportation barriers may hinder low income

households from getting stable employment, it may also hinder those households from getting healthy diet (Rose, 2010) due to possible transportation costs and expenses related to acquiring food. It seems that transportation is a critical mechanism to access to food for low income households, however, a study by Kirkpatrick and Tarasuk (2010) did not find any association between costs for transportation that households incurred to and from the grocery shopping and whether they were food insecure. In contrast, though, Heflin, Corcoran, and Siefert (2007) have found a positive relationship between transportation expenses and food insecurity even the significance was small.

II. **Specific types of debt obligations**

When examining economic determinants of food insecurity in the United States, Rose (1999) pointed out the importance of considering changes in recent economy, in order to better realize and understand the food insecurity issue among households. If Rose's study emphasized the impact and importance of economic changes on food insecurity even back in late 1990s, it would be critical to look at such changes in today's market, such as recent changes and boom in credit cards market, as well as increase in consumer debt. Since the opening of credit cards to individuals, using credit cards has become a convenient and common way to meet consumers' basic needs, because credit cards allow consumers to borrow their future income today. While access to credit has become easier for both low and middle income households, as a result, they have a substantial amount of debt where they have to pay interest on (Pressman & Scott, 2009).

A study by Pressman and Scott (2009) argued that such interest that must be paid on debt needs to be included in the survey and data when looking at household debt, because interest payments reduce household's purchasing power to buy goods and services.[3] They further

[3] SIPP data do not include questions related to interest that must be paid on the use of household's debt.

proposed the differences between households that are counted as poor and debt poor – those who are in the poor category under government's poverty threshold, and those who are not counted as poor but cannot purchase goods and services due to interest payments they have to pay on borrowed credit, respectively. According to the Federal Reserve System's historical data on consumer credit, consumers' outstanding credit debt was $406.1 billion in 1995, $814.1 billion in 2005, and now it has reached up to $910.2 billion as of June, 2015 (Federal Reserve System, 2016). The data showed, however, that during the year 2008 it exceeded $1,000 billion and was reduced to more than $900 billion in 2009. This suggests that there was a rapid increase in total consumer debt in 2008 until the financial crisis hit the market and it started to decrease during the year 2009; yet, it started to rise again from late 2011 and up until now. Furthermore, the average credit card debt among U.S. households was $15,762 as of Q4 (October, November, and December), 2015 (Issa, 2016).

Today, many households are buying consumer goods such as food on credit, and those who are in low income families tend to rely on credit to supplement their short incomes (Fellowes & Mabanta, 2007). However, this would not always be the case. In a study of looking at factors and household food insecurity, Tarasuk (2001) found that among the respondents' responses on the kinds of strategies the households use when experiencing food shortage, 'purchased food on credit' was least reported. Also, Sullivan's (2008) study found that the households that are very low in assets were still vulnerable in terms of accessing to credit market, and they often experienced low credit limits and also received denial for more credit limit. Furthermore, a study by Thomas, Desai, and Seenivasan (2010) showed an interesting finding that the respondents found themselves using credit cards to be relatively painless and easy to make impulsive decisions than using cash payment, and so they were more likely to

purchase unhealthy foods when they paid with credit card. Therefore, even if households have credit access to buy foods, it would not always lead to purchasing nutritious food. However, still, as it seems that the households depend on credit sources during economic crisis, considering changes in financial market trend, especially credit card market, as well as household's use of credit card would be insightful in looking at the correlation between changes in credit card debt and its effect on household transitions in food insecurity status.

In their study, Gorton, Bullen, & Mhurchu (2009) collected articles and developed a literature review to examine environmental impacts on food security especially in high income countries, and found the household financial resources as a leading factor among other factors that is associated with food security. Moreover, other studies have found that credit access factors (Gundersen & Gruber, 2001), low financial resources (Heflin et al., 2007), household's asset and liquidity constraints (Chang et al., 2014) and financial management skills (Gundersen & Garasky, 2012) are associated with food security status. Furthermore, a study by Ribar and Hamrick (2003) showed that not the income but income-to-needs ratio was associated with transitioning into and out of food security status. The fact that several studies have already started to investigate the relationship between the household financial factors and the household food insecurity may signal the importance of the correlation between financial resources and household food insecurity transition. However, the effect of a household's unsecured debt and its effect on household food insecurity transition is not studied well, and it needs a more attention from a household perspective, because there seems to be a close linkage between household food insecurity and household financial insecurity (Tarasuk, 2001). These above studies have found in common that the household's financial resources were better represented by assets than household income when exploring food security status. Again, income alone is not enough to

address household food insecurity issue because food insecurity is dynamic and not a static condition (Rose, 1999), and what is more important seems to be the household's financial management practices from the economics point of view.

As mentioned earlier, financial management skills were found to be significantly associated with the likelihood of becoming food insecure, where households with better skills were less likely to become food insecure and vice versa (Gundersen & Garasky, 2012; Fitzpatrick, 2013). Since paying off bills is considered as one of the financial management practices, considering the association between any kinds of financial debt and a household's transition into and out of food insecurity would be important and critical to look into. Gundersen and Garasky's (2012) study emphasized that there is a need and room for a research to explore such relationship and see whether changes in household's behavior towards debt or change in household's debt amount are significantly associated with household food security transition status. Furthermore, a study by Lent, Petrovic, Swanson, and Olson (2009) found that chronic health status may affect a household's ability to accumulate income, which then may put them into the risk of food insecurity; yet, Tarasuk, Mitchell, McLaren, and McIntyee (2013) found a significant association between household's health status and food insecurity even after controlling for economic resources such as household income and home ownership. This might mean that there are significant factors, other than just income, that might affect household food insecurity, and the transition into and out of food insecurity. Ultimately, my study presumes that household debt obligations could be one of those significant factors.

Access to credit allows low income households to have usable income, but at the same time the debt level for low income households have increased substantially (Fellowes & Mabanta, 2007). However, this increase did not happen after the 2008 financial crisis as Lusardi

and Tufano (2009) found that more than 40% of households struggled with debt in late 2007 before such crisis occurred. They specifically focused on debt literacy and found that the households had very low levels of debt literacy, in which household members did not understand how credit cards or interest rate works. Furthermore, vulnerable populations, such as low income households, elderly, women, and certain minorities, were limited in understanding how debt works, and that those with less knowledge towards credit card paid a larger portion of fees. Lusardi and Tufano's study seemed to raise the concern for households that may be paying more fees that could be avoided if they had known how interest rates, credit cards, or debt worked, and I expect that there may be food insecure households with lower income or wealth that are exposed to huge credit card debt due to low debt literacy. Therefore, as a very large population carries debt in U.S., it could be critical to look at how food insecure households deal with debt management and whether debt has a significant association with the transition of household food security status. Moreover, debt was found to increase material hardships because it makes the households pay for the interest rather than using their economic resources to invest in consumption, savings, or asset accumulation (Tach & Greene, 2014). As Lusardi (2011) mentioned the importance of looking at the household debt and debt management in addition to asset in order to understand financial capability, I assume that the debt would have a significant correlation with household food insecurity, as food insecurity can be presented as a part of household's financial capability due to its relation to household's economic resources.

As households that hold debt have to make tradeoffs when dealing with it, a study by Tarasuk (2001) examined a relationship among women's food intake, self-rated health, and household resources, and found that women tend to give up food money for other goods and services, and also give up money for food in order to pay for accumulated debt and other

necessary bills. For the households with any kinds of diseases that need to rely on medication, however, such necessary bills could be medical expenditures, and they often times would need to make tradeoff decision between the food and medical expenses. As such, a study by Berkowitz, Seligman, and Choudhry (2014) have used an interesting phrase 'Treat or Eat' to express the difficulty and the complex tradeoffs the adults with chronic disease have to deal with between their medication cost and basic needs such as food. They found that many study participants could not afford food or medication, or even both, and that adults in food insecure status are at high rates of insufficient medication consumption. What seems to be remarkable and important with this finding is that food insecure adults still experience insufficient economic resources to meet other basic needs in their lives, which further raises a question that whether such adults would ever have enough of food and enough of other necessary needs at the same time. As like the phrase that they used, 'Treat or Eat' could be applied to different vulnerable populations who are constantly facing tradeoffs between food and other necessary needs. Such tradeoff cycle would keep households living under insufficient condition where they would hardly meet the full basic needs.

Furthermore, a study by McPherson (2006), which investigated the specific reasons to why people use food banks among current food bank clients, found that over 12% of those who use food banks have accumulated debt. Although one cannot conclude that all the food insecure households use a food bank and that food bank clients are food insecure, the fact that actual food bank users stated debt as one of the reasons using food bank (McPherson, 2006) seems to signal that there might be a significant relationship between household debt and food insecurity transition. However, Chang, Chatterjee, and Kim (2014) investigated the relationship between a household's debt burden, such as financial strain, asset inadequacy, and insolvency, and the

likelihood of increase in food insecurity, and did not find debt to be a significant predictor of household food insecurity. Instead, they found that household asset hardship, such as being liquidity constrained, was correlated with SNAP participation. Another study that looked at the factors that affect household exits from the food assistance program, and the difference in severity of food insecurity status among those who left SNAP and currently stayed in SNAP, found that a large portion of the sample who left the program still remained in food insecure due to accumulated debts (Nord & Coleman-Jensen, 2010). Furthermore, in a study of low income households' spending patterns, more than 25% of those who participate in SNAP had accumulated debt (Castner & Mabli, 2010). I expect that such findings about the relationship between food insecure and accumulated debt could be expanded through my study.

Moreover, the above findings might draw the conclusion that debt put households into food insecurity; however, one cannot argue that households that have more debt tend to be food insecure, as households with less income does not always mean they are food insecure and vice versa, especially when households hold other assets. One possible explanation for a predictive positive relationship between debt and food insecurity might be that the food insecure households tend to have lower savings rate that would not be enough for them to weather any unexpected expenses or income shocks (Gundersen & Gruber, 2001; Olson, Rauschenbach, Frongillo, & Kendall, 1996). Both Gundersen and Gruber's (2001) and Olson, Rauschenbach, Frongillo, and Kendall's (1996) studies investigated a household's economic issues and resources as well as their financial behavior or management practices and food insecurity status. As both studies found a lack of savings as one of the significant factors that would increase food insufficiency, lacking in savings or facing liquidity constraints would probably lead households into using credit market and may cause them to use high interest credit products or have debt.

From this perspective, one could write a scenario where the food insecure households started off with low income compared to food secure households, which cause them to lack in savings and to find access to credit market as probably the most convenient method for covering up the food expense, and it would eventually put them into debt trap cycle.

Using the credit as smoothing consumption method for daily food may have different point of view – some might think using credit is a bad practice because it creates debt, and vice versa, as it may be also related to their confidence in financial management ability (Gundersen & Garasky, 2012). Yet, some studies have found that accessing to credit or financial market should be encouraged that it may improve household food insecurity status (Zeller & Sharma, 2002; Zeller, Scherieder, Braun, & Heidhues, 1997). For some households, access to credit markets would be the only option, other than any program benefits or informal supports from families and friends.

In general, some may have accumulated debt due to business, education, etc., but still might have enough access to nutritious food, whereas some low income households that have relatively less debt due to limited access to financial market still might not have access to nutritious food. Perhaps, those households that are financially struggling might get support from government or family and friends, and thus might be able to avoid food insecurity for a short period of time. As income alone cannot easily predict the household's food insecurity status, the role unsecured debt obligation plays in predicting household food insecurity status seems to be complicated as well. Also, with the significant increase in household debt and food insecurity in the nation, it is crucial to further explore the association between household debt and household food insecurity transition. In this study, I am trying to look at whether household changes in the

use of credit and or debt put a greater risk on the household's transitions into or out of food insecurity.

III. **Disability and Food Insecurity**

Disability is considered as a "dynamic process" (Huang, Guo, & Kim, 2010, p. 120), and it is defined as a "physical or mental impairment that substantially limits one or more major life activity" under the Americans with Disabilities Act (Americans with Disabilities Act of 1990, 2009). The act also defined the major life activities as things that are based on and related to the human's basic five sense organs, such as seeing, hearing, smelling, tasting, touching, and SIPP data includes the most of such life activities defined by the act. More specifically, *Americans with Disability: 2010* report categorized disability into two different types – severe and non-severe, and applied different age range to some of the specific types of disabilities (Brault, 2012). Dividing into two types seem to be important in examining the disability issue and its prevalence in America, because the report have found differences between individuals with severe and non-severe disability in terms of some of the economic conditions such as employment and poverty rate. In addition, Huang, Guo, and Kim (2010) suggested the importance of knowing the severity and type of disability in order to examine the relationship between disability and food insecurity. Moreover, severity of disability works as a common eligibility criterion for social programs that are available for persons with disabilities (Palmer, 2011), thus, considering severity and duration of disability would be helpful in understanding a household's severity of food insecurity as well.

In terms of severity of disability, however, it would be different for every disabled individuals, because based on which or how many types or symptoms of disability an individual has, he or she will be classified as either severe or non-severe disability, and this might affect the whole household's economic issues differently (Meyer & Mok, 2009). The Americans with

Disability report used the SIPP data and has found an increase in the rate of disability population among United States between the years of 2005 and 2010 (approximately 2.2 million increase). This finding is somewhat significant and it would be necessary to look at the changes in disability rate during those years, because my study uses the 2008 panel of SIPP, which shows disability status between the years 2008 and 2011. Not only the disability rate has changed, but also, according to the *2015 Disability Statistics Annual Report* (Kraus, 2016), employment percentage for those with disability kept decreasing since 2008; however, from 2009 to 2010 the percentage dropped comparatively at a lower rate than it did from 2008 to 2009. Furthermore, the statistics data showed that the median earnings for those people with disabilities decreased from 2008 to 2009, but there was a slight increase from 2009 to 2010.

However, as different studies have supported, compared to people without disabilities, people with disabilities had significantly lower earnings (Brault, 2012; Meyer & Mok, 2009), thus, such slight increase in median earnings might not be large enough for them to cope with economic hardships related to disability. On the other hand, the report proposed that during the time frame, the poverty rate for those with a disability increased, and the rate was a little more than doubled compared to those without disability. To help such individuals with disability and households with member(s) with a disability, the United States has various benefits and programs available for them such as, food and nutrition assistance, housing assistance, health care, social security benefit, and so on (Benefits.gov, 2016). However, with a significant increase in the disability rate in the nation, and as so many different symptoms could be categorized under disability and thus many people could be easily considered as disabled, it might be critical to continuously lookout for this population and their living situations from both economic, physical, and social perspectives.

In terms of the characteristics of being food insecure individuals, different studies have found that those individuals were more likely to be disabled (Leete & Bania, 2010; Ribar & Hamrick, 2003; She & Livermore, 2007). Leete and Bania (2010) have found in there study that the households that have a member with disability were two times more likely to be food insecure, and disability also appeared to be a risk factor in predicting household food insecurity (Coleman-Jensen & Nord, 2013). Moreover, a disabled person's food intake or diet has been found to be worse compared to a non-disabled person, and also had a higher decline in income and food consumption (Meyer & Mok, 2009). Yet, there is still room for looking at the relationship between disability and food insecurity, and my research is trying to examine a possible correlation between the changes in disability status and a household's transition into and out of food insecurity over one-year period. As disability was found to have a significant effect on the various types of hardships for working aged adults, including food insecurity (She & Livermore, 2007), and may put them at the risk of such hardships, it is important to examine disability and come up with policy and programs to alleviate food insecurity among disabled households. A study by Huang, Guo, and Kim (2010) investigated the association between disability and food insecurity, and they wanted to look at the transition into and out of disability between two years, 1997 and 1999. Specifically, they focused on three mechanisms proposed by Heflin, Corcoran, and Siefert's (2007) study – "coping abilities, work-related demands, and resources" (Heiflin et al., 2007, p.8). However, due to the lack of measures in PSID data that is utilized in their study, Huang et al. (2010) only tested two mechanisms, which are household resource availability and competing demands.

Even though Heflin, Corcoran, and Siefert (2007) did not take into account of disability factor in their study of predicting household food insecurity transitions, it seems worthwhile to

note and consider how they theorized individuals' constraints in each mechanism and apply them in the association between disability and food insecurity as Huang, Guo, and Kim (2010) did in their study. For resources available for households, Huang et al. (2010) specifically focused on household assets, such as net worth, liquid assets, and homeownership, as assets may provide smoothing consumption for the households and help them in the times of economic hardships. On the other hand, for competing demands, they utilized household food costs as well as out-of-pocket health expenditures for the people with disabilities would normally use and need more health services than non-disabled individuals, and thus would face more tradeoff between taking medication and purchasing food (Berkowitz et al., 2014). They found a positive association between disability status and food insecurity, and also that even at the same level of economic resource availability, households with disabled household head were significantly at economically disadvantaged position compared to households with non-disabled household head. Consistent with other studies, they also found household assets to be a better representative of household financial resources in terms of food insecurity than income, and that it plays an important role of protecting disabled people from the risk of food insecurity. Yet, they did not consider vehicles as one of those household assets under resource availability. Furthermore, they did look at how the changes in disability status affect food insecurity and took into account of disability status of household heads and their wives, however, they did not consider the effect of their children's disability status due to the unattainability of disability status of other family members in the data.

