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Food Insecurity and Affordable Housing

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FOOD INSECURITY AND AFFORDABLE HOUSING

BY

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This thesis is approved as a creditable and independent investigation by a candidate for the master's degree and is acceptable for meeting the thesis requirements for this degree. Acceptance of this does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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ABSTRACT

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Food insecurity in household with children in the US is about 13.6 percent. Food insecurity among households with children headed by a single woman is 28.7 percent and among households with incomes below 185 percent of the poverty threshold (the Federal poverty line was $25,926 for a family of four in 2019) is 27.6 percent (USDA, 2019). This research is about the effect of affordable housing on food security in the United States. The data include observations on 50 states and Washington, D.C., from 2004 to 2017 resulting in a total sample of 714 observations. The research used the 50th percentile FMR and housing vouchers as proxies for affordable housing. In researching the main objective, the research examined on how the presence of SNAP affects the relationship between food insecurity and housing affordability, the research also investigated on how the presence of WIC affects the relationship between food insecurity and housing affordability. To run the analysis, the study used the fixed effect model followed by the IV regression in efforts to overcome endogeneity. We found that an increase in the 50th percentile FMR causes food insecurity to increase, while an increase in housing vouchers increases food insecurity. The results of the fixed effect model show that there is positive relationship between WIC and food insecurity, while the effect of SNAP on food insecurity is absent. The results show that an increase in the median fair market rents causes food insecurity to increase, so a reduction in rent prices targeted to poor households would help low-income families improve their food security. That is, gaining access to affordable housing helps poor families become more food secure

CHAPTER 1: INTRODUCTION

1.1 Introduction

Having an adequate diet and access to affordable housing are key components of a person's or a family's health and well-being. Because both food and housing security are basic needs for individuals and families, having to choose between paying for food or paying rent is particularly difficult when budgets are small and limited. This choice may be a reality for low-income families who struggle when deciding whether they should risk getting evicted in order to eat adequate food or letting go of adequate food to pay rent. When poor families live in affordable homes, they are more likely to afford nutritious food for their families, so having access to affordable housing will allow them to allocate a greater share of their income to food.

Many low-income households suffer from food insecurity due to several barriers, the most important of which is insufficient income in combination with high rental costs, food expenditures, and transportation costs (USDA, 2009). Poor families are forced to spend a large proportion of their income on accommodation, so as housing costs increase, food insecurity tends to increase as well (Charette et al., 2014). In this study, I investigate the effect of housing affordability on food security in the United States, while taking into account participation in federal nutrition programs such as the Supplemental Nutrition Assistance Program (SNAP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC).

1.2 Background

A household is considered food-secure when it has adequate food for the whole family (USDA, 2019). The persistence of food insecurity remains a challenge in designing appropriate health, nutrition, and social policies in the United States and elsewhere. Food insecurity has fluctuated throughout history in the United States. Over the past two decades, the prevalence of food insecurity rose from 10.5 percent to 12 percent of total households between 2001 and 2004, and then declined to 11 percent in 2005. It stayed constant at 11 percent until 2007, then increased to 14.6 percent in 2008. Food insecurity reached its peak of 14.9 percent in 2011 and has been declining ever since (USDA, 2019), but it recently underwent a dramatic increase as a result of the Covid-19 pandemic. Findings show that in 2018 about 7.1 percent of households with children experience food insecurity (Coleman-Jensen et al., 2019). Food security is particularly important for children because it not only affects their day-to-day health, but also their physical, mental, and social development and therefore their future health and well-being (Coleman-Jensen, 2019).

The U.S. Department of Housing and Urban Development (HUD) defines affordable housing as the situation in which a household can acquire a home for 30 percent or less of its income. HUD's mission is to "create strong, sustainable, inclusive communities and quality affordable homes for all" (HUD, 2020). As households reduce the proportion of their income on housing, they are able to increase their remaining spending on other needs, including food. Because low-income families have limited funds, they may be unable to access a healthy diet, so having access to affordable housing increases the likelihood for them to obtain adequate and healthy food by relieving the pressure of high housing costs on their budgets (Charette et al., 2014). In other words, there

is a positive relationship between having access to low-cost housing and access to adequate food. High housing expenses make it difficult to buy food, and once that burden is reduced, then families have more money available to purchase food (Meisenheimer, 2015). For example, Meisenheimer (2015) showed that 52 percent of households who were clients of Vermont's Foodbank had to choose between paying for food and paying for their rent or mortgage.

Providing affordable housing is an indirect approach to improving food insecurity, but few studies delineate the relationship between food security and affordable housing. Programs such as the Low Income Housing Tax Credit and housing vouchers aimed at improving the supply of affordable housing are meant to help households financially. Living in a low-rent home allows families to allocate money for other essentials such as food and daycare. In other words, improving housing affordability can improve food security.

1.3 Problem Identification

Even though the scope of the relationship between food security and housing affordability is broad, to the best of my knowledge only a limited number of studies specifically link food security to housing affordability in the U.S. There are also few studies that assess the relationship between food security and affordable housing based on observations made in other countries, including Canada and Malaysia.

1.4 Objectives

This study addresses the linkage between food security and housing affordability in the United States. I also examine how the introduction of SNAP and WIC influence the association between food insecurity and housing affordability, and address the relationship

between food insecurity, unemployment, poverty, and gross domestic product. Specifically, the main objective of this thesis is to establish an association between food insecurity and housing affordability. The data used to accomplish the objective are based on annual state-level observations from 2004 to 2017. The data were obtained from HUD, the Kaiser Family Foundation (KFF), the Center on Budget and Policy Priorities (CBPP) and the University of Kentucky Center for Poverty Research (UKCPR). The specific objectives of the study are:

1. To analyze whether improving housing affordability can reduce food insecurity among low-income families.
2. To examine how the presence of SNAP affects the relationship between food insecurity and housing affordability,
3. To investigate how the presence of WIC affects the relationship between food insecurity and housing affordability.

1.5 Justification

Although there is a positive relationship between having access to affordable housing and food security from a theoretical perspective, little is known about how SNAP and WIC affect this relationship. Additionally, little research has been done on the relationship between affordable housing and food security in an empirical sense in a U.S. setting. Results of this study are expected to help inform which affordable housing methodology can help reduce food insecurity. The study used the housing vouchers program and the 50^{th} percentile FMR, which is based on a formula to calculate the median of fair market rents used by HUD, as proxies for affordable housing. Knowing which one of them has more impact in reducing food insecurity will help redirect assets toward the

right one. The results of this study are also expected to contribute to the existing literature on the relationship between housing affordability and food insecurity in the United States. This research could also help officials, policymakers, service providers and the public to assess the changing needs for assistance and the effectiveness of existing programs. Research on this topic could motivate private and public nutrition assistance providers and affordable housing providers to work together to improve nutrition within communities.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter provides a review of studies on food security and housing affordability from an economic perspective. The chapter is divided into five parts: first I provide background information on affordable housing, followed by a definition of food insecurity. Third, I describe SNAP, and the fourth section consists of a review of existing studies on the link between affordable housing and food insecurity. The chapter is closed with a discussion on how affordable housing and food insecurity influence other outcomes.

2.2 Affordable Housing

According to the U.S. Department of Housing and Urban Development's (HUD) definition of housing affordability, a household can acquire a home by spending an equivalent of 30 percent or less of their income (Belsky, Goodman, & Drew, 2005). The amount of money people spend on housing varies by state. The amount of money a household spends on housing directly determines the financial resources that remain available to the household for food and other expenditures. Lest evicted, a household is likely to pay its housing costs in full on a monthly basis in the short-term. Nevertheless, high housing costs are a problem for low-income earners. The purpose of HUD and housing subsidies from other sources is to help low-income earners afford their monthly rent and thereby increase the amount of financial resources available for other expenditures. The common programs for rental assistance are Low Income Housing Tax Credit (LIHTC), Public Housing, privately owned subsidized housing, and Housing Choice Vouchers. Low Income Housing Tax Credit is the most significant federal source of new affordable rental

housing in the U.S. The program incentives developers to invest in affordable housing (Daniel, 2018). With the privately owned subsidized housing, apartment owners provide lower rents to low-income tenants. Public Housing offers apartment at a lower price for low-income families, the elderly, and persons with disabilities. With the housing vouchers, tenants find their own place and use the vouchers to pay for either a part or all of the rent (HUD, 2020).

Yglesias (2015) commented that something is wrong with the official definition of affordable housing. He argued that the affordable housing metric does not count in transportation costs when low-income families move farther away from job centers by trying to reduce their housing costs. He also added that the concept of Area Median Income (AMI) can overstate the affordability of housing in high-income areas, because when low-income families leave as a result of only being able to afford sub-standard housing, this increases the local median income and the standard of what makes housing affordable.

