FOOD INSECURITY DYNAMICS OF HOUSEHOLDS IN THE UNITED STATES BETWEEN 2005-2017

A Thesis

Presented to the Faculty of the Graduate School

of Cornell University

In Partial Fulfillment of the Requirements for the Degree of

Master of Science

by

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August 2020

ABSTRACT

The prevalence of food insecurity in the United States is a persisting issue and poses several implications to public health. In this study, we use data from the Current Population Survey and its Food Security Supplement to explore food insecurity dynamics in the United States over the period of 2005-2017. During and after the Great Recession, we find food insecurity rates worsening drastically between 2005-2009, plateauing in 2009-2013, before slowly declining again between 2013-2017, yet still not meeting pre-recession levels. We examine several characteristics that may influence U.S. households' food security status, including education, race, marital status, family size, age, metropolitan proximity, and state. Our results suggest that particularly individuals with lower educational attainment are severely affected by increasing rates of food insecurity and are at persistent risk of entering into food insecurity almost a decade after the recession.

BIOGRAPHICAL SKETCH

Judith Martin is interested in the dynamics of food insecurity in the U.S. and beyond. With a passion for agriculture while growing up in Germany, she began pursuing her interest in food security dynamics during her studies at Purdue University earning a Bachelor's in Agricultural Economics with a minor in Political Science. While at Purdue she worked in a laboratory for specialty crop production systems where she managed research trials on hops and was involved in extension outreach programs. During her time at Cornell, pursuing a Master's Degree in Applied Economics and Management with concentration in International and Development Economics, she interned with the Tata Cornell Institute in New Delhi, where she analyzed the time allocation of women in rural India. She went on to participate in the SMART program of the Emerging Markets Program in the Charles H. Dyson School traveling to Uganda to work with the social enterprise Golden Bees Ltd. In the future, she hopes to pursue a career focused on alleviating food insecurity and poverty by applying theories and practices of agriculture and economics.

ACKNOWLEDGMENTS

First and foremost, my gratitude belongs to my chair Dr. John F. Hoddinott for his immeasurable patience and support in the process of selecting a somewhat novel topic and the subsequential crafting of this thesis. His exceptional advising through the trying times of a global pandemic were prominent through numerous Zoom meetings irreplaceable to this research project.

Many thanks belong to Dr. Christopher B. Barrett serving as committee member to this thesis and making time even while being on sabbatical. He and his team recently started research efforts on food security dynamics in the U.S. making his inputs to the progress of this thesis' work invaluable.

Finally, I am forever grateful for the support and help of Dr. Calum G. Turvey, without whom this venture may have not been possible.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ASEC	Annual Social and Economic Supplement of the CPS
ATUS	American Time Use Study
BLS	U.S. Bureau of Labor Statistics
CNSTAT	Committee on National Statistics
CPS	Current Population Survey
DHHS	Department of Health and Human Services
ERS	Economic Research Service of the USDA
FNS	Food and Nutrition Service Agency of the USDA
FPL	Federal Poverty Line
FSS	Food Security Supplement of the CPS (used interchangeably with HFSM)
GDP	Gross Domestic Product
HFSM	Household Food Security Module of the CPS (used interchangeably with FSS)
IPUMS	Integrated Public Use Microdata Series
NHANES	National Health and Nutrition Examination Survey
NIU	Not in Universe
PSID	Panel Study of Income Dynamics
SIPP	Income and Program Participation
SNAP	Supplemental Nutrition Assistance Program
U.S.	United States
USDA	United States Department of Agriculture
*	Used to indicate a significance level of $p<0.1$
**	Used to indicate a significance level of $p<0.05$
***	Used to indicate a significance level of $p<0.01$

Introduction

Despite the U.S. widely being regarded as a developed nation or a first world country, taking the throne as wealthiest nation by GDP on the planet and fiscal powerhouse with the largest economy since the late 1800s, it is a country in which food insecurity remains an existent issue for a sizeable part of its population. The Constitution of the United States of America "does not contain provisions related to the right to adequate food" (*USA | The Right to Food around the Globe | Food and Agriculture Organization of the United Nations*, n.d.), making it the only, long standing developed country not regarding food as a human right within its borders.[1] The U.S. signed the International Covenant on Economic, Social and Cultural Rights that recognizes ample food as right in 1977, but never became a state party. (*USA | The Right to Food around the Globe | Food and Agriculture Organization of the United Nations*, n.d.) In the Explanation of Vote on the Right to Food at the 34th Human Rights Council in 2017, the U.S. explained that "we do not treat the right to food as an enforceable obligation" (Geneva, 2018, para. 8).

The latest data suggest that approximately 11.1% or 14.3 million U.S. households and over 37 million Americans, including 11 million children suffered from food insecurity in 2018. (Coleman-Jensen, 2018) Perhaps surprisingly, these numbers reveal that food insecurity rates have recuperated and are reaching pre-recession levels. While the economy was fairly quick to recover from the 2009 Great Recession, households suffered long-term consequences, with increases in food insecurity status by 35% and peak food insecurity rates of 15.4% in 2008. (Anderson et al., 2014) Progress in regaining food security status and recovering from the impacts of the recession required some households almost a decade.

[1] Singapore, a nation not regarding food as right gained "developed" status only at the end of the 20th century

Table 1, below, reflects the development of food security rates in the U.S. over the timeframe of the selected years for this research.

Table 1: U.S. Food Security Rates in 2005, 2009, 2013, 2017

Food Secure / Food Insecure	**2005**	**2009**	**2013**	**2017**
Food Secure	89%	85.32%	85.72%	88.20%
Food Insecure	11%	14.68%	14.28%	11.80%

Food insecurity implies an economic and social condition on the household level of "limited or uncertain availability of nutritionally adequate and safe foods" (*USDA ERS - Measurement*, n.d.) for an active and healthy life. Due to insufficient money or other resources, these households experience inabilities to acquire sufficient and "acceptable foods in socially acceptable ways" (*USDA ERS - Measurement*, n.d.) to meet their basic nutritional needs. While the numbers are similar, not all of these households experiencing food insecurity, however, live in poverty. "Only about half of those living in poverty report being food insecure" (Tiehen et al., 2019), indicating that food security is an issue reaching far beyond income.

Producing and accelerating many serious health consequences and exposing people to an increased risk for a variety of negative health outcomes and health disparities, food insecurity manifests as a leading public health care crisis in the U.S. (*Food Insecurity | Healthy People 2020*, n.d.) Some of these negative health outcomes associated with food insecurity, for groups of all ages include: higher risks of some birth defects; anemia; lower nutrient intakes; greater cognitive problems; mental health problems, such as higher levels of aggression, anxiety, and depression, as well as a higher probability of behavioral problems; poorer general health, including a higher probability of asthma, diabetes, higher levels of chronic disease, and worse outcomes on health exams, along a higher probability of being

hospitalized, and increased occurrences of oral health problems. (Gundersen, 2013)[2] It has been estimated that food insecurity results in a surplus of "$77.5 billion in health care expenditure annually" (Berkowitz et al., 2018). Other, and subjectively, secondary consequences of food insecurity include diminished productivity due to deficient nutritional energy availability and sick days, accruing substantial loss of economic potential for the nation.

Although the literature is evolving, at this point, there is little academic research that explores the influencing factors on food security dynamics in the United States. Few survey sources offer reliable and nationally representative data that in some cases lead to over- and under representation of food insecurity itself and some of its determinants. (Tiehen, 2019) This study specifically aims to understand the extend that the Great Recession had on the food security status of American households. It further seeks to emphasize to which level some of the determining characteristics influence the American population's food security status, and how these may have changed over the twelve year period of this study, from 2005 to 2017.

We begin with an exploration of the history of the U.S. food security measure; the emergence of initial interest in this area and the subsequent need for a universal understanding of the meaning of this issue, followed by the development of definitions of food security and its ranges. We then follow with a discussion of several literatures starting with the connection of food security to poverty, how children are affected by food insecurity, various health and economic impacts of food insecurity, followed by a snapchat of the Great Recession on food

[2] Citing Research from Siefert et al. 2004; Heflin, Siefert, and Williams 2005; Cook et al. 2006; Skalicky et al. 2006;Whitaker, Phillips, and Orzol 2006; Carmichael et al. 2007; Eicher-Miller et al. 2009; Gundersen and Kreider 2009; Hernandez and Jacknowitz 2009; Muirhead et al. 2009; Yoo, Slack, and Holl 2009; Huang, Matta Oshima, and Kim 2010; Kirkpatrick, McIntyre, and Potestio 2010; Howard 2011; Melchior et al. 2012; Chi et al. 2014, Lee and Frongillo 2001; Tarasuk 2001; McIntyre et al. 2003; Stuff et al. 2004; Kirkpatrick and Tarasuk 2007; Seligman et al. 2007; Seligman, Laraia, and Kushel 2009; Ziliak and Gundersen 2013

insecurity and lastly an exploration of determinants of food insecurity, as well as available data sources that have been utilized by researchers in the assessment of food insecurity issues in the U.S. In the succeeding Data & Methods sections, a detailed overview and history of the evolvement of the Current Population Survey and its Food Security Supplement are provided with an exploration of its data and how it measures food insecurity. This section furthermore includes a detailed overview of the covariates selected for this research that have been informed by the preceding literature, as well as a description of our analytical approach, including a linear probability model and an Oaxaca-Blinder Decomposition. We move on to discuss our findings in three sections, including the distribution of food insecurity in form of descriptive results, the determinants of food security reflecting our regression results, followed by the results of our Oaxaca-Blinder Decomposition. We finish by drawing conclusions from our study's findings and provide recommendations for future research.

Literature Review

Defining Food Security

While most households in the U.S. are food secure and have access to enough food for an active and healthy lifestyle, many other households suffer under some form of food insecurity each year. These households experience an insufficient access to adequate food due to a lack in a multitude of resources. Often they do not dispose of the necessary economic resources, such as enough money. In other instances, households experience limited physical access to adequate retail locations to acquire the food to meet their daily needs.

The term food security translates into all members within a household having enough food in order to live a healthy and active life at all times. To a minimum, this includes the momentary availability of nutritious and safe foods, as well as the ability to acquire adequate foods in socially acceptable ways. Food insecurity, on the other hand, means that all or some members of a household experience limited or uncertain availability of nutritious and safe foods or the limited or uncertain ability to acquire adequate foods in socially acceptable ways. ("Core Indicators of Nutritional State for Difficult-to-Sample Populations," 1990)

i. History of the Food Security Measure

The U.S. has been active in the elimination of hunger in its nation through early efforts of food and nutrition programs starting in 1946 with the introduction of the School Lunch Program, which was followed by the developed of the Food Stamp Program and other programs targeted towards most vulnerable groups. This lead towards a wide reduction of extreme forms of hunger amongst the U.S. population. (Gary Bickel et al., 2000) During the 1960s concerns about the presence of food insecurity and hunger in the U.S. resurfaced, and by the end of the decade, President Nixon convened the White House Conference on Food,

Nutrition and Health to “end hunger in America”, requesting increases of funding towards initiations and expansions of federal food programs. (Radimer, 2002) Severe forms of hunger, however, continued to prevail, which finally led to the establishment of the President’s Task Force on Food Assistance in September 1983 by Executive Order 12439 that mandated to:

> *“[…] analyze Federal and other programs intended to render food assistance to the needy and shall make recommendations to the President and to the Secretary of Agriculture with respect to how such programs may be improved. […]”* (p. ix).

The task force introduced their report asserting that:

> *“It has long been an article of faith among the American people that no one in a land so blessed with plenty should go hungry. […] Hunger is simply not acceptable in our society”* (p. 2).

In this report, the task force laid the groundwork towards the development of food security measures by concluding that prior to the writing of this report:

> *“There is no official "hunger count" to estimate the number of hungry people, and so there are no hard data available to estimate the extent of hunger directly. .... We regret our inability to document the degree of hunger caused by income limitations, for such lack of definitive, quantitative proof contributes to a climate in which policy discussions become unhelpfully heated and unsubstantiated assertions are then substituted for hard information”* (p. 39).

In response to the completion of the group’s report in January 1984, President Reagan in a Statement on Receiving the Report of the President’s Task Force on Food Assistance reaffirmed that:

"God has blessed our great country with rich abundance… In this land of plenty, there can be no excuse for hunger" (para. 3).

In large portion motivated by this report, a research body focusing on the topics of appropriate measures for food security in the U.S. was cultivated. The conceptual framework and initial definition of hunger was developed through the research for a doctoral dissertation at Cornell University in the late 1980's. In her dissertation, Kathy Radimer partitions hunger into four components consisting of quantity, quality, psychological, and social acceptability, describing the sensation as "the ability to acquire or consume an adequate quality or sufficient food in socially acceptable ways, or the uncertainty that one will be able to do so" (Radimer, 1990). Her research results found consensus among researchers and experts in the field of nutrition and education, and presented the foundation for the official definitions to measure food security. Following the development of the conceptual framework defining food insecurity, Congress legislated the National Nutrition Monitoring and Related Research Act of 1990, proclaiming the need for a stronger measuring instrument for assessing and monitoring the dietary and nutritional status of the U.S. population. This act and long term plan, jointly formulated by the US Departments of Agriculture (USDA) and Health and Human Services (DHHS), confined the purpose to develop a consistent and standard monitoring scheme at state and local levels. (*H.R.1608 - 101st Congress (1989-1990): National Nutrition Monitoring and Related Research Act of 1990*, n.d.) To realize this vision, the Food Security Measurement Project was established in 1992. This federal interagency working group was formed in the effort to create the needed measure in collaboration with experts from the private sector and the U.S. Census Bureau. It was the working group's aim to design the final measure to be applicable in the form of food security surveys. Finally, this

purpose was realized with the introduction of the Food Security Supplement of the Current Population Survey in 1995, utilizing a hunger and food insecurity measurement scale that had been developed and analyzed at Cornell University in the scope of Radimer's dissertation research.

ii. Definitions of Ranges of Food Security

In following years, the USDA described definitions and sub-categories of food insecurity. After consultations with the Committee on National Statistics (CNSTAT) of the National Academies on USDA's wishes, an expert panel was formed to review the current measurements and definitions used by the agency to model food insecurity in the U.S.. The panel described their observations and recommendations in the Measuring Food Insecurity and Hunger: Phase 1 Report, released in 2005. Based on these recommendations, the USDA introduced a new lingo to describe the ranges of severity of food insecurity. While the depiction of labels for food security changed, the assessment methods remained unaltered, ensuring direct comparability of statistics for 2005 and later with those for corresponding categories from earlier years. The ranges of food security as currently described by the USDA are, as follows:

⇒ Food Security:

- High Food Security (*old label=Food security):* no reported indications of food-access problems or limitations.
- Marginal Food Security (*old label=Food security):* one or two reported indications—typically of anxiety over food sufficiency or shortage of food in the house. Little or no indication of changes in diets or food intake.

⇒ Food Insecurity:

- Low Food Security (*old label=Food insecurity without hunger):* reports of reduced quality, variety, or desirability of diet. Little or no indication of reduced food intake.
- Very Low Food Security (*old label=Food insecurity with hunger):* Reports of multiple indications of disrupted eating patterns and reduced food intake.

In addition to the clear definitions of ranges of food insecurity, the CNSTAT panel placed special emphasis on the distinction and separation of the definition of hunger in relation to food insecurity and recommended a distinct differentiation between hunger and food security. (*Measuring Food Insecurity and Hunger*, 2005) In response, the USDA developed the following distinction:

⇒ Food Insecurity: the condition assessed in the food security survey and represented in USDA food security reports – is a household-level economic and social condition of limited of uncertain access to adequate food.

⇒ Hunger is an individual-level physiological condition that may result from food insecurity.