Compared to non-disabled people, disabled people tend to be vulnerable in terms of economic resources as they have fewer resources (Coleman-Jensen & Nord, 2013; Parish et al., 2010), where it might affect their employment and poverty rate (Wang, 2005). A study found

that those who become unemployed due to disability were found to be 12 to 15% more likely to be food insecure (Nord et al., 2014). Having disability might not only affect their employment rate and poverty rate, but also it might be critical when it comes to food insecurity through indirect relationship. In terms of entering into poverty, Ribar and Hamrick (2003) found that disability is one of the factors that puts individuals into higher probability of entering poverty. What is more, Groce, Kett, Lang, and Trani (2011) investigated the complex relationship between disability and poverty, and proposed the importance of understanding broader causalities that exist in such relationship. Specifically, they mentioned disability and poverty at the household level as family member's disability status would affect the household's economic resources which may result in reducing basic expenses such as food. In the same context, Palmer (2011) proposed that disability significantly affects other members in the household, and thus it is 'not an individual phenomenon' (p. 213). The authors seemed to thoroughly understand the dynamic and challenging issues that disabled individuals experience beyond a simple poverty environment. Both studies tended to propose that the problem of the relationship between disability and poverty is more embedded within the social problem or system that would hinder disabled individuals from addressing basic needs and accessing resources such as food, education, employment, health, social supports, and so on. The argument that both authors made about the significant impact of one family member's disability status has on the entire household's economic well-being seems to signify the importance of examining household members' changing in disability status in looking at household transitions into and out of food insecurity.

Moreover, not specifically defined as disability, but health problems that limit individuals' coping capabilities in daily activities, such as mental health problem or physical

limitation were significantly associated with probability of reporting food insufficiency among a study sample of women in Michigan (Heflin, Corcoran, & Siefert, 2007). A study by Heflin, Corcoran, and Siefert (2007) concluded that having such health problems that limit women's coping skills and lacking resources for basic needs are most important determinants that affect the changes in food insufficiency status. Noonan, Corman, and Reichman's (2014) study also have found the strong positive relationship between maternal depressive symptoms and household food insecurity. Their study did not mention or classify maternal depression as one of the disability conditions; however, according to U.S. Census Bureau's *Americans with Disabilities: 2010* report (Brault, 2012), having depressed symptoms that limit daily lives is considered as severe disability. Furthermore, according to Murray and Lopez's (2013) study of assessing the global burden of disease, depression was among the top causes of disability. In fact, their study mentioned that compared to 1990, the depressive disorder ranked higher among the leading causes for disability in 2010.

Thus, connecting the dots with Noonan, Corman, and Reichman's (2013) finding and the increasing rates of depressive symptoms and hence greater concern of the disability issue, it seems appropriate and needed to look into different types of health shocks (Noonan et al., 2013)—such as disability—on household food insecurity status. Moreover, using CPS Food Security Supplement data, Coleman-Jensen and Nord (2013) focused on investigating the association between disability and food insecurity, and included six specific types of disabilities – which are hearing, vision, mental, physical, self-care, or going-outside-home disability, as similar to what the disability act defined earlier in the review. The authors divided households into two groups, one with working aged members with disabilities that prevent them from work, and other with disabilities that are not preventing them from work activities. Their study found

disability to be a significant determinant of household food insecurity. However, they suggested in the future research using the SIPP data as one of the data sources to explore the relationship between asset, disability, and food insecurity. Thus, using the SIPP data, this study will consider using working disabilities.

Studies that have looked at such association, like Coleman-Jensen and Nord's (2013) did in their study, showed that there is an association between household's disability status and possibility of entering into food insecurity (Coleman-Jensen & Nord, 2013; Ribar & Hamrick, 2003). Especially, looking at households with children, Hofferth's (2004) study investigated the association between changes in disability status of parents and household's entry into and exit out of food insecurity between years 1997 and 1999, using the PSID data. They found that the households headed by disabled parent(s) or headed by parent(s) who became disabled between two years were more likely to enter into food insecurity, compared to those households with parents who were disabled in neither year. Furthermore, in another study, it was found that among a study sample, more than half of those who experienced severe food insecurity also had disabilities (She & Livermore, 2007). Previous studies that have focused on determinants of household food insecurity have included disability status as one of the variables. However, not many studies focused specifically on the changes in disability status, and a study by Coleman-Jensen (2011) have excluded disabled household heads from the sample, thinking that those disabled individuals might have different issues that may affect a greater probability of becoming food insecure. Yet, in the later work and as mentioned earlier, Coleman-Jensen and Nord only looked at the households with a member with a disability and investigated the prevalence and severity of food insecurity among such households. Furthermore, they examined the proportion

of the SNAP participation among those households to see whether the program participation rate is different by disability and food security status.

Those studies that focused on households with one or more members with disabilities also considered their household economic status, as it is assumed that they would need more resources than others without disabilities to compensate for the possible medical expenses and for the loss of earnings. Both studies by Coleman-Jensen and Nord (2013) and Tarasuk, Mitchel, McLaren, and McIntyre (2013), therefore, considered the two main mechanisms – effect on decreased income as well as high expenses related to disability. Generally, there would be extra costs associated with disabilities that the households need to pay, such as medication and special transportation. Gundersen and Gruber (2001) used a household maximizing utility framework and concerned households tradeoffs between food and other goods expenditure, where they found that disabled individuals use and need more of the expenditures toward other goods (medical expenditure, for example) than food. Those high costs would be burdensome to the households, which might also have a direct or indirect but strong effect on their food insecurity status. This is supported by a study by Huang, Guo, and Kim (2010), where they found the reduction in the relationship between disability and household food insecurity when they controlled for health expenditures related to disability. Such results might reflect the point that for those households with a member with disability, high expenses related to disability would increase the likelihood of being in food insecure.

In addition, specifically looking at the income and asset disparities between households with and without adult members with disabilities, Parish, Grinstein-Weiss, Yeo, Rose, and Rimmerman (2010) found a significant gap in the assets held by two groups. As households with an adult with disabilities were significantly disadvantaged in assets and net worth, they were

more likely to experience hardships and less likely to experience economic well-being. Both of Gundersen and Gruber (2001) and Guo's (2011) studies found savings as an important protective factor that easily provides economic resources for food insecure households to spend in the times of need; however, Parish et al. (2010) found that individuals with disabilities experience challenges in saving or accumulate assets due to high medical related costs that they have to bear. Moreover, disabled individuals constantly encountered a dilemma where they have to choose either to save money and accumulate net worth or to receive social and income supports (Parish et al., 2010).

In terms of the association between financial difficulty and food accessibility among older women with disabilities, Klesges and colleagues (2001) found that almost half of older disabled women had financial difficulties in obtaining food. Furthermore, it is shown that household members with disability have a relatively higher participation rate for food assistance programs when compared to household members without disability, but it might be the case that they have a special benefit associated with disability (Coleman-Jensen, 2013). Therefore, as studies showed households with an adult with a disability experience significantly less financial and economic well-being than their counterparts, and as disability rates have been increasing, using longitudinal data like the SIPP to examine the association between disability measures and financial difficulty obtaining in food would be useful (Klesges et al., 2001) in further understanding of the possible correlation between the changes in disability status and transition into and out of household food insecurity.

Theoretical Framework

Previous studies that have examined household food insecurity issues have used theoretical framework where they based it on the household utility maximization model subject

to its budget constraint (Gundersen & Gruber, 2001; Gundersen & Oliveira, 2001; Noonan et al., 2014). From a household utility maximizing framework, utility is defined by food and other goods that households may purchase and tradeoff in the time of need. Gundersen and Gruber's (2001) theoretical framework of using household utility maximizing model have explained in detail of how households make consumption decisions over food and other goods, and applied dynamic determinants such as income shock, lack of savings, asset holdings, as well as liquidity constraints into the model to see whether the effects of these determinants may explain the food insecurity phenomena that is missing from investigating only with mean income. Thus, it might have been appropriate to use Gundersen and Gruber's (2001) theoretical framework in this study, because they argued that unanticipated negative shocks to a household's budget and economic resources may put households into food insecurity and changes in vehicle ownership, debt obligation, as well as disability status may be unexpected and bring negative shocks to a household's budget.

However, beyond looking at the determinants of food insecurity, I am more interested in examining a household's transitioning behavior in food insecurity status over the one year study period, and furthermore, interested in investigating whether the changes in factors that are of interest in this study significantly affect such behavior of the households.

Intertemporal Choice

The early consumer consumption idea was proposed by the economist Keynes in 1936, where he presented that consumers' consumption solely depended on current income and did not take into account of the future incomes (Keynes, 1936). However, later economists such as Irving Fisher, Franco Modigliani, and Milton Friedman came up with alternative income hypotheses, where they proposed that consumers' consumption does not depend only on the

current income but the other resources and future income. Fisher's (1930) idea of intertemporal choice assumed that consumers maximize their utility or satisfaction by taking into account both current and future consumption choice. Thus, intertemporal choice explores consumers in two-period model, the present and the future, and take into account of income, consumption, as well as borrowing in both period. The main difference between Keynes' and Fisher's idea is that Keynes' only focused on the present time of consumer's consumption behavior, whereas Fisher's extended a single period model into two-period model and also assumed that consumers can either save or borrow for and from future resources. Furthermore, in his theory, Friedman (1957) assumed that consumers' consumption behavior heavily depends on their permanent income rather than transitory income, because he believed that consumers' consumption decisions are determined by their expected longer term income than short term unexpected income. Last but not least, Ando and Modigliani's (1963) life income hypothesis stated that a household's income changes throughout the lifetime in different life stages.

When applying such idea to the household's food insecurity issue, Ribar and Hamrick (2003) used household life cycle model, where they considered two-period model with two commodities – food and all other goods. In terms of the household's food consumption matter in their model, they then further considered not only the current income in one period, but other assets, resources, and income in the other period as well with the assumption that households can smooth their food consumption through borrowing from or saving for the future. One time period or static model that looks at one point states that only current income is important in determining food or all other good consumption. On the other hand, the intertemporal model states that not only current income but also other resources are important between two periods. As food

insecurity literature has found, a household's food insecurity status cannot be solely explained or determined by a household's income, but by other economic related resources as well.

Hypotheses

Based on theoretical framework and the preceding evidence from the empirical literature, the following null hypotheses are investigated among households that experienced a food insecurity status transitioned:

Ho_1 → There is no relationship between a household's gain (or loss) of a vehicle and food insecurity transition status.

Ha_1 → There is a relationship between a household's gain (or loss) of a vehicle and food insecurity transition status.

Ho_2 → There is no relationship between a household's unsecured debt ratio and food insecurity transition status.

Ha_2 → There is a relationship between a household's unsecured debt ratio and food insecurity transition status.

Ho_3 → A household member's work limiting disability status is unrelated to the household's food insecurity transition status.

Ha_3 → A household member's work limiting disability status is related to the household's food insecurity transition status.

The reasoning behind the hypotheses above are as follow: First, due to food insecurity, households might have to sell an asset (such as vehicle) to have extra resources to buy food (Usfar, Fahmida, & Februhartanty, 2007), whereas due to not having a reliable transportation or vehicle households do not have accessibility to nutritious food (Walker et al., 2010) or employment (Fletcher et al., 2010) and possibly become food insecure. Second, due to food

insecurity, households might use credit cards and have debt to purchase food (Darko, Eggett, & Richards, 2013), whereas due to having unsecured debt obligations households might not have enough economic resources to buy food and thus become food insecure. Lastly, due to food insecurity, households might not get enough nutrition and report poor health (Stuff et al., 2004) or become disabled, whereas due to disability treatment and health related expenditures households might not have enough economic resources (She & Livermore, 2007) and thus become food insecure. In this study, I am particularly interested in the households that have made transitions into food insecurity.

As mentioned above, I will be using a fixed effects model in examining household's transition into and out of food insecurity over one year. In addition to incorporating Allison's (2005) fixed effects model strategy, and considering how Rhine and Greene (2013) used their theoretical framework on looking at household bank transitioning behavior, I test my hypotheses by integrating risk factors related to food insecurity defined by Campbell (1991) and Barrett (2002). Barrett's conceptual framework on food insecurity issues is well developed through a combination of Becker's (1965) household model as well as household choice model in seeking to maximize each members' physical well-being and food security status, with relation to labor productivity and human capital. Campbell (1991) conceptualized risk factors associated with food insecurity as factors that would limit household economic resources, such as money, time, information, and health. She then explained such factors could limit employment status as well as increase in other goods expenditures such as medical expenses. In a similar context, Barrett's study defined several risk structures that would negatively impact food insecurity. Those risk factors that may make households more likely become food insecure are: "low labor

productivity, adverse terms of trade, limited market access, asset poverty, restricted borrowing capacity, and the absence of a reliable safety net to provide transfers" (Barrett, 2002, p. 17).

For the purpose of this study I consider labor force participation, proxies for limited market access, asset poverty, as well as restricted borrowing capacity. A household's unexpected health shock such as disability may decrease their work productivity (Coile, 2004), which might then affect their budget and economic resources. Changes in assets, especially vehicle ownership, may hinder households from and affect their ability to access to food/labor market. Among the four mechanisms of food security, physical accessibility is one of them; thus, access to market is important. Both asset poverty and restricted borrowing capacity are related to a household's ability to access credit, because due to increase in debt obligations households may face borrowing constraints.

CHAPTER 3

METHODOLOGY

The purpose of this study is to investigate factors associated with household transitions into and out of food insecurity over the course of a one-year study period, specifically focusing on three household economic related factors – changes in vehicle ownership, debt obligations, and disability status. In order to examine household food insecurity transitions and related factors, I utilized data from the 2008 panel of the Survey of Income and Program Participation (SIPP), conducted by the U.S. Census Bureau. The rest of this chapter presents the methods employed in previous research that have investigated household food insecurity, discusses data and sample of households as well as measurement of variables used in this study, and explains the statistical analyses used in this research.

Method Used in Prior Work

Gundersen and Garasky (2012) note the challenge presented by unobserved factors in explaining household food insecurity. Fortunately SIPP data allow researchers to treat vehicle ownership and availability, unsecured debt levels, and disability status as observed factors.[4] Among notable studies that have looked at food insecurity transitions, a study by Nord and Coleman-Jensen (2010) used logistic regression models to investigate the transition into and out of SNAP participation. Furthermore, to investigate the transition in food insecurity status among

[4] Gundersen and Garasky (2012) defined 'unobserved variable' in their study as a variable that may contribute significantly in explaining household's food insecurity but are not available in datasets. However, the vehicle, credit debt, and disability are available in SIPP 2008 panel data, therefore, I treat them as observed factors.

welfare recipients in Michigan, Heflin, Corcoran, and Siefert (2007) used logistic regression and fixed effect models, controlling for unobserved factors that are changeable across times.

For my study, a conditional fixed effects regression methodology (Allison, 2005) and a typology similar to Rhine and Greene's (2013) study were utilized. Rhine and Greene investigated those families who made the transition of bank status between two periods, and created four groups – those households that were banked in both period 0 and 1, those unbanked in both period 0 and 1, those banked in period 0 and unbanked in period 1, and those unbanked in period 0 and banked in period 1. They were mostly interested in the households that became unbanked in period 1. Extending a single period model to two-period model allowed the authors to capture the changes in factors or circumstances that might significantly be associated with household transitions in banking status from one period to the next.

Likewise, this study created four subpopulations (groups) – those households that were food secure in both period 1 and 2, those food insecure in both period 1 and 2, those food secure in period 1 and food insecure in period 2, and those food insecure in period 1 and food secure in period 2. These four subpopulations served different purposes in the analyses; the first two groups did not experience a change in their food insecurity status and were appropriately removed from analyses that estimate transitions. The second two groups were included in all analyses that estimate the correlates of transitioning from food secure to food insecure (and vice versa). All four groups were used when describing the sample and larger population from which it was derived.

Data and Sample

As mentioned earlier, this study utilized the 2008 panel of SIPP from the U.S. Census Bureau. The dataset includes different household related variables such as social and economic

information, welfare program participation, as well as measures of household food insecurity. It is a large and a nationally representative survey which follows the same households for four years. Many studies that have looked at household food insecurity issue have also utilized SIPP data as it includes a food insecurity assessment and related demographic, social, economic, and policy variables. Different studies have mentioned limitations of using the SIPP data, including the possibility that it may not properly or accurately measure respondents' hardship level (Boushey & Gundersen, 2001), does not allow researchers to look at household liquidity constraints status due to lack of related questions (Gundersen & Gruber, 2011), and that it also does not allow to examine the duration of disability status as well as hardship directly (She & Livermore, 2007). Yet, as one of the advantages, it allows researchers to look at dynamics in food insecurity as well as poverty (Bania & Leete, 2007), and its four-month intervals in each wave of the dataset allows researchers to examine both short and long term intervals of food insecurity condition (Wunderlich, Norwood, & National Research Council, 2006), which would be advantageous in looking at transitions into and out of food insecurity. As evidence of its utility for short-duration transition models, Rhine and Greene (2013) used SIPP data to look at how changes in measured determinants, especially economic shocks, affect household transitions in banking status.