In attempts to improve the measurement of housing affordability, Herbert et al. (2018) used three disparate metropolitan areas to assess the 30 percent of income standard performance in measuring housing-burden rates to the residual income. The three metropolitan areas the authors compared were Los Angeles (representing an area with high housing costs), Phoenix (with moderate housing costs), and Cleveland (with low housing costs). The authors found that the 30-percent of income standard in measuring housing affordability is similar to using residual income as a measurement of housing affordability. Due to its intuitive appeal, I apply the 30-percent of income standard as my measurement for affordable housing in this study.

According to Maher (2019), the federal government and researchers generally consider housing affordable when the marginal propensity to consume housing (the amount of income spent on housing) is equal or less than 30 percent. When the marginal propensity to consume housing is more than 50 percent, a household is considered extremely cost-burdened. In his analysis of the housing market in Dane county, Wisconsin, Maher (2019) noted that most families are left to sacrifice their basic needs and cleanliness in their quest to search for housing, because 46 percent of all renter households were either cost-burdened or extremely cost-burdened according to the data from HUD between 2011 and 2015. The author also documented that as the proportion of low-income households' and people of color's budgets spent on housing increased, spending on other necessities, such as food and health care, decreased.

Rice et al. (2008) suggest affordable housing is important for the healthy development of a child. The authors further indicated that housing instability – defined as the gap between poor families' incomes and housing costs – is associated with increased mental health problems and illness among children. Based on a survey of 2,500 poor families in the U.S. with one or more children over a seven-year period, the authors found that among families experiencing housing instability, 13 percent lived on the street or in a shelter. The authors noted that serious housing problems exist throughout every demographic, racial, and ethnic group and renters living in urban, suburban, and rural areas in the country.

This subsection described ways to measure affordable housing, the effects of financial pressures on food expenditures and health care among low-income households,

and the impacts of affordable housing on children's health. The next section provides an overview of food security.

2.3 Food Insecurity

In 1995, the Current Population Survey (CPS) introduced a measurement of food insecurity. After several evaluations, the Core Food Security Module (CFSM) designed 18 official questions for households, both with and without children, to measure food insecurity in the United States (USDA, 2019). Those eligible to answer the CFSM questions are households facing financial constraints. People required by their religion to fast or those dieting are not eligible to provide affirmative answers to the CFSM questions. Individuals responding positively to eight or more questions are considered facing a low level of food security (very low food security). This study is concerned with households facing very low food security. The USDA (2019) defines households as facing very low levels of food security whenever one or more household members are hungry during a period of a year due to their inability to afford food.

Among factors that influence food insecurity, several authors consider demographic and socioeconomic variables. For instance, Nord et al. (2010) established that households with African Americans as heads, of Hispanics, whose members never married, of divorced or separated persons or groups, of young persons, of renters, and people with relatively low levels of education are more prone to be food insecure as compared to their respective counterparts or groups. The authors also found that food insecurity is more common in urban relative to rural areas and suburbs close to the urban areas. However, poverty rates in rural areas tend to exceed those in urban areas in 2017 according to the USDA (2019).

Gundersen and Gruber (2001) found that some households with average incomes greater than the poverty lines face food insecurity, and some household with average incomes lower than the poverty lines are food secure, using a sample of households from the Survey of Income and Program Participation (SIPP). This is consistent with results of Nord and Brent (2002), who found that households with relatively high incomes (over $50,000 a year) also face food insecurity, based on data from the CPS Food Security Supplements of April 1995, September 1996, and April 1997. Gundersen and Gruber's (2001) findings also indicate that households with liquid assets are less likely to be food insecure than those without.

Ribar and Hamrick (2003) applied multivariate and discrete-choice regression models to establish a relationship between poverty and food insecurity, using panel data from both SIPP and the Survey of Program Dynamics (SPD). The authors suggest that income volatility is associated with food insecurity, because assets are protective against food insecurity for poor households. Applying a logistic regression model, Leete and Bania (2010) also used SIPP data from 2001 and established that liquidity-unconstrained households are less likely to be food insecure than constrained households. However, the authors suggest that increased probabilities of food insecurity are the result of negative income shocks – not positive income shocks – and the level of household income.

Using state-level data from the 2001-2009 CPS, Gundersen et al. (2011) used fixed-effect regression analysis which also is the methodology utilized in this study to explain the role of economic factors on food insecurity. The authors demonstrate that the magnitude of the effect of unemployment on food insecurity is relatively larger than that of poverty on food insecurity, while controlling for state fixed effects and year fixed

effects. The reason for why the relationship between employment and food insecurity is vital is because an unemployed person is not equivalent to a person being poor. This suggests that it is important to go beyond the poverty rate only in seeking to understand food insecurity, and that other variables such as the employment rate may help explain food insecurity.

A more in-depth study on factors affecting food insecurity was conducted by Sriram and Tarasuk (2016), this time in Canada. The study provides useful information about variables for consideration in my research. The authors analyzed factors that determine household food insecurity in Canada. The study employed data on food insecurity and income distribution from a 2011-2012 Canadian Community Health Survey in 20 census metropolitan areas and included 42,355 households. The authors employed three multi-level logistic regressions to obtain economic predictors of household food insecurity and found that high housing cost is positively correlated with high food insecurity risk. Variables included in the study are household-level characteristics, household structure, education level, the main source of household income, housing tenure, the aboriginal status of the respondent, the immigrant status of the respondent, and Census Metropolitan Areas (CMA)-level characteristics. The researchers also found that food insecurity varied substantially across metropolitan areas. However, CMA unemployment and low-income rates were not associated with household food security status.

Other research on food insecurity showed that low-income households tend to have more limited access to food than high-income households. Alam et al. (2016) investigated low-income households in the east coast economic region of Malaysia, based on a survey held among 460 poor households in both rural and urban areas. Using random sampling,

the authors found that among low-income households, about 47 percent had various forms of food insecurity.

Food insecurity varies at the local, state, and national levels, but few researchers have studied the variation of food insecurity by U.S. state. Bartfeld and Dunifon (2006) examined the variation in household food security among the various states using data from the Food Security Supplements to the Current Population Survey (CPS-FSS). The authors analyzed households with children and programs targeting children over 1998-2001, and found that food security programs benefit low-income families, and that food security infrastructure promotes food security among vulnerable families. The authors examined food insecurity variation across states and how well household and state-level characteristics can explain such variations. Their results confirm that state-level characteristics such as federal food programs and other economics programs explain a major part of the food insecurity rates experienced across various states.

De Marco and Thorburn (2009) examined the effect of social support on the relationship between income and food insecurity among residents of Oregon. They used logistic regressions to explain how households with little social support and low wages moderate the association between income and food insecurity, while adjusting for potentially confounding variables. The authors compared the difference between a constrained model and a full model. In the constrained model, the independent variables included the main effects of income and total social support. For the full model, the independent variables included the main effects of income and the interaction between income and total social support. Results showed no evidence of an association between social support and food insecurity. Additionally, there was no evidence that social support

acted as a moderator between low-income and food insecurity, irrespective of the measure of social support used.

Studies on the relationship between food insecurity and economic factors reviewed in this section considered variables such as income, the poverty rate and unemployment, while other studies looked at food insecurity and low-income families in Canada and Malaysia. This paper includes economic factors such as the unemployment rate, GDP and poverty rates as controls in examining the relationship between food insecurity and affordable housing.

2.4 The Supplemental Nutrition Assistance Program (SNAP)

There are several food assistance programs in the United States, and their main objective is to curb food insecurity among their participants. The Supplemental Nutrition Assistance Program (SNAP) – previously known as the Food Stamp program – is one of the major food assistance programs in United States. SNAP eligibility and household benefits are determined by a number of factors. For a household to be eligible for and receive SNAP, it must satisfy conditions related to three variables: gross-income, net-income, and asset conditions – although some states do not have asset conditions (CBPP, 2020). Household income and resources decide SNAP eligibility, while household size, net income and deductions for certain expenses decide household benefits. Households are eligible for SNAP if their gross income is equivalent to or below 130 percent of the poverty line for each year. The net income of a household is calculated by subtracting living expenses of the household from their gross household income. The household's income must be at or below the poverty line after the deductions are applied. The resource requirement for SNAP eligibility is an asset amount of approximately $2,250 or less

(approximately $3,500 or less for households with someone older than 60 or a disabled member) in 2019 (USDA, 2019).

An increase in household size causes the maximum SNAP benefits received by eligible households to increase at a falling rate. A household's net-income determines if it is qualified to receive the full or a partial amount of SNAP benefits. Households with no net income receive the largest amount of benefits for their household size. Eligible households obtain SNAP benefits via an Electronic Benefit Transfer (EBT) card. The magnitude of the SNAP benefit is determined by the income level and family size of the qualifying household.

Food assistance programs in general and SNAP in particular serve a large number of people. In 2019, SNAP distributions were about $60 billion (USDA, 2020). The fiscal year 2017 report shows that about 68 percent of American children between the ages of one- and 18-years dwell in households that participate in food assistance programs. The same report shows that 19 percent of elderly (age 60 + years) and disabled non-elderly are SNAP recipients (CBPP, 2019).