Academic Literature

Despite the development of the food security measure and the establishment of the HFSM as an annual supplement to the CPS and resulting readily available data, the literature on the topic of food security in the U.S. has remained rather small. The USDA publishes annual reports monitoring food security in the U.S. These include numerous statistics describing the prevalence of food security in U.S. households, alongside technical and statistical supplement documentation to their analyses. Yet, academic interest to conducting research on the topic and subsequent literature has only started to emerge more consistently

over recent years. Besides the exploration of data and descriptive statistics to identify common correlates among households experiencing food insecurity, researchers have been starting to ask more in depth questions reaching beyond observable characteristics.

i. Food Security & Poverty

In the early years of the administration of the HFSM, Nord et al conducted an analysis over three consecutive years, 1996-1998, by state and found that "some 10 million U.S. households (9.7 percent of total) were food insecure" (Nord et al., 1999, abstract). The report compared food insecurity rates with poverty rates at state level and discovered substantial variations across states along with an association of food insecurity and economic well-being. (Mark Nord et al., 1999) With food insecurity being widely associated to poverty, the report furthermore compared rates of these two occurrences and found surprising results with poverty rates "below the national average in 18 of the 20 States with low rates of food insecurity" (Mark Nord et al., 1999, p. 8), and poverty rates above the national average in 9 out of 11 states with the highest food insecurity rates. (Mark Nord et al., 1999) Several and more recent research confirm these results and suggest a variety of reasons for households becoming food insecure that reach beyond income, and are linked to a multitude of negative health outcomes across all age groups. (Gundersen & Ziliak, 2015, 2018) Anderson et al. came to similar conclusions in 2016 utilizing the CPS and National Health and Nutrition Examination Survey (NHANCES). Their study found that income does play a role in determining food insecurity among children, but "even after flexibly controlling for income-to-poverty rates some household characteristics […] have important additional explanatory power" (Anderson et al., 2016, p. 1078). Further outcomes of this study suggest an "important

role for both mental physical health of adults in the household in determining the food security status of children" (Anderson et al., 2016, p. 1080).

ii. Food Insecurity among Children

There is a growing body of research and literature with a focus directed on child food security on a global scale. This is with good reason, as adverse effects of physical and psychological development are associated among children with compromised nutritional intake. Longitudinal studies in Canada resulted in findings that hunger in children is "related to poor health outcomes, including a higher risk of depression and suicidal ideation in adolescents, and chronic conditions, particularly asthma" (Ke & Ford-Jones, 2015, p. 89). It is widely known that nutrient deficiencies negatively impact children's cognitive abilities and impair their learning capabilities, resulting in reduced productivity. Chilton et al. argue that "even the slightest forms of food insecurity can affect a young child's development and learning potential" (Mariana Chilton et al., 2007, p. 262). As a consequence, children affected by food insecurity may carry the magnitudes of it well into adulthood. Another study found that food insecurity "was detrimental to children's self-control, math, and working memory scores" (Grineski et al., 2018, p. 715). Negative effect were also found on interpersonal skills. With educational attainment negatively affected and subsequent ability for human capital development compromised, the result of child food insecurity "is the perpetuation of another generation in poverty" (Mariana Chilton et al., 2007, p. 262). Research by Kennedy et al. suggests that children entering food insecurity are likely to experience several consecutive years of it, based on linked data from the HFSM. Their findings underline the impact of the Great Recession on food insecurity affecting children by increasing their likelihood of entering and persisting in food insecurity. (Kennedy et al., 2013)

iii. Health and Economic Impacts of Food Insecurity

Extensive research has been conducted in finding out about how exactly peoples' health is affected in order for health care professionals to be able to direct care to emerging health issues related to food insecurity, as well as to inform policies targeted to diminish the prevalence of the lack of food. Hypertension, arthritis, diabetes, asthma, chronic bronchitis, and emphysema are some of the most common chronic conditions for adults experiencing food insecurity. (Garcia, 2020) Prevention in this situation may be the economically smartest alternative, as health care cost triggered by food insecurity add extra pressure to health care expenditures in the form of a surplus of $77.5 billion annually. (Berkowitz et al., 2018) According to the Centers for Disease Control and Prevention, the additional health care cost associated with food insecurity in 2014 where over $160 billion. (Garcia, 2020) Added to these extra expenditures have to be the cost of not only compromised productivity due to health issues but also the time missed spent participating as an active member in the economy. The earning potential decreases, while at the same time the spending potential decreases, increasing the pressure on the ability to provide sufficient dietary energy availability to meet the requirements of an active work-life balance. The Center for American Progress estimates the loss of lifetime earnings for 2010 due to poorer educational outcomes as a result of food insecurity to be 19.2 billion for 2010 alone. Combining these costs of lost economic productivity, "more expansive public education because of the rising costs of poor educational outcomes" (Donald S. Shepard et al., 2011, p. 10), preventable health care expenditures and the amount of charity required for feeding families, the Center for American Progress' report calculates that food insecurity cost the U.S. an estimated $167.5 billion in 2010. (Donald S. Shepard et al., 2011)

iv. Food Insecurity & the Great Recession

These findings in Shepard et al. represent the year immediately after the Great Recession in 2009 that caused food insecurity rates to increase by 35%. Contributors to this sharp rise in food insecurity was the collapse in housing prices and an increase in the duration of unemployment. (Anderson et al., 2014) In their study observing food insecurity during the Great Recession, Anderson et al. looked at the roles of unemployment duration, credit and housing markets and found that the rates and duration of unemployment following the recession rose to highest levels and lengths since the early 1980s, with median lengths of almost 6 months. It is suggested in this research that "households' access to resources that are not well captured by traditional income-to-poverty measures changed over time" (Anderson et al., 2014, p. 0). Low-income households' spending, below the 180% poverty threshold, had previously been 10-15% more based on income-to poverty ratios compared to post recession calculations, according to their results. In a report from the same year with the aim of understanding food insecurity during the Great Recession, Anderson et al. note "that the unemployment rate may be serving as a proxy for other factors in the macro economy that were particularly harmed" (p. 2), mentioning that rates of leverage and prices of housing may represent important explanatory roles. The report concludes that one of the strongest explanatory variables of the sharp increase of food insecurity rates during the Great Recession is a drop in the overall rate of consumption relative to income. This, Anderson et al. suggest is met with a consistent underlying pattern of "psychological factors, an increase in saving, and loss of credit" (p. 2).

The recession prompted a weakening of the macroeconomy with higher unemployment, lower incomes, and widening inequality. This also prompted an increase in

participation rates in the Supplemental Nutrition Assistance Program (SNAP). From 2007 to 2011, households' participation increased by 68.7 percent. (Ziliak, 2013) Ziliak finds that participation rates among full-time and year-round employees, even with some college education and incomes up to two times of the poverty threshold is increasing. "In other words, the program is increasingly operating as a work support for higher educated, but low-income households, […] while still maintaining its universal entitlement to disadvantaged children and seniors, and the disabled" (Ziliak, 2013, p. 19). In related research, Ziliak and Gunderson (2016) look at multigenerational households and their correlation to food insecurity. They state that the heightened rates of food insecurity "during and after the Great Recession is due to both increased entry into food insecurity and decreased exit out of food insecurity" (Ziliak & Gundersen, 2016, p. 1148). These trends held true for multigenerational households, as well. Once grandchildren moved in with their grandparents, which they were more likely to during the recession, they were then more likely to stay there. Oftentimes, Ziliak and Gundersen find, the entry of a grandchild even shielded the household from experiencing more extreme forms of food insecurity, while the exit of a grandchild put the household at greater risk for food insecurity. This, they conclude, is most likely due to the additional resources households qualify for with the entry of child, such as SNAP. When the child exits, the household in addition loses its SNAP qualifications. Nevertheless, the overall rates of food insecurity among households with grandchildren present are "at least twice as high as households without grandchildren present" (Ziliak & Gundersen, 2016, p. 1163).

v. Determinants & Data

The determinants of food insecurity have been widely established by the literature. Socioeconomic and demographic characteristics commonly associated with food insecurity in

the U.S. are households that are headed by a Black or Hispanic person who is divorced or separated and a renter. Younger and less educated persons, as well as households with children are more likely to be food insecure than their counterparts. (Nord et al., 2010; Gundersen et al., 2011) Data sets utilized to create these findings have included the Current Population Survey (CPS), and various of its supplements such as the Annual Social and Economic (ASEC) and the Household Food Security Module (HFSM), the Panel Study of Income Dynamics (PSID), the Survey of Income and Program Participation (SIPP), the National Health and Nutrition Examination Survey (NHANCES), the American Time Use Study (ATUS), and data sets from the Early Childhood Longitudinal Study. Alongside these larger, often nationally representative surveys, more small-scale data sets limited to certain geographical areas have been contributing to some of these findings.

Data & Methods

The Current Population Survey

For the exploration of the food security dynamics of households in the United States and how these dynamics may have been impacted by the 2009 recession, we utilized the 2005, 2009, 2013, and 2017 data from the Food Security Supplement (FSS) of the Current Population Survey (CPS), sourced from the (Integrated Public Use Microdata Series) IPUMS-CPS.

vi. The Basic CPS

The CPS is one of the oldest and largest surveys in the United States conducted by the Bureau of Census for the Bureau of Labor Statistics. It collects comprehensive data on person and household characteristics and serves as primary source of labor force statistics for the population of the United States.

Its development was initiated following the Great Depression. In the early 1930s, mass unemployment rates increased the need for statistics as no direct measurements of employment existed. After first attempts resulted in estimates that were widely contrasting, research groups and local governments began experimenting with direct surveys and samples of the U.S. population, categorizing the population into one of three groups of "working", "looking for work", or "not in labor force". (*History of the Current Population Survey*, 2009) By the late 1930s, precise concepts of labor force classification were developed. After these concepts were implemented in the national household, the Monthly Report of Unemployment survey, it was transferred from the Work Projects Administration to the Census Bureau in 1942. Reflective of the vast source of data this survey represents on various demographic, social, and economic characteristics of the population eventually became the Current

Population Survey in 1948. (*History of the Current Population Survey*, 2009) While the Census Bureau continues to collect the data, in 1959 responsibilities for analyzing and publishing the CPS was reassigned to the Bureau of Labor Statistics (BLS). (*History of the Current Population Survey*, 2009)

The CPS is a multistage stratified statistical sample consisting of approximately 72,000 assigned housing units that are located within 824 sample areas. These "sample areas are designed to measure demographic and labor force characteristics of the civilian noninstitutionalized population [15] years of age and older". (*Current Population Survey Design and Methodology*, 2006, p. 3-1) Basing the selection process of household participation in the CPS on geographical location and address intends to create a national representative sample of hundreds of households that share similarities. The survey is conducted in the calendar week of the 19th day of the of the month and interviews approximately 54,000 households from all 50 states and the District of Columbia each month. The remainder are non-interview housing units due to either vacancies, non-residency, or nonresponse of the household. (*Current Population Survey 2017 Annual Social and Economic (ASEC) Supplement*, 2017) Selected households are interviewed in a 4-8-4-month sampling scheme. Once entering the survey, each household is interviewed once each month for four consecutive months. It then leaves the survey for an eight months' period and re-enters the survey for another four consecutive months. After completing this round of sampling, the household is then released from the survey. According to the BLS (U.S. Bureau of Labor Statistics) each of these interviews takes between 10 to 15 minutes on average. To qualify as respondent in the CPS, individuals must be 15 years of age or older, noninstitutionalized and not in the Armed Forces. (*Current Population Survey Design and Methodology*, 2000) The

institutionalized population, comprising of long-term care facilities and correctional institutions are excluded from participation in the survey.

Beyond the basic monthly questions, the CPS inquires multiple supplement surveys. Some of these are conducted annually, bi-annually, or even only once and are aimed to focus and provide information on the social and economic well-being of the population.

vii. The Food Security Supplement

One of these supplemental surveys is the Food Security Supplement (FSS) that since 2001 has been conducted annually in December. The names and abbreviations of the FSS and the Household Food Security Module (HFSM) identify the same survey supplement and are used interchangeably. The supplement was first introduced in 1995 with the purpose to provide data for measuring food insecurity in the U.S. While the basic monthly CPS is sponsored jointly by the Census Bureau and the U.S. Bureau of Labor Statistics, sponsorship for conducting the food security supplement is given by the FNS (Food and Nutrition Service Agency) and ERS (Economic Research Service) of the USDA (U.S. Department of Agriculture). The FSS provides data on sections regarding the food security status of households, including food expenditures, food assistance participation, food sufficiency, and coping mechanisms.

With the intentions to reduce the strain of participating in the CPS, households with an income above 185% of the federal poverty line giving no indication or affirmation to the set of screening questions, as seen in Figure1, are deemed food secure and are not asked further questions included in the food security assessment sequence. All other households with incomes below the 185% poverty line are included and asked the questions of the HFSM.

This module consists of 10 questions for households where no children are present, and 18 questions for households with children present.

Figure 1: *Screening Question and Follow-up Items*

Question #	Question
Q1	Which of these statements best describes the food eaten in your household in the last 12 months: we always have enough to eat and the kinds of food we want; we have enough to eat but not always the kinds of food we want; sometimes we don't have enough to eat; or often we don't have enough to eat?
Q1a	(IF SOMETIMES OR OFTEN NOT ENOUGH TO EAT) Here are some reasons why people don't always have enough to eat. For each one, please tell me if that is a reason why you don't always have enough to eat. Not enough money for food Too hard to get to the store On a diet No working stove available Not able to cook or eat because of health problems
Q1b	(IF ENOUGH FOOD, BUT NOT THE KINDS WE WANT) Here are some reasons why people don't always have the kinds of food they want or need. For each one, please tell me if that is a reason why you don't always have the kinds of food you want or need. Not enough money for food Too hard to get to the store On a diet Kinds of food we want not available Good quality food not available

The assessment of the module and all questions included are addressed towards the entire household, and unless a single-person household is interviewed, no questions are asked about any information on individual household members. The scales computed from the information obtained through the HSFM represent all members of a household in aggregate and as one unit.

CPS & FSS Data

The CPS core and FSS that we are utilizing for our analysis employ a 12-month and 30-day reference period, asking participants questions concerning observations and experiences during the course of either the past year or latest month. In some instances, and in regards to job employment, wages, and hours worked are referred to on a basis of the previous week. The universe of the collected data through these surveys and survey supplements describes households and person records of the noninstitutionalized U.S. population living in housing units which, as explained before, are selected based on a probability sample. (*Current Population Survey 2017 Annual Social and Economic (ASEC) Supplement*, 2017) To correct for biases due to under-coverage of the survey, the CPS applies weighting procedures prior to releasing the collected data. We obtained the relevant variables and data points from the IPUMS that provides data from the CPS and its supplements as combined dataset with harmonized variables. The IPUMS-CPS samples are weighted with the mention that some records may represent more instances compared to others. This implies that certain person and household characteristics are over-represented, while others are underrepresented in the samples. In order to obtain representative results of the U.S. population, comprehensive and comparable of our selection of the supplements, it is necessary to apply different weighting variables into our analysis. The weights we are employing into our analysis are tailored to households and obtained through each of the supplements.

We selected four years as focus of our analysis in order to create an appropriate synopsis of how households' food security status have been affected. In this respect, we selected 2005 as a year to represent pre-recession conditions. For this year, the technical documentation for the Food Security Supplement File lists 153,049 logical records, 16,875

non-interview households, and 54,556 households with 136,174 person records. About 15% percent of the households that completed the CPS core module declined to complete the FSS. These numbers are reflected in Table 2, which lists the participation numbers of households in the CPS for each sample year, 2005, 2009, 2013, and 2017.