Prior to the 2008 panel of the data, food insecurity was measured only once per panel; this severely limited the SIPP's utility for measuring changes in food-related hardships. However, the food insecurity measure appears twice in the 2008 panel – in years 2010 and 2011. The inclusion of two time measurements allows one to capture the changes in food security status of households. Furthermore, this panel includes repeated measures for all the necessary questions about vehicle/transportation, credit/debt, as well as disability. Hence, this specific

panel allows a researcher to look into the changes of any of these factors and its association with household food insecurity status, if any.

The statistical methodology that was used in this study is a conditional fixed effects logistic regression model over two-year period as outlined by Allison (2005), in order to examine such factors' correlation with households transitioning into and out of food insecurity. This method excluded households that have not changed their food insecurity status over the study period, and only investigated households that have made such change, as well as the effect of time variant predictors on the response variable. Food insecurity is measured in waves 6 and 9 of the panel, whereas vehicle and credit card debt information are measured in waves 4 and 7, and disability is measured in every wave.[5] Therefore, I can estimate the differences and effect of changes of the predictors on a household's food insecurity status, with the caveat that the exact timing of the measures is imperfect; measures of vehicle and credit card debt precede other time-variant variables by four to eight months. Figure 3.1 illustrates the timing of the variables and weighted mean household values.

The slight temporal mismatch is a function of the SIPP's data collection method. SIPP data have both core modules and topical modules. Core modules in each wave (a four month period) include questions related to demographics, income, employment, and program participation of household. Some of the topics of questionnaires that are asked in each wave's topical modules include: household food insecurity assessment, assets and liabilities, disability

[5] The disability question that appears in every wave (EDISABL) asks whether household head or household member had a physical or mental condition that would limit working. Another disability variable (recoded as RDISAB), includes numerous disability-related conditions and is a recode from the Americans with Disability report series. This specific disability variable asks whether household head or member of household has either severe or non-severe disability, or no disability. The latter one might be better to capture severity and overall disability condition. However, it only appears in wave 6, and does not capture the changes in household disability status as needed in fixed effects models.

status, as well as material hardships.[6] The food insecurity assessment is included in the adult well-being topical module that is collected in waves 6 and 9.

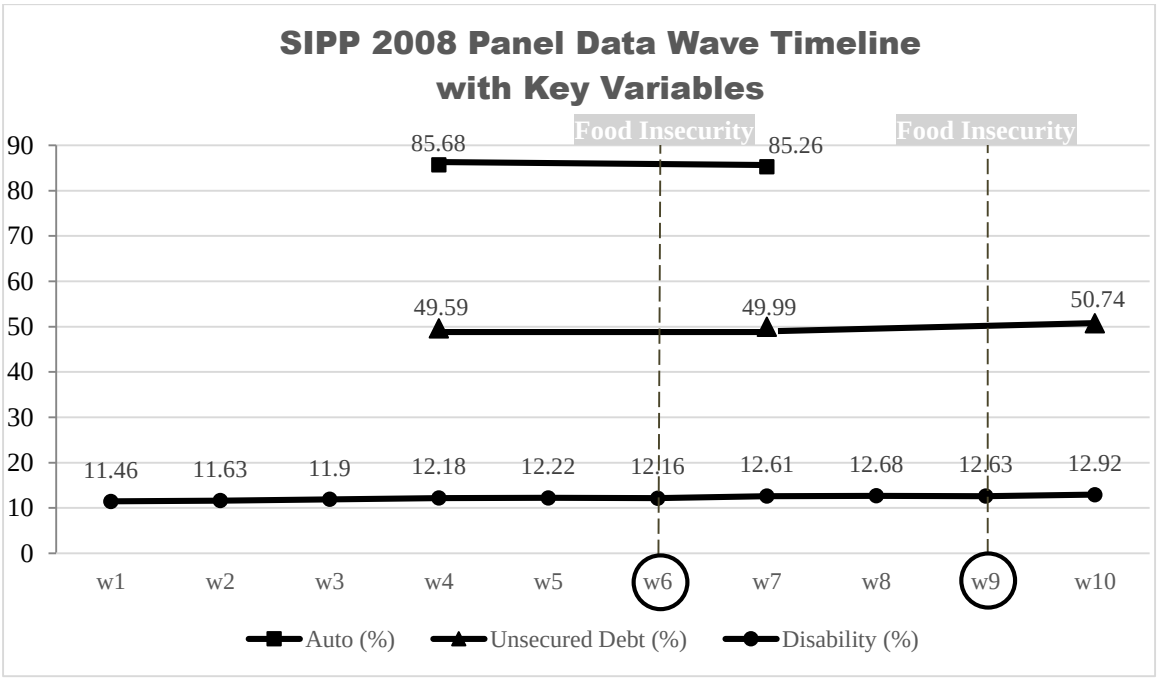

Figure 3.1 SIPP 2008 panel data wave timeline with primary variables of interest and food insecurity[7]

Measurement of Variables

As far as food insecurity measure is concerned, topical modules 6 and 9 in the SIPP 2008 panel data ask the household head six food security related questions – EAFLAST, EAFBALN, EAFSKIP, EAFLESS, EAFDAY, and EAFOOD1 (Nord, 2006). The question and responses for each variable are as follow[8]:

[6] For more information about 2008 panel topical module list with time periods for each wave can be found here: http://www.census.gov/programs-surveys/sipp/tech-documentation/topical-modules/topical-modules-2008.html

[7] This figure is to show that vehicle, unsecured debt, and disability variables appear before food insecurity measurement in waves 6 and 9. Wave 4 covers Sept 2009 – Dec 2009. Wave 6 covers May 2010 – Aug 2010. Wave 7 covers Sept 2010 – Dec 2010. Wave 9 covers May 2011 – Aug 2011.

[8] The following definitions are from the 2008 SIPP Panel Date FTP website: http://thedataweb.rm.census.gov/pub/sipp/2008/p08tm6d.txt

Table 3.1 Food Security Questions in SIPP 2008 Panel Data

Variable	Question	Responses
EAFLAST	**Food we bought just didn't last** "The food that (I/WE) bought just didn't last and (I/WE) didn't have money to get more." Was that often, sometimes or never true for... in the last four months?	1. Often true 2. Sometimes true 3. Never true
EAFBALN	**Couldn't afford balanced meals** "(I/WE) couldn't afford to eat balanced meals." Was that often, sometimes or never true for ... in the last four months?	1. Often true 2. Sometimes true 3. Never true
EAFSKIP	**Cut size or skipped meals** In the past four months did you or the other adults in the household ever cut the size of your meals or skip meals because there wasn't enough money for food?	1. Yes 2. No
EAFLESS	**Ate less than felt you should** In the past four months did you or the other adults in the household ever eat less than you felt you should because there wasn't enough money to buy food?	1. Yes 2. No
EAFDAY	**Didn't eat for a whole day** In the past four months did you or the other adults in the household ever not eat for a whole day because there wasn't enough money for food?	1. Yes 2. No
EAFOOD1	**Sufficiency of food eaten in household** Which of these statements best describes the food eaten in your household in the last four months	1. Enough of the kinds of food we want 2. Enough but not always the kinds of food we want to eat 3. Sometimes not enough to eat 4. Often not enough to eat

Specifically, household food security variables – AAFDSEC, RAFSRAW, RAFSSCAL, and RAFSSTAT (in Table 3.2) – were created from the five food security variables above.

Table 3.2 Household Food Security Questions in SIPP 2008 Panel Data

Variable	Question	Responses
AAFDSEC	**Allocation flag for RAFSRAW, RAFSSCAL, and RAFSSTAT**	0. Not imputed 1. 1 or more scale variables imputed
RAFSRAW	**Food security raw score**	Number of affirmative responses ranges from 1 to 5
RAFSSCAL	**Food security scale score**	Rasch measurement ranges from 3.16 to 9.14
RAFSSTAT	**Food security status category**	3. Food-Secure (High or marginal food security) 4. Low food security 5. Very low food security

The five food security variables for the scale are included in the U.S. Food Security Survey Module, and originally, USDA's official food security questionnaires include 18 questions – which are implemented in the Current Population Survey (Coleman-Jensen et al., 2011). However, the SIPP data used a subset of food security scale questions similar to the ones that were developed by the researchers at the National Center for Health Statistics (Economic Research Service, 2012).[9] Therefore, the questionnaires, affirmative responses, and scale scores are based on standard CPS 1998 item scores; however, the questions in the SIPP data refer to the prior 4 months of the survey while the CPS data refer to the previous 12 months of the survey (2011). Still, when compared with the standard U.S. Food Security Scale, the SIPP scale appeared to be reliable (2006).

Among those five variables, EAFLAST and EAFBALN have the "Often true", "Sometimes true", and "Never true" responses, whereas EAFSKIP, EAFLESS, and EAFDAY have the "Yes" and "No" responses. Therefore, when constructing the food security scale that

[9] The six-subset questions developed by the researchers at the National Center for Health Statistics include all those five food security variables mentioned above, except the food insufficiency question (EAFOOD1) that is included in the SIPP data. The last question that is included in the six-subset but not in the SIPP data is: "[IF YES ABOVE, ASK] How often did this happen – almost every month, some months, but not every month, or in only 1 or 2 months?"

ranges from 1 to 5, only the "Often true" or "Sometimes true" and "yes" responses were coded as representing "yes" answer to such questions, and "no" otherwise.[10] Then, each raw score on the scale was given a food security scale score that ranges from 3.16 to 9.14[11]:

Table 3.3 Household Food Security Raw and Scale Scores and Food Security Status Category in SIPP 2008 Panel Data

Raw Score	Scale Score	Food Security Status Category
1	3.16	Food secure
2	4.39	Food insecure without hunger OR Low food security
3	5.54	Food insecure without hunger OR Low food security
4	7.54	Food insecure with hunger OR Very low food security
5	9.14	Food insecure with hunger OR Very low food security

As shown in Table 3.3, households with 3.16 scale score were categorized into food secure. Households with scale scores of 4.39 and 5.54 were categorized into food insecure without hunger or low food security. Lastly, households with scale scores of 7.54 and 9.15 were categorized into food insecure with hunger or very low food security. Simply put, if the households answered yes to at least two of those five questions were considered as food insecure without hunger/low food security, and if households answered yes to at least four of those five questions were considered as food insecure with hunger/very low food security. Furthermore, if households answer "yes" to at least two of those five questions were classified into being food

[10] This is the same procedure described in *U.S. Household Food Security Survey Module: Six-Item Short Form* report by Economic Research Service, USDA (2012). http://www.ers.usda.gov/datafiles/Food_Security_in_the_United_States/Food_Security_Survey_Modules/short2012.pdf

[11] As mentioned before, the scale scores are based on standard CPS item scores, however, the scale scores are slightly different – the six item short version of the food security questionnaires mentioned in the report by the Economic Research Service (2012) has the scale score that ranges from 2.86 to 8.48, whereas the SIPP's scale score ranges from 3.16 to 9.14 (Nord, 2006).

insecure for the specific wave (either 6 or 9, or both waves). Since food security is measured at the household level, all the statistical results will be analyzed at the household level.[12]

For vehicle ownership variables, there were questions asking whether a household owns a vehicle or not, and the number of vehicles the household own. For the vehicle ownership of a household member, it asks whether anyone in the household own a car, van, or truck, excluding recreational vehicles and motorcycles. Therefore, those households that own a vehicle (either car, van, or truck) is recoded as 1 and 0 otherwise in this study. Furthermore, the number of vehicles owned by a household asks the number of cars, trucks, or vans owned by members of the household. The minimum and maximum number of vehicle(s) the household can respond is 1 and 20, respectively, and only the respondent who are in a household that owns a vehicle can answer this question.

Compared to the vehicle variables, credit card and debt information related variables were slightly more complicated. The data include the amount of money owed for loans or credit cards, amount of debt on home, stocks, mutual funds, rental property, business, and total debt. However, I am interested in unsecured debt which includes credit card debt, and Sullivan's (2008) study found that majority of unsecured debt in SIPP data was accounted for by credit card debt. According to Anderson (1999), consumer debt is composed of unsecured debt, such as credit card debt, store bills, unsecured loans, as well as money owed to others, and secured debt, such as vehicle debt, mortgage debt, etc. For the 2008 panel of SIPP data, waves 4 and 7 have total unsecured debt variable, recoded as RHHUSCBT and THHUSCBT, respectively, and these variables include amount owed for store bills or credit cards, amount owed for loans, and amount

[12] SIPP data defined a household as a group that "consists of all persons who occupy a housing unit; A household includes the related family members and all the unrelated persons, if any,… who share the housing unit" (SIPP 2008 Panel, p. 3-1).

owed for other debt – including medical bills that are not covered by insurance, owed to other individuals, as well as education loans (both joint amount with spouse, and owed in own name). To examine what percentages of total household debt are unsecured debt, I created a ratio by dividing unsecured debt (RHHUSCBT for wave 4 and THHUSCBT for wave 7) by THHDEBT (same for waves 4 and 7), which is a total household debt.

The disability variable, EDISABL, is assessed every wave and indicates whether anyone in the household had a work-limiting physical or mental condition. Specifically, the question asks: Does … have a physical, mental, or other health condition that limits the kind or amount of work … can do at a job or business? And it is coded as -1, 1, and 2, where -1 is not in universe, 1 is yes, and 2 is no. This was dichotomized so that the presence of a work-limiting condition is equal to 1 and 0 otherwise.

Other independent variables of interest are chosen based on the previous studies about socioeconomic and demographic determinants of household food insecurity. Such variables are: age, race, employment, education, housing, both informal and government public assistance participation, presence of children in the household, health insurance (private and public), household income, poverty (a binary measure and income-to-needs ratio), household type, and health condition. For education, reference persons are categorized into either less than high school, high school graduate or received GED, finished some college, or graduated from college. In terms of health insurance variable, household are divided into three different categories – those who have public insurance, private insurance, or no insurance at all. Participation in food assistance programs are divided into the following categories – informal assistance, government assistance, SNAP benefit, or WIC benefit.[13] Moreover, the household type are divided into five

[13] For the model purpose later, informal and government assistance are grouped as one – receiving either informal or government assistance, and SNAP and WIC benefits – the amount of both benefits.

different compositions – two adult household, family household with male headed, family household with female headed, non-family household with male headed, and non-family household with female headed.[14]

Description of Sample

As shown in Table 3.4, among the full weighted sample, 10.07% and 10.33% of households were food insecure in 2010 and 2011, respectively. In both years, about 16-17% of all households received government assistance; about 50% of those who were always food insecure received it and only 12% of those who were never food insecure received it. Among those who transitioned into food secure or food insecure in between the years, the percentage of people who received the government assistance ranged from 30~40%. The median household income in both years was about $49,000 ($48,636 in 2010 and $48,915 in 2011); however, those who were never food insecure had higher median income in both years ($53,072 in 2010 and $53,792 in 2011).

Those who were ever food insecure had a median annual household income that ranged between $23,000-$34,400, with the lower values attributed to those who were food insecure both years. Compared to 2010, median monthly SNAP benefit for all groups in 2011 increased from as small as $4 to as large as $50. When compared to those who transitioned either into food secure or food insecure and who were always food insecure, those who were never food insecure tended to have higher income, greater college graduation rates, were less likely to have children under age 18, more likely to have private health insurance, and less likely to be in poverty. Furthermore, such households had a higher rate of seniors living in the household. Expectedly,

[14] However, for the simplicity in the model later, a two adult household is classified as married household, family household with male/female headed is classified as single-parent household, and non-family household with male/female headed as non-family household.

those who were always food secure had higher rate of home ownership when compared to other groups.

Table 3.5 shows vehicle equity, car ownership, unsecured debt percentage, and disability status. The reason I separated such variables from basic dependent variables is because vehicle equity, vehicle, unsecured debt, and disability appear in the same wave (waves 4 and 7) and thus they are measured in different interviews than food insecurity. By separating them into two different tables, I wanted to point out the importance of looking at changes of the three main variables that appear prior to food insecurity measure in both years.

The descriptive statistics suggest that compared to those households that were never food insecure, households that were always food insecure had significantly lower amount of vehicle equity in both years of 2010 and 2011. Furthermore, those who were always food insecure also had lower household median income compared to other three groups as shown in Figure 3.2. In both years of 2010 and 2011, households (N = 22,671) held about 49~50% of unsecured debt out of total household debt, while those who were food insecure in both years (n = 998) held about 67% of unsecured debt. Moreover, in both years, about 85~86% of the households in full sample owned a vehicle, whereas for households that were always food insecure, 71~72% of households owned a vehicle.