When low-income households face food insecurity, they may qualify for food assistance and nutrition programs. This is seen in a study conducted by Bhattarai et. al (2005), who investigated the participation of low-income households in the Food Stamp program and those who used food pantries in the United States. The study used Current Population Survey data, which contains information on government programs and food insecurity, from March and April 1999. Respondents of this recall survey were interviewed with 18 different questions. The study used a sample of 3,059 households. Using a bivariate probit model, the authors found that the probability that low-income households

participated in the Food Stamp program was high. Food prices are volatile and accessing healthy food could be expensive, so participating in the Food Stamp Program could help in that matter. Unfortunately, not all low-income households participate in the Food Stamp program. Providing and promoting affordable housing to the ones left out could be an important tool, whether pursued at the local, state, or national level.

Several researchers have analyzed the impact of SNAP on food insecurity (for example, Gundersen and Oliveira, 2001; Borjas, 2004; Wilde and Nord, 2005; and Gundersen and Kreider, 2008). Nord et al. (2010) and Gundersen et al. (2009) noted that food insecurity among recipients is twice as prevalent among qualified non-recipient households compared to recipient households, which suggests that SNAP's main purpose of alleviating food insecurity is to some degree achieved. Gundersen and Oliveira (2001) also investigated food insecurity among SNAP participants and non-participants. Using SIPP data and applying a simultaneous equation model with probit estimates, they found that SNAP recipients are equally or less likely to be food insecure than non-recipients.

Various studies have investigated the effect of SNAP on food insecurity, but this study examines the relationship between food insecurity and housing affordability in the presence of SNAP and WIC.

2.5 Links Between Food Insecurity and Affordable Housing

Financial constraints may make it difficult for low-income households to obtain food, because their available resources after paying their monthly rent are limited. Several housing subsidies and related programs can help low-income households afford increasing housing costs (McIntyre, 2003). Though housing subsidies are not meant to alleviate food insecurity directly and instead are intended to provide low-income households with

affordable housing options, the subsidies provide them with extra income that may be spent on other necessities such as food.

The association between household food insecurity and housing affordability is not well established in the United States. A review of the literature indicates that most studies assessing the relationship between food security and affordable housing are based on observations made in countries other than the United States. Kirkpatrick and Tarasuk (2007) conducted a study on a section of the Canadian populace, spread throughout Canada, to investigate the impact of housing costs on food expenditures. The authors studied the effectiveness of housing subsidies on poor households and used survey data on spending patterns among 15,535 households by Statistics Canada in 2001. Using multivariate logistic regression, the researchers found that food expenditures decline as additional income is allocated to housing. The authors also established that housing subsidies increased food expenditures among low-income households, but their average food expenditures remained below the cost of a basic nutritious diet. The authors further investigated the relationship between housing costs and access to food among low-income families. They used a quota sampling survey (involving a selection of research participants who exhibit selected characteristics) where structural interviews (entailing interviewing a person with primary responsibility for food shopping and management) were used to obtain information concerning housing and food access situations among households. Survey participants lived in Toronto, Canada between November 2005 and January 2007, and were from 12 high-poverty census tracts. Households were divided into families living in subsidized accommodations and those living in rental units. The study considered three types of households: those with two people with an income level at or below $30,000 (in

Canadian dollars); those with three or four people having an income between $30,000 and $40,000; and households with five or more people and an income between $40,000 and $60,000. Recipients eligible for data collection were households with a child of 18 years or younger, who stayed in their place for a month, whose members were fluent in English, and had a gross household income at or below a low-income threshold adopted from Statistics Canada. Based on a sample of 473 households, the authors found that increasing housing costs had a negative effect on food access. Like Kirkpatrick and Tarasuk (2007), the authors found that the problem of food insecurity was prevalent among families in subsidized accommodations and among those in rental accommodations.

In theory as well as in empirical studies, as housing costs increase, food expenditures decrease and so does food access. That is, if a household cannot afford to buy food, it does not have access to food. Several empirical studies on the relationship between food insecurity and housing affordability have been conducted abroad, but to my knowledge this is the first attempt to investigate this relationship under U.S. conditions.

Similar to the work by Kirkpatrick and Tarasuk (2007), I analyze the relationship between food insecurity and affordable housing. Unlike their work, the focus of my study is on U.S. residents and it includes a unique set of variables.

2.6 Food Insecurity, Affordable Housing, and their Influence on Health and other Outcomes

Affordable housing and food security play an important role when it comes to the health of household members. Food insecurity has several negative effects on household members, and it does not exclude any age group. The body of literature on the effect of the food insecurity on household health is extensive. Meyers et al. (2005) examine the

connection between access to subsidized housing and children's nutritional and health status in low-income, food-insecure families. Based on surveillance data among 11,723 low-income renter families in six states (Arkansas, California, Maryland, Massachusetts, Minnesota, and Washington, DC), the authors showed that 24 percent of low-income families without housing subsidies were food insecure and 22 percent of families with housing subsidies were food insecure. This is a minimal difference, which seems to suggest that housing subsidies had very little impact on food insecurity. Perhaps more importantly, among food-insecure families, the authors found that children in families who received housing subsidies had a greater weight for their age than those whose families did not receive such subsidies.

Similarly, Pollack et al. (2010) analyzed housing affordability and health among homeowners and renters and examined whether housing affordability is connected to selected important health outcomes and whether this association differs by housing tenure. Based on data from the Philadelphia Public Health Management Corporation's 2008 Southeastern Pennsylvania Household Health Survey, the researchers found that people living in unaffordable housing had high levels of poor self-rated health. Additionally, renters were associated with having high levels of poor self-rated health, while there was no such connection between homeowners and health issues. The authors concluded that promoting affordable housing may help lessen health issues and improve food security.

Hernández (2016) examined how low-income households efficiently allocate their scarce resources to afford a home and ensure their health and safety. The author documented the housing decisions and health challenges that households adjust to. The study includes a qualitative component, based on interviews and ethnographic observations

in Dorchester, Massachusetts in the United States. Hernández (2016) documented that the difficulty in generating funds to meet housing expenses led to fear of food insecurity and eviction. The author also found that there is an association between housing hardship and health, stress, depression, and food insecurity.

Che and Chen (2003) studied the prevalence of food insecurity, characteristics of people most likely to live in households lacking enough funds for food, and several related health problems in Canada. Using logistic regression analysis, the researchers examined the associations between five health outcomes and food insecurity while controlling for age, sex, and household income. Their results showed that food-insecure households had a higher percentage of people with poor health than those who were food secure. The disparity was the same even when controlling for the effects of age, sex, and household income. Twenty-one percent of food-insecure residents had at least three chronic conditions while 14 percent of food-secure residents had the same problem. Perhaps somewhat surprisingly, food insecurity was associated with obesity – the authors observed a higher percentage of obesity among food-insecure households than among food-secure households. Distress and depression were also higher among food-insecure households than among food-secure households, even when controlling for age, sex, and household income.

Fox (2020) reported on the estimates of the prevalence of poverty in the United States using the official measure and the Supplemental Poverty Measure (SPM) based on information collected in 2020 and earlier Current Population Survey Annual Social and Economic Supplements (CPS ASEC). SPM includes the official measure of poverty and also many of the government programs designed to assist low-income families and

individuals that are not included in the official poverty measure. The report shows differences between the official measure of poverty and the SPM where the SPM has higher poverty rate than the official poverty measure from 2009 to 2019. The report also explains that adding SNAP, WIC, housing subsidies, Temporary Assistance to Needy Families (TANF)/general assistance, and Low-Income Home Energy Assistance Program (LIHEAP) in the SPM calculation reduced the poverty rates in 2019 compared to 2018.

Most research on affordable housing and food insecurity utilizes either logistic regression (for example, De Marco and Thorburn, 2009; Kirkpatrick and Tarasuk, 2007; Sriram and Tarasuk, 2016; Kirkpatrick and Tarasuk, 2011) or probit regression (such as Bhattarai et al, 2005; Gundersen and Oliveira, 2001). In this study, I used a fixed effect regression method because I have a panel data. The data used for the study is over the period from 2004 to 2017. Kirkpatrick and Tarasuk (2011) used data covering 2001 and between 2005 and 2007, Pollack et al. (2010) used 2008 data, Gundersen et al. (2011) used data from the 2001 to 2009, Bartfeld and Dunifon (2006) used data from 1998-2001. Lastly, research on food insecurity and affordable housing was done in Canada (Kirkpatrick and Tarasuk, 2011; Kirkpatrick and Tarasuk, 2007). I use a similar research approach but focus on the United States.

CHAPTER 3: DATA AND METHODOLOGY

3.1 Introduction

This chapter discusses the data sources and the study sample and explains how the research question will be addressed. Then the chapter is finalized by addressing the choice of dependent, independent, and control variables.