Table 2: Interview Participation of Households in the CPS Core Module and FSS

	2005	**2009**	**2013**	**2017**
Person Records	136,174	134,357	131,213	126,065
CPS Core Module	54,556	53,973	53,410	51,937
FSS - Non Response	149	148	140	85
FSS - Not in Universe	7,038	8,462	11,263	14,548
TOTAL	**47,369**	**45,363**	**42,007**	**37,304**

For 2009, the year we selected as a contemporary reflection of the direct impact from the recession of the previous year, 53,973 households were interviewed for the CPS core module. 148 households declined to respond, with an additional 8,462 responses being classified as not in universe (NIU). The universe, in reference to the CPS, describes the population of the U.S. consisting of all civilian and non-institutionalized persons 15 years of age or older living in households. (*Current Population Survey, December 2017 Food Security File Technical Documentation CPS—17*, n.d.) According to the IPUMS, these are commonly responses from persons within a qualifying household who, however, do not fall within the qualifying range or the universe to reply to questions asked. If, for instance, a person under the age of 15 responds to a question intended to a person over the age of 15, the reply will be labeled “NIU” on the codes pages of the questionnaire. (IPUMS Staff, 2013) A point of consideration follows, as the FSS is a questionnaire intended to reflect situations on a household level, we omit individual person records collected during the interview process of the basic CPS and focus our analysis on data collected of the household head to gain a

reflection of households rather than individuals with a more fluent connection of the CPS with the FSS data. It results, as seen in table above, that for the years we selected to exemplify post-recession impacts, 2013 and 2017, participation rates of 53,410 and 51,937 households for the CPS core module were recorded, of which 42,007 and 37,304 households are included in our analysis, due to non-responses and responses falling outside of the universe.

The Food Security Measure

The measure of food security describes conditions on the household level and distinguishes only between food secure and food insecure. The set of questions included in the FSS, as shown in Figure 2 below, comprise the food security scale values, reaching from 0 to 10, determining the food security status of households. For the development of this food security scale, the USDA utilizes the Rasch model as the mathematical scaling method. Distinction is made between households with children present and households without children. The scale is based on the number of affirmative responses given to the questions in the FSS. Most generally and according to this scale, households are considered as food secure by answering 1-2 questions affirmatively, and food insecure by answering the remainder of the questions in negation. The ranges of food insecure are then further disaggregated with more detail, into marginal food security by affirming to 3-5 questions or 3-7 with children, low food security with the affirmation of 6-8 questions and 8-12, and finally very low food security requiring an affirmation of 9-10 questions and 13-18 with children present.

Figure 2: Food Security Supplement Questions

Questions 1-10 were asked all household with income < 185% of FPL
1. "We worried whether our food would run out before we got money to buy more." Was that often, sometimes, or never true for you in the last 12 months?
2. "The food that we bought just didn't last and we didn't have money to get more." Was that often, sometimes, or never true for you in the last 12 months?

3. "We couldn't afford to eat balanced meals." Was that often, sometimes, or never true for you in the last 12 months?
4. In the last 12 months, did you or other adults in the household ever cut the size of your meals or skip meals because there wasn't enough money for food? (Yes/No)
5. (If yes to question 4) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?
6. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food? (Yes/No)
7. In the last 12 months, were you ever hungry, but didn't eat, because there wasn't enough money for food? (Yes/No)
8. In the last 12 months, did you lose weight because there wasn't enough money for food? (Yes/No)
9. In the last 12 months did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food? (Yes/No)
10. (If yes to question 9) How often did this happen – almost every month, some months but not every month, or in only 1 or two months?

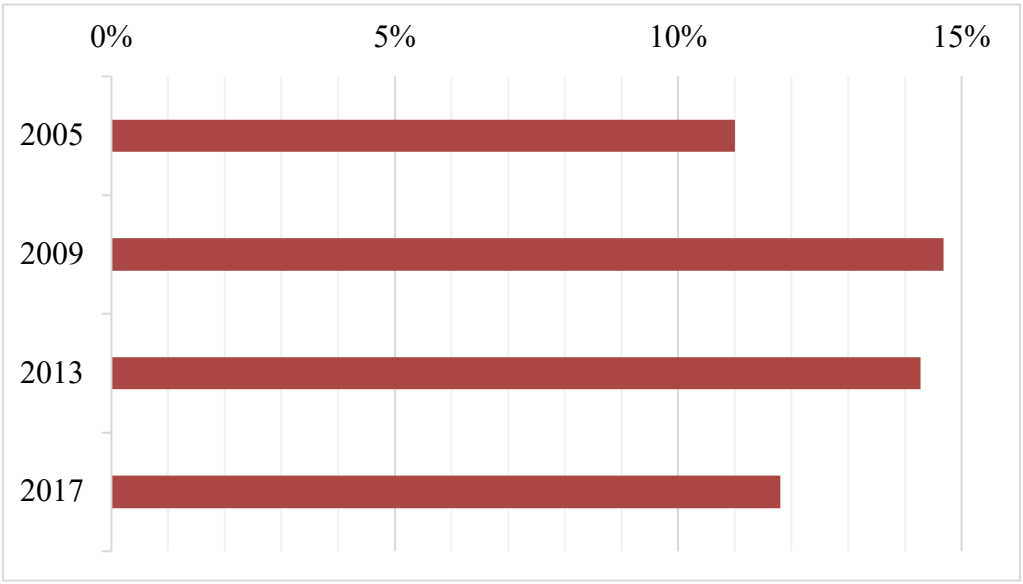
Questions 11-18 were asked only if the household included children age 0-17:

11. We relied on only a few kinds of low-cost food to feed our children because we were running out of money to buy food.‖ Was that often, sometimes, or never true for you in the last 12 months?
12. We couldn't feed our children a balanced meal, because we couldn't afford that.‖ Was that often, sometimes, or never true for you in the last 12 months?
13. The children were not eating enough because we just couldn't afford enough food.‖ Was that often, sometimes, or never true for you in the last 12 months?
14. In the last 12 months, did you ever cut the size of any of the children's meals because there wasn't enough money for food? (Yes/No)
15. In the last 12 months, were the children ever hungry but you just couldn't afford more food? (Yes/No)
16. In the last 12 months, did any of the children ever skip a meal because there wasn't enough money for food? (Yes/No)
17. (If yes to question 16) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?
18. In the last 12 months did any of the children ever not eat for a whole day because there wasn't enough money for food? (Yes/No)

A household is categorized as food secure when responding affirmatively to up to 2 questions of the FSS and is categorized as food insecure when responding affirmatively to 3 or more questions of the 18 questions of the FSS for households with children or 10 questions for

households without children. The scope of the food insecurity classification includes ranges from less severe forms of food insecurity to more sever forms. On the less severe form of the food insecurity spectrum, the respondent of the household indicates at least some anxiety about sufficiency of food or even shortages of food without indications of anyone within the household having to change their diet or food intake. It also includes the most severe form of food insecurity in which at least one or more members of a household report disrupted eating patterns and reduced food intake on multiple occasions.

Figure 3: Prevalence of Food Insecurity Across the U.S. in 2005, 2009, 2013, 2017



Our analysis applies the most basic measure and distinguishes only between food secure and food insecure households. We construct a 0/1 indicator variable for food insecurity which is set equal to one if a household is considered food insecure. A household is considered food insecure if it indicates any form or falls into any range of food insecurity, including conditions of moderate food security, low food security, and very low food security. Otherwise it is considered food secure and the indicator variable is set equal to zero. As can be seen in Figure 3, the prevalence of food insecurity across the selected survey years, started

at an 11% in 2005 prior to the 2008-2009 recession. Food insecurity rates plateaued in the year immediately after the recession in 2009 at 14.68%, and show only minimal improvements four years later in 2013. Even in 2017, eight years post-recession, at 11.8% food security rates across the U.S. are still recovering and have yet to reach levels observed preceding the Great Recession.

Covariates

With insights gained through existing literature and the computation of descriptive statistics, we were able to identify key characteristics relevant in influencing food security status of persons and households. Some of these primary characteristics include educational status, race, sex, marital status, size of family, and age. For each of these criteria, indicator variables were created with subcategories distinguishing between several level.

Accordingly, our educational variables are divided into five subcategories of no high school diploma, high school diploma, associate's degree, bachelor's degree, and post graduate degree. The survey records sixteen unique values for educational attainment, grouped by partial completion of primary education through college with grade year indication. It is further distinguished whether or not a degree was obtained. For our analysis, educational scores were grouped, with any attainment below obtaining a high school diploma classified as no high school diploma, and the obtainment of a high school diploma or equivalent, such as GED along with the completion of some college but without the obtainment of a degree reflected as high school diploma. Anything above the completion of two or more years of college that did not result in the obtainment of a bachelor's degree but qualifies in an associate's degree is represented as such. This pattern was applied to further distinguish educational groups of bachelor degree, and post graduate degree holders. The post graduate

degree category includes educational attainment past a master's degree, including the completion of a doctorate degree. Figure 4 illustrates the distribution of these education attainment groups throughout the sample period. It can be obtained from this figure that whilst the number of people holding a high school diploma as highest attainment declines, the number of bachelor degree holders increases throughout the sample years.

Figure 4: Educational Attainment Among Sample for 2005, 2009, 2013, and 2017

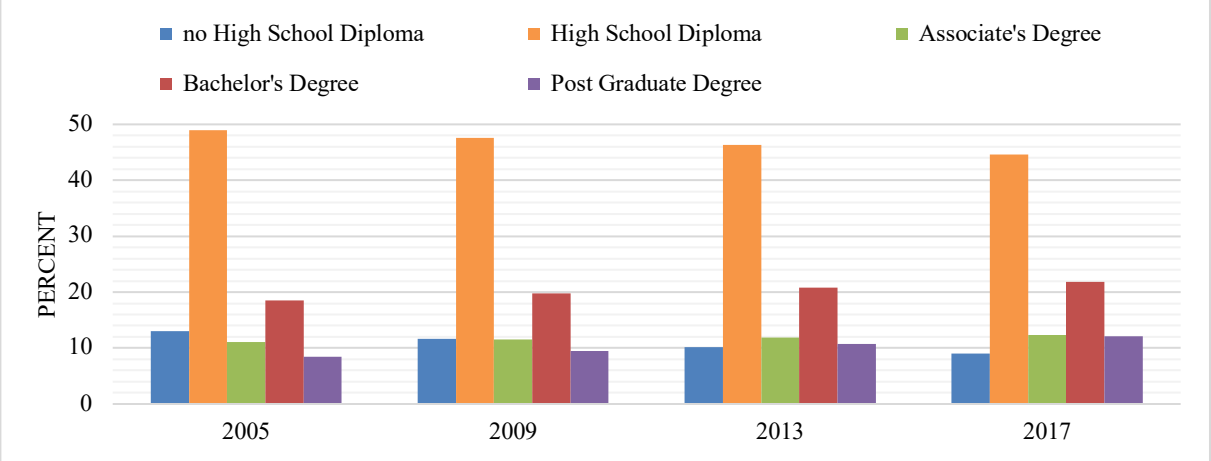


Table 3: Mean Prevalence of Food Security by Educational Attainment

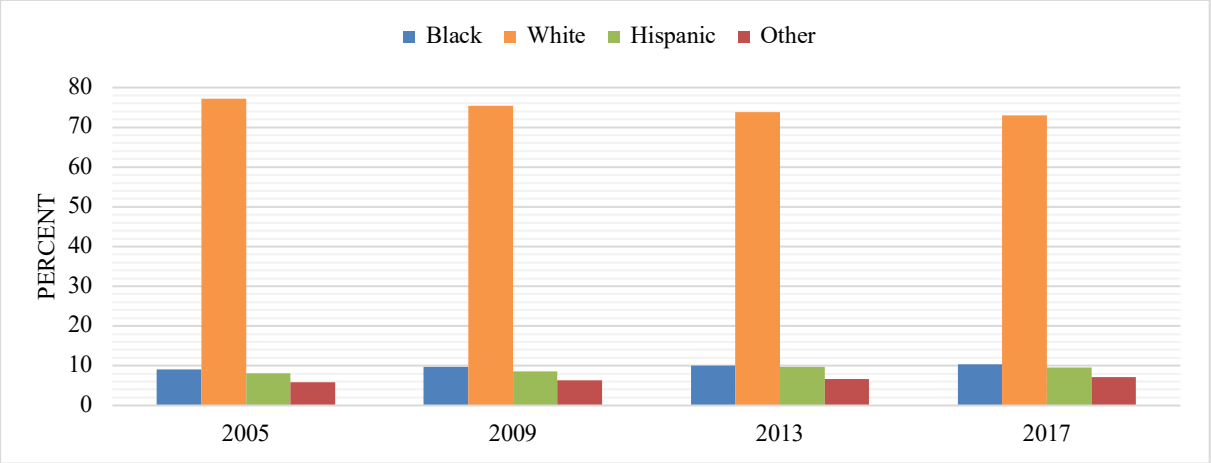
Education	**2005**	**2009**	**2013**	**2017**
No High School Diploma	0.213	0.271	0.278	0.280
High School Diploma	0.126	0.172	0.170	0.175
Associate's Degree	0.087	0.125	0.116	0.124
Bachelor's Degree	0.041	0.069	0.059	0.060
Post Graduate Degree	0.025	0.038	0.038	0.038

Similar trends can be observed for the part of the sample not holding a high school degree, it declines. Comparing these observations to Table 3, above, although the likelihood for incidents of food insecurity increased among all educational groups, specifically for this latter group of no high school diploma, the likelihood of experiencing food insecurity has increased significantly, by almost 7%, much beyond the initial stroke of the Great Recession. Groups

with educational attainment including a college experienced increases of food insecurity, as well, but in comparatively smaller magnitude and below 3%.

As race has been established to be a strong influencing factor of whether or not food insecurity may be experienced, four racial categories were created in reflection of the predominant racial demographics of the U.S. population, including Black, Hispanic, White, and other. The CPS classifies descendants from countries south of the southern U.S. border, including Mexico, middle America, and the South American continent as Hispanic. We left this categorization unchanged and generated an indicator variable that embeds this. Our categorization of other entails predominantly Asian populations, as well as persons that neither identify themselves as Black, Hispanic, or White. Equally, people identified as Black or White during the survey process are categorized as such in our analysis with indicator variables representing each. The distribution of these categories among the sample is shown in Figure 5. People identifying as White make up the largest proportion of our sample at over

Figure 5: Racial Distribution Among Sample for 2005, 2009, 2013, and 2017



70%, compared to people that identify as Black, at around 10%. A slightly smaller fraction of the sample is identified as Hispanic. Conversely, it can be observed in the means Table 4,

below, that Black identifying people face on average the highest chances of experiencing food insecurity, while the largest population faces the lowest probability rates of occurrences of food insecurity throughout our sampling period. In each of the racial categories, a spike in food insecurity rates around the time of the recession is observable, which relaxes in the following years after.

Table 4: Mean Prevalence of Food Insecurity by Racial Category

Race	**2005**	**2009**	**2013**	**2017**
Black	0.224	0.249	0.261	0.218
Hispanic	0.178	0.264	0.235	0.176
Other	0.104	0.151	0.132	0.112
White	0.082	0.110	0.106	0.088

A wide complexity of additional considerations may be introduced with the consideration of sex. Persistent wage disparities between men and women, as well as remaining but evolving differences in educational and professional skill levels, the distribution of roles within U.S. households, and the persistence of women being the primary caregivers of children. Figure 6 and Table 5, below, exhibit the relationship between sex and food insecurity. The graph displays the fraction of the sample by gender. It is observable that the gender distribution undergoes a slight change throughout the sampling period. While in 2005 more households were male headed, during the periods 2009 and 2013 more households were headed by females, until 2017 female headed households surpassed the number of households headed by men. This may contribute to higher food insecurity rates, overall. As observable in Table 5, female headed households are substantially more likely, by around 5 percentage points throughout the sampling period, to being food insecure relative to male headed households. The familiar pattern for sharp increases in food insecurity for both gender

groups following the recession are apparent, before food security slowly increases again, not quite reaching pre-recession levels by 2017.