When it comes to disability, about 12~13% of the households had disability in both years. For those households that transitioned either into food insecure or food secure (n = 1,363 and 1,320, respectively), about 21~25% had disability in both years. However, when comparing households that were always food insecure and were never food insecure, there seems to be a huge gap in terms of prevalence of disability – about 35~37% of households that were always

food insecure had disability whereas about 10% of households that were never food insecure had disability in both years.

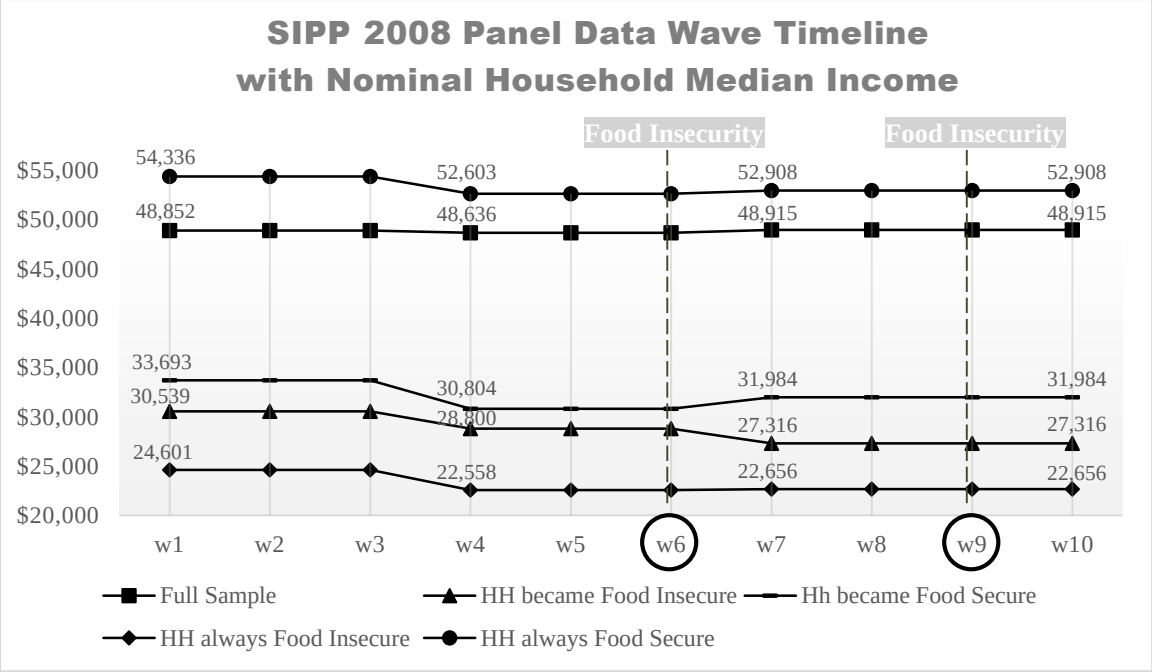

Figure 3.2 Nominal household median income by household type.[15]

[15] SIPP asks question about the total household income: (THTOTINC) Reaggregated total household income for relevant month of the reference period after topcoding. It can range from -$1,500,000 to $1,500,000.

Table 3.4 Selected Characteristics of Food Secure and Food Insecure Households (weighted)

Selected Characteristics	Full Sample (N=22,671)	Household Food Insecurity Pattern: 2010 to 2011			
		Secure to Insecure[a] (N=1,363)	Insecure to Secure[b] (N=1,302)	Insecure Both Years[c] (N=998)	Insecure Neither Year[d] (N=19,008)
Percent of households	100	6.01	5.74	4.40	83.84
Median household income in 2010	$48,636	$28,830	$31,633	$23,327	$53,072
Median household income in 2011	$48,915	$28,031	$33,998	$23,902	$53,792
Median monthly SNAP benefit in 2010[e]	$220	$256	$250	$202	$209
Median monthly SNAP benefit in 2011[e]	$230	$260	$300	$215	$215
	%	%	%	%	%
Food insecure 2010	10.07	0.0	100.0	100.0	0.0
Food insecure 2011	10.33	100.0	0.0	100.0	0.0
Received food assistance					
Informal assistance 2010	0.58	0.71	1.36	3.12	0.39
Informal assistance 2011	0.64	2.25	0.75	3.92	0.35
Government assistance 2010	16.41	38.59	33.44	50.51	11.90
Government assistance 2011	16.98	40.24	33.81	51.02	12.41
Education (ref. person)					
Less than HS in 2010	11.21	20.33	17.60	21.27	9.60
Less than HS in 2011	11.14	20.48	17.55	21.44	9.53
HS graduate/GED in 2010	22.85	25.15	30.87	28.28	21.86
HS graduate/GED in 2011	22.73	24.82	30.73	27.82	21.77
Some college in 2010	34.63	38.16	33.86	40.89	34.11
Some college in 2011	34.48	37.89	33.80	40.35	33.98
College graduate 2010	31.31	16.37	17.67	9.57	34.44
College graduate 2011	31.60	16.81	17.88	10.39	34.70
No children under age 18 in 2010	67.70	57.51	57.62	57.45	69.95
No children under age 18 in 2011	68.25	58.99	59.16	59.70	69.98
Health insurance (ref. person)					
Public insurance in 2010	31.51	34.74	33.14	40.87	30.68
Public insurance in 2011	32.78	37.19	34.08	41.81	31.91
Private insurance in 2010	72.44	47.52	47.13	30.82	78.11

Private insurance in 2011	72.38	43.33	48.62	32.67	78.13
Uninsured 2010	13.81	26.59	28.55	34.24	10.83
Uninsured 2011	13.32	27.74	26.30	32.13	10.43
In poverty in 2010	10.94	24.09	23.06	31.42	8.11
In poverty in 2011	11.17	26.80	23.07	32.76	8.12
Age 65 and older in 2010 (ref. person)	22.80	14.19	13.34	10.34	24.71
Age 65 and older in 2011 (ref. person)	24.31	14.97	14.75	10.96	26.32
Homeowner in 2010	69.75	49.06	52.05	39.90	73.99
Homeowner in 2011	69.82	48.74	51.82	39.02	74.04
Metro area residence in 2010	78.99	80.05	80.30	80.03	78.77
Metro area residence in 2011	79.05	79.90	80.46	79.90	78.84
Mover in 2010	3.54	4.12	3.99	6.90	3.29
Mover in 2011	2.89	4.41	3.03	4.97	2.66
Poor health in 2010	14.63	25.84	22.73	37.02	12.12
Poor health in 2011	14.63	25.84	22.73	37.02	12.12

Note: N=22,671. Food insecurity variable appears in wave 6 and 9, which corresponds to years 2010 and 2011, and most of the variables appear in waves 4 and 7, which corresponds to years 2009 and 2010. Therefore, since dependent variable is food insecurity status, and I am looking at household's food insecurity status and socioeconomic characteristic, all the variables refer to years 2010 and 2011 here. [a]Refers to households that made transition from food secure to food insecure, [b]refers to households that made transition from food insecure to food secure, [c]refers to households that remained in food insecure status during study years, and [d]refers to households that remained in food secure status during study years.

Table 3.5 Key Independent Variables by Food Insecurity Status (weighted)

Variable	Full Sample (N=22,671)	Household Food Insecurity Pattern: 2010 to 2011			
		Secure to Insecure[a] (N=1,363)	Insecure to Secure[b] (N=1,302)	Insecure Both Years[c] (N=998)	Insecure Neither Year[d] (N=19,008)
Mean Household Vehicle Equity					
Household Vehicle Equity in 2010	$6,179	$3,153	$3,693	$2,022	$6,780
Household Vehicle Equity in 2011	$6,785	$3,634	$4,167	$2,346	$7,420
	%	%	%	%	%
Household Unsecured Debt Ratio					
Household Unsecured Debt in 2010	49.59	60.65	58.64	67.40	47.26
Household Unsecured Debt in 2011	49.99	60.24	58.89	67.52	47.75
Household Car Ownership					
Car Owner in 2010	85.68	78.11	77.53	71.17	87.52
Car Owner in 2011	85.26	77.80	78.21	71.99	87.01
Household Disability Status					
Have Disability in 2010	12.43	24.20	21.21	35.39	9.80
Have Disability in 2011	12.82	25.12	23.08	36.59	10.01

Note: N=22,671. Food insecurity variable appears in wave 6 and 9, which corresponds to years 2010 and 2011, and all of the variables appear in waves 4 and 7, which corresponds to years 2009 and 2010. Therefore, since dependent variable is food insecurity status, and I am looking at household's food insecurity status and socioeconomic characteristic, all the variables refer to years 2010 and 2011 here. [a]Refers to households that made transition from food secure to food insecure, [b]refers to households that made transition from food insecure to food secure, [c]refers to households that remained in food insecure status during study years, and [d]refers to households that remained in food secure status during study years. Household unsecured debt ratio was created by dividing total household unsecured debt by total household debt to see how much percentage of household total debt are comprised of unsecured debt. Household disability status variable used in descriptive statics appear in every wave.

Data Analysis

To first assess whether there was evidence of a relationship between food insecurity transitions and the primary independent variables of interest—vehicle ownership, unsecured debt ratios, and work limiting disability—the analysis begins with bivariate measures (chi-squares and t-tests as appropriate) of association. Next, two multi-period multivariate models examine whether the bivariate associations (or lack thereof) remain when controlling for other theoretically- and empirically-relevant factors. The first multivariate model is an unweighted conditional fixed effects logistic regression model; the second is the same model estimated as a

weighted subpopulation analysis with state fixed effects. Lastly, to gain a better understanding of the association between household food insecurity and my main variables of interest, a weighted cross-sectional logistic regression model is estimated that is similar to many cross-sectional food insecurity regression models found in the literature. This serves as a way to assess the overall sample and model results against the literature described in Chapter 2. All of the results for the models are described in the Results section in Chapter 4.

Conditional Fixed Effects Model

In order to explore household food insecurity transitions over a two-year period I utilized Allison's (2005) conditional fixed effects model estimation strategy. The conditional fixed effects model with two time periods is as follows:

$$y_{i1} = \mu_1 + \beta x_{i1} + \gamma z_i + \alpha_i + \varepsilon_{i1} \quad \text{(a)},$$

$$y_{i2} = \mu_2 + \beta x_{i2} + \gamma z_i + \alpha_i + \varepsilon_{i2} \quad \text{(b)},$$

$$y_{i2} - y_{i1} = (\mu_2 - \mu_1) + \beta(x_{i2} - x_{i1}) + (\varepsilon_{i2} - \varepsilon_{i1}) \quad \text{(c)},$$

where y_{i1} and y_{i2} are the value of the response variables for a household *i* in period 1 and 2 (which is 2010 and 2011, respectively). In this study, μ represents the intercept which varies with study time, both β and γ represent row vector of coefficients, α represents differences between households that did not change food insecurity status over the study period and those who did change, and ε represents random variable that has a probability distribution. In the above equation, (c) represents the final equation where the value of the response variable for a household in period 1 is subtracted from period 2. By doing this subtraction, the equation eliminates (differences out) those variables that do not vary over time and estimates households that have transitioned (show a mathematical difference) between the two time periods. In this study, the main predictor variables were:

VEHICLE	1 if a household currently owns at least one vehicle, otherwise 0
# of VEHICLES	Number of vehicles owned by the household (continuous variable which ranges from 1 to 10)
UNSECDEBT	Ratio of household unsecured debt out of household total debt (continuous variable which ranges from 0 to 1 since it is ratio
DISABILITY	1 if a household member currently has disability, otherwise 0

When applying such an equation and model form to this specific study's three independent variables of interest, it would be as follows:

FI*(t)* = $\mu(t) + \beta_1 \text{VEHICLE}(t) + \beta_2 \text{UNSECURED DEBT RATIO}(t) + \beta_3 \text{DISABILITY}(t) + \varepsilon(t)$,

where for *(t)* it will be 1 and 2 (years 2010 and 2011, respectively). However, according to Allison, the above equations are somewhat limited where it presumes that the slopes do not vary over study period. Therefore, the equations are modified to allow coefficients to vary over time.

$$y_{i1} = \mu_1 + \beta_1 x_{i1} + \gamma z_i + \alpha_i + \varepsilon_{i1} \quad \text{(d)},$$

$$y_{i2} = \mu_2 + \beta_2 x_{i2} + \gamma z_i + \alpha_i + \varepsilon_{i2} \quad \text{(e)},$$

$$y_{i2} - y_{i1} = (\mu_2 - \mu_1) + \beta_2 x_{i2} - \beta_1 x_{i1} + (\varepsilon_{i2} - \varepsilon_{i1}) \quad \text{(f)}$$

However, even with these above equations, this study would not be fully examined because the response variable in this study is categorical: whether the household was food insecure or not. Therefore, I take into account of logarithm and probability in the equation per Allison (2005, Chapter 3). The extended logistic model for dichotomous response variable is as follow:

$$\log\left[\frac{p_{it}}{1-p_{it}}\right] = \mu_i + \beta x_{it} + \gamma z_i + \alpha_i \quad \text{(g)},$$

where in this case the value of the response variable for household *i* in period *t*, y_{it} , will have a value of either 0 or 1, because it is a dichotomy. This formula treats p_{it} as a probability that the

value of response variable for household *i* on *t* is 1 ($y_{it} = 1$). In the above formula, as previously explained, μ represents the intercept which varies with study time, both β and γ represent row vector of coefficients, and α represents differences between households that did not change with food insecurity status over the study period and those who did. Furthermore, z_i and x_{it} represent column vector of factors where z_i does not change over time, and x_{it} changes over time (p.50).

$$\Pr(y_{i1} = 0, y_{i2} = 0) = (1 - p_{i1})(1 - p_{i2}) \quad \text{(h)},$$

$$\Pr(y_{i1} = 1, y_{i2} = 0) = p_{i1}(1 - p_{i2}) \quad \text{(i)},$$

$$\Pr(y_{i1} = 0, y_{i2} = 1) = (1 - p_{i1})\, p_{i2} \quad \text{(j)},$$

$$\Pr(y_{i1} = 1, y_{i2} = 1) = p_{i1}p_{i2} \quad \text{(k)},$$

Here, from (h) to (k), they all represent four categories of households that do or do not make a food insecurity transition. Equation (h) represents households that were never food insecure in 2010 and 2011. Equation (i) represents those households that were food insecure in 2010 but became food secure in 2011. Equation (j) represents those households that were food secure in 2010 but became food insecure in 2011. Lastly, equation (k) represents those households that were always food insecure both in 2010 and 2011. Since there would be no within-household variation or change on the response variable for both (h) and (k) groups of households that did not make any change, only the probability for (i) and (j), those who have within-household variation is estimated. A logarithm step of the ratio of probabilities for (i) and (j) is then estimated as follows:

$$\log\left[\frac{\Pr(y_{i1} = 0, y_{i2} = 1)}{\Pr(y_{i1} = 1, y_{i2} = 0)}\right] = \log(1 - p_{i1}) + \log p_{i2} - \log p_{i1} - \log(1 - p_{i2})$$

$$= \log\left[\frac{p_{i2}}{1-p_{i2}}\right] - \log\left[\frac{p_{i1}}{1-p_{i1}}\right]$$

$$\log\left[\frac{\Pr(y_{i1} = 0, y_{i2} = 1)}{\Pr(y_{i1} = 1, y_{i2} = 0)}\right] = (\mu_2 - \mu_1) + \beta(x_{i2} - x_{i1})$$

As previously mentioned, this method discards households that do not make food insecurity transition between 2010 and 2011, and allows examination of those who do transition by estimating the difference scores of time varying independent variables that predict the dependent variable.

By incorporating Allison's conditional fixed effects method to estimate food insecurity status transitioning behavior to understand households' assets (vehicles), unsecured debts, and disability status as risk factors as Campbell (1991) and Barrett's (2002) conceptualized[16], I will be able to test hypotheses mentioned earlier.

[16] Their conceptualization of risk factors are explained in Chapter 2 Literature Review section.

CHAPTER 4

RESULTS AND DISCUSSION

In this chapter I provide the results of the analyses and discuss the importance of the results. First, I present and analyze t-test and chi-square analyses to investigate whether there is a significant association between household food insecurity and vehicle ownership, disability, and unsecured debt ratio. Second, to further explore the relationships among primary variables of interest that changed over one year period and the association of these have with household food insecurity transition, I present the results of an unweighted conditional fixed effects logit model. Third, I present the results of a weighted logistic regression model that incorporates appropriate adjustments for the SIPP's complex sample design, subpopulation analysis, and state fixed effects. This model allowed me to use the full sample (N = 22,671) for appropriate estimation of standard errors and still investigate those who made transitions in food insecurity status (n = 2,665) by using a weighted subpopulation analysis. Lastly, I present the results of a post-hoc weighted cross-sectional logistic regression model that is similar to many cross-sectional food insecurity regression models found in the literature. This serves as a way to assess the overall sample and model results against the literature described in Chapter 2.