3.2 Research Design

To examine the association between food insecurity and housing affordability, I applied the fixed effect estimation technique by including state-level and year-based fixed effects to control for unobserved heterogeneity. Most existing studies such as those by De Marco and Thorburn (2009), Kirkpatrick & Tarasuk (2007), Sriram & Tarasuk (2016), and Kirkpatrick & Tarasuk (2011) applied logistic regressions. For this study, a fixed effect model is used because the use of panel data and to control for time-invariance. Similar to Gundersen et al. (2011), the state and year fixed effects were used to control for unobserved heterogeneity.

The fixed effects models are specified as:

$$FI_{i,t} = \beta_0 + \beta_1\ RP_{i,t} + \beta_2\ X_{i,t} + \beta_3\ GDP_{i,t} + \beta_4\ UR_{i,t} + \beta_5\ PR_{i,t} + \gamma_i\ + \gamma_t + \ \varepsilon_{i,t} \text{ and} \quad (1)$$

$$FI_{i,t} = \beta_0 + \beta_1\ HV_{i,t} + \beta_2\ X_{i,t} + \beta_3\ GDP_{i,t} + \beta_4\ UR_{i,t} + \beta_5\ PR_{i,t} + \gamma_i\ + \gamma_t + \ \varepsilon_{i,t}, \quad (2)$$

where FI represents the percentage of individuals being food insecure out of the total population in a state. RP is the 50th percentile rent estimates (the median of the fair market rent [FMR]), HV is the number of families using vouchers, X represents both the average

SNAP benefits per recipient or WIC funds received per recipient, UR is the unemployment rate, GDP is Gross Domestic Product per capita, PR is the poverty rate, and ε is the error term, which is created when the model does not fully represent the actual relationship between the independent variables and the dependent variables, and γ_i and γ_t represent state and year dummies, respectively. Equation (1) uses the rental rate of a two-bedroom apartment as a proxy for affordable housing and equation (2) uses the number of families using vouchers as another proxy for affordable housing.

The housing vouchers aim to make rental costs affordable for low-income families and the 50th percentile FMR is a rent estimate. Because they have the same objective, I decided to use them as proxies for affordable housing to find out how each of them affects food insecurity. The goal is to find which one is a better program for low-income families, thus the two equations. Most studies discussed in the literature review used fixed effects, which is the same methodology used in this study. However, this approach encounters endogeneity issues. A variable is endogenous when its value is influenced by one or more independent variables. An exogenous variable is a variable that is not affected by other variables in the model. In efforts to overcome endogeneity, I used IV regression, which performed better than fixed effects regression. Before running the IV regression test, I took the lagged values of all the independent variables. The objective of using lagged values as instruments is to overcome the endogeneity issues encountered with the fixed effect regression model. The procedure ensures that the instrument only influences the dependent variable. The lagged values reduce bias and the root mean square error (RMSE) for common ranges of parameter values.

3.3 Variables Definitions

3.3.1 Food Insecurity

The dependent variable in the above equation is household food insecurity. By the definition of the Integrated Public Use Microdata Series- Current Population Survey (IPUMS-CPS), household is food insecure “when a household answers "yes" to three or more questions from the Core Food Security Model, CPS”. According to IPUMS-CPS, the food insecurity rate reflects the fraction of individuals who are food insecure. The IPUMS-CPS categorizes households as experiencing marginal levels of food insecurity, food insecurity, and very low food security. When a household responds positively to eight or more questions, then the household has very low food security. For this study, food insecurity is the dependent variable, and it is a discrete variable. The other two levels of food security were not providing significant results with the other variables, so the study did not use them. I expect food insecurity to have a positive relationship with the 50^{th} percentile FMR, which is the median market rate, and a negative relationship with the number of families using vouchers. As the 50^{th} percentile FMR decreases, food insecurity decreases and as the number of families using vouchers increases, food insecurity decreases.

3.3.2 Affordable Housing

The main independent variable is the 50^{th} percentile FMR (RP) in equation (1) which should have a positive relationship with food insecurity. FMRs are gross rent estimates calculated and used by HUD for more than 600 metropolitan areas and nearly 2,000 nonmetropolitan county FMR areas. The 50^{th} percentile is based on a formula to calculate the median of fair market rents (HUD, 2018). The median rental estimates are

available by metropolitan area from 2001 to 2017. Since the median rental rate is available by metropolitan area in each state, I calculated the mean of these variables to represent state level observations. The mean of the variables is then used as a proxy for affordable housing. The 50th percentile FMR are reported as the prices pertaining to units with zero, one, two, three, and four bedrooms. I selected the two-bedroom rental price, because it is the median unit size and because rental rates are positively correlated with the number of units – see Table 1. As mentioned before, there should be a positive relationship between food insecurity and the 50th FMR.

Table 1: Correlation Matrix of Bedroom Rent Prices

	rent0brm	rent1brm	rent2brm	rent3brm	rent4brm
rent0brm	1				
rent1brm	0.9931	1			
rent2brm	0.9819	0.9931	1		
rent3brm	0.969	0.9803	0.9921	1	
rent4brm	0.9704	0.9802	0.9858	0.9931	1

Data on the number of families using vouchers were obtained from the Center on Budget and Policy Priorities (CBPP) and are available by local housing agency from 2004 to 2017. The local housing agencies are offices placed in different towns of each state to collect data on the number of families using vouchers. I calculated the total number of families using vouchers of the different agencies to get the total number of participants in thousand per state. The total participants per state was multiplied by 1,000 to convert the total number of families using vouchers into million participants per state, then divided by the population to get the total participants per capita, which was used as a proxy for affordable housing. The data represent the number of participants in the Housing Vouchers Program, which is a public program for low-income families that allows low-income

families to pay low rent prices. I expect that the number of families using vouchers has a negative relationship with food insecurity.

3.3.3 SNAP and WIC

One of the objectives of the study is to analyze the influence of SNAP on the relationship between food insecurity and housing affordability. SNAP participants receive benefits to purchase food, and SNAP benefits vary by family size. Benefits are expressed in dollars per SNAP recipient. The association between food insecurity and SNAP is expected to be negative. That is, a cut in SNAP benefits per recipient would be expected to result in an increase in food insecurity.

Another key objective of this study is to examine WIC's effect on the relationship between affordable housing and food insecurity. WIC is a large U.S. food assistance program for women, infants, and children. The program offers nutritious food assistance to allow the healthy development of its participants. The WIC variable is expressed as the total WIC expenditures per state divided by the number of people living in the state which provides the amount of WIC funds received per recipient in each state. The relationship between WIC and food insecurity is expected to be negative.

3.3.4 Control Variables

The unemployment rate (UR) represents the percentage of unemployed people in the labor force. It captures the number of people who are actively looking for a paid job but cannot find one. Gross Domestic Product per capita (GDP) in million dollars is measured as each state's gross domestic product divided by its total population, then multiplied by 1,000 to get the results into billion dollars per capita. The Poverty Rate (PR) is the number of people whose income is below the poverty line, which is updated each

year for inflation using the Consumer Price Index for All Urban Consumers (CPI-U), divided by the total population in each state. Table 2 shows the definition of each variable.

Table 2: Variable Definitions

Variable	Definitions	Source
FI	Percentage of households that are food insecure	UKCPR National Welfare Data
RP	Median price of the fair market rents for bedroom apartments	HUD
HV	Number of families using vouchers per capita	CBPP
SNAP	Average benefit per SNAP recipient	KFF
WIC	Average benefit per WIC recipient	USDA
GDP	Gross Domestic Product per capita	UKCPR National Welfare Data
UR	Number unemployed people as a percentage of the labor force	UKCPR National Welfare Data
PR	Number of people below the poverty line as a percentage of the total population	UKCPR National Welfare Data

3.4 Data Sources

Data were obtained from a variety of sources. Data on food insecurity, the unemployment rate, gross domestic product, and the poverty rate were collected from the University of Kentucky Center for Poverty Research (2020). Data on the 50^{th} percentile rent estimates were collected from HUD (2020). Data on the housing voucher program were obtained from CBPP (2020). Data on SNAP were taken from KFF (2020), and WIC data were obtained from the USDA (2020).

3.5 Data Description

Food insecurity data are available from 2001 to 2017. However, housing vouchers data are only available from 2004 to 2017, so the analysis is based on the latter time period. The data include observations on 50 states and Washington, D.C., resulting in a total sample of 714 observations.