Figure 6: Gender Among Sample for 2005, 2009, 2013, and 2017

Table 5: Mean Prevalence of Food Insecurity by Gender

Gender	**2005**	**2009**	**2013**	**2017**
Male	0.085	0.121	0.116	0.092
Female	0.136	0. 173	0. 169	0. 143

With some literature suggesting some influence of marital status on food security, which descriptive analysis of our data confirmed, we incorporate an indication of whether or not the household head is legally married, independent of the presence of the spouse or not. The latter category entails the survey's categorizations of never married, divorced, and widowed. The reasoning of the inclusion of widowed in the category of not being married is solely based on the availability of income. While widowed individuals with low income may qualify for receiving supplemental payments in case of disability or age above 65 in addition to social security benefits, neither of these options stand in comparison to the missed salary of a spouse. (Weaver, 2010) The gap between marital statuses among our sample does not differ significantly, but declines over the time period from 2005 to 20017, as can be seen in Figure

7. Instances of food insecurity are higher among the sample that reports not being married (see Table 6). Similarly to the previous educational and racial categories, food insecurity rates plateau around the recession, before they are then slowly declining again.

Figure 7: Marital Status Among Sample for 2005, 2009, 2013, and 2017

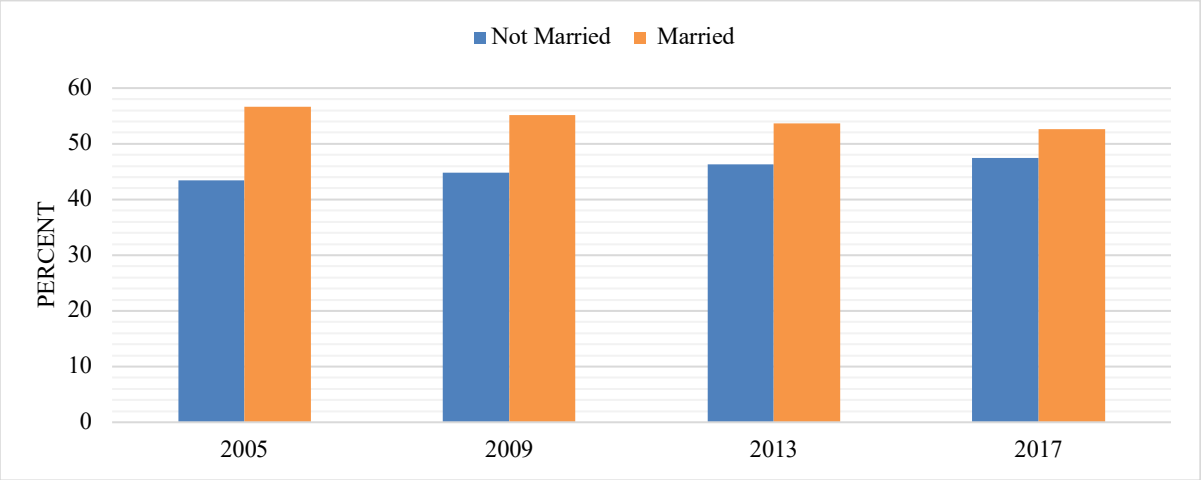


Table 6: Mean Prevalence of Food Insecurity by Marital Status

Marital Status	**2005**	**2009**	**2013**	**2017**
Not Married	0.143	0.188	0.185	0.158
Married	0.083	0.113	0.105	0.081

In the case of the size of a family, distinction were made in the form of indicator variables representing the presence of one to seven family members each. Based on descriptive statistics indicating little to change to food security status of families with 8 or more family members present, we capped categorization at this point and included an additional dummy variable with this indication. The majority of families in our sample have one or two family members present. Significantly fewer have three, four, or five family members present, with very few large families included in our sample. Table 7, below, displaying the mean prevalence of food insecurity among family members present in a household conveys that having one other family member present may protect from

experiencing food insecurity, compared to single households. Larger households, on the other hand are more likely to experience food insecurity, with at the 5 family members present mark. The pattern follows of a spike in food insecurity rates post-recession, before these rate are slowly recovering.

Figure 8: Size of Family Among Sample for 2005, 2009, 2013, and 2017

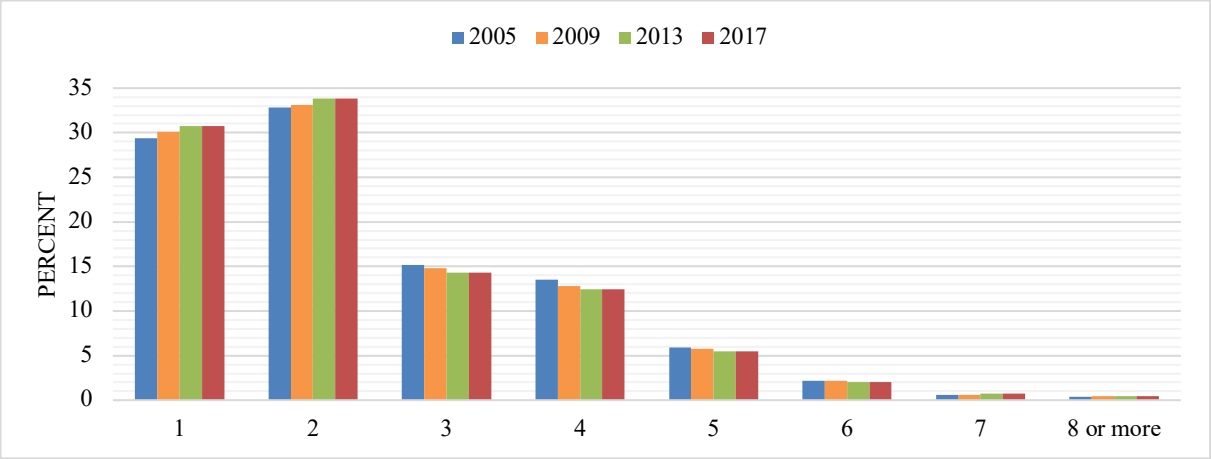


Table 7: Mean Prevalence of Food Insecurity by Family Size

Family Size	**2005**	**2009**	**2013**	**2017**
1 family member present	0.113	0.149	0.149	0.135
2 family members present	0.081	0.104	0.106	0.082
3 family members present	0.125	0.162	0.155	0.126
4 family members present	0.111	0.167	0.152	0.123
5 family members present	0.153	0.202	0.185	0.160
6 family members present	0.190	0.274	0.264	0.168
7 family members present	0.210	0.300	0.315	0.268
8 or more family members present	0.274	0.354	0.315	0.131

Food security is often a condition experienced at certain stages in life and influenced by factors that are typically age related. For this reason, we individualize several age groups in our analysis, with increasing ranges as age increases. As can be seen in Figure 9, our sample includes predominantly age groups, 36 years of age and older. The established pattern

is observable in Table 8, showing plateaus of food insecurity rates following the recession, before slow declines are observable. Some groups surpass pre-recession rates, while others, predominantly in the age groups 36 and older appear to struggle with higher than pre-recession rates. Noteworthy is that even the group aged 65 and up does not reach food security rates as they were observable prior to the recession. Reaching the age of 65 qualifies the U.S. population for a number of Social Security benefits, including the participation in Medicaid and pension payments.

Figure 9: Age Distribution of Sample for 2005, 2009, 2013, and 2017

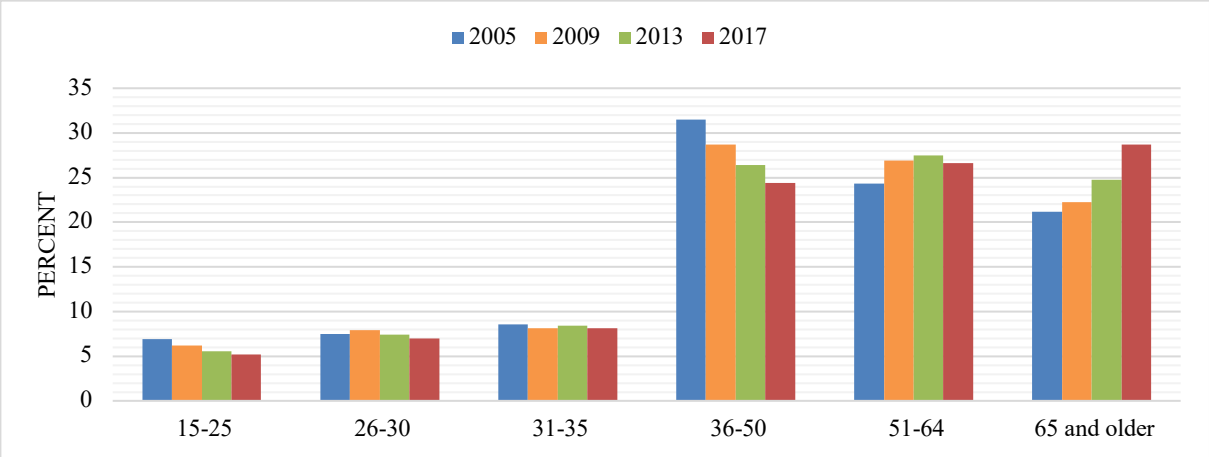


Table 8: Mean Prevalence of Food Insecurity by Age Group

Age	**2005**	**2009**	**2013**	**2017**
15-25	0.177	0.215	0.208	0.154
26-30	0.160	0.198	0.179	0.155
31-35	0.139	0.196	0.170	0.134
36-50	0.120	0.178	0.161	0.132
51-64	0.094	0.126	0.145	0.128
65 and older	0.056	0.068	0.079	0.061

Generally, educational attainment scores inherit a strong correlation in the determination of a person's real income potential, which on the other hand is generally closely

tied to a household's food security status. Although, several literature point out that fractions of households earning less than the federal poverty threshold record being food secure while some households with incomes surpassing the poverty line experience food insecurity, income is commonly and strongly associated with food security status of households. The survey, by design, classifies households with an income above 185% of the FPL as food secure, indicating that the design of the survey may instill a measurement error problem. If, for instance, a household is at 250% of the FPL, the survey defaults this household as being food secure, even if it is not. The household may still be ask the screening question to the FSS, but unless affirmative indication to food stress is given, no further questions related to food security status from the supplement will be asked. At the same time, households below the 185% poverty level will be regarded as food insecure, even when they are not, and will be included in the FSS. This measurement error imposed by the survey design, may lead to an artificial downward misclassifications of households' food security status. We hence suspect that incorporating the income variable into our analysis, which is included in the basic questionnaire of the CPS may lead to biasing of coefficient estimates. Since income is likewise strongly correlated to educational attainment, our estimates for variables on education would result in being biased, for instance. The reach of the income variable does not stop here but includes other areas, such as racial categories, as well. As a result, we decided to omit the income variable from our analysis.

We find that food insecurity is predominantly correlated to population groups with educational attainment of no high school diploma and high school diploma. Scores of educational attainment vary significantly across the United States, especially within the aforementioned educational groups. State level variations are moreover prevalent in terms of

food assistance and the support food insecure population groups are receiving. This consideration becomes particularly important when accounting for state and local level governments' post-recession budget adjustments. With fiscal pressures after the recession, governments were faced with an increased pressure to balance their budget amendments, which largely included adjustments to food assistance programs at the state level. In order to reflect these geographical variations among educational attainment, scope of food assistance, and racial categories, we include state level indicator variables in our analysis. Beyond state level variables, we add additional indicators for metropolitan and rural area specifications. The proximity of a household within or close to a metropolitan area can dictate whether or not households have access to food assistance, particularly in contrast to households located in rural areas. Accordingly, our indicators imply the location of a household in a central city, outside of a central city such as suburbs, and rural areas, along with a variable accounting for non-disclosure of household location for privacy reasons. In both of these cases, for the selection of baseline variables for metropolitan area, as well as state indicators, pre-analysis statistics were computed in order to identify the lowest prevalence of food insecurity in those specifications of metropolitan location (see Figure 10) and state indicators (refer to Figure 11), as well for the educational attainment variables. The categories with lowest food insecurity rates were selected as baseline variables and omitted from our analysis.

Primarily, households in our sample are in areas that are outside of a central city limits and located in suburban regions, as displayed in Figure 10. It can be seen that over the period of the sample years, proportions living in either suburban areas or in a central city are slightly increasing, while fewer participating people are living in rural areas. From Table 9, below, it can then be seen that food insecurity rates for the rural population are indeed slow to recover

and plateau only in 2013 instead of the year immediately after the recession in 2009. Largest impacts were nevertheless experienced by population groups within and outside central cities. Mostly due to privacy reasons, a portion of the sample was not willing to reveal their location. This portion does remain the smallest in our sample, and follows the established pattern, with increases in food insecurity immediately after the recession, another spike in the next four-year period, before slowly declining, however, still not yet reaching pre-recession food security status.

Figure 10: Metropolitan Proximity Among Sample for 2005, 2009, 2013, and 2017

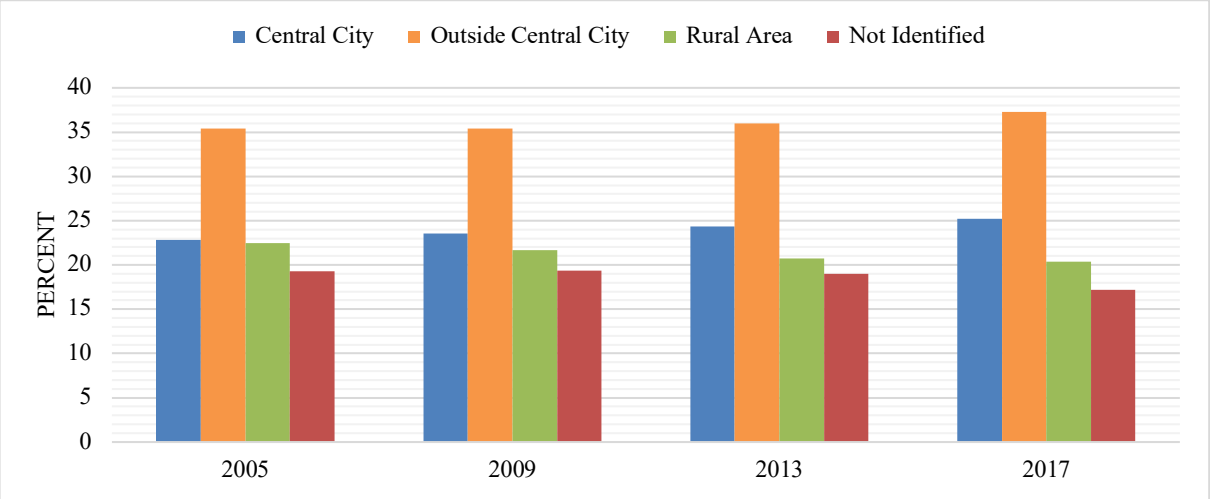
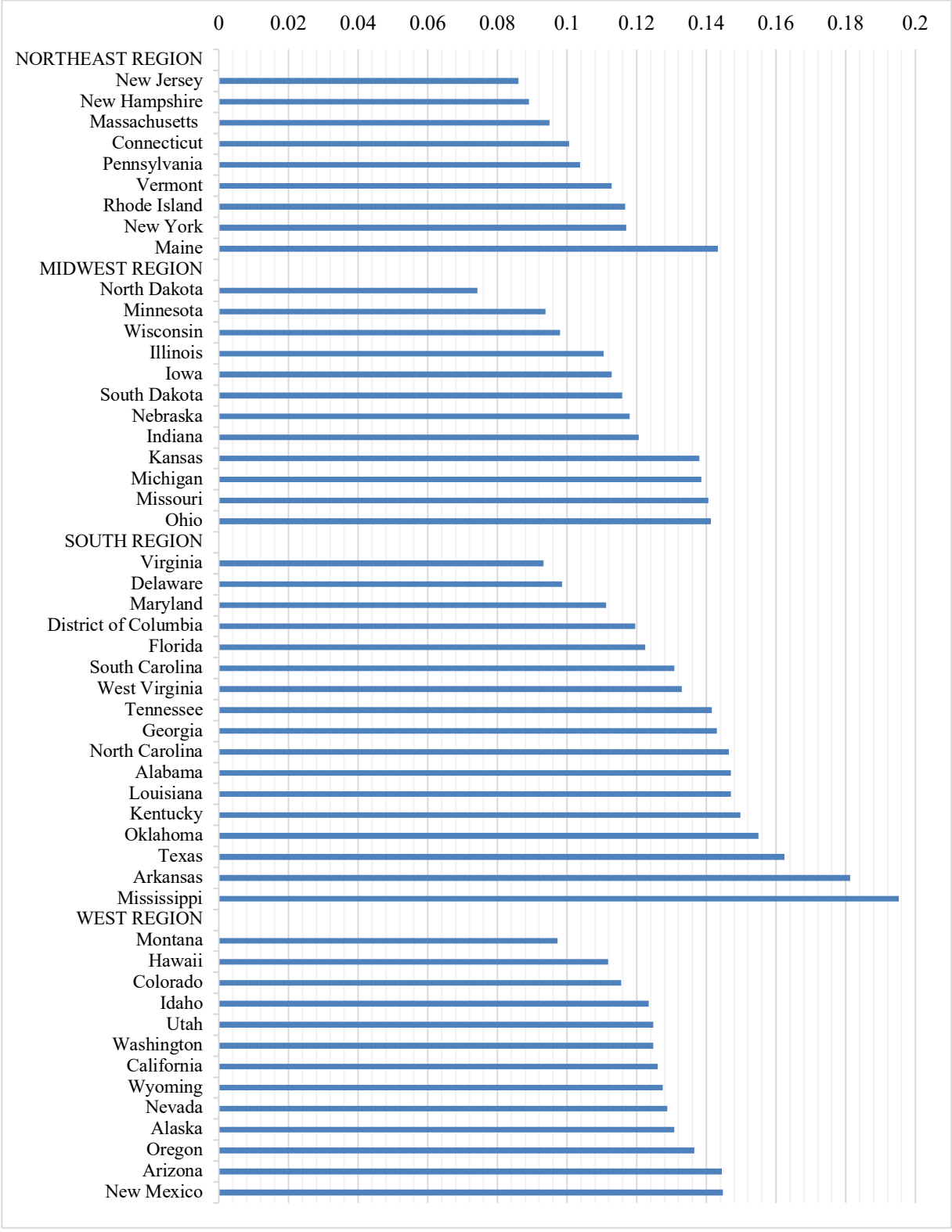