Bivariate Test Results

To determine whether there is evidence that food insecurity status and the three primary variables of interest in this study systematically covary, I ran four bivariate chi-squares and one bivariate t-test. Once again, the three primary variables of interest are vehicle ownership, disability status, and unsecured debt ratio. The first three contingency tables (Tables 4.1, 4.2, and

4.3) show the relationship between food insecurity status in 2011 and disability status. Here, I used different disability variables to examine the relationship between food insecurity and severity of household disability status. The main disability variable that defines whether a household member has severe or non-severe disability only appears in wave 6 of the data, whereas regular disability variable appears in every wave and indicates whether a member of the household has a work-limiting physical or mental condition. The fourth chi-square analysis (Table 4.4) shows the relationship between food insecurity status and household vehicle ownership. The null and alternative hypotheses for the first three chi-square tests are as follows:

H_0: There is no systematic relationship between a household's disability status and food insecurity status.

H_1: There is a systematic relationship between a household's disability status and food insecurity status.

The null and alternative hypotheses for the vehicle ownership chi-square test are as follows:

H_0: There is no systematic relationship between a household's vehicle ownership and food insecurity status.

H_1: There is a systematic relationship between a household's vehicle ownership and food insecurity status.

Table 4.1

Results of Chi-square Test for Food Insecurity Status by Disability Status

	Work-Limiting Disability Status	
Food Insecure in 2011	With Disability	Without Disability
Yes	755 (23.85%)	1,606 (8.23%)
No	2,410 (76.15%)	17,900 (91.77%)
Total	3,165 (100%)	19,506 (100%)

Note. χ^2_{R-S} = 440.86***, df = 1. Numbers in parentheses indicate column percentages. ***$p < 0.001$. Surveyfreq procedure with Rao-Scott chi-square was performed in SAS. Sample size of households that were food insecure in 2011 is n=2,361; households that were not food insecure in 2011 is n=20,301.

Table 4.2

Results of Chi-square Test for Food Insecurity Status by Severe Disability Status

	Severe Disability Status	
Food Insecure in 2011	With Severe Disability	Without Severe Disability
Yes	861 (19.45%)	1,500 (8.22%)
No	3,565 (80.55%)	16,745 (91.78%)
Total	4,426 (100%)	18,245 (100%)

Note. χ^2_{R-S} = 394.57***, df = 1. Numbers in parentheses indicate column percentages. ***$p < 0.0001$. Surveyfreq procedure with Rao-Scott chi-square was performed in SAS. Sample size of households that were food insecure in 2011 is n=2,361; households that were not food insecure in 2011 is n=20,301.

Table 4.3

Results of Chi-square Test for Food Insecurity Status by Non-Severe Disability Status

	Non-Severe Disability Status	
Food Insecure in 2011	With Non-Severe Disability	Without Non-Severe Disability
Yes	224 (11.91%)	2,137 (10.28%)
No	1,656 (88.09%)	18,654 (89.72%)
Total	1,880 (100%)	20,791 (100%)

Note. χ^2_{R-S} = 4.64*, df = 1. Numbers in parentheses indicate column percentages. *$p < 0.05$. Surveyfreq procedure with Rao-Scott chi-square was performed in SAS. Sample size of households that were food insecure in 2011 is n=2,361; households that were not food insecure in 2011 is n=20,301.

Chi-square results

The results in Tables 4.1, 4.2, and 4.3 show an association between food insecurity in 2011 and household disability status, severe disability status, and non-severe disability status, respectively. By looking at the above contingency tables, one can notice that compared to the number of households that were both food insecure and had non-severely disabled household member, a larger number of those households that were food insecure had a severely disabled household member in 2011. Furthermore, interesting result is that compared to the percentage of households without a member who has working/severe/non-severe disability, a higher percentage of households with a member with working/severe/non-severe disability were food insecure. Specifically, the Table 4.1 shows that 23.85% of households with a member with working disability were food insecure, while only 8.23% of households without disabled member were food insecure. Table 4.2 shows that 19.45% of households with a member with severe disability

were food insecure, while only 8.22% of households without any member with severe disability were food insecure. Although there was not much difference in the percentage between households with and without non-severe disability member and their food insecurity status, the chi-square test still shows that a higher percentage of households with a member with non-severe disability were food insecure than households without a member with non-severe disability.

All of the chi-square tests were estimated with complex design effects (strata and clustering commands in SAS) with weights; therefore, Rao-Scott F adjusted chi-square statistics were used. Not included in the tables, but the sample size of households that were food insecure in 2011 is 2,361, whereas the sample size of households that were not food insecure is 20,301. Results in both Tables 4.1 and 4.2 show that disability and severe disability status have Rao-Scott chi-square statistics, χ^2_{R-S} = 440.86 and 394.57, respectively, both at the significance level of $p < 0.0001$. Also, Table 4.3 results show that non-severe disability status have chi-square statistics, χ^2_{R-S} = 4.64 with significance level of $p < 0.05$. Therefore, all three chi-square results reject the null hypothesis and conclude that there is bivariate evidence that food insecurity status and disability systematically covary with food insecurity status.

Table 4.4

Results of Chi-square Test for Food Insecurity Status by Vehicle Ownership

	Household Vehicle Ownership	
Food Insecure in 2011	Own Vehicle	Do Not Own Vehicle
Yes	1,769 (9.15%)	592 (17.76%)
No	17,568 (90.85%)	2,742 (82.24%)
Total	19,337 (100%)	3,334 (100%)

Note. χ^2_{R-S} = 154.47***, df = 1. Numbers in parentheses indicate column percentages. ***$p < 0.0001$. Surveyfreq procedure with Rao-Scott chi-square was performed in SAS. Sample size of households that were food insecure in 2011 is n=2,361; households that were not food insecure in 2011 is n=20,301.

Results in Table 4.4 show an association between food insecurity in 2011 and household vehicle ownership status. The above contingency table shows that overall, most of the

households owned a vehicle (85.16% of the full sample of households owned a vehicle whereas 14.74% did not own vehicle). Among the households that owned vehicle, 9.15% were food insecure, whereas 90.85% were not food insecure. In contrast, among the households that did not own vehicle, 17.76% were food insecure, whereas 82.24% were not food insecure. This shows that relatively higher percentages of households that do not own vehicle were food insecure, compared to households that own vehicle. Similar to the chi-square analysis for disability, I used complex design adjustments with population weights for vehicle ownership chi-squares. The Rao-Scott chi-square statistics indicate a rejection of the null hypothesis, providing evidence that there is a systematic difference between households that own a vehicle and those that do not own a vehicle when it comes to household food insecurity (χ^2_{R-S} = 154.47, $p < 0.0001$). When including clustering for chi-square with complex sampling design, a researcher would expect to see design correction, or *gdeff*, to be greater than 1 (Lewis, 2013). All of the above chi-square statistics show *gdeff* greater than 1.

T-test results

Next is the two-group independent samples t-test to see whether there is a statistically significant mean difference in unsecured debt ratios of food insecure households and food secure households in 2011. The null and alternative hypotheses for the below t-test are as follows:

H_0: Mean of the unsecured debt ratio is the same for both food insecure and food secure households.

H_1: Mean of the unsecured debt ratio is not the same for both food insecure and food secure households.

Table 4.5

Results of t-test for Unsecured Debt Ratio by Household Food Insecurity Status

	Estimate	Std. Error	t Value	df
Intercept	0.485	0.004	124.19***	114
Food Insecure in 2011	0.148	0.011	13.72***	114

Note *** $p < 0.0001$. In lieu of an independent samples t-test, which is not available using the "survey" procedures in SAS, a weighted surveyreg procedure was estimated with the simple regression model: unsecured debt ratio = food insecure.

The above table provides evidence of a statistically significant mean difference in unsecured debt ratio between food insecure households and food secure households at the significance level of $t(114) = 13.72$, $p < 0.0001$. Households that were food insecure in 2011 used 0.148 more unsecured debt ratio than those who were not food insecure in 2011. This test was done with Surveyreg procedure in SAS, and significance of the t-test ($p < 0.0001$) suggests that there is a difference in the mean unsecured debt ratio between households that were food insecure and those who were not.

These chi-square and t-test statistics offer preliminary evidence that there is a significant relationship between household food insecurity and the three primary variables of interest (vehicle ownership, disability, and unsecured debt). In order to more fully investigate the relationship between the main variables, and see if those associations still reveal significance even after controlling for other theoretically- and empirically-related factors, several alternative multivariate logistic regression models were estimated.

Conditional Fixed Effects Logit Model Analysis

To further examine relationships among time variant variables that changed over a one year period and the association these have with food insecurity transition, I ran an unweighted conditional fixed effects logistic model without any complex sample design effects. Using Allison's (2005) fixed effects model methodology I used a differenced dataset (n = 2,665) extracted from the full dataset (N = 26,671). These differenced data excluded households that did

not make any food insecurity transitions in between year 2010 and 2011. Using a fixed effects model is appropriate when examining time varying variables (Allison, 2005). Table 4.6 shows the results of the unweighted conditional fixed effects logistic regression model.

The dependent variable, which is insecure_w9[17], is a binary variable equal to 0 if households were food secure and 1 if households were food insecure in 2011. The key independent variables are vehicle ownership, number of vehicles, disability, and unsecured debt ratio. Vehicle ownership and disability are binary variables, where 0 means no and 1 means yes. Both number of vehicles and unsecured debt ratio are continuous. Other independent variables, which are included because of evidence in the existing literature, that were significantly associated with food insecurity include: receiving any food assistance, food stamp plus WIC amount households received (in dollars), household type (married or single-headed)[18], number of kids under age 18 in the household, education of the respondent, full-time employment status of the respondent, health insurance status, health status of the respondent, income to poverty ratio, homeownership, and whether or not the respondent is a senior (age 65 or older).

This model (and all later models) used *descending* option so that the model would predict the probability of households transitioning into food insecurity (insecure_w9 = 1) versus transitioning out of food insecurity (insecure_w9 = 0).[19]

[17] _w9 after insecure means that this variable appears in wave 9 – which covers the interview months May 2011 to August 2011.

[18] Reference category for household type is Non-family Household. SIPP data defines household types as follows: 1. Family household – Married couple, 2. Family household – Male householder, 3. Family household – Female householder, 4. Nonfamily household – Male householder, and 5. Nonfamily household – Female householder. For this study, if households fall into: (1) then they are classified as married household, (2) or (3) then as family with single-headed household, and (4) or (5) then as non-family household.

[19] Since food insecurity measurement appears in waves 6 and 9, it compares household's food insecurity status in both years (2010 and 2011). Therefore, households that are insecure_w9=0 in the model are classified as those who transitioned out of food insecurity whereas households that are insecure_w9=1 in the model are classified as those who transitioned into food insecurity in this study. Since I am more interested in households that transitioned into food insecurity, this *descending* option is appropriate.

Table 4.6. Conditional Fixed Effects Logistic Regression Results (unweighted)

Variables	$\boldsymbol{B}$	$\boldsymbol{SE_B}$	$\boldsymbol{e^B}$
Food assistance			
Received food assistance	.232**	.115	1.261
Food stamp + WIC amount	-.001**	.000	0.999
Household type			
Non-family Household (reference category)			
Married Household	-.170	.249	0.843
Single-headed Household	-.124	.206	0.884
Number of kids age less than 18 in household	-.004	.091	0.996
Education (ref. person)			
Less than HS (reference category)			
High school graduate	-.512	.719	0.599
Some college	.494	.565	1.639
College graduate	.350	.289	1.420
Full-time employment during previous 4 months	-.247**	.106	0.781
Health insurance (ref. person)			
Uninsured (reference category)			
Private insurance	-.325***	.113	0.722
Public insurance	.142	.138	1.152
Poor health (ref. person)	.061	.088	1.063
Income to poverty ratio	-.047	.034	0.954
Homeownership	.036	.190	1.036
Age 65 and older (ref. person)	-.592	.353	0.553
Vehicle			
Vehicle ownership	.137	.119	1.147
Number of vehicle	-.103**	.048	0.902
Disability	-.264**	.130	0.768
Unsecured debt ratio	-.046	.095	0.955

Wald χ^2	43.00
Dsf	19

Note: *$p < 0.10$. **$p < 0.05$. ***$p < 0.01$ Full sample N=22,671 households. Conditional logistic regression above (n=2,665) is a two-period fixed effects model that includes only households that transitioned into or out of food insecurity in one year period.

Control variables

The results of the conditional fixed effects logistic regression model (Table 4.5) present significant variables that contribute to a household's transitioning into food insecurity over 12 months (from 2010 to 2011). In the model, receiving food assistance, food stamp and WIC amount, full-time employment, number of vehicle, and disability showed significance at 0.05 significance level, whereas private health insurance revealed significance at 0.01 significance level. Receiving either informal food assistance (from church, family member, or community) and/or government food assistance (such as Supplement Nutrition Assistance Program (SNAP), WIC, or other assistance from government) was related with the increase in the likelihood of transitioning into food insecurity by 1.3 times. This is consistent with Nord (2013)'s finding that from 2009 to 2011, those who had SNAP benefits experienced worsened food insecurity.

Furthermore, Mayer, Hillier, Bachhuber, and Long (2014) found when compared to those who did not receive any food assistance, those who received SNAP benefits were more likely to be food insecure. On the other hand, they did not find significance when comparing to those who do not receive food assistance to those who receive WIC benefit or who receive both WIC and SNAP benefit. In this study, an increase in food stamp or WIC benefits was associated with a decrease in the likelihood of transitioning into food insecurity. This is similar to DePolt, Moffitt, and Ribar's (2009) study in which they found a negative relationship between food stamp participation and food hardships.

Similar to the results of Nord, Coleman-Jensen, and Gregory (2014), found a significant negative association between employment and food insecurity; households that had a full-time employment during previous 4 months were associated with less likely to be transitioning into food insecurity. Furthermore, as Gundersen and Garasky (2012) found, households with health insurance were more likely to be food secure (although they just classified into households that have and do not have health insurance, and not into specific types of health insurance), I found households that transitioned from uninsured into private health insurance were 28% less likely to be transitioning into food insecurity than uninsured households. Since employers provide private health insurance to employees, private health insurance is often linked to employment and thus households with private health insurance might have more access to economic resources when it comes to food insecurity.

Primary variables of interest

Interestingly enough, I did not find significant result for unsecured debt ratio and vehicle ownership and household food insecurity transitions, but the increase in number of vehicle appeared to be significantly associated with decrease in the likelihood of transitioning into food insecurity. This seems to be consistent with what Fitzpatrick and Ver Ploeg (2010) have found. Specifically, they did not find a significant result of the association between vehicle ownership and food distress; however, they found some evidence that vehicle owners spend less on food because those who have vehicle are more likely to have access to lower priced foods than those who do not have vehicle. A presence of increasing asset levels appears to reduce the likelihood of transitioning into food insecurity.

Lastly, those households that have a member transitioning from non-disabled into disabled were less likely to be transitioning into food insecurity. This is somewhat inconsistent

with previous literature that family members with a disability are at greater risk of experiencing food insecurity (Huang et al., 2010; Coleman-Jensen & Nord, 2013). However, since it is just capturing a household's change in disability status within one year, and there are some government benefits and programs available to help individuals and households with member with disability (including food and nutrition assistance) (Benefits.gov, 2016), such benefits may help them from entering food insecurity for certain periods of time. Contrary results in the upcoming second model suggest that further investigation of disability over time is warranted.

Discussion of the conditional fixed effects logit model

I did not find any significance on different types of household, number of children in households, education, poor health, income to poverty ratio, homeownership, senior, as well as unsecured debt ratio. Yet, there were some variables where so few households made transitions in one year that it might have been difficult to capture the effects of changes in those variables to food insecurity transition. Education was one of the variables where few households made transitions, and my study did not find any significance between households that transitioned from less than high school graduate to upper educational levels and food insecurity status. However, studies such as Rose et al. (1998), Alaimo, Briefel, Frongillo, and Olson (1998), and Gundersen and Garasky (2012) found high school graduates were less likely to be food insufficient. Furthermore, Nord, Coleman-Jensen, and Gregory (2014) found households with an adult who graduated from college were less likely to be food insecure compared to households with an adult who are only high school graduates.

One key variable, unsecured debt ratio, did not show any significant results, and I wanted to dig deeper into the relationship between this variable of interest and food insecurity. Although I found some significant results with this preliminary conditional fixed effects model, the

coefficients in this model are not representative of U.S. population because it includes just those households that made food insecurity transitioning moves over the year (n = 2,665) and are unweighted. The next model is weighted, adjusted for complex sample design, utilizes a subpopulation analysis, and includes state fixed effects using the full sample (N = 22,671).