Table 3 provides descriptive statistics of all variables in the study. The mean and standard deviation of food insecurity (FI) are 13.92 and 3.43 respectively, suggesting the average percentage of individuals experiencing very low food insecurity is nearly 5. The maximum percentage of individuals who are food insecure is about 10, for Oklahoma in 2009. For the 50^{th} percentile FMR (RP), the mean and standard deviations are $777.91 and $232.34, respectively, so the average rent payment of a two-bedroom unit per month was close to $800 per month. The maximum price of the 50^{th} percentile FMR was approximately $1,700 in 2017 in Washington, D.C., while the minimum price was around $420 in 2004, for the state of Oklahoma. The number of families using vouchers (HV) has a mean and standard deviation of 7 and 2, respectively, with a maximum of 19 families in 2006, Washington, D.C. So, on average, 7 families use vouchers in a state. Looking at SNAP and WIC, the mean values are $115.49 and $40.69 per recipient per month, respectively.

The mean and standard deviation of GDP are $50.98 and $20.16 per capita, respectively. The mean and standard deviation for the unemployment rate (UR) are 5.97 percent and 2.09 percent, respectively. Finally, the poverty rate (PR) has a mean and standard deviation of 13.04 percent and 3.36 percent, respectively.

Table 3: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Median	Max
FI	714	13.92	3.43	11.53	13.67	22.43
HA	713	777.91	232.34	423.56	709	1746.00
HV	714	6.67	2.37	3.06	6.12	19.27
SNAP	714	115.49	22.44	69.00	119.5	236.00
WIC	714	40.69	6.36	25.68	40.34	61.68
GDP	714	50.98	20.16	26.73	46.98	193.15
UR	714	5.97	2.09	2.40	5.5	13.70
PR	714	13.04	3.36	5.40	12.5	23.10

Table 4 lists the Pearson correlation matrix, which shows that the variables do not appear to suffer from a large degree of multicollinearity, given that most bivariate correlations are less than 0.6. GDP have a correlation coefficient larger than 0.6 with RP and HV. PR and FI share a correlation coefficient larger than 0.6. The correlation coefficients in asterisks are significant at the 5% level. The correlation coefficient shows that there is a negative relationship between food insecurity (FI) and the number of families using vouchers (HV) and a negative relationship between food insecurity and the 50^{th} percentile rents (RP).

Table 4: Correlation Matrix

	FI	RP	HV	SNAP	WIC	GDP	UR	PR
FI	1							
RP	-0.1660***	1						
HV	-0.1124***	0.4750***	1					
SNAP	0.2187***	0.5562***	0.1051**	1				
WIC	0.1490***	0.3948***	0.3044***	0.5439***	1			
GDP	-0.1778***	0.6550***	0.6326***	0.2538***	-0.1686***	1		
UR	0.5240***	0.1267***	0.0553	0.3824***	0.2631***	0.0103	1	
PR	0.6624***	-0.1921***	0.0935*	0.1549***	0.2102***	-0.0269	0.4852***	1

Note: ***, **, and * indicate significance at 0.01, 0.05, and 0.10 levels, respectively.

The figures below provide a visual display of the relationship between the 50th percentile FMR and food insecurity. Figures 1 and 2 represent the states with the highest (California) and lowest rental rates (Mississippi), and Figure 3 represents South Dakota. The figures show the food insecurity and the 50th percentile FMR for the three states between 2004 and 2017, as well as rental rates of apartments of sizes zero to four bedrooms. The figures show that rent prices for each apartment size steadily increased from 2004 to 2017. Food insecurity was steady from 2004 to 2007, then increased from 2007 to 2008, and finally decreased slowly from 2008 to 2017. Figure 3 shows that food insecurity in South Dakota fluctuated and rent prices for each bedroom steadily increased from 2004 to 2017.

Figure 1: Mississippi 50th Percentile FMR and Food Insecurity

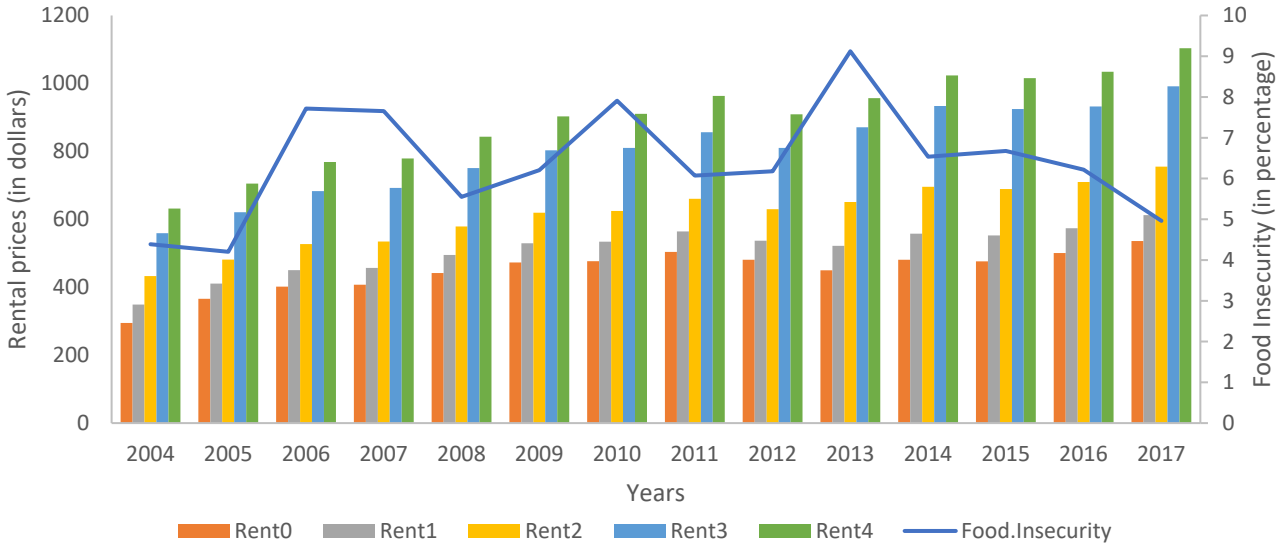


Figure 2: California 50th Percentile FMR and Food Insecurity

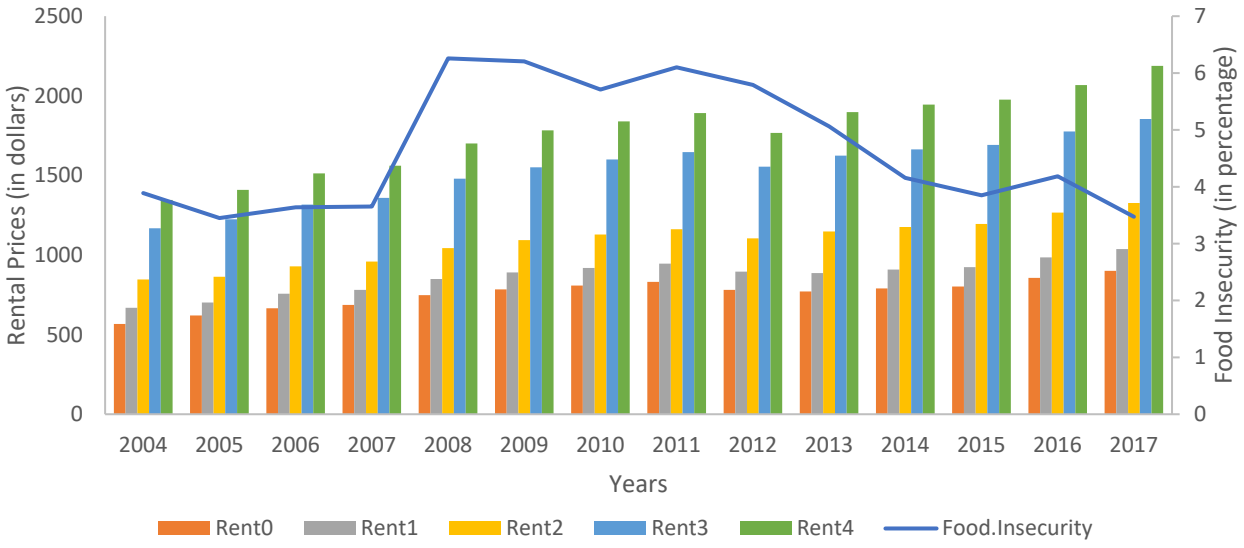
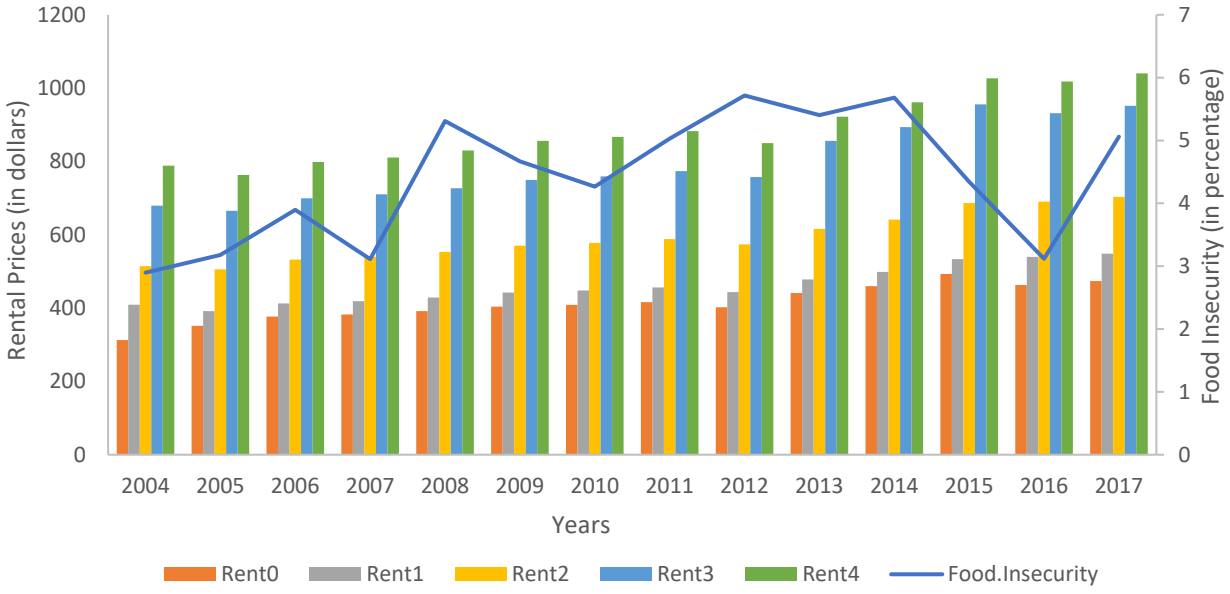