Table 9: Mean Prevalence of Food Insecurity by Metropolitan Specification

Metro Area	**2005**	**2009**	**2013**	**2017**
Central City	0.135	0.172	0.167	0.138
Outside Central City	0.087	0.132	0.121	0.094
Rural Area	0.121	0.144	0.152	0.132
Not Identified	0.117	0.143	0.149	0.138

Figure 11: Mean Prevalence of Food Security by State Across the Sampling Period



Linear Probability Model

Following common societal expectations as well as established literature in the study of food security, we hypothesize that education will not only have an influence on food security status, but that disaggregated educational groups may be disproportionately affected in their food security status consequential of the Great Recession. Similar patterns are expected to be observed for race, marital status, size of family, and age. With drastic variations of food security in relation to these characteristics across and within the U.S. for each of these categories, state and proximity to metropolitan areas indicators are projected to capture these changes.

These presumed linkages are represented by the following equation, where α signifies the constant, β_1 through β_8 represent the parameter estimates for each categorical characteristic, *t* denotes the time as year, and ε stands as the random error term:

$$FoodStat_t = \alpha + \beta_1 Education_t + \beta_2 Race_t + \beta_3 Sex_t + \beta_4 MaritalStat_t + \beta_5 FamilySz_t + \beta_6 Age_t + \beta_7 State_t + \beta_8 Metro_t + \varepsilon_t$$

The observable characteristics of the independent variables for educational rank, are programmed as indicator variables for the obtainment of no high school diploma, high school diploma, associate's degree, bachelor's degree, and some form of post graduate degree. The latter category of having obtained a post graduate degree performs as the base group since incidents of food security are expected to be lowest under this classification. Race is a vector of four dummy variables, omitting the racial category White as it displays lowest food insecurity rates; Sex is programmed as 1 for female and 0 otherwise; similarly, MaritalStat is programmed as 1 for being married and 0 otherwise; to better capture the scales of the influence age, in addition to the continuous age variable, we add a dummy variable indicating

ages over 65 years of age as 1 and 0 otherwise with the consideration for social security benefits becoming available at that age; and FamilySz are continuous variables. The State variable entails indicators for each of the 50 states of the U.S. including the District of Columbia. State indicators omitted, again, based on lowest food insecurity rates are North Dakota, New Jersey, New Hampshire, Virginia, and Minnesota. Similarly, Metro as a vector of four dummy variables, omits the lowest observed food insecurity category as baseline: outside central city.

This linear probability model is employed for the years 2005, the year prior to the Great Recession, 2009, the year immediately affected by the regression, and the years 2013 and 2017, monitoring potential longer term effects. These years were selected for the purpose of gaining a broader understanding of the impact the Great Recession inferred on the food security status of American households. The gap of 4 years in between these selected sample years ensures an adequate amount of time for observable changes to occur, while the set of 4 years compares to a representable sample size.

Utilizing survey data requires the application of weights to our analysis. Taking advantage of Stata's svyset command, we are able to specify and implement a weight variable to adjust the survey's representativeness of households nationwide. Subsequently using the svy command applies the specified weight, which in our case is a probability weight, to our analysis and in addition, adjusts standard errors for survey design and corrects them using the first-order Taylor-series linearization method.

Oaxaca - Blinder Decomposition

With the inclusion of these considerations and in order to explore and establish insights into the underlying and determining factors of food security dynamics prevailing in

the U.S., our analysis is comprised of an Oaxaca-Blinder Decomposition. We intend to analyze the reason and extent of certain educational groups being impacted more disproportionately than others, based on a set of variables reflecting educational attainment scores, sex, marital status, racial groups, family size, and age of the household head, along with state and metropolitan indicator variables.

As the name indicates, Oaxaca (Oaxaca, 1973) and Blinder (Blinder, 1973) developed a decomposition based in regression analysis that allocates a gap in outcome between two groups into components attributable to a set of selected characteristics and unattributable to these selected characteristics. Both Oaxaca and Blinder present this decomposition in their 1973 work analyzing the wage difference between sexes to define which portion of the wage gap between these groups may be explainable by the difference in skill level and which portion may be attributable to discrimination.

In our analysis, we utilize this model to determine the portion of difference in food security status which may be attributable to characteristics of the population including educational attainment, sex, marital status, race, family size, and age and which portion may be attributable to the effects of the Great Recession. We estimate a set of regression equations considering the difference in food security status between each transitional sample period, such as from year 2005 to 2009, 2009 to 2013, and 2013 to 2017, where each period is denoted as t1 and t2. The mean food security status for the groups of years can be estimated, as:

$$FoodStat_i^{t1} = \beta_0^{t1} + \sum_{j=1}^{n} \beta_j^{t1} X_{ji}^{t1} + \varepsilon_i^{t1}$$

$$FoodStat_i^{t2} = \beta_0^{t2} + \sum_{j=1}^{n} \beta_j^{t2} X_{ji}^{t2} + \varepsilon_i^{t1}$$

where X represents a set of *n* characteristics, $FoodStat_i$ is the mean value of the outcome variable, and β represents the column vector of coefficients characterizing the association between the predictors comprised in X_j and food security status, which were obtained through running descriptive statistics and separate regressions of the groups' outcomes.

The average difference in food security status can be expressed as follows:

$$(\beta_0^{t1} - \beta_0^{t2}) + \sum_{j=1}^{n} (\beta_j^{t1} X_{ji}^{t1} - \beta_j^{t2} X_{ji}^{t2})$$

Grounded in this equation, it can be assumed that difference in food security status may result from differences in the mean values of the X variables or from the differences in the values of the β coefficients. In the Oaxaca-Blinder model these differences are partitioned into the two components of the values and mean values of X:

$$(\beta_0^{t1} - \beta_0^{t2}) + \sum_{j=1}^{n} (\beta_j^{t1} X_{ji}^{t1} - \beta_j^{t2} X_{ji}^{t2}) + \sum_{j=1}^{n} (\beta_j^{t1} X_{ji}^{t2} - \beta_j^{t1} X_{ji}^{t2})$$

This equation then becomes the standard linear Oaxaca-Blinder decomposition with the difference in food security status being expressed as the following:

$$[\sum_{j=1}^{n} (X_{ji}^{t1} - X_{ji}^{t2}) \beta_j^{t1}] + [(\beta_0^{t1} - \beta_0^{t2}) + \sum_{j=1}^{n} (\beta_j^{t1} - \beta_j^{t2}) X_{ji}^{t2}]$$

Here, the first summation term represents the value that can be attributed to the segment of selected characteristics. It is the differences in the mean values of the X variables – the endowments. The second sum denotes the differences in food security status that cannot be explained by the selected characteristics. This can be attributed to the difference in the coefficient estimates, including the intercepts β_0. Even if each group shared similar mean

levels of characteristics, this is the difference in food security status that would persist. In more detail, the measures used in our analysis are comprised of:

The Differential:

$$R = \beta_0^{t1} + \sum_j \beta_j^{t1} X_{ji}^{t1} - (\beta_0^{t2} + \sum_j \beta_j^{t2} X_j^{t2})$$

The portion of differences attributable to characteristics:

$$E = \sum_j \beta_j^{t1} (X_{ji}^{t1} - X_{ji}^{t2})$$

The portion of difference attributable to coefficients:

$$C = \sum_j X_{ji}^{t2} (\beta_j^{t1} - \beta_j^{t2})$$

The portion of the differences remaining unexplained:

$$U = \beta_0^{t1} - \beta_0^{t2}$$

Results

Distribution of Food Insecurity

In order to better understand the dynamics of food insecurity related to the characteristics we selected based on existing literature to assess in the scope of this thesis research, we computed a series of descriptive statistics. Figures 12-14 show the percentages of selected characteristic categories of the sample population reporting food insecurity. These characteristics include educational attainment, race, and age and were selected based on their magnitude of influence on food insecurity as examined in the previous chapter.

Figure 12: Distribution of Food Insecurity Among Educational Attainment Groups for 2005, 2009, 2013, and 2017

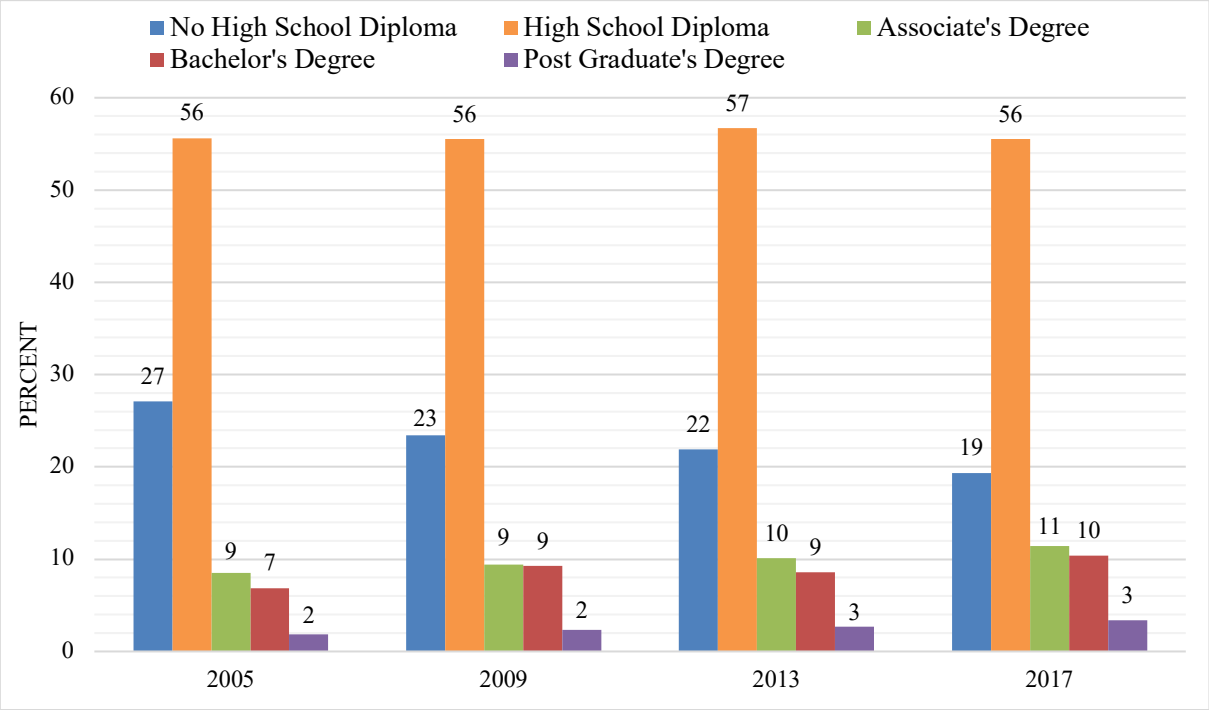
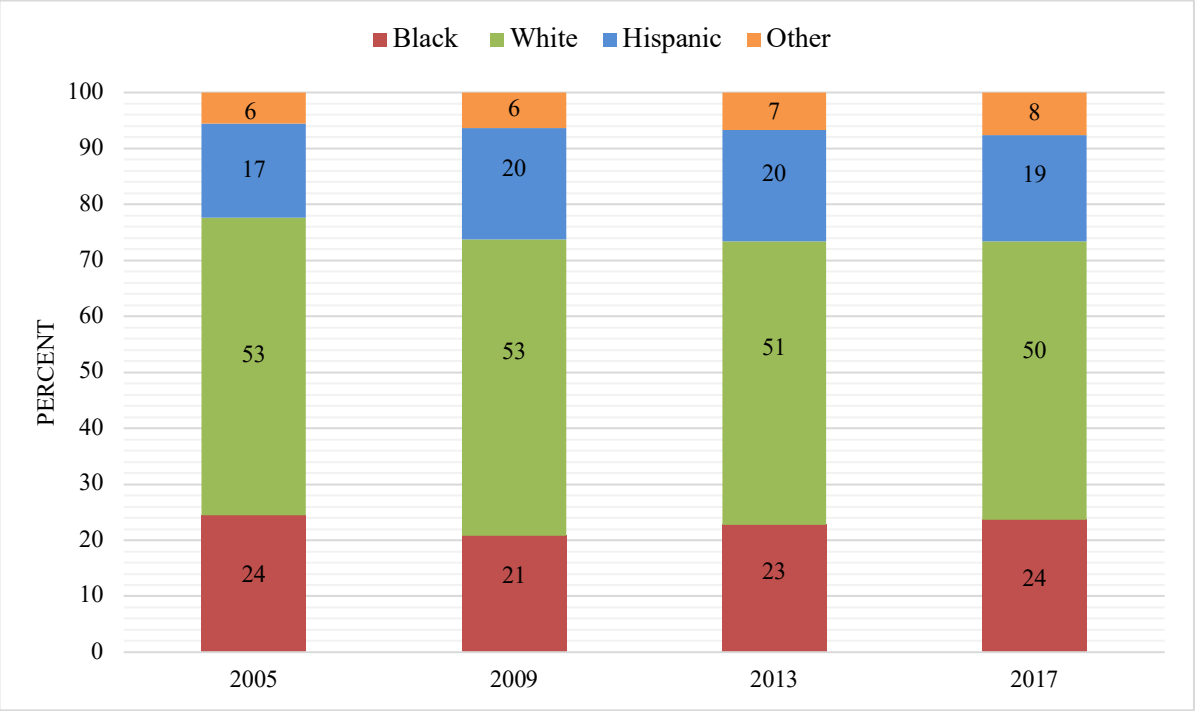


Figure 12, above, shows the prevalence of educational attainment among the sample that reported being food insecure. With few exceptions among our sample period, at least 56% of the population experiencing food insecurity held a high school diploma or equivalent.

A downward trend is observable for the group with no high school diploma. It is to note, however, that as previously observed in the means table for educational attainment (Table 3) the magnitude by which food insecurity grew for this group is the largest. The above figure further suggests slight increases for people holding some form of college degree in the prevalence of food insecurity.