Conditional Fixed Effects Model with Subpopulation Analysis

Next, a weighted subpopulation analysis with state fixed effects was estimated.[20] State effects were included because of the possibility that different states' policies and program benefits, as well as eligibility to food assistance programs, affect households' economic resources available for them to meet their food needs (Bartfeld, Dunifon, Nord, & Carlson, 2006). Because these sources of variation are not directly observable, state fixed effects are included. This is important because I am interested in food policies that are affected by, and will most likely vary, between states. For example, for eligibility for the SNAP, some states exclude the value of household's vehicle as an asset, or have varying rules about the level at which the vehicle's value is accounted for (USDA, 2016).

The main difference between the first conditional fixed effects logit model and this model is that this model uses the full sample size (N = 22,671), but with subpopulation (domain command in SAS) option. For the specification of the model, I defined the domain as the subpopulation of households that made transitions in their food insecurity status over the year. Specifically, I set domain as 1 for those who transitioned from food secure to food insecure (or vice versa) between year 2010 and 2011 (n = 2,665), and domain as 0 for those who did not transition (n = 20,006). Therefore, using the Surveylogistic with domain procedure, the same

[20] For fixed effects model with subpopulation analysis, I ran two different models one with unweighted and the other with weighted. When I tested those two models, the results in unweighted models were similar, however, unweighted subpopulation analysis is inappropriate given the SIPP's sampling design.

model is estimated for each of the two domains, but only the model where domain=1 is useful and reported here. This process allows the weighted estimation of the regression coefficients to reflect population parameters, while simultaneously making available all of the complex sample design information (the cluster and strata variables) for proper estimation (via Taylor series linearization method) of the complex sample standard errors.

Results

Table 4.7 shows the results of this second model that includes a weighted subpopulation analysis and state fixed effects. Unlike the unweighted model, the results for food assistance are no longer statistically significant whereas food stamp and WIC amount remain significant at the 0.05 level. Households that made transitions in and out of receiving either food stamp, WIC benefits, or both, were less likely to be transitioning into food insecurity. Employment, insurance, and number of vehicle were still significant at 0.05 significance level, whereas private health insurance was at 0.01 significance level.

Full-time employment during previous 4 months of the survey was associated with decrease in the likelihood of becoming food insecure. Similar to the result in the previous model, this model showed that households that transitioned from being uninsured to private insurance were associated with 35% less likely to be transitioning into food insecure than uninsured households. Furthermore, consistent with the previous finding in the first model, increase in the number of vehicle was associated with 11% less likely to be transitioning into food insecure. However, inconsistent with the result in the previous model, disability became insignificant in this model and further explanation on this finding will be discussed in the discussion section.

In the preceding literature review, the presence of a person with a disability, as well as physical health and whether or not the household lived in poverty, was one of the strong

predictors of food insecurity. However, I did not find any significant association among those variables and households transitioning into and out of food insecurity. One of the reasons that the variables did not appear to be significantly associated with household food insecurity transition may be that one year period is not long enough to explore transitions that households make. Therefore, for the post-hoc analysis I wanted to run a cross-sectional model with the full sample and not using differenced sample to examine whether the variables of interest show significant association with household food insecurity as suggested by the literature.

Table 4.7 Surveylogistic with Subpopulation Analysis and State Fixed Effects Regression Results (weighted)

Variables	***B***	***SE B***	e^{B}
Food assistance			
Received food assistance	.172	.114	1.187
Food stamp + WIC amount	-.001**	.000	0.999
Household type			
Non-family Household (reference category)			
Married Household	-.093	.306	0.911
Single-headed Household	-.159	.253	0.853
Number of kids age less than 18 in household	-.077	.102	0.926
Education (ref. person)			
Less than HS (reference category)			
HS graduate/GED	-.582	.723	0.559
Some college	-.098	.667	0.907
College graduate	.727	.738	2.070
Full-time employment during previous 4 months	-.248**	.115	0.781
Health insurance (ref. person)			
Uninsured (reference category)			
Private insurance	-.435***	.114	0.648
Public insurance	.158	.161	1.171
Poor health (ref. person)	.067	.115	1.069

Income to poverty ratio	-.081	.045	0.922
Homeownership	-.078	.226	0.925
Age 65 and older (ref. person)	-.612	.330	0.542
Vehicle			
Vehicle ownership	.105	.134	1.111
Number of vehicle	-.118**	.056	0.889
Disability	-.218	.158	0.804
Unsecured debt ratio	-.071	.100	0.931
Wald χ^2		20103.83	
Df		63	

Note: *$p < 0.10$. **$p < 0.05$. ***$p < 0.01$ Full sample N=22,671 households. Surveylogistic regression (weighted) with domain analysis and state fixed effects. Domain = 0 if households didn't transition and 1 if households transitioned their food insecurity status. The model is fit for the entire data (with N=22,671) and gives results with 1) full households 2) households without transition (domain=0), and 3) households with transition (domain=1). Only results domain=1 are presented here.

Cross-Sectional Weighted Logistic Model Analysis

Model description

Because the first two models offered very few insights into the transitioning behavior of households, I thought it would be wise to further investigate the relationship between my primary variables of interest and household food insecurity. To do this, I ran a cross-sectional logistic regression model that did not take into account of differenced data and fixed effects concepts. I chose this route because there seemed to be very little variation in many of the variables, suggesting that a relatively short 12 month transition period may not be enough time for transitions to be manifested in different outcomes. As a reminder, the gold standard for food insecurity assessments remains the Current Population Survey, which utilizes a full 12 month reference period when assessing household food insecurity. Perhaps the four month reference period for the SIPP's measure offers too little opportunity to transition. So, to determine whether

the SIPP data produce cross-sectional results that are consistent with the literature, I estimated a model to predict household food insecurity in 2011. Included in this model were time invariant variables such as race and ethnicity.[21] Table 4.8 shows the weighted cross-sectional model, which reveals some interesting results that are consistent with the existing literature. Notably, in this cross sectional model all three null hypotheses regarding the primary variables of interest (vehicle ownership, disability, and unsecured debt) are rejected. That is, when estimated as a simple cross-sectional model, as many researcher do, there is evidence of a relationship between food insecurity and vehicle ownership, the presence of a disability, and the level of unsecured debt held by the household.

Control variables

Households receiving food assistance were more likely to be food insecure whereas food stamp and WIC amount did not appear to be significant this time. Coleman-Jensen (2011) found married households were associated with lowest probability of food insecurity while female-headed households had the highest probability, however, whether household are married or single-headed household did not significantly associated in predicting food insecurity in this model. Furthermore, Furness, Simon, Wold, and Asarian-Anderson (2004) found that children present in the household were associated with an increase in the likelihood of being food insecure, yet my study did not find number of kids age less than 18 in household as significant in predicting household food insecurity.

[21] These and other time invariant variables were included as interaction terms in exploratory models, but these yielded no substantially different results.

Consistent with Nord, Coleman-Jensen, and Gregory's (2014) study[22], household head who was a college graduate was 23% less likely to be food insecure compared to household reference person with less than a high school degree. On the other hand, Alaimo, Briefel, Frongillo, and Olson (1998), and Gundersen and Garasky (2012) found high school graduates were less likely to be food insufficient, but my study did not find high school graduate as significant. Private health insurance again was significant in predicting household food insecurity, where household with private health insurance was 44% less likely to be food insecure compared to uninsured household.

A study by Bartfield, Dunifon, Nord, and Carlson (2006) found that households that have income less than 185 percent of the poverty line and home renters were associated with higher probability of food insecurity. Consistent with their study, I found that income to poverty ratio and homeownership show significant negative relationship with food insecurity. Furthermore, homeowner households were 35% less likely to be food insecure than non-homeowner households.

Households having a reference person who reported poor health were more likely to be food insecure, which is consistent with Tarasuk, Mitchell, McLaren, and McIntyee's (2013). In their study, a household where one member had a chronic health condition was related to an increase in the probability of household food insecurity. When it comes to the relationship between health and food insecurity, however, there is a two-way direction (Tarasuk et al., 2013) and other studies have examined the reverse association. Yet, for the focus and intention of my research, I do not consider deeper meaning into the effect of health towards food insecurity and

[22] They had four different categories of educational attainment level: less than high school, some college, bachelor degree, and professional or advance degree, where they treated them as dummy variables and set less than high school as reference category.

vice versa. Furthermore, Nord et al. (2014) found that non-Hispanic Blacks and Hispanics, when compared to Whites, were more likely to be food insecure, and Black and Hispanic households were associated with a higher probability of food insecurity than White households in my study.

Primary variables of interest

Interestingly enough, and unlike the conditional fixed effects two-period models, all of the key variables of interest now show significance in predicting household food insecurity. Those who own a car were more likely to be food insecure, whereas the number of vehicle shows that the more vehicle household have they are less likely to be food insecure. For the disability variable, I used severe and non-severe disability instead of work-limiting disability in order to capture incremental disability effect of households in predicting food insecurity.[23] Households with a member with severe and non-severe disability was associated with a higher probability of food insecurity at the 0.01 significance level. Furthermore, unsecured debt ratio shows significance at the 0.01 level, and it tells that those households that have a greater percentage of their total debt as unsecured debt are less likely to be food insecure.[24] Further explanations on such finding will be presented in discussion section.

[23] This specific disability variable only appeared in wave 6 (disability recode = RDISAB), whereas other disability variable that I used for the previous two models (EDIS) appeared in every wave. Since cross-sectional model did not take into account of differenced data, I was able to use the severe and non-severe disability variable (RDISAB) in this model. I could have still used the other disability variable (EDIS) in this model, but as mentioned in here, I wanted to capture incremental disability effect of households in predicting household food insecurity.

[24] Different cross-sectional regression models were attempted which includes vehicle-related variables with interaction with metro, but none contributed any significant results to my original cross-sectional model.

Table 4.8 Cross-Sectional Model with Logistic Regression (weighted)

Variables	B	SE_B	e^B
Food assistance			
Received food assistance	.475**	.071	1.607
Food stamp + WIC amount	-.000	.000	1.000
Household type			
Non-family Household (reference category)			
Married Household	-.126	.074	0.882
Single-headed Household	-.032	.073	0.969
Number of kids age less than 18 in household	-.011	.034	0.989
Education (ref. person)			
Less than HS (reference category)			
HS graduate/GED	-.060	.094	0.942
Some college	.063	.082	1.065
College graduate	-.262***	.097	0.769
Full-time employment during previous 4 months	-.112	.072	0.894
Health insurance (ref. person)			
Uninsured (reference category)			
Private insurance	-.574***	.063	0.563
Public insurance	-.108	.091	0.898
Poor health (ref. person)	.433***	.076	1.542
Income to poverty ratio	-.202***	.027	0.817
Homeownership	-.432***	.076	0.650
Age			
Age (ref. person)	.076***	.012	-
Age Square	-.001***	.000	-
Age 65 and older (ref. person)	-.203	.143	0.816
Race			
White (reference category)			
Black	.307***	.082	1.360
Others	.097	.110	1.102
Hispanic	.207**	.089	1.230

Vehicle			
Vehicle ownership	.246***	.082	1.279
Number of vehicle	-.089**	.038	0.915
Disability			
Severe disability	.616***	.080	1.851
Non-severe disability	.467***	.103	1.595
Unsecured debt ratio	-.175***	.066	0.839
Wald χ^2		2181.31	
Df		25	

Note: *$p < 0.10$. **$p < 0.05$. ***$p < 0.01$ Full sample N=22,671 households. Cross-sectional logistic regression model (weighted, with variances adjusted via Taylor series linearization method) is a model that includes the full sample and did not take into account of differenced data.

Discussion

In the results section, by running chi-square and t-tests, I first examined whether there is an evidence of association between:

1. Households transitioning into and out of food insecurity and vehicle ownership
2. Households transitioning into and out of food insecurity and disability status
3. Households transitioning into and out of food insecurity and unsecured debt ratio

All three tests revealed a bivariate association between household food insecurity transition and three primary variables, at the significance level of $p < 0.05$ or $p < 0.0001$.[25] Next, I ran two different two-period models to see whether there is still evidence of such association when controlling for other relevant time varying factors. The first model was a conditional fixed effects logit model (unweighted) that takes account of only those households that made food insecurity transitions (n = 2,665) over a 12-month period bounded by 2010 and 2011; this

[25] Using surveyfreq procedure in SAS, Rao-Scott Chi-square test p-value for association between disability/severe disability/number of vehicle and household food insecurity was < 0.0001, whereas for association between non severe disability and household food insecurity was 0.0312 ($p < 0.05$). Furthermore, using t-test procedure in SAS, *p*-value for the association between unsecured debt ratio and household food insecurity was $p < 0.0001$.

necessarily considered only time-variant variables.[26] This difference estimation did not reveal vehicle ownership and unsecured debt ratio to be significantly and literature suggests are associated with the transitioning into and out of food insecurity, yet, it showed change in number of vehicle and disability status as significantly associated with the transitioning moves at the significance level of $p < 0.05$.

As shown in Table 3.5, a minority of households change vehicle ownership or disability, or other socio-economic related status, within one year. However, even though I did not see a significant association between change in unsecured debt ratio and food insecurity transition ($p = 0.625$), the model still revealed significant associations with my other two main variables and food insecurity, despite the short time period for capturing such change. In my hypothesis section earlier in the literature review, I hypothesized that:

Ho_1 → There is no relationship between a household's gain (or loss) of a vehicle and their food insecurity transition status.

Ha_1 → There is a relationship between a household's gain (or loss) of a vehicle and their food insecurity transition status.

Ho_2 → There is no relationship between a household's unsecured debt ratio and their food insecurity transition status.

Ha_2 → There is a relationship between a household's unsecured debt ratio and their food insecurity transition status.

Ho_3 → A household member's work limiting disability status is unrelated to the household's food insecurity transition status.

[26] I mentioned about it earlier, but the reason it only takes into account of time-invariant variables is because fixed effects model, according to Allison's (2005) method, takes differenced data and therefore variables or observations that do not change over time will be excluded from the model.

Ha_3 → A household member's work limiting disability status is unrelated to the household's food insecurity transition status.

These hypotheses tested whether a household's change in vehicle ownership, unsecured debt ratio (mostly credit card debt), or disability status are related to household's transition into food insecurity between years of 2010 and 2011. My first model rejects the null hypothesis for vehicle ownership and disability hardship ($p < 0.05$) and concludes that there is a significant difference between those households that transitioned into food insecurity (TFI) who have experienced change in vehicle ownership/disability status between years of 2010 and 2011, and TFI who did not experience vehicle ownership/disability status hardship. However, for the unsecured debt, my model cannot reject the null hypothesis and must therefore conclude that there is no significant difference between those households transitioned into food insecurity (TFI) who have experienced increase or decrease in unsecured debt ratio (mostly credit card debt) between years of 2010 and 2011, and TFI who did not experienced an increase or decrease in unsecured debt ratio.

The second model was fixed effects model with subpopulation analysis (weighted), where it included the full sample (N = 22,671) and set the subpopulation as those who transitioned and who did not transition. Since this model used the full sample with weight, subpopulations were grouped (1 = households that transitioned, 0 = households that did not transition), to appropriately use the complex sample design information, with coefficients representative of the U.S population of households instead of only accounting for those households that made food insecurity transition (n = 2,665).

The main difference in the results for the first and second model was that both receiving food assistance and disability status became insignificant in the second model. The vehicle

variable still showed an association with household food insecurity as expected and suggested in the literature. However, disability became insignificant. In my first model, I rejected the null hypothesis for disability with p value less than 0.05 but in the second model with weighted sample I could not reject the null hypothesis ($p > 0.05$). Furthermore, even though disability in the first model showed significance, the coefficient did not make sense at all – literature suggested that households with a member with a disability are more likely to be food insecure, but my coefficient ($B = -.264$) says that households that have a member transitioning from not having disability to having disability were less likely to be transitioning into food insecurity and vice versa. After all, this might tell the story that the first model (unweighted conditional fixed effects model) is not the correct model and is likely to have made Type I Error by rejecting the null hypothesis when the null is true.

For the last model, I ran a cross-sectional model and the results were consistent with the literature. As Wilde and Nord (2005) found that households that transition into food stamp participation were more likely to enter into food insecurity, my study found that those who received food assistance (either informal or formal) were more likely to be food insecure ($p < 0.05$). Different studies have found a significant association between education and food insecurity (Gundersen & Garasky, 2012; McIntyre, Bartoo, & Emery, 2012; Rose et al., 1998). Especially, these studies found that high school graduates were less likely to be food insufficient; however, my study did not find significance between different categories of educational level and food insecurity except with college graduate and food insecurity ($p < 0.0001$). This finding is consistent with Nord, Coleman-Jensen, and Gregory's (2014) study where they found households with an adult who graduated from college were less likely to be food insecure compared to households with an adult who are only high school graduates.

In terms of health insurance, my study found a negative significant association between private insurance and food insecurity and this is consistent with Gundersen and Garasky's (2012), although they classified health insurance as those who have insurance and who do not have it.[27] Furthermore, Vozoris and Tarasuk (2003) found an association between food insufficiency and poor health conditions, and this is also consistent in my study that household reporting poor health are more likely to be food insecure ($p < 0.0001$). Coleman-Jensen, Nord, and Singh (2013) found households living with incomes near or below the poverty line, and Black and Hispanic households were more likely to be food insecure, and this is consistent with my study findings.