Figure 3: South Dakota 50th Percentile FMR and Food Insecurity



The following figures show the percentage of the total number of families who used vouchers and the percentage all vouchers that were authorized between 2004 and 2017 for California, Mississippi, and South Dakota. The figures portray how many of the authorized vouchers are used. The percentage of authorized vouchers is expressed as the ratio of the total number of vouchers provided by the Housing Choice Voucher Program divided by the population, multiplied by 100. The percentage of families using vouchers is the ratio of total number of families using vouchers divided by the population multiplied by 100. Figure 4 shows that in California the share of families using vouchers has a decreasing trend from 0.83 percent in 2004 to 0.77 percent in 2017. The authorized vouchers decreased from 2004 to 2009, and then increased from 2009 to 2017. Figure 5 shows that in Mississippi, both the number of families using vouchers and the number of authorized vouchers increased slowly from 2004 to 2017. Figure 6 shows that in South Dakota, the authorized vouchers were stable from 2004 to 2009. It increased suddenly from 2009 to 2011 then stabilized from 2011 to 2017. The number of families using vouchers decreased

from 2004 to 2017 with the highest percentage of 0.71 in 2004 and the lowest percentage of 0.62 in 2017.

Figure 4: California Housing Vouchers

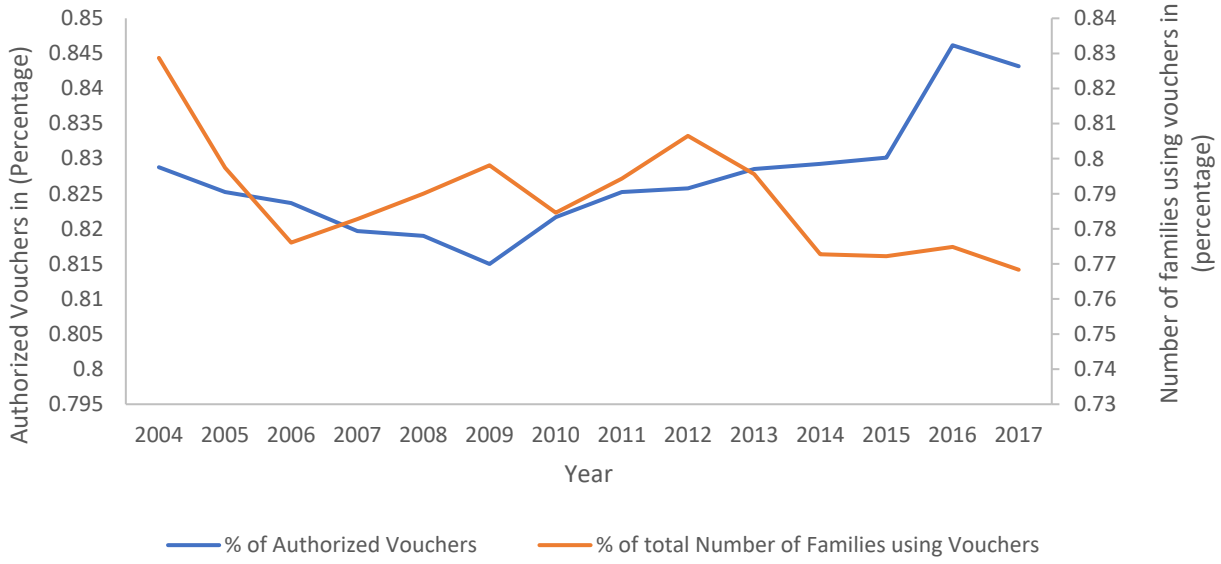


Figure 5: Mississippi Housing Vouchers

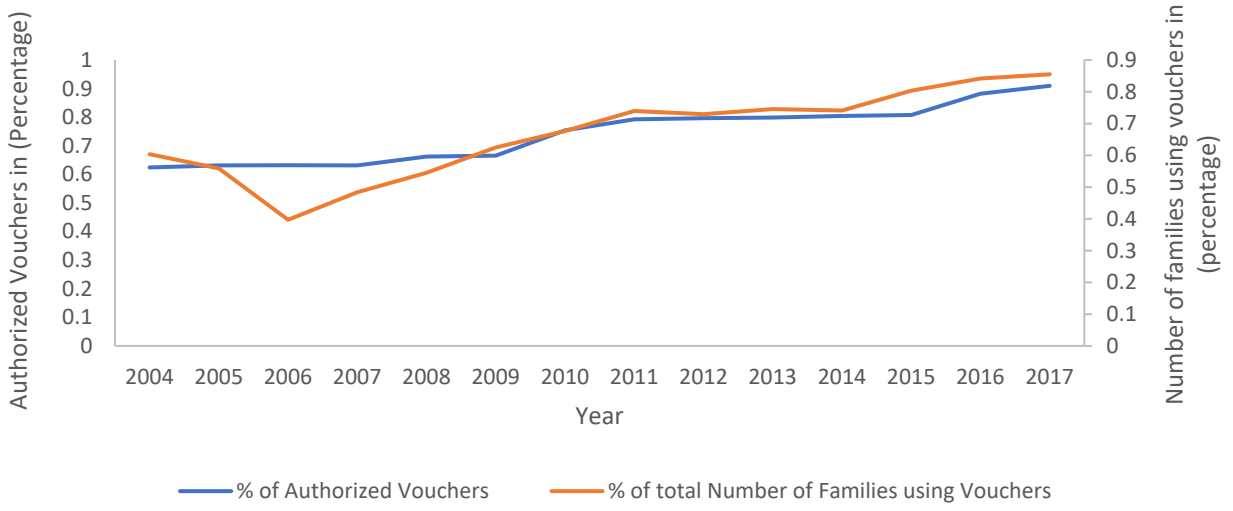
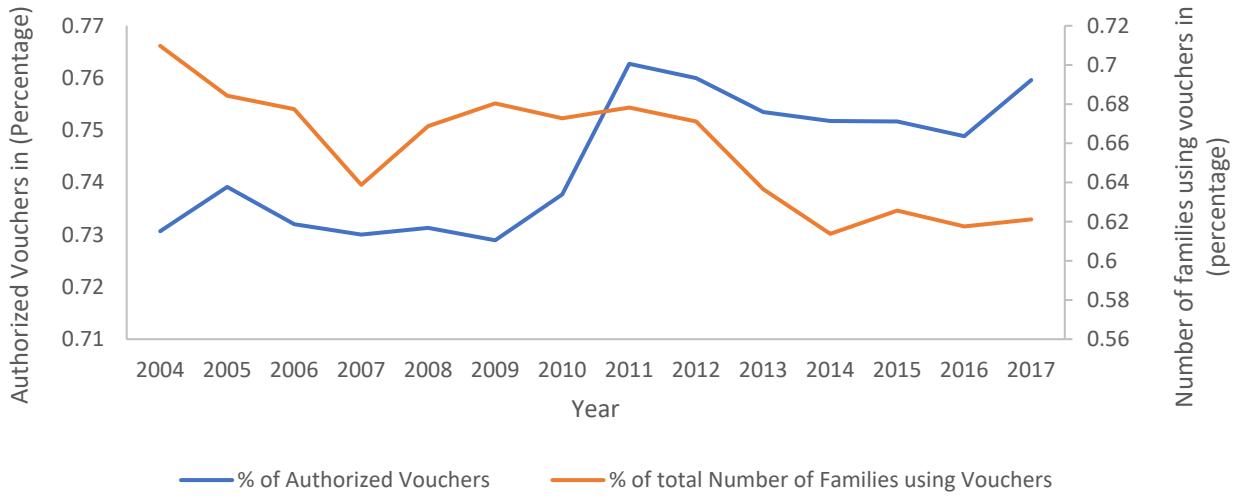


Figure 6: South Dakota Housing Vouchers



CHAPTER 4: RESULTS

4.1 Empirical Findings

In this chapter, equations 1 and 2 are analyzed using two different analytical methods, namely fixed effects regression and instrumental variable (IV) regression. Estimates are considered significant if they have a statistical significance of at least at the 10 percent level. The results of the three methods vary and are unstable, suggesting that it is difficult to show a causal relationship between the variables. In particular, the relationships between the incidence of food insecurity, the 50th percentile, and the number of families using vouchers strictly depend on the type of methodology used. I used the IV regression to eliminate the endogeneity effect encountered in the fixed effect regression by using lagged values as instruments.