Figure 13: Distribution of Food Insecurity Among Racial Categories for 2005, 2009, 2013, and 2017



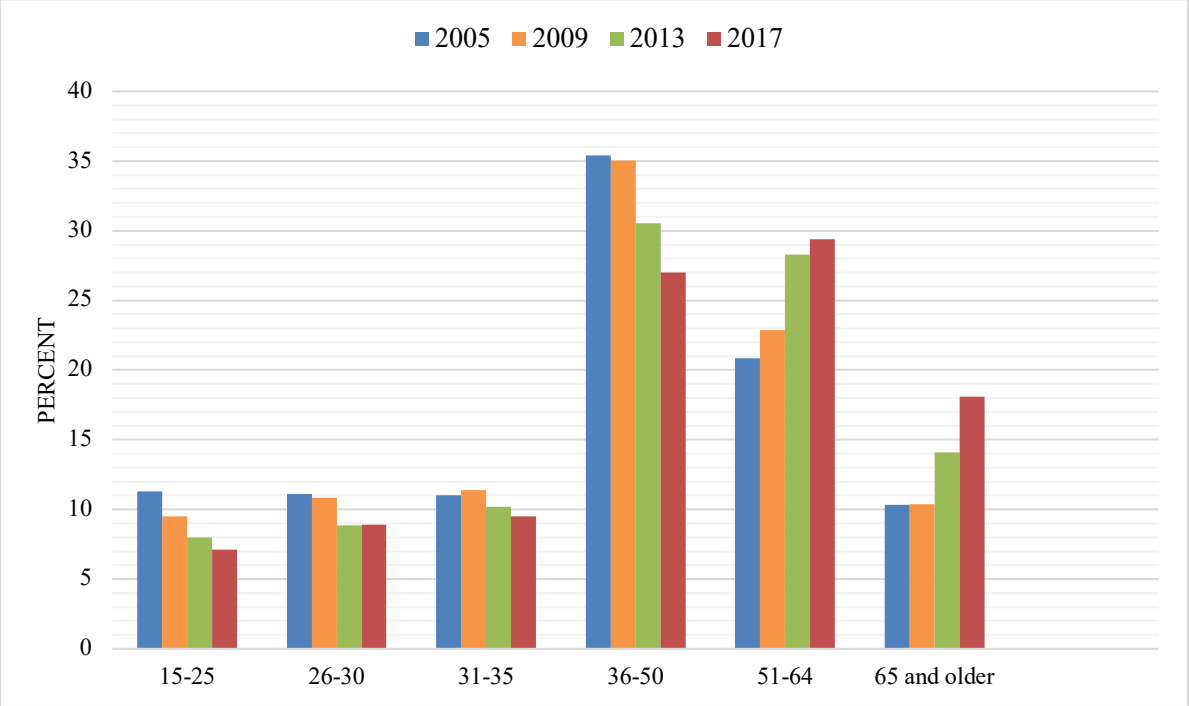
Again, bearing in mind observations from the previous sections comparing sample population and food insecurity mean values, Figure 13, above, conveys a disproportionate population effect of food insecurity. While the Black population accounts for only around 10% of survey participants, of the people experiencing food insecurity 24% were Black in 2005, and then again in 2017. During the year of the recession this racial group actually

reports fewer incidents of food insecurity. It could be speculated that reasons for this slight upturn in food security among the Black population during the period heaviest affected by the recession is to find in the labor market. In comparison to the White population, Blacks earn on average less. (Blinder, 1973 & Oaxaca, 1973; Karageorge, 2017) During periods of economic depressions, cheaper labor gains demand, which may cause higher employment rates for Blacks. Similarly to the Black population, while making up below 10% of survey participants, Hispanics represent a disproportionately large portion of the food insecure population. This group experienced a sharp increase in food insecurity during the recession, barely recovering during the following years. Food security rates for the White population appear to go up post-recession, reaching higher levels than observed prior to the 2009 recession.

Considering age groups in Figure 14, below, we find that the populations within the age groups up to 50 years, experience an increase in food security over the sample period. The opposite is observable for age groups 51 years and older. Again, reasons for this increase in food insecurity among these age groups can be speculated. Specifically, the group of 65 years of age and older is an age group that qualifies for social security benefits and often relies on food benefits and local sources for food such as food pantries. During and after the recession, federal, state, and especially local governments experienced budget pressures and cuts that may have been affecting the availability of funds for food assistance and aid, leading to higher food insecurity rates among people 65 years and older. Multiple causes for the increase in food insecurity for the age group 51-64 could be speculated. Historically, this age group represents the largest holdings of the remaining fraction of higher paying blue-collar jobs which may have experienced larger cuts during the recession. This age group is generally faced with low rates of finding new employment. Disabilities may be another growing

concern among this age group. Not qualifying for pension and other Social Security benefits yet, such as Medicaid, loss of income due to unemployment, paired with budget cuts to food aid programs, such as SNAP could all account for the sharp increase of food insecurity for the group 51-64 years of age.

Figure 14: Distribution of Food Insecurity Among Age Groups for 2005, 2009, 2013, and 2017



Determinants of Food Insecurity

Employing a linear probability model, we estimate the relationship between several demographic characteristics, with the inclusion of state effects and food insecurity. We present these linear probability regression estimates for the determinants of food insecurity in Table 10 for each separate year.

Table 10: Food Insecurity Estimates for 2005, 2009, 2013, 2017

	Food Security Status			
	2005	2009	2013	2017
Education[a]:				
No High School Degree	0.162***	0.200***	0.205***	0.175***
	(0.007)	(0.008)	(0.009)	(0.010)
High School Degree	0.080***	0.113***	0.114***	0.093***
	(0.004)	(0.005)	(0.005)	(0.005)
Associate's Degree	0.042***	0.064***	0.066***	0.063***
	(0.005)	(0.006)	(0.006)	(0.006)
Bachelor's Degree	0.003	0.016***	0.011**	0.012***
	(0.004)	(0.005)	(0.004)	(0.005)
Race[b]:				
Black	0.099***	0.087***	0.103***	0.080***
	(0.007)	(0.008)	(0.008)	(0.008)
Hispanic	0.035***	0.073***	0.059***	0.031***
	(0.007)	(0.008)	(0.008)	(0.008)
Other	0.015**	0.022***	0.012	0.019**
	(0.007)	(0.008)	(0.008)	(0.008)
Sex (female)	0.034***	0.037***	0.034***	0.036***
	(0.003)	(0.004)	(0.004)	(0.004)
Married	-0.057***	-0.082***	-0.081***	-0.073***
	(0.004)	(0.005)	(0.005)	(0.005)
Family Size	0.013***	0.020***	0.019***	0.012***
	(0.002)	(0.002)	(0.002)	(0.002)
Age	-0.001***	-0.002***	-0.001***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Age > 65				
Metropolitan Area[c]:				
City Center	0.021***	0.006	0.009*	0.025***
	(0.004)	(0.005)	(0.005)	(0.005)
Unknown City Status	0.022***	0.008	0.025***	0.041***
	(0.005)	(0.006)	(0.006)	(0.006)
Rural Area	0.016***	0.001	0.012*	0.032***
	(0.005)	(0.006)	(0.006)	(0.006)
STATE EFFECTS BY REGION[d]				
Northeast Region:				

Connecticut	0.000	0.009	0.025*	0.052**
	(0.010)	(0.011)	(0.013)	(0.022)
Maine	0.082***	0.064***	0.047***	0.021
	(0.012)	(0.013)	(0.014)	(0.018)
Massachusetts	0.014	0.031**	-0.005	0.016
	(0.011)	(0.013)	(0.013)	(0.013)
Rhode Island	0.035***	0.047***	0.022	0.020
	(0.013)	(0.014)	(0.014)	(0.019)
Vermont	0.029**	0.060***	0.043***	0.012
	(0.013)	(0.014)	(0.015)	(0.015)
New York	-0.001	0.009	0.033***	0.006
	(0.008)	(0.010)	(0.010)	(0.011)
Pennsylvania	0.011	0.011	0.013	0.009
	(0.009)	(0.010)	(0.010)	(0.012)
Midwest Region:				
Illinois	-0.005	0.018*	-0.002	0.023*
	(0.009)	(0.011)	(0.010)	(0.012)
Indiana	0.016	0.022	0.024	0.005
	(0.012)	(0.014)	(0.015)	(0.015)
Michigan	0.039***	0.050***	0.050***	0.030**
	(0.011)	(0.012)	(0.013)	(0.013)
Ohio	0.052***	0.049***	0.041***	0.043***
	(0.011)	(0.011)	(0.012)	(0.012)
Wisconsin	0.019*	0.022*	0.008	-0.006
	(0.011)	(0.012)	(0.012)	(0.014)
Iowa	0.047***	0.018	0.004	0.003
	(0.012)	(0.012)	(0.012)	(0.016)
Kansas	0.041***	0.048***	0.064***	0.022
	(0.013)	(0.014)	(0.015)	(0.017)
Missouri	0.038***	0.038***	0.059***	0.026*
	(0.012)	(0.014)	(0.015)	(0.015)
Nebraska	0.022*	0.038***	0.030*	0.016
	(0.012)	(0.014)	(0.015)	(0.016)
South Dakota	0.020*	0.023*	0.015	0.025
	(0.012)	(0.013)	(0.014)	(0.018)
South Region:				
Delaware	-0.043***	-0.022*	0.016	-0.011
	(0.011)	(0.013)	(0.016)	(0.018)
District of Columbia	-0.020	-0.007	0.003	-0.013

	(0.015)	(0.015)	(0.016)	(0.014)
Florida	-0.011	0.048***	0.018*	0.037***
	(0.008)	(0.010)	(0.011)	(0.011)
Georgia	0.016	0.035***	0.023*	-0.003
	(0.012)	(0.013)	(0.013)	(0.013)
Maryland	0.004	0.014	0.014	0.016
	(0.010)	(0.012)	(0.012)	(0.017)
North Carolina	0.010	0.050***	0.044***	0.034**
	(0.012)	(0.013)	(0.013)	(0.014)
South Carolina	0.051***	0.004	-0.024*	0.001
	(0.015)	(0.014)	(0.014)	(0.015)
West Virginia	0.000	0.036**	0.043**	0.038***
	(0.013)	(0.016)	(0.018)	(0.014)
East South Central Division:				
Alabama	0.006	0.055***	0.028	0.009
	(0.014)	(0.018)	(0.017)	(0.014)
Kentucky	0.050***	0.054***	0.065***	0.008
	(0.014)	(0.015)	(0.016)	(0.015)
Mississippi	0.055***	0.033*	0.090***	0.028**
	(0.018)	(0.019)	(0.020)	(0.014)
Tennessee	0.032**	0.024	0.055***	0.012
	(0.015)	(0.015)	(0.017)	(0.014)
Arkansas	0.058***	0.069***	0.076***	0.067***
	(0.016)	(0.018)	(0.019)	(0.016)
Louisiana	0.044**	-0.028*	0.020	0.040***
	(0.020)	(0.016)	(0.018)	(0.015)
Oklahoma	0.053***	0.046***	0.050***	0.040**
	(0.014)	(0.016)	(0.018)	(0.017)
Texas	0.038***	0.039***	0.038***	0.030***
	(0.009)	(0.010)	(0.010)	(0.010)
West Region:				
Arizona	0.019	0.055***	0.031*	0.012
	(0.014)	(0.017)	(0.017)	(0.015)
Colorado	0.039***	0.026**	0.044***	0.006
	(0.011)	(0.012)	(0.012)	(0.016)
Idaho	0.043***	0.006	0.058***	0.006
	(0.015)	(0.015)	(0.018)	(0.014)
Montana	0.014	0.036**	-0.000	-0.006
	(0.014)	(0.016)	(0.016)	(0.013)

Nevada	-0.013	-0.007	0.036**	0.034*
	(0.011)	(0.014)	(0.016)	(0.019)
New Mexico	0.071***	0.024	-0.036**	0.036**
	(0.018)	(0.020)	(0.017)	(0.015)
Utah	0.084***	0.041**	0.019	0.018
	(0.016)	(0.018)	(0.018)	(0.015)
Wyoming	0.030**	0.017	0.048***	0.017
	(0.013)	(0.014)	(0.017)	(0.016)
Alaska	0.059***	0.037**	0.006	0.008
	(0.015)	(0.016)	(0.017)	(0.016)
California	0.006	0.032***	0.016*	0.003
	(0.007)	(0.009)	(0.009)	(0.009)
Hawaii	0.018	0.024	0.009	-0.012
	(0.013)	(0.016)	(0.015)	(0.015)
Oregon	0.056***	0.049***	0.076***	0.036**
	(0.014)	(0.014)	(0.016)	(0.015)
Washington	0.024**	0.066***	0.044***	0.021
	(0.011)	(0.014)	(0.014)	(0.013)
Constant	0.051***	0.069***	0.030**	0.020
	(0.011)	(0.012)	(0.012)	(0.013)
Observations	47,369	45,363	42,007	37,304
R-squared	0.081	0.094	0.093	0.075

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
[a]Reference category is "Post Graduate Degree".
[b]Reference category is "White".
[c]Reference category is "Outside Central City".
[d]Reference categories are New Hampshire, New Jersey, North Dakota, Minnesota, Virginia

The results in Table 10, above, with respect to the educational variables and relative to the omitted base category of post-graduate degree, indicate that the population groups with lower educational grades have a higher likelihood of being food insecure. According to these results, the population with no high school diploma is most likely to experience food insecurity, directly followed by the populations holding a high school diploma and associate's degree. Among educational attainment and proportional to the base category, people holding a bachelor's degree are least likely to experience food insecurity. This pattern becomes more

defined when observing the coefficients for each of these educational groups and their change across the sample year measures. A substantial increase of the coefficients for no high school and high school diploma are observable between the selected years of 2005 and 2009. While rising food insecurity rates are observable for both college degree variables, as well, the rises are not as dramatic as for the former two educational variables. Food insecurity rates for the former two educational attainment groups of no high school and high degree go up from 16.2 and 8 to 20 and 11.3 percentage points, respectively. These rates stay persistently high, plateauing in 20013, before they start to decline again during the 2017 sample period. The estimates for racial categories on food insecurity suggest with statistical significance that Hispanics face the highest likelihood of experiencing food insecurity, relative to the bassline category of being White. This probability of food insecurity increases sharply between 2005 and 2009, before declining to pre-recession levels. The Black population is 9.9 percentage points more likely to be food insecure than their White counterparts. As observed in earlier analysis, food security for Blacks increases during the year of the recession, before it decreases again, only to fall again four years later in 2017. The likelihood for female headed households to experience food insecurity by 34 percentage points in 2005 is substantially higher than for the for male headed households, which is used as base category. Somewhat of a yo-yo effect is observable with an increase of 3 percentage points during the recession, a receding to pre-recession levels in 2013, before another increase to 36 percentage points is observable in 2017. The effects of marital status throughout the sample period show with statistical significance that being married protects against food insecurity. The married population was 5.7 percentage points less likely to experience food insecurity prior to the recession, increasing to 8.2 percentage points following the recession in relation to our

omitted category of not being married. The table further shows that the size of family makes households more susceptible to entering food insecurity. This likelihood sharply increases during 2009, stays persistently high during 20013 and only then recovers to pre-recession levels. Age is persistently protective against experiencing food insecurity, increasingly so following the recession, before it loses substantial protectiveness throughout 2017. Statistically significant, family size exposes to food insecurity, however, in relatively magnitudes. According to the table and with respect to metropolitan proximity categories, it appears that the population not willing to disclose their location faced highest food insecurity rates prior the recession with a plateau in 2017. These results further suggest substantially but not statistically significant lower food insecurity rates during the year of the recession. Generally and relative to our base category of suburban populations, people living in rural areas appear more food secure pre-recession but much more food insecure eight years after the recession in 2017 with an increase 16 percentage points. The city center population experiences an increase of 4 percentage points during this period.