Moreover, my study found that homeowners are less likely to be food insecure and this is consistent with previous study findings (Bartfield, Dunifon, Nord, & Carlson, 2006; Guo, 2011). In terms of the coefficients for age and age squared, Chang, Chatterjee, and Kim (2014) did not find significance, whereas in my study I found both variables to be significantly associated with household food insecurity. Age showed positive significant association with food insecurity while age squared showed negative significant association. This seems to be consistent with Strickhouser, Wright, and Donley's (2014) finding about decrease in the rate of food insecurity as age increases. Moreover, vehicle ownership, disability, and unsecured debt ratio appeared to be significantly associated with household food insecurity. Despite no significant association between some other control variables, including unsecured debt, and transitioning into food insecurity, the cross-sectional model provided the same correlates as the literature suggests, giving further weight to the possibility that the 12-month transition time in the SIPP doesn't offer enough opportunity to identify enough variation in these transitions.

[27] My study grouped health insurance into uninsured, private health insurance, and public health insurance.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

I started this study with an expectation to find some meaningful relationship between households transitioning into and out of food insecurity and changes in vehicle ownership/disability/unsecured debt ratio between the years 2010 and 2011 using the nationally representative data (SIPP). What excited me more was the fact that food insecurity measurement appeared twice in one panel for the first time, which allowed me to capture the household's changing in food insecurity status. Since the introduction of the concept 'food insecurity' emerged in America, Ribar and Hamrick (2003) and Hofferth (2004) were among the first investigators that explored the issue of dynamics related to household food insecurity over time and both used longitudinal data. They specifically took into consideration of a household's changing disability status and food insufficiency status in between their study years, but have not looked at vehicle and unsecured debt.

The 2008 SIPP panel data showed that 10.07% of households were food insecure in 2010 while 10.33% were food insecure in 2011. This was lower than Coleman-Jensen, Nord, Andrews, and Carlson (2012)'s finding that 14.9% of U.S. households were food insecure in 2011.[28] Overall, description of the full sample in this study showed that there was not much of a difference between percentages of households that owned a car/had disability/had unsecured debt in 2009 and 2010. However, chi-square and t-tests revealed that there is an evidence of an

[28] Their study used food security supplement in Current Population Survey, which had larger sample size (N=43,770) of households in the data compared to the SIPP data which I used in this study.

association between household food insecurity and the main three variables of interest. Although, after controlling for other relevant factors, my conditional fixed effects model did not show significance of whether changes in unsecured debt ratio affects household food insecurity transition and it probably have made Type I error by rejecting the null hypothesis for disability when the null may have been true, it still showed that both vehicle and disability had significant association with food insecurity transition. Fixed effects model using subpopulation analysis and weights crossed out the significance effect for disability, however, it still showed that vehicle was significantly associated with households transitioning into and out of food insecurity. Result for disability in both models was inconsistent with Hofferth's (2004) and Ribar and Hamrick's (2003) finding that households with a head who was disabled in one year or both study time years were associated with increase in the likelihood of becoming food insecure.

Yet, cross-sectional models supported the relationship between relevant factors and household food insecurity as suggested in the literature. As mentioned earlier, households that own vehicles were more likely to be food insecure whereas the more vehicles a household have the less likely they will be food insecure. These inconsistent findings are somewhat interesting. Chang, Chatterjee, and Kim (2014) found significantly negative association between vehicle ownership and food insecurity, however, Fitzpatrick and Ver Ploeg (2010) did not find a significant result of the association between vehicle ownership and less food distress. The reason behind positive relationship between vehicle ownership and food insecurity might be that maintaining vehicle would require other expenditures – such as repairing/maintenance/insurance costs. On the other side of the reasoning, the negative relationship between the number of vehicle and food insecurity might be due to the possibility that households have more members within household who are employed and therefore households have more economic resources overall,

as Raphael and Rice (2002) found a strong relationship between vehicle ownership and probability of employment and working hours. Moreover, when it comes to vehicle and food insecurity, there is a counterintuitive reasoning that a reliable transportation is associated with a household's overall economic status (Bird et al., 2011), yet, Gundersen and Gruber (2001) mentioned having assets such as vehicle may put rural low income households into hardships due to the fact that it may decrease their eligibility for programs supported by government (Gundersen & Gruber, 2001).

Furthermore, households that have a member with either severe or non-severe disability were more likely to be food insecure, while households that have more unsecured debt out of total debt were less likely to be food insecure. This might be consistent with Gundersen and Gruber's (2001) finding that more access to credit for low income households might help them improve their well-being including food security. Their study found that food insufficient households in their sample are liquidity constrained and therefore emphasized the importance of smoothing consumption and access to credit to weather the unexpected negative income falls. Likewise, my study might support their reasoning that the more access to credit would help households from becoming food insecure, but until for certain periods of time before households fall into debt hardship.

Although my fixed effects models did not support a strong association between changes in unsecured debt ratio and disability with transitioning into food insecurity, all other bivariate and cross-sectional models suggest that there is a significant evidence of association between vehicle ownership/unsecured debt/disability and household food insecurity. This evidence might tell a story that one year study period may not be enough time for many of the changes to contribute to a change in the household food insecurity status. Therefore, for the future research,

I would recommend to explore more than one year period to capture the significant changes in time-variant factors.

Limitations

The 2008 panel of SIPP data included food insecurity measurement twice in one panel for the first time, which allowed me to capture the changing behavior of household food insecurity as well as other economic related factors. Therefore, it is an appropriate data to use to look at dynamics in food insecurity (Bania & Leete, 2007), however, it would be even better if there are more questionnaires available as to how households purchase for food (methods of purchasing for food), how far they drive to access to food (either to market or food pantry/church/community organization), and/or how much they spend on their food.

One of the limitations of this study is that, as Gundersen and Gruber (2011) mentioned, there is a lack of a household's liquidity constraints status related questions in the SIPP data.[29] For example, there are questions in the data which ask households whether they owe any amount on credit card, the amount they owed on card, and the household's total secured and unsecured debt amount. However, there is no question in regards to a household's credit card limit or remaining balance in card usage. Also, there is no question asking whether households were accepted or denied when they applied for a credit card. Although using the unsecured debt ratio seemed appropriate to use as a proxy for the household's unsecured debt instead of using the household's actual dollar amount of credit card debt and track the changes in dollar amount, it would have been interesting and informative to see whether household credit use behaviors (such as payment history or debt management) contribute to transitioning into and out of food insecurity.

[29] For more information, in the Appendix page, I prepared an Excel table that shows the credit care/debt related questions which appear in the 2008 Panel of SIPP data.

To examine an association between household liquidity constraints status and food insecurity, Leete and Bania (2010), using SIPP data, came up with a proxy for the household's liquidity constraint status by using a ratio of assets to household income. Their reasoning behind interpreting this proxy was that households in the upper quartiles will less likely to be liquidity constrained compared to households in the lower quartiles. Using this proxy measure, they found that a household's liquidity constraint status was positively associated with household food insecurity, which is similar to what my study found that households using more unsecured debt (unconstrained due to access to credit) out of total debt were less likely to be food insecure. For future research, therefore, I may use the same proxy that Leete and Bania (2010) developed in their study to further understand household credit card debt related behavior and food insecurity transition.

Furthermore, I would have been interested in looking at children's disability status in my study as well, however, children's disability recode (RKDISAB) only appeared in wave 6 and so it did not allow me to capture the changes in children's disability status in one panel.[30] Other limitation of this study is that when looking at differenced data (n = 2,665 for only those who made transitions in between years), I checked the number of households that made changes in educational level, homeownership, and other control variables. However, since it is such a short period of time, not that many households made changes from one stage/status to other stage/status within one year. Therefore, short period of time might have not been enough to capture the changes that households make.

Lastly, not specifically considered as a limitation because it is a natural economic event that had happened in U.S., but the Great Recession that had a huge impact on consumers' lives

[30] For more information, in the Appendix page, I prepared an Excel table that shows the adult and children disability related questions which appear in the 2008 Panel of SIPP data.

between November 2008 and April 2010 (Hurd & Rohwedder, 2010), may have affected households' responses to food insecurity question as well as other economic related questions. Since the recession caused a significant drop in household income due to increase in unemployment (Bivens, Fieldhouse, & Shierholz, 2013) as well as drops in household wealth (Pfeffer, Danziger, & Schoeni, 2013), pure consequences of the recession may have impacted households' responses to economic resources as well as food insecurity. Therefore, it would be helpful to understand deeper into the pure effect of vehicle ownership, unsecured debt, and disability status on household transitions into and out of food insecurity when controlling for the Great Recession and examine households' responses following the recession.

Recommendations

One of the important recommendations for the future research is to examine longer than one year time period, as food insecurity is a dynamic phenomenon and the longer the time period the better it will allow the researcher to capture a household's changing behaviors in terms of household economic decisions. Previous studies have found the association between metro versus non-metro, rural versus urban, and household food insecurity (Garasky, Morton, & Greder, 2006; Nord et al., 2014). However, in my study I did not find any significant relationship between metro and household food insecurity. When checked with the number of households that moved from metro to non-metro and vice versa, few households changed metro status within one year period. Therefore, again I recommend using a longer time period when examining households transitioning into and out of food insecurity.

In future research, I would investigate deeper into a question asking whether there is a significant difference on sociodemographic characteristics by the following types of households:

A) Households that transitioned from food secure to food insecure (TFI),

B) Households that have transitioned from food insecure to food secure (TFS),

C) Households that stayed as food secure throughout the study period (SFS), and

D) Households that stayed as food insecure (SFI) throughout the study period

Descriptive statistics show differences in the frequencies and the mean values of household socioeconomic and demographic characteristics, but I did not investigate whether all those characteristics are significantly different by the above types of households. If there seems to be a significant difference in between the groups, researchers and policy makers may want to pay attention as to which specific sociodemographic variables affect different household groups by their food insecurity status.

Moreover, to further understand the unsecured debt ratio finding, the more unsecured debt households use out of their total debt the less likely they will be food insecure, I would first use Leete and Bania's (2010) proxy for liquidity constraint status, and also examine the interaction effects of unsecured debt ratio and other variables, such as employment, health insurance, food assistance, vehicle, poverty, amount owed on credit cards, as well as education. Different interaction terms were tested using vehicle and other vehicle related variables; however, interaction terms with unsecured debt ratio and other variables were not tested in this study. Therefore, for future research, I would test interaction terms of unsecured debt ratio and variables related to household financial management skills, behaviors, or practices.[31]

When it comes to food insecurity and use of credit cards, it is important to acknowledge a household's practice in using credit cards as one of the ways to cover for food (Darko, Eggett, & Richards, 2013) when they run out of the available budget to use. My study found an inverse relationship between a household unsecured debt ratios and food insecurity, and Gundersen and

[31] This could be done using other datasets since SIPP does not ask questions related to household's financial skills, behaviors, or practices.

Gruber (2001) pointed out the importance of expanding access to credit for low income households and providing them with means of weathering negative income shocks. However, Darko, Eggett, and Richards (2013) warned of the possibility of using credit cards without limitation, which may lead to economic hardship due to high interest rate when they cannot afford to pay the card balances in full.

Therefore, in terms of food insecurity and food policy, there seems to be pros and cons of expanding access to credit cards even when households are liquidity constraint. A study by Stegman and Faris (2005), thus, examined financial behaviors, especially banking and credit usage, among households that were formerly as well as currently a part of the Temporary Assistance for Needy Families (TANF) program, with the hope of helping them not to fall back into economic hardships after they leave the TANF program. They found that the leavers still struggled economically even after they left the program, and were more likely to have credit problem and debt burden. To help such families to have stable economic opportunities once they leave the program, Stegman and Faris mentioned and suggested the importance of providing greater access to credit and financial education programs for the current members and the leavers of TANF program. Participants could learn the habits and importance of savings, as saving is significantly and negatively associated with food insecurity (Guo, 2011), and as Stegman and Faris (2005) found savers are less likely to incur debts.

Furthermore, Olson, Rauschenbach, Frongillo, and Kendall (1996) found a lack of saving as one of the significant contributors to food insecurity. However, since households that are in food insecure are, by definition, already in economically vulnerable situations and may not have left over money from monthly income to invest in their savings. Providing financial education and saving programs not only for those TANF leavers, but also for general food insecure

households, would be beneficial. Moreover, Stegman and Faris (2005) also found an association between having bank account and saving, and growing up in a banked household and credit card debt. Therefore, in terms of examining a household's unsecured debt and food insecurity, it would be helpful to include information about each household's banking status and saving behavior.

In terms of disability and food insecurity, policy makers may want to consider the finding that disability, especially severe disability, has a significant association in predicting food insecurity and that disability rate has been increasing in U.S. Especially, Huang, Guo, and Kim's (2010) finding on disability, that when it comes to food insecurity for people with disability liquid assets were better protective resources than income seems important and critical when they apply for government based benefit programs that require asset tests. Furthermore, for future research, it would be important to examine interaction terms between disability and other assets, as well as government based programs to see any interaction effect it has on households transitioning into and out of food insecurity. Since disability, employment, vehicle ownership, access to credit card, eligibility criteria for assistance programs may be interconnected to each other either directly or indirectly, in my future study I would dig deeper into the relationship among those variables in examining the complexity of household transition into food insecurity.

The findings from this study provide some implications for organizations, policy makers, consumer educators, and researchers who focus on preventing households from transitioning into food insecurity, and/or helping currently food insecure households to become food secure through household economic educations and resources. Additional research on different socioeconomic factors and household food insecurity transition might also help policy makers and educators to further acknowledge the factors that play important roles in preventing and

solving household food insecurity transition issues. First, this study found a positive relationship between food stamp and WIC amount and household food insecurity transition, which may suggest that government food assistance programs help households receive beneficial food assistance. This study also found a positive relationship between number of vehicles and food insecurity transitions. However, when applying for SNAP and other food assistance programs, households need to meet an asset limit criteria in order to be eligible for such assistance, where some states include vehicle as household asset. Vehicles, as literature suggested, not only plays an important role as household asset, but it also provides physical accessibility for households to acquire food and to work. Therefore, although some states currently let households exempt from vehicle rules, policy makers could set different rules within current food assistance programs to help and focus on the households that are food insecure but cannot qualify for such programs due to failing to meet asset limit criteria or having a primary vehicle for the household where its value is higher than the maximum asset limit. In addition, this study suggested that having a full time employment reduces the probability of households transitioning into food insecurity. However, some low income households would have no means to afford vehicle and may rely on public transportation to go to work. Considering the literature that vehicle ownership and employment have a negative relationship, therefore, consumer educators should provide education to low income or food insecure households the important skills of keeping or getting a job and encourage them to keep their vehicle and not to sell it just to meet the asset tests and qualify for the assistance program. Households should first seek for other assistance help and think of selling vehicle or liquidate assets as a last resort.

Second, realizing the importance of asset and its role in the times of economic hardships especially for low income households and disabled people, studies have suggested creating and

emphasizing asset building strategies and policies (Chang et al., 2014; Huang et al., 2010). In taking further steps of supporting asset building policies, Guo (2011) suggested incorporating Individual Development Accounts (IDAs) within government food assistance programs. Such matched savings accounts may help households to save and invest for their large assets (e.g. home), educational purposes, etc. Although my cross-sectional analysis found that the more unsecured debt households use out of total household debt, the less likely they will be food insecure, if they use credit cards and incur more unsecured debt without saving or investing, they would not have available resources left over to cover up for other expenses, and may fall into debt trap. Therefore, consumer educators should encourage food insecure households or households that are at a high risk of becoming food insecure to participate in such savings program and teach them the importance of both pros and cons of using unsecured debt and advantages of savings. Furthermore, organizations that have the goal of reducing household food insecurity may seek for funding opportunities to set up IDAs within their communities, where the households not only get the basic food help, but also build savings so that they could rely on their own household asset and resources (Guo, 2011) once they transition out of food insecurity.

Lastly, according to the USDA's SNAP special rules on households with a disabled member, such households may have $3,250 in countable assets compared to $2,250 for households without an elder or disabled member (USDA, 2016). Such difference in the amount of asset limit criteria would be necessary and huge advantage for households with disabled member due to disability-related medical costs that households have to bear. Yet, for households with a member with severe disability may need more careful treatment and spend higher medical expenditures compared to households with a member with less severe disability. As my cross-sectional analysis found that both severe and non-severe disability are significantly correlated

with household food insecurity, therefore, more careful food assistance eligibility rules for households with different types and severity levels of disability may be needed. In addition, my chi-square tables showed that among the full sample, there were more households that have a member with severe disability than non-severe disability.