Tables 5 and 6 show the regression results of the fixed effects method. Table 5 shows the regression results of food insecurity and the 50th percentile FMR as a proxy for housing affordability. Table 6 shows the regression results of the relationship between food insecurity and the number of families using housing vouchers as the other proxy for housing affordability. In both tables, columns 1 report the relationship between the incidence of food insecurity and the housing affordability proxy. Columns 2 of each table include SNAP benefits per recipient as an explanatory variable, to examine its impact on the relationship between food insecurity and the housing affordability proxy. Finally, columns 3 of each table show the effect of the amount of WIC benefits per recipient on the relationship between food insecurity levels and the housing affordability proxy.

Table 5 shows the regression results of percentage of the population that experiences food insecurity and the 50th percentile FMR as the proxy for housing affordability. Columns 1 and 2, respectively, show a positive and significant relationship between the incidence of food insecurity and the 50th percentile rent levels. From the result, a $100 decrease in rents would decrease food insecurity by four percent (0.004*100). This result is consistent with those of Kirkpatrick and Tarasuk (2007), who found a negative relationship between food spending and income allocated toward housing. As a family allocates less of their income to housing, they can spend more money on food which would reduce food security. In column 1, there is a significantly negative relationship between a state's gross domestic product (GDP) and the share of the population that experiences food insecurity (FI). Consistent with Kirkpatrick and Tarasuk's hypotheses, the unemployment rate (UR) and poverty rate (PR) both have a significantly positive relationship with food insecurity. The percentage of households experiencing food insecurity would be expected to decrease if GDP would increase if the unemployment rate would fall, and if the poverty rate would decline. Leete and Bania (2010) found that liquidity-unconstrained households are less likely to be food insecure than constrained households. Sriram and Tarasuk (2016) found that unemployment and income were not associated with household food security status. The relationship established in column 1 between GDP, unemployment, poverty, and food insecurity did not change with the inclusion of SNAP and WIC benefits per recipient in columns 2 and 3, respectively. The results indicate that there is no association between the incidence of food insecurity and the amount of SNAP benefits per recipient, while there is a significantly positive association between the incidence of food insecurity and amount of WIC benefits per recipient. According to CBPP (2019), SNAP reduced

households' food insecurity by 5 to 10 percentage points in 2013. Therefore, my findings are not consistent with my hypothesis and results from earlier studies. This may be due to various reasons such as the differences in the rent prices within states and the way the variables SNAP and WIC were measured in dollar benefits per recipient. These results suggest the need for additional empirical investigation, particularly regarding the unit of analysis of each variable. Having the same unit of analysis for all the variables might provide better results. An alternative solution would be doing the analysis in a county level to improve the research.

Table 5: Results with the 50th Percentile FMR

	Food Insecurity		
	(1)	(2)	(3)
HA	0.004**	0.004**	0.003
	(0.0014)	(0.002)	(0.001)
GDP	-0.001	0.003	-0.021
	(24.220)	(26.499)	(24.535)
UR	0.615***	0.631***	0.560***
	(0.057)	(0.074)	(0.058)
PR	0.297***	0.302***	0.270***
	(0.060)	(0.062)	(0.060)
SNAP		-0.003	
		(0.010)	
WIC			0.093***
			(0.025)
Constant	3.684***	3.538***	2.048
	(0.929)	(1.024)	(1.016)
State	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	713	713	713
R-Squared	0.3221	0.3034	0.3428

Standard errors in parentheses
Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

In Table 6, column 1 represents my main regression results for the number of families using housing vouchers. The results indicate that there is no association between

the percentage of the population experiencing food insecurity and the number of families using housing vouchers. That is, in contrast to expectations, an increase in the number of families using housing vouchers has no impact on the incidence of food insecurity. This may be because low-income families do not necessarily allocate more income to food expenditures, or perhaps due to the unit of analysis of the housing vouchers. Housing vouchers are expressed in terms of the number of families receiving voucher. A preferred approach would be to use the dollar value of the vouchers received by families in each state. Yglesias (2015) argued that in high-income areas, a house could technically qualify as being affordable but still be out of the price range for low-income households. Although rental prices may be low, low-income families likely spend a larger share of their income on housing than on food.

The relationship between the control variables (GDP, the unemployment and poverty rates) and food insecurity is positive and significant. The results of columns 2 and 3, respectively, show that the inclusion of SNAP and WIC did not affect the relationship between unemployment and poverty rate on food insecurity. While there is no relationship between food insecurity and SNAP, there is a significantly positive relationship between food insecurity and the amount of WIC benefits received per recipient, which indicates that as WIC benefits per recipient increase, food insecurity increases. The result contrast the hypothesis.

Table 6: Results with the number of families using vouchers

	Food Insecurity		
	(1)	(2)	(3)
HV	0.298	0.274	0.196
	(0.159)	(0.164)	(0.160)
GDP	0.047***	0.036	0.019
	(13.306)	(23.229)	(15.004)
UR	0.662***	0.632***	0.598***
	(0.054)	(0.075)	(0.056)
PR	0.306***	0.297***	0.278***
	(0.060)	(0.062)	(0.060)
SNAP		0.005	
		(0.009)	
WIC			0.095***
			(0.025)
Constant	1.5918	2.0015	0.5674
	(1.368)	(1.528)	(1.380)
State	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	713	713	713
R-Squared	0.1966	0.2324	0.2782

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; Standard errors in parentheses.

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Tables 7 and 8 report the IV regression results of Equations 1 and 2. However, none of coefficient of the IV regressions are significant. Table 7 shows the results of food insecurity and the 50th percentile of the FMR as a proxy for housing affordability, and Table 8 shows results of the relationship between food insecurity and the number of families using housing vouchers as the other proxy for housing affordability. In both tables, column 1 examines the relationship between food insecurity and the proxy for housing affordability. Column 2 of each table includes SNAP benefits per recipient as an explanatory variable, to examine the impact of SNAP benefits per recipient on the relationship between food insecurity and the proxy for housing affordability. Finally,

column 3 of each table shows the effect of the amount of WIC benefits per recipient on the relationship between food insecurity levels and the proxy for housing affordability.

Table 7 shows the regression results of the percentage of the population experiencing food insecurity and the 50th percentile of the FMR as the housing affordability proxy. Columns 1, 2 and 3 show no statistically significant relationship but a positive sign between the incidence of food insecurity and the 50^{th} percentile rent levels. Columns 1, 2 and 3 show no association between a state's gross domestic product (GDP) and the share of the population that experiences food insecurity (FI). Neither the unemployment rate (UR) nor poverty rate (PR) both have a significant relationship with food insecurity. The relationship established in column 1 between GDP, unemployment, poverty, and food insecurity did not change with the inclusion of SNAP and WIC benefits per recipient in column 2 and 3, respectively. The results indicate no association between the share of the population that is food insecure and the amount of SNAP benefits per recipient. The same result holds for the amount of WIC benefits per recipient and the incidence of food insecurity.

Table 7: IV Regression Results with the 50th percentile of the FMR

	Food Insecurity		
	(1)	(2)	(3)
HA	0.003	0.004	0.003
	(0.003)	(0.004)	(0.003)
GDP	-0.014	-0.022	-0.014
	(0.104)	(0.102)	(0.105)
UR	0.334	0.333	0.340
	(0.443)	(0.444)	(0.456)
PR	0.333	0.353	0.327
	(0.902)	(0.923)	(0.916)
SNAP		-0.022	
		(0.031)	
WIC			-0.008
			(0.047)
Constant	5.290	6.498	5.662
	(13.942)	(12.841)	(14.828)
N	662	662	662

Standard errors in parentheses
Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results of Table 8 are similar to those of Table 7. Column 1 shows the IV regression result with the number of families using housing vouchers. The IV regression shows no significant values for any of the independent variables in either table. While coefficients of the variables representing the number of families using housing vouchers are not significant, they have a positive sign. That is, in contrast to expectations, as the number of families using housing vouchers increases, the incidence of food insecurity does not change. No relationship between the control variables (the unemployment rate and the poverty rate) and food insecurity was determined. Similarly, no relationship between GDP and food insecurity was observable. The results of columns 2 and 3 show that the inclusion

of SNAP and WIC, respectively, did not affect the relationship between unemployment and the poverty rate on food insecurity. Although the coefficients for both SNAP and WIC are negative, they have no association with food insecurity.