The last set of variables in our analyses focuses on the effect state variables may have on food security status. Each state of the U.S., including the District of Columbia is represented in the above table, with baseline states comprised of New Hampshire, New Jersey, North Dakota, and Virginia. Rather than depicting each of these 46 state variables, a selected few states, by region, will be highlighted which are either displaying substantially higher rates in food insecurity relative to our baseline states or substantial spikes in food insecurity rates across our sample period. With this in mind, the Northeastern states generally display the lowest food security rates across the U.S. Maine accounts for the highest food insecurity rates in this region, and contrary to previously and consistently observed patterns of

spikes in food insecurity, manages to increase food security substantially throughout the sample period and post-recession. The East South Central Region of the U.S. on the other hand persistently experiences the highest food insecurity rates, with Arkansas and Mississippi displaying the lowest rates among the states at a statistical significance level of $p<0.01$. According to our results, food insecurity rates in Mississippi appear to fluctuate substantially across the sample year. It starts out at 55 percentage points in 2005, declines by over 20 percentage points in 2009, before it rises again by staggering 57 percentage points in 2013, and declines once more by equally staggering 62 percentage points. Arkansas rates are more consistent, rising by over 15 percentage points over the course from 2005 to 2013, before starting to decline again. In the West Region, Washington experiences the largest spike in food insecurity rates from 2.4 percentage points in 2005 to 6.6 in 2009. Some states, including Colorado, Oregon, and Oklahoma increased their rates of food insecurity during 2009 and experienced lagged effect of the recession with decreasing rates the following period of 2013. Similar to Maine, Ohio and Texas are states that seem to have managed a constant decline in food insecurity rates. These effects are relatively small in magnitude but noteworthy nonetheless for the states' avoidance of hits to food security in spite of the recession that affected the majority of states in significant negative trends during the years of 2009 and 2013. Another point of consideration should lie in the fact that many states do not display statistical significance for part or all the years covering the sample period at a level of at least 0.1. It should further be noted that changes in the state coefficients to not play a big role in explaining the rise in food insecurity, while there are, however, these few interesting state effects as mentioned above.

Likelihoods of Food Insecurity

The likelihood for certain groups of people to experience food insecurity is extraordinarily high. Specifically, based on a bundle of characteristics these groups of people are more or perhaps less likely to be food insecure. To illustrate this likelihood of experiencing food insecurity, based on our regression results, we are able to calculate the chances of food insecurity for certain groups. These calculations can be found and referred to in Table 11. For instance, a White, 68 year old, married male, holding a high school diploma, living with his spouse in a rural area, had a 8.2 percentage points possibility of experiencing food insecurity in 2005. During the 2009 recession, this likelihood fell to only 1.6 percentage points. His Black counterpart, on the other hand and throughout our reference period is around 10 percentage points more likely to experience food insecurity, while meeting the same characteristics. The worst outlook in this thought experiment had an unmarried Hispanic, 53 year old female, living with her 3 children in a city center, while not holding a high school diploma. Her household faced a 33.9 percentage point likelihood of experiencing food insecurity during 2009, which increased further to 34.1 in 2013, and only slightly improved to 32.3 percentage points in 2017. Similarly living in a city center, a White, separated, yet married 34-year old female, holding a Bachelor's degree, and caring for her only child had a negative likelihood of experiencing food insecurity during and right after the recession in 2009 and 2013. Her unmarried, Black counterpart, holding all else constant, faced substantially higher possibilities of experiencing food insecurity with 16.7 and 17.2 percentage points, respectively for 2009 and 2013. Perhaps unsurprisingly, lowest food insecurity chances were experienced by a post-graduate, 58 year-old, White, married male, living with his wife and child in a suburban area. His households' likelihood of experiencing

food insecurity remain negative throughout our sample period, reaching negative peaks through 2009 and 2013 of -8.9 and -7.1 percentage points. While these examples have been randomly selected by us, they have been selected in order to demonstrate the magnitudes of food insecurity that prevailing groups of people meeting these sets of characteristics face throughout our sample period.

Table 11: Likelihood of Food Insecurity for Selected Groups of Characteristics for 2005, 2009, 2013, and 2017

Characteristics	**2005**	**2009**	**2013**	**2017**
Constant	0.051	0.069	0.030	0.020
High School Diploma	0.162	0.200	0.205	0.175
White	0.000	0.000	0.000	0.000
Male	0.000	0.000	0.000	0.000
Married	-0.057	-0.082	-0.081	-0.073
1 Family Member Present	0.013	0.020	0.019	0.012
68 Years Old	-0.103	-0.192	-0.128	-0.055
Rural	0.016	0.001	0.012	0.032
TOTAL	**0.082**	**0.016**	**0.057**	**0.111**
Constant	0.051	0.069	0.030	0.020
High School Diploma	0.162	0.200	0.205	0.175
Black	0.099	0.087	0.103	0.080
Male	0.000	0.000	0.000	0.000
Married	-0.057	-0.082	-0.081	-0.073
1 Family Member Present	0.013	0.020	0.019	0.012
68 Years Old	-0.103	-0.192	-0.128	-0.055
Rural	0.016	0.001	0.012	0.032
TOTAL	**0.181**	**0.103**	**0.160**	**0.191**
Constant	0.051	0.069	0.030	0.020
No High School Diploma	0.162	0.200	0.205	0.175
Hispanic	0.035	0.073	0.059	0.031
Female	0.034	0.037	0.034	0.036
Not Married	0.000	0.000	0.000	0.000
3 Children Present	0.039	0.060	0.057	0.036
53 Years Old	-0.053	-0.106	-0.053	0.000
City Center	0.021	0.006	0.009	0.025

TOTAL	**0.289**	**0.339**	**0.341**	**0.323**
Constant	0.051	0.069	0.030	0.020
Bachelor's Degree	0.003	0.016	0.011	0.012
White	0.000	0.000	0.000	0.000
Female	0.034	0.037	0.034	0.036
Married	-0.057	-0.082	-0.081	-0.073
1 Child Present	0.013	0.020	0.019	0.012
34 Years Old	-0.034	-0.068	-0.034	0.000
City Center	0.021	0.006	0.009	0.025
TOTAL	**0.031**	**-0.002**	**-0.012**	**0.032**
Constant	0.051	0.069	0.030	0.020
Bachelor's Degree	0.003	0.016	0.011	0.012
Black	0.099	0.087	0.103	0.080
Female	0.034	0.037	0.034	0.036
Not Married	0.000	0.000	0.000	0.000
1 Child Present	0.013	0.020	0.019	0.012
34 Years Old	-0.034	-0.068	-0.034	0.000
City Center	0.021	0.006	0.009	0.025
TOTAL	**0.187**	**0.167**	**0.172**	**0.185**
Constant	0.051	0.069	0.030	0.020
Post-Graduate Degree	0.000	0.000	0.000	0.000
White	0.000	0.000	0.000	0.000
Male	0.000	0.000	0.000	0.000
Married	-0.057	-0.082	-0.081	-0.073
2 Family Members Present	0.026	0.040	0.038	0.024
58 Years Old	-0.058	-0.116	-0.058	0.000
Suburban	0.000	0.000	0.000	0.000
TOTAL	**-0.038**	**-0.089**	**-0.071**	**-0.029**

Decomposition Results

Based on our results up to this point, it is clear that educational attainment, as well as race, marital status, and to a certain size of family and age, as well as living location such as metropolitan and state classification play a significant part in the determination of whether or

not populations experience food insecurity. Among these characteristics that influence food insecurity, we have been able to observe the pattern of a spike of food insecurity occurrences following the recession, before food insecure rates start slowly declining again. The question remains whether these changes in food security status are attributable to larger proportions of the population portraying these characteristics or due to these characteristics making people more predisposed to experiencing food insecurity. For the assessment of this consequential relationship between covariates and coefficient on food security status we present a Oaxaca-Blinder Decomposition for the periods 2005-2009, 2009-2013, and 2013-2017 in Tables 12-17. Although, as in the previous regression analysis, state variables were included in the execution of the decompositions, however, not included in the tables below. (For the complete reports of state effects please refer to Appendix 1 for 2005-2009, Appendix 2 for 2009-2013, and Appendix 3 for 2013-2017 state effects.) Each set of tables presents the changes in food insecurity over a connecting two-year period of sample range, and within each set of tables, the first presents a summary of the Oaxaca-Blinder Decomposition, and the latter a more detailed version of the decomposition, including all previously incorporated characteristics.

Beginning with Table 12, a summary of the Oaxaca-Blinder Decomposition for the period 2005-2009, we show the predicted food insecurity for 2005 and 2009, with the change indicating a worsening of food insecurity rates by 3.7 percentage points between these two years. While the covariates of our analysis contributed to an increase in food security of only 0.4 percentage points, the estimated coefficients contributed to a 4 increase in food insecurity over the period 2005-2009. In other words, the characteristics included in this analysis, predisposed the sample population to experiencing food insecurity.

Table 12: Changes in Food Insecurity 2005-2009, Oaxaca-Blinder Decomposition Summary

Predicted Food Insecurity, 2005	0.110*** (0.002)
Predicted Food Insecurity, 2009	0.147*** (0.002)
Change (2005-2009) (R)	-0.037*** (0.003)
Contribution of Change in Mean Value of Covariates (E)	0.003*** (0.001)
Contribution of Change in Estimated Coefficients (C)	-0.039*** (0.002)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This can be broken down into more detail, as shown in Table 13, below. While the endowment effects remain relatively small in magnitude, as reflected in the summary table above, the coefficients to only some of the characteristics display large enough magnitudes to account for the change in food security status from 2005 to 2009, relative to the baseline categories. Predominantly, characteristics such as having a high school diploma as well as family size appear to be drivers in worsening food security. Smaller negative effects are observable for characteristics such as no high school degree, associate's degree, and Hispanic. Marital Status and age are coefficients positively contributing to food insecurity, perhaps reversing some of the negative effects of other characteristics for this population group. Living in a city center or rural area, appears to have been slightly protective from food insecurity, relative to suburban areas, as well. Illinois, North Carolina, Arizona, and Washington had slight negative effects on food security levels during the period between 2005 and 2009. Strongest negative effects, as suggested by the regression results are observable for California and Florida between 2005 and 2009. Louisiana and South Carolina

on the other hand appeared to have improving effects on food security, which, however, for Louisiana reversed in the next period, 2009-2013. (For more details of states effects please refer to Appendix 1.)

Table 13: Changes in Food Insecurity 2005-2009, Detailed Oaxaca-Blinder Decomposition

	2005-2009		
	Endowments	Coefficients	Interaction
Education[a]:			
No High School Degree	0.003***	-0.005***	-0.0005***
	(0.001)	(0.001)	(0.000)
High School Degree	0.001***	-0.016***	-0.0004**
	(0.000)	(0.003)	(0.000)
Associate's Degree	-0.000	-0.002***	0.000
	(0.000)	(0.001)	(0.000)
Bachelor's Degree	-0.0002***	-0.003**	0.000*
	(0.000)	(0.001)	(0.000)
Race[b]:			
Black	0.000	0.001	0.000
	(0.000)	(0.001)	(0.000)
Hispanic	-0.0005**	-0.004***	0.000**
	(0.000)	(0.001)	(0.000)
Other	-0.00009*	-0.000	0.000
	(0.000)	(0.001)	(0.000)
Gender	-0.0005***	-0.001	0.000
	(0.000)	(0.003)	(0.000)
Married	-0.001*	0.014***	0.000*
	(0.000)	(0.003)	(0.000)
Family Size	0.000	-0.017***	0.000
	(0.000)	(0.006)	(0.000)
Age	0.001***	0.011	0.000
	(0.000)	(0.012)	(0.000)
Age > 65	0.001***	0.005**	-0.0002*
	(0.000)	(0.002)	(0.000)
Metropolitan Area[c]:			
City Center	0.000	0.004**	0.000

	(0.000)	(0.002)	(0.000)
Unknown City Status	0.000	0.002*	0.000
	(0.000)	(0.001)	(0.000)
Rural Area	0.000	0.003**	0.000
	(0.000)	(0.001)	(0.000)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
[a]Reference category is "Post Graduate Degree".
[b]Reference category is "White".
[c]Reference category is "Outside Central City".

Table 13 displays the summary of Oaxaca-Blinder Decomposition for the period 2009-2013. Between these two years, food security levels improved only slightly by 0.4 percentage points, contrary to the previous 2005-2009 period, predominantly attributable to the covariates of our analysis or, stated differently, an increase in proportion of the population featuring these characteristics. Only a quarter of the change in food security status is due to these characteristics inheriting a susceptibility of experiencing food insecurity.

Table 14: Changes in Food Insecurity 2009-2013, Oaxaca-Blinder Decomposition Summary

Predicted Food Insecurity, 2009	0.147*** (0.002)
Predicted Food Insecurity, 2013	0.143*** (0.002)
Change (2009-2013)	0.004 (0.003)
Contribution of Change in Mean Value of Covariates	0.003*** (0.001)
Contribution of Change in Estimated Coefficients	0.000 (0.003)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In Table 15, it can be observed that age has the largest negative coefficient with -4.2 percentage points. Recounting from earlier analyses, large portions of the sample population of age 36 and older reported the prevalence of food insecurity. While for the age group 36-50,

food insecurity rates declined in proportion to the sample population over the course of the sample period, for the age groups 51-64, and 65 and older, these rates worsened. While the sample population aged 51-64 did change drastically, their experience of food insecurity did. Similarly, the age group 65 and older did not experience any changes in food security, based on Figure 14 in the Distribution of Food Insecurity section of this thesis. It may have taken some time after the recession for governments to balance budgets and the effects of decreased aids for food assistance to become observable. Decreases in food assistance would explain this rather reversed effect of age during this period of time, compared to the previous 2005-2009 period. The second largest observable effect is taking place for the endowment of the population that does not hold a high school diploma. Here again, recalling from previous analysis that the proportion of the population with no high school diploma is decreasing over the sample period, consequential improvements to population food security are observable. With a previously observed decrease in married, and increase in unmarried sample population, this variable now shows a minor negative effect on food security, despite being a protecting determinant from insecurity.

Table 15: Changes in Food Insecurity 2009-2013, Detailed Oaxaca-Blinder Decomposition

	2009-2013		
	Endowments	Coefficients	Interaction
Education[a]:			
No High School Degree	0.003***	-0.001	0.000
	(0.001)	(0.001)	(0.000)
High School Degree	0.001**	0.000	0.000
	(0.000)	(0.003)	(0.000)
Associate's Degree	-0.0004**	0.000	0.000
	(0.000)	(0.001)	(0.000)
Bachelor's Degree	-0.000*	0.001	0.000
	(0.000)	(0.001)	(0.000)

Race[b]:			
Black	0.000	-0.002	0.000
	(0.000)	(0.001)	(0.000)
Hispanic	-0.001***	0.002	0.000
	(0.000)	(0.001)	(0.000)
Other	0.000	0.001	0.000
	(0.000)	(0.001)	(0.000)
Gender	-0.0003*	0.001	0.000
	(0.000)	(0.003)	(0.000)
Married	-0.001***	0.000	0.000
	(0.000)	(0.004)	(0.000)
Family Size	0.001***	0.003	0.000
	(0.000)	(0.007)	(0.000)
Age	0.001***	-0.042***	0.001***
	(0.000)	(0.013)	(0.000)
Age > 65	0.001***	0.001	0.000
	(0.000)	(0.002)	(0.000)
Metropolitan Area[c]:			
City Center	0.000	-0.001	0.000
	(0.000)	(0.002)	(0.000)
Unknown City Status	0.000	-0.003**	0.000
	(0.000)	(0.001)	(0.000)
Rural Area	0.000	-0.002	0.000
	(0.000)	(0.001)	(0.000)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
[a]Reference category is "Post Graduate Degree".
[b]Reference category is "White".
[c]Reference category is "Outside Central City".