Therefore, when helping and providing food assistance to households that contain a disabled member, disability related policies and consumer educators should provide different levels of resources depending on the household member's severity level of disability. To support consumer educators, then, there should be more research investigating how the severity levels of household food insecurity change depending on household member's types of and severity levels of disability. Although the SIPP data include whether the household member's disability is severe or non-severe, it does not include whether the disabled member is or was the primary worker (or breadwinner) because food insecurity is measured at the household level. A re-estimation of these analyses in a way that identifies the primary wage earner before the onset of disability may provide insights into these complex households. Also, since disability can happen to anyone at any age stage, further research also should look at disability by age group and household food insecurity.

Above all, when looking at a larger picture, the most helpful strategy of preventing households from transitioning into food insecurity and saving households out of food insecurity would be to help households build their own resources such as savings and assets. Since households cannot and should not always rely on food assistance programs but create their own household economic abilities, policy makers, consumer educators, organizations, and researchers should focus on long-term goals that could help households come out from food insecurity and not fall back into food insecurity. Prevention is an important task, yet, in terms of household

food insecurity, maintaining stable food security status after household come out from food insecurity status seems to be important as well.

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APPENDIX

Appendix A. List of Variable Description Used in this Study

Variable	Description on SIPP data	Recoded in my study
Dependent Variable		
Food Insecurity	Four food insecurity variables created from the food insecurity scale, which is developed by combining five food insecurity variables – EAFLAST, EAFLAN, EAFSKIP, EAFLESS, and EAFDAY.	Households that answered "yes" to at least two of these five food insecurity variables were considered as food insecure. (Specifically, households that answered "yes" to more than two of these five variables were categorized as low food security, and to more than four were categorized as very low food security).
Key Independent Variables		
Vehicle Ownership	**Household (HH) member ownership of vehicle** Question mainly asks "Does anyone in this household own a car, van, or truck, excluding recreational vehicles (RV's) and motorcycles?" -1. Not in Universe 1. Yes 2. No	It was a dummy variable, and recoded into 1/0 (1 indicates HH owns vehicle, 0 indicates HH does not own vehicle)
Number of Vehicle	**Number of vehicles owned by HH** Question asks "How many cars, trucks, or vans are owned by members of this household? -1. Not in Universe 1:20. Number of vehicles	It was treated as continuous variable.
Unsecured Debt Ratio		
Total Unsecured Debt	**Total unsecured debt** 0. Not or not in universe 1:999999999 Amount in dollars	Unsecured debt ratio variable was created by dividing HH total unsecured debt variable by HH total debt recode variable.
Total Household Debt	**Total debt recode** 0. None or not in universe 1:999999999 Amount in dollars	
Disability		

Work-Limiting Disability	**Had a work-limiting physical or mental condition** "Does…have a physical, mental, or other health condition that limits the kind of amount of work…can do at a job or business?" -1. Not in universe 1. Yes 2. No	It is a dummy variable, and recoded into 1/0 (1 indicates HH has a work-limiting disability, 0 indicates HH does not have a work-limiting disability)
Severity of Disability	**Disability recode from Americans with Disability** -1. Not in universe 1. With a severe disability 2. With a non-severe disability 3. No disability	This variable appears only in wave 6, therefore, it was not included in fixed effects model. However, it was included when exploring cross-sectional model.
Independent Variables		
Age	**Age as of last birthday** 0.Less than 1 full year old 1:90. Number of years old	This variable was treated as continuous variable.
Senior	**Age as of last birthday** 0.Less than 1 full year old 1:90. Number of years old	If households answered age as being greater than 65 years old, then households are classified as senior.
Educational Attainment Level	**Highest degree received or grade completed** "What is the highest level of school…has completed or the highest degree…has received?" -1. Not in universe 31. Less than 1st grade 32. 1st, 2nd, 3rd, or 4th grade 33. 5th or 6th grade 34. 7th or 8th grade 35. 9th grade 36. 10th grade 37. 11th grade 38. 12th grade, no diploma 39. High school graduate 40. Some college, but no degree 41. Diploma or certificate from a vocational, technical, trade or business school beyond high 43. Associate (2-yr) college degree 44. Bachelor's degree 45. Master's degree 46. Professional school degree 47. Doctorate degree	This variable was recoded into four different education categories, and wavely dummies for each category were created. [31, 32, 33, 34, 35, 36, 37, and 38] were categorized as 'Less than high school'. [39] was categorized as 'High school graduate'. [40, 41, and 43] were categorized as 'Some college education'. [44, 45, 46, and 47] were categorized as 'College graduate'.

Household Type	**Household type** 1. Family hh-married couple 2. Family hh-male householder 3. Family hh-female householder 4. Nonfamily hh-male householder 5. Nonfamily hh-female householder 6. Group quarters	Recoded into household type categories. [1] was categorized into married household. [2 and 3] were categorized into single parent household. [4] was categorized as it is. [5] was categorized as it is. Those in [6] were excluded due to small N.
Employment Status	**Employment status recode for month** [Response 1] state HH member with a job entire month, worked all weeks [Responses 2 – 5] state HH member with a job entire month or at least 1 but not all weeks [Responses 6 – 8] state HH member no job all month	Only the [Response 1] was included in the coding. Since this variable appears in every wave, first, monthly dummies for employed all weeks all month were created. Then, employed dummies for entire wave were created by summing up employed dummies for 4 consecutive months.
Number of Kids age less than 18 years old	**Total number of children under 18 in family** 0:30 Number of children	This variable was treated as continuous variable.
Food Assistance Received Food Assistance	**Received formal gov't. food assistance** • EFOODSC1 [Food assistance source (FAS): Government agency • RCUTYP25 [WIC Coverage flag] • RCUTYP25 [Food Stamp Coverage flag] • EFREELUN [Qualify for free or reduced price school lunch] • EFREEBRK [Qualify for free or reduced price breakfast] **Received informal food assistance** • EFOODSC2 [FAS: Community or religious charity] • EFOODSC3 [FAS: Family or friends] • EFOODSC4 [FAS: Someplace else] • EFOODTP1 [Food assistance received (FAR)-money, vouchers for groceries] • EFOODTP2 [FAR-bags of groceries] • EFOODTP3 [FAR-Meals from shelter/charity]	To create 'receive food assistance' variable, first, formal government food assistance and informal food assistance dummies for every wave were created. Therefore, households that received formal government or informal food assistance or both assistances were categorized into 'received food assistance'.

	• EFOODTP4 [FAR-other]	
Food stamp + WIC Amount	**Food stamp plus WIC amount (Dollar value)** • THFDSTP [Total HH food stamps received recode] – ranges from 0 to 150000 amount in dollars • T25AMT [Amount of WIC payments] – ranges from 1 to 99999 amount in dollars	To create 'food stamp + WIC amount' variable, first, dollar amount of food stamps and WIC for every wave were created (with the condition that HH's received dollar amount is greater than 0). Then, the variable for dollar amount of food stamps and WIC was created by combining two amount variables. Therefore, this variable represents HH's dollar amount received from food stamp, WIC, or both.
Health Insurance		
Private Insurance	**Source of health insurance** 1. Current employer or work 2. Former employer 3. Union 4. TRICARE/CHAPTUS 5. CHAMPVA 6. Military/VA health care 7. Privately purchased 8. Other	Households that answered to any of these types of health insurance were coded into having private health insurance.
Public Insurance	**Medicaid coverage flag** 1. Yes, covered 2. No, not covered **Medicare coverage in this month** 1. Yes, covered 2. No, not covered	Households that answered to 'yes, covered' to either of Medicaid or Medicare were coded into having public health insurance.
Uninsured	**Household uninsured** Private health insurance, employee health insurance, individual health insurance, military health care, other health insurance, Medicaid, and Medicare.	Households without any of these sources of health insurance were coded into uninsured.
Poverty to Income Ratio	**Ratio** • RHPOV [Poverty threshold for this household in this month] – ranges from 1 to 5000 dollar amount • THTOTINC [Total household income] – ranges from -1500000 to 1500000 dollar amount	Poverty to income ratio was created by dividing total household income by poverty indicators.

Homeownership	**Ownership status of living quarters** 1. Owned or being bought by…or someone in…'s household 2. Rented 3. Occupied without payment of cash rent	If households answered 'owned or being bought by…someone in …'s household', then households were classified as being homeowner.
Poor Health	**Report of current health status** 1. Excellent 2. Very good 3. Good 4. Fair 5. Poor	If households answered either 'Fair' or 'Poor' to own health status, then they are classified as having poor health.
Race	**The race(s) the respondent is** 1. White alone 2. Black alone 3. Asian alone 4. Residual	Race and Hispanic dummies were created separately due to the fact that the race and Hispanic origin questions appear separately.
	Spanish, Hispanic, or Latino Is…Spanish, Hispanic, or Latino? 1. Yes 2. No	

Note. The full description of questionnaire and variable lists can be found here: http://thedataweb.rm.census.gov/ftp/sipp_ftp.html

Appendix B. SIPP 2008 Panel Topical Modules List

WAVE	TIME PERIOD	TOPICAL MODULES
1	Sep 2008 – Dec 2008	Recipiency History Employment History Tax Rebates
2	Jan 2009 – Apr 2009	Work Disability History Education and Training History Marital History Migration History Fertility History Household Relationships Tax Rebates
3	May 2009 – Aug 2009	Welfare Reform Retirement and Pension Plan Coverage
4	Sep 2009 – Dec 2009	Assets and Liabilities Real Estate, Dependent Care, and Vehicles Int Accts, Stocks, Mortg, Val of Bus, Rental, Other Medical Expenses/Utilization of Health Care - Adults and Children Poverty (Work-related Expenses/Child Support Paid) Child Well-Being Economic Stimulus Questions
5	Jan 2010 – Apr 2010	Annual Income and Retirement Accounts Taxes Child Care Work Schedule
6	May 2010 – Aug 2010	Adult Well-being Child Support Agreements Support for Non-household Members Functional Limitations and Disability - Adults Functional Limitations and Disability - Children Employer-Provided Health Benefits
7	Sep 2010 - Dec 2010	Assets and Liabilities Real Estate, Dependent Care, and Vehicles Int Accts, Stocks, Mortg, Val of Bus, Rental, Other Medical Expenses/Utilization of Health Care - Adults and Children Poverty (Worked-related Expenses/Child Support Paid)
8	Jan 2011 – Apr 2011	Annual Income and Retirement Accounts Taxes Child Care Work Schedule
9	May 2011 - Aug 2011	Informal Care-giving Adult Well-being

10	Sep 2011 - Dec 2011	Assets and Liabilities Real Estate, Dependent Care, and Vehicles Int Accts, Stocks, Mortg, Val of Bus, Rental, Other Medical Expenses/Utilization of Health Care - Adults and Children Poverty (Worked-related Expenses/Child Support Paid) Child Well-Being
11	Jan 2012 - April 2012	Retirement and Pension Plan Coverage
12	May 2012 - Aug 2012	NA
13	Sep 2012 - Dec 2012	Professional Certifications and Educational Certificates
14	Jan 2013 - April 2013	NA
15	May 2013 - Aug 2013	NA
16	Sep 2013 - Dec 2013	NA

Source: U.S. Census Bureau (2014). http://www.census.gov/programs-surveys/sipp/tech-documentation/topical-modules/topical-modules-2008.html

Appendix C. Key Variables Time Period List

KEY VARIABLES	WAVE	TIME PERIOD
Food Security Status	Wave 6 Wave 9	May 2010 – Aug 2010 May 2011 – Aug 2011
Vehicle Ownership	Wave 4 Wave 7	Sep 2009 – Dec 2009 Sep 2010 – Dec 2010
Unsecured Debt	Wave 4 Wave 7	Sep 2009 – Dec 2009 Sep 2010 – Dec 2010
Disability Status	Every Wave	Sep 2008 – Dec 2013

Source: U.S. Census Bureau (2014). http://www.census.gov/programs-surveys/sipp/tech-documentation/topical-modules/topical-modules-2008.html

Appendix D. SIPP 2008 Credit/Debt Variable Information

Category	Variable	Wave	Item
Credit Card/Debt	Money owed	4, 7	EALJDB
	Money owed	4, 7	EALJDL
	Money owed	4, 7	EALJDO
	Amount owed	4, 7	TALJDAB
	Amount owed	4, 7	TALJDAL
	Amount owed	4, 7	TALJDAO
	Debts in own name	4, 7	EALIL
	Debts in own name	4, 7	EALIDB
	Debts in own name	4, 7	EALIDL
	Debts in own name	4, 7	EALIDO
	Amount owed in own name	4, 7	TALIDAB
	Amount owed in own name	4, 7	TALIDAL
	Amount owed in own name	4, 7	TALIDAO
Debts on Home	Mortgage on Home	4, 7	EHMORT
	Number of debts on Home	4, 7	ENUMMORT
	Mortgage or debt on Mobile home	4, 7	EMHLOAN
	Site or mobile home debt	4, 7	EMHTYPE
	Total debt owed on Home	4, 7	THHMORTG
Total Debt	Total debt	4, 7	THHDEBT
	Total secured debt	4, 7	THHSCDBT
	Total unsecured debt	4, 7	THHUSCBT
Debt on Stocks / Mutual Funds	Debt against stocks/funds	4, 7	ESMJMA
	Amount of debt on S/MF	4, 7	TSMJMAV
	Debt on S/F in own name	4, 7	ESMIMA
	Debt on S/F in own name	4, 7	TSMIMAV
Debt on Rental Property	Debt on rental properties	4, 7	ERJDEB
	Debt on rental properties not located on residence	4, 7	ERIDEB
	Debt on unattached joint rental property	4, 7	ERTDEB
Debt on Business	Total debt on business	4, 7	TVBDE1
	Total debt on business	4, 7	TVBDE2

Note. The full description of questionnaire and variable lists can be found here: http://thedataweb.rm.census.gov/ftp/sipp_ftp.html

Appendix E. SIPP 2008 Disability Variable Information

Category	Variable	TM	Item
Limitations in Functional Activities	Seeing	6	ESEEDIF
	Seeing	6	ESEENOT
	Hearing	6	EHEARDIF
	Hearing	6	EHEARNOT
	Speaking	6	ESPEECHC
	Speaking	6	ESPEECHD
	Walking/using stairs	6	EWALKC
	Walking/using stairs	6	ESTAIRSC
	Walking/using stairs	6	EWALKD
	Walking/using stairs	6	ESTAIRSD
	Grasping	6	EGRASPC
	Grasping	6	EGRASPD
	Lifting and Carrying	6	ECANT10
	Lifting and Carrying	6	EDIF10
Activities of daily living (ADLs)	Difficulty getting around inside the home	6	EINHELP
	Difficulty getting around inside the hoe	6	EINDIF
	Getting in/out of a bed/chair	6	EBEDHELP
	Getting in/out of a bed/chair	6	EBEDDIF
	Bathing	6	EBATHH
	Bathing	6	EBATHDIF
	Dressing	6	EDRESSH
	Dressing	6	EDRESSD
	Eating	6	EEATHELP
	Eating	6	EEATDIF
	Toileting	6	ETOILETH
	Toileting	6	ETOILETD
Instrumental activities of daily living (IADLs)	Difficulty going out	6	EOUTHELP
	Difficulty going out	6	EOUTDIF
	Managing money	6	EMONEYH
	Managing money	6	EMONEYD
	Preparing meals	6	EMEALSH
	Preparing meals	6	EMEALSD
	Doing Housework	6	EHWORKH
	Doing Housework	6	EHWORKD
	Doing Housework	6	EHWRKDIF
	Taking prescriptions	6	EMEDH
	Taking prescriptions	6	EMEDD
	Using the phone	6	ETELEC
	Using the phone	6	ETELED

Others	Wheelchairs, crutches, canes, or walkers	6	ECANE
	Wheelchairs, crutches, canes, or walkers	6	EWCHAIR
	Mental Functioning	6	EALZ
	Mental Functioning	6	EMR
	Mental Functioning	6	EOTHERM
	Difficulty working at a job or business	6	EJOBDIF
	Difficulty working at a job or business	6	EHWRKNO
	Difficulty working at a job or business	6	EINTRFER
	Developmental disabilities	6	EDEVDIS
	Learning disabilities	6	ELDIS
	First conditions causing difficulty	6	ECOND1
	Second condition causing difficulty	6	ECOND2
	Third condition causing difficulty	6	ECOND3
	First condition causing fair/poor health	6	ECONDPH1
	Second condition causing fair/poor health	6	ECONDPH2
	Third condition causing fair/poor health	6	ECONDPH3
	First condition causing limitation in working	6	ECONDW1
	Second condition causing limitation in working	6	ECONDW2
	Third condition causing limitation in working	6	ECONDW3
	Variable	**Wave**	**Item**
Limitations in Functional Activities	Hearing difficulty	4, 7	EDIS1
	Vision difficulty	4, 7	EDIS2
	Cognitive difficulty	4, 7	EDIS3
	Ambulatory difficulty	4, 7	EDIS4
	Self-care difficulty	4, 7	EDIS5
	Independent living difficulty	4, 7	EDIS6

Note. The full description of questionnaire and variable lists can be found here: http://thedataweb.rm.census.gov/ftp/sipp_ftp.html