Table 8: IV Regression Results with Housing Vouchers

	Food Insecurity		
	(1)	(2)	(3)
HV	0.560	0.555	0.525
	(0.245)	(0.249)	(0.276)
GDP	0.039	0.0420	-0.045
	(0.121)	(0.126)	(0.076)
UR	0.410	0.420	0.473
	(0.477)	(0.467)	(0.474)
PR	0.365	0.388	0.049
	(1.025)	(1.059)	(0.886)
SNAP		-0.016	
		(0.029)	
WIC			-0.034
			(0.050)
Constant	0.204	1.211	8.952
	(14.771)	(13.605)	(11.604)
N	663	663	663

Standard errors in parentheses

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

CHAPTER 5: IMPLICATIONS

5.1 Overview

The results in Table 5 indicate that using the 50th percentile FMR as a proxy for housing affordability has an effect on the percentage of the population that experiences food insecurity. The positive coefficient of the 50th percentile FMR suggests that an increase in the 50th percentile FMR would increase food insecurity. In other words, higher rental prices would result in an increase in the median of the local FMR which increase food insecurity. However, in Table 6 the number of families using vouchers has no significant influence on food insecurity. The inclusion of the dollar amount of SNAP and WIC per recipient in Table 5 did not affect the relationship between the 50th percentile FMR and the incidence of food insecurity. The same result occurs in Table 6 when assessing SNAP and WIC payments per recipient. Prior studies found that SNAP reduces food insecurity. The difference of result in this study may be explained by the unit of analysis used for SNAP and WIC. The relationship between food insecurity and the number of families using vouchers remains unchanged. The result implies that the number of families using vouchers does not affect food insecurity.

The results imply that a reduction in the median fair market rental price is associated with a reduction in food insecurity. Because the 50th percentile of the fair market rent is simply the median of gross rent estimate, a reduction in gross rent prices would contribute to a decrease in food insecurity, while the number of families using vouchers shows no impact on food insecurity. This result may be explained by the unit of analysis used for the housing vouchers. This could also be explained by the fact that rents chosen by families were not

as affordable as they should be even when using the housing vouchers. Because decreasing rental prices is associated with lowering the prevalence of food insecurity, gaining access to affordable housing would enable poor families to spend less on housing and more on food. Kreider et al. (2012) and CBPP (2019) found that SNAP decreases the prevalence of food insecurity. SNAP is not significant in Tables 5 and 6, suggesting that SNAP does not affect food insecurity. However, WIC has a significantly positive relationship with food insecurity in Tables 5 and 6, implying that an increase in WIC spending per recipient increases food insecurity. This finding may be due to the endogeneity effect with the self-selection of more needy and food-insecure households into SNAP and WIC. A selection problem arises because unobserved factors such as expected future health status, parents' human capital characteristics, and financial stability, are all thought to be jointly related to participation in the programs (Kreider et al., 2012). When GDP decreases, food insecurity decreases too. UR and PR both significantly impact household food insecurity. In particular, a decrease in the unemployment rate causes food insecurity to decrease. Likewise, a decrease in the poverty rate decreases food insecurity. The results from Table 6 indicate that number of housing vouchers has a positive but not significant impact on food insecurity, which implies that an increase in the number of families using vouchers is associated with an increase in the incidence of food insecurity. Most of these results are not as expected which brought me to the conclusion that there is need for more empirical work by using a different unit of analysis for SNAP, WIC and the housing vouchers or by doing the study on local or county levels. A further analysis is needed on the relationship between food insecurity and SNAP, WIC, and the housing vouchers. The IV regression

shows no significant values in both tables for all variables, suggesting that for the IV regression there is no effect for any variable.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Food insecurity is common among low-income households. Some of the factors that contribute to increased food insecurity among low-income households include insufficient income, high rental costs, food expenditures, and transportation costs. Meisenheimer (2015) argues that housing expenses influence food expenditures. The author suggests that when house rents decline, food expenditures among households will increase, thereby reducing the level of food insecurity among families. In this study, I investigate the effect of housing affordability on food security for all states and Washington, D.C. in the United States over the period from 2004 to 2017, using annual state-level observations. I also examine the impact of the federal nutrition programs SNAP and WIC on household food insecurity. The analyses involved the use of three different empirical approaches, including fixed effects regression, and instrumental variables regression.

The results show that an increase in the 50th percentile FMR causes food insecurity to increase, while the number of families using housing vouchers does not significantly determine household food insecurity. Per the results, $100 increase in the 50th percentile FMR would increase food insecurity by 0.4 in the fixed effect regression. That is a quite important impact. The results of the fixed effect model show that there is positive relationship between WIC and food insecurity, while the effect of SNAP on food insecurity is absent. The results show that an increase in the median fair market rents causes food insecurity to increase, so a reduction in rent prices targeted to poor

households would help low-income families improve their food security. That is, gaining access to affordable housing helps poor families become more food secure. The same result did not occur with the housing vouchers maybe because of the unit of analysis. Another factor could be the freedom of choice given to the families. Although the housing vouchers is supposed to help make rents affordable, the freedom given to families to find their own place might be a factor. In choosing their own place, the rents might still not be affordable for the poor families even when using the housing vouchers. Thus, they may not allocate enough money for their food.

While most studies on food insecurity focus on specific states in United States, this study contributes to the existing literature by examining the relationship between housing affordability and food insecurity for all the U.S. states. Finding from this research may help officials, policymakers, service providers and the public to evaluate the need for assistance and the effectiveness of existing programs like SNAP and WIC.

6.2 Recommendations

Because the results of this state-level analysis are inconsistent, future research efforts on the determinants of food insecurity may consider analyses at the household, local or county levels. When analyzing food insecurity at the state level, there is the need to control for macroeconomic variables, which may influence housing affordability on food insecurity. For example, a GDP increase may have offsetting effects on food insecurity and housing affordability. Based on the results in Chapter 4, the 50^{th} percentile FMR has a positive relationship with food insecurity. Because WIC mitigates the effects of food insecurity, one recommendation based on this work is that policy makers may

consider prioritizing food nutrition programs in their efforts to help alleviate food insecurity.

When considering housing affordability proxies, future research efforts may consider using the dollar amount of vouchers for families instead of the number of families using vouchers as a measure of housing affordability. Another idea is to make housing more affordable since results show that higher median of FMR increases food insecurity. Providing subsidies for rents to low-income families could help making housing more affordable at any location in the United States. Yglesias (2015) suggests that the government could give money directly to the low-income families or give them discounted housing.

6.3 Limitations

One of the shortcomings of the current study is that data availability for some variables is limited. The housing vouchers data were available only from the period from 2004 to 2017. The CBPP could not provide data for years before 2004 because the collect of the date started in 2004 while the 50^{th} percentile FMR had data starting in 2001. Also, aggregate state-level data may not accurately capture within-state differences. Another issue that is difficult to overcome is the endogeneity of food insecurity, SNAP and WIC, which likely affected my results. Finally, the measurement of the variables such as the housing vouchers, SNAP, and WIC could be a factor to the results.

Future research efforts may consider including health expenditures in addition to food expenditures as a major household budget item. Also, future studies could consider analyzing how housing affordability affects food insecurity in the United States by categorizing or grouping states according to housing cost levels.

APPENDIX

Table 9: Abbreviations used in the text

Abbreviation	Meaning
CBPP	Center on Budget and Policy Priorities
CFSM	Core Food Security Module
CMA	Census Metropolitan Areas
CPI-U	Consumer Price Index for All Urban Consumers
CPS	Current Population Survey
CPS ASEC	Current Population Survey Annual Social and Economic Supplements
CPS-FSS	Food Security Supplement to the Current Population Survey
FI	Food Insecurity
FMR	Fair Market Rents
GDP	Gross Domestic Product
HA	Affordable Housing
HUD	U.S. Department of Housing and Urban Development
HV	Housing Vouchers
IPUMS-CPS	Integrated Public Use Microdata Series-Current Population Survey
KFF	Kaiser Family Foundation
LIHTC	Low Income Housing Tax Credit
PR	Poverty Rate
SIPP	Survey of Income and Program Participation
SNAP	Supplemental Nutrition Assistance Program
SPD	Survey of Program Dynamics
SPM	Supplemental Poverty Measure
UKCPR	University of Kentucky Center for Poverty Research
UR	Unemployment Rate
USDA	U. S. Department of Agriculture
WIC	Special Supplemental Nutrition Program for Women, Infants and Children

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