During the last period of our sample, the transition between 2013 and 2017, food security rates can be seen to further improve in the summary Table 16. The substantial improvement on food security during this period is now more prominently attributable to the coefficients of the characteristics in our analysis, while, similar to the previous summary table, one quarter remains attributable to the explainable part of endowments.

Table 16: Changes in Food Insecurity 2013-2017, Oaxaca-Blinder Decomposition Summary

Predicted Food Insecurity, 2013	0.143*** (0.002)
Predicted Food Insecurity, 2017	0.118*** (0.002)
Change (2013-2017)	0.025*** (0.003)
Contribution of Change in Mean Value of Covariates	0.005*** (0.001)
Contribution of Change in Estimated Coefficients	0.019*** (0.003)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

A handful contributing characteristics to the overall increase in food insecurity are shown in Table 17. The educational characteristics of the populations with no high school diploma and high school diploma display favoring contribution in both endowments and coefficients. Proportions of the population with either of these educational attainment decreases further during this time period, as observed previously, while the proportion of college degree holders increases. At the same time, holders of a high school diploma are becoming proportionately pre-disposed of experiencing food insecurity, explaining the increase for coefficient to 0.9 percentage points. A small decline in endowment for marital status remains, while an increasing decline in coefficients is observable. Both married and unmarried populations experienced a substantial reductions of food insecurity during this period, making marriage a persistently protective factor of experiencing food insecurity. While more people reporting food insecurity are Hispanic in 2017 compared to any previous year, food insecurity rates decreased significantly between 2013 and 2017 for this populations group, explaining the small increase in magnitude of coefficient. Smaller proportions of the

population have three or more family members present. Experiences of food insecurity remain higher for larger families, but rates improve sharply between 2013 and 2017, explaining the positive contribution to population food security. Age remains negative in coefficient but less so in comparison to the previous period. Demographic change towards an older population in our sample is observable (Figure 9), while especially the middle aged population between the ages of 36-50 is declining in direct proportion. In addition, more people beyond the age of 51 are reporting food insecurity between 2013 and 2017, despite an overall slight decrease in mean value for experiencing food insecurity. Food security for people living in city centers and rural areas worsened over this period compared to the baseline of people living outside of city centers.

Table 17: Changes in Food Insecurity 2013-2017, Detailed Oaxaca-Blinder Decomposition

	2013-2017		
	Endowments	Coefficients	Interaction
Education[a]:			
No High School Degree	0.003***	0.003**	0.000**
	(0.000)	(0.001)	(0.000)
High School Degree	0.002***	0.009***	0.000**
	(0.000)	(0.003)	(0.000)
Associate's Degree	0.000	0.000	0.000
	(0.000)	(0.001)	(0.000)
Bachelor's Degree	-0.0002**	0.000	0.000
	(0.000)	(0.001)	(0.000)
Race[b]:			
Black	0.000	0.003**	0.000
	(0.000)	(0.002)	(0.000)
Hispanic	-0.0002**	0.004**	-0.0002*
	(0.000)	(0.002)	(0.000)
Other	-0.0002**	-0.001	0.000
	(0.000)	(0.001)	(0.000)
Gender	0.000	-0.001	0.000
	(0.000)	(0.003)	(0.000)

Married	-0.001**	-0.004	0.000
	(0.000)	(0.004)	(0.000)
Family Size	0.0003**	0.017***	0.0002*
	(0.000)	(0.007)	(0.000)
Age	0.000	-0.020	0.000
	(0.000)	(0.014)	(0.000)
Age > 65	0.001***	-0.001	0.000
	(0.000)	(0.002)	(0.000)
Metropolitan Area[c]:			
City Center	-0.0003***	-0.005**	0.0002*
	(0.000)	(0.002)	(0.000)
Unknown City Status	0.0005***	-0.002*	0.000
	(0.000)	(0.001)	(0.000)
Rural Area	0.0006***	-0.003**	-0.0004**
	(0.000)	(0.001)	(0.000)

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

[a]Reference category is "Post Graduate Degree".

[b]Reference category is "White".

[c]Reference category is "Outside Central City".

Final Remarks

Food insecurity is an ongoing problem in the United States and affects more than 14 million households annually. These numbers experienced a substantial upturn following the sharp decline of economic activity in the U.S. during the Great Recession that started in December of 2007 and lasted until June of 2009. Since the Great Depression in the late 1920s, this was the most severe economic downturn that subsequently ensued a global recession in 2009. The U.S. economy was fairly quick to recover, and has been growing ever since, up until the earlier months of 2020. Food security among U.S. households, however, was not. While it would be expected for food security to be negatively affected during the immediate aftermath of a substantial economic recession, it would be expected for these numbers to go back up as the economy starts to recover. Instead, what we observed is a sharp increase of food insecurity during 2005-2009, a plateau in 2009-2013, and only then between 2013 and 2017 food security rates started to improve. Yet, largely still not meeting pre-recession levels. In order to illuminate this situation more we selected a number of demographic characteristics that existing literature suggests are associated with food insecurity occurrences in the U.S. These include a series of educational attainment and racial category variables, along with marital status, family size, and age. Additionally, we included metropolitan specification variables as well as state indicator variables as we expected to see some potentially disparities based on location and access, as well as among states. What our results suggest is that particularly lower levels of educational attainment are strongly associated with increased food insecurity rates between the years of 2005 and 2009. Although a variety of these characteristics suggest increased likelihoods of experiencing food insecurity, they do not account for as much change as not having a high school diploma and having a high school

diploma or equivalent. These initial rises in food insecurity are subsequently due to either increases in population with these characteristics that are predisposing to becoming food insecure or these characteristics are increasingly predisposing populations to becoming food insecure. While the mean values do not change significantly over this period from 2005-2009 for this group, we find that their coefficients are changing instead. In fact, coefficients are changing specifically for the groups with either no high school diploma or high school diploma. In other words, food insecurity rates are sharply increasing during this 2005-2009 period because these educational groups are so strongly and negatively affected. The plateauing of food insecurity during the period of 2009-2013 is largely attributable that neither the population means of their coefficients are changing substantially. Only during the period of 2013-2017 do the coefficients for these lower educational attainment groups start to decline in magnitude along with to a certain extend some of the racial categories. Consequently, we are able to observe food insecurity to decline at last.

The most imminent notion for future work, following this research lies in the exploration of the reasons for these groups of lower educational attainment being affected in such sever magnitude by food insecurity during the period between 2005-2017. The job market and industry, for instance, underwent drastic transformations during and after the recession. Particularly, skilled and unskilled blue collar jobs have been negatively affected by the Great Recession with the U.S. Labor Secretariat finding that the majority of jobs lost in this category and during this period are jobs lost forever. (Sum et al., 2010) The demographic group most severely affected by these changing dynamics in the job market were Black males, and males under the age of 30 years. (Sum et al., 2010) Given these facts, future research may

consider exploring and relating the dimensions of employment trajectories on food security status of U.S. American households over time.

Concerning the utilization and data from the CPS offering many possibilities, but posing a few limitations, as well. Specifically, some questions asked during the collection of particularly food security data may be interpreted differently by people based on educational attainment that may lead to food security being either under- or overreported. Similar for households with children present, parents may be reluctant to admitting not being able to feed their child or children a balanced and healthy diet when interviewed by a federal employee out of fear of exposing themselves to the fact of not being able to properly care for their children and perhaps being reported, and ultimately losing custody of their children. Few changes have been made to the CPS' HFSM since its introduction in 1995, aiding in the consistency of the data. After this relatively long period of time, in which the demographic of the U.S. population experienced a number of substantial changes, including the predominance of urbanization, it may be appropriate to expand on the survey. A growing concern, for instance, is the prevalence of food deserts and how their potential presence may affect people's access to food and subsequently their diet or even food security status. An additional question may be added in an effort to learning about the proximity or reachability to a store with food offerings, with a potential follow-up for specification whether or not the establishment in question is a superstore. Overall, the CPS is a comprehendible and valuable source for data characteristics of persons and households in the United States.

Overall, this research may offer a glimpse on the food insecurity dynamics of households in the United States and how these were affected by the Great Recession over the period of 2005-2017, based on data from the Current Population Survey. While consistently

evolving, the literature concerning food insecurity in the United States remains small and offers many opportunities for further exploration.

Appendix 1 – Detailed Oaxaca-Blinder Decomposition for State Effects, 2005-2009

	2005-2009		
	Endowments	Coefficients	Interaction
Northeast Region:			
Connecticut	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Maine	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Massachusetts	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Rhode Island	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Vermont	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
New York	0.000	-0.001	0.000
	(0.000)	(0.001)	(0.000)
Pennsylvania	0.000	0.000	0.000
	(0.000)	(0.001)	(0.000)
Midwest Region:			
Illinois	0.000	-0.001*	0.000
	(0.000)	(0.001)	(0.000)
Indiana	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Michigan	0.000	0.000	0.000
	(0.000)	(0.001)	(0.000)
Ohio	0.000	0.000	0.000
	(0.000)	(0.001)	(0.000)
Wisconsin	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Iowa	0.000	0.0003*	0.000
	(0.000)	(0.000)	(0.000)
Kansas	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Missouri	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)

Nebraska	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
South Dakota	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
South Region:			
Delaware	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
District of Columbia	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Florida	0.000	-0.004***	0.000
	(0.000)	(0.001)	(0.000)
Georgia	0.000	-0.001	0.000
	(0.000)	(0.001)	(0.000)
Maryland	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
North Carolina	0.000	-0.001**	0.000
	(0.000)	(0.001)	(0.000)
South Carolina	0.000	0.001**	0.000
	(0.000)	(0.000)	(0.000)
West Virginia	0.000	-0.0002*	0.000
	(0.000)	(0.000)	(0.000)
East South Central Division:			
Alabama	0.000	-0.001**	0.000
	(0.000)	(0.000)	(0.000)
Kentucky	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Mississippi	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Tennessee	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Arkansas	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Louisiana	0.000	0.001***	-0.0002*
	(0.000)	(0.000)	(0.0001)
Oklahoma	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Texas	0.000	0.000	0.000

	(0.000)	(0.001)	(0.000)
West Region:			
Arizona	0.000	-0.001*	0.000
	(0.000)	(0.000)	(0.000)
Colorado	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Idaho	0.000	0.0002*	0.000
	(0.000)	(0.000)	(0.000)
Montana	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Nevada	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
New Mexico	0.000	0.0003*	0.000
	(0.000)	(0.000)	(0.000)
Utah	0.000	0.0003*	0.000
	(0.000)	(0.000)	(0.000)
Wyoming	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Alaska	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
California	0.000	-0.003**	0.000
	(0.000)	(0.001)	(0.000)
Hawaii	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Oregon	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Washington	0.000	-0.001**	0.000
	(0.000)	(0.000)	(0.000)

[d]Reference categories are New Hampshire, New Jersey, North Dakota, Minnesota, Virginia

Appendix 2 – Detailed Oaxaca-Blinder Decomposition for State Effects, 2009-2013

	2009-2013		
	Endowments	Coefficients	Interaction
Northeast Region:			
Connecticut	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Maine	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Massachusetts	0.000	0.001*	0.000
	(0.000)	(0.000)	(0.000)
Rhode Island	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Vermont	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
New York	0.000	-0.001*	0.000
	(0.000)	(0.001)	(0.000)
Pennsylvania	0.000	0.000	0.000
	(0.000)	(0.001)	(0.000)
Midwest Region:			
Illinois	0.000	0.001	0.000
	(0.000)	(0.001)	(0.000)
Indiana	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Michigan	0.000	0.000	0.000
	(0.000)	(0.001)	(0.000)
Ohio	0.000	0.000	0.000
	(0.000)	(0.001)	(0.000)
Wisconsin	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Iowa	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Kansas	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Missouri	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Nebraska	0.000	0.000	0.000

	(0.000)	(0.000)	(0.000)
South Dakota	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
South Region:			
Delaware	0.000	-0.0001*	0.000
	(0.000)	(0.000)	(0.000)
District of Columbia	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Florida	0.000	0.002**	0.000
	(0.000)	(0.001)	(0.000)
Georgia	0.000	0.000	0.000
	(0.000)	(0.001)	(0.000)
Maryland	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
North Carolina	0.000	0.000	0.000
	(0.000)	(0.001)	(0.000)
South Carolina	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
West Virginia	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
East South Central Division:			
Alabama	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Kentucky	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Mississippi	0.000	-0.001**	0.000
	(0.000)	(0.000)	(0.000)
Tennessee	0.000	-0.001	0.000
	(0.000)	(0.000)	(0.000)
Arkansas	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Louisiana	0.000	-0.001**	0.000
	(0.000)	(0.000)	(0.000)
Oklahoma	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Texas	0.000	0.000	0.000
	(0.000)	(0.001)	(0.000)

West Region:			
Arizona	0.000	0.001	0.000
	(0.000)	(0.001)	(0.000)
Colorado	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Idaho	0.000	-0.0003**	0.000
	(0.000)	(0.000)	(0.000)
Montana	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Nevada	0.000	-0.0004**	0.000
	(0.000)	(0.000)	(0.000)
New Mexico	0.000	0.0004**	0.000
	(0.000)	(0.000)	(0.000)
Utah	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Wyoming	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Alaska	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
California	0.000	0.002	0.000
	(0.000)	(0.001)	(0.000)
Hawaii	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Oregon	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Washington	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)

[d]Reference categories are New Hampshire, New Jersey, North Dakota, Minnesota, Virginia

Appendix 3 – Detailed Oaxaca-Blinder Decomposition for State Effects, 2013-2017

	2013-2017		
	Endowments	Coefficients	Interaction
Northeast Region:			
Connecticut	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Maine	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Massachusetts	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Rhode Island	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Vermont	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
New York	0.000	0.002*	0.000
	(0.000)	(0.001)	(0.000)
Pennsylvania	0.000	0.000	0.000
	(0.000)	(0.001)	(0.000)
Midwest Region:			
Illinois	0.000	-0.001	0.000
	(0.000)	(0.001)	(0.000)
Indiana	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Michigan	0.000	0.001	0.000
	(0.000)	(0.001)	(0.000)
Ohio	0.000	0.000	0.000
	(0.000)	(0.001)	(0.000)
Wisconsin	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Iowa	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Kansas	0.000	0.0004*	0.000
	(0.000)	(0.000)	(0.000)
Missouri	0.000	0.001**	0.000
	(0.000)	(0.000)	(0.000)
Nebraska	0.000	0.000	0.000

	(0.000)	(0.000)	(0.000)
South Dakota	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
South Region:			
Delaware	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
District of Columbia	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Florida	0.000	-0.001	0.000
	(0.000)	(0.001)	(0.000)
Georgia	0.000	0.001	0.000
	(0.000)	(0.001)	(0.000)
Maryland	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
North Carolina	0.000	0.000	0.000
	(0.000)	(0.001)	(0.000)
South Carolina	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
West Virginia	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
East South Central Division:			
Alabama	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Kentucky	0.000	0.001**	0.000
	(0.000)	(0.000)	(0.000)
Mississippi	0.000	0.001**	0.000
	(0.000)	(0.000)	(0.000)
Tennessee	0.000	0.001**	0.000
	(0.000)	(0.000)	(0.000)
Arkansas	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Louisiana	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Oklahoma	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Texas	0.000	0.001	0.000
	(0.000)	(0.001)	(0.000)

West Region:			
Arizona	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Colorado	0.000	0.001*	0.000
	(0.000)	(0.000)	(0.000)
Idaho	0.000	0.0003**	0.000
	(0.000)	(0.0001)	(0.000)
Montana	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Nevada	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
New Mexico	0.000	-0.0005***	0.000
	(0.000)	(0.0002)	(0.000)
Utah	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Wyoming	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Alaska	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
California	0.000	0.001	0.000
	(0.000)	(0.001)	(0.000)
Hawaii	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Oregon	0.000	0.001*	0.000
	(0.000)	(0.000)	(0.000)
Washington	0.000	0.001	0.000
	(0.000)	(0.000)	(0.000)

[d]Reference categories are New Hampshire, New Jersey, North Dakota, Minnesota, Virginia

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