BROKE AT THE BUFFET: FOOD INSECURITY IN AMERICA

by

CHARLES WILLIAM HAWLEY

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Spencer D. Wood

Abstract

It is the intention of this thesis to come to a better understanding of the factors that lead to food insecurity, a concept for understanding if people have enough food to eat. The tool for household measurement was developed by the United States Department of Agriculture, and is the backbone of the Food Security Supplement, which is conducted annually as part of the Current Population Survey. Three literature are reviewed: concentration of markets, civic agriculture and localism, and food security and nutrition. Each approaches understanding food security from a different angle offering insights along with its shortcomings. Most US studies consider food insecurity as a contributing component of poor health. In this study, I ask instead, "What are the major predictors of household food insecurity?" Using data from the Food Security Supplement of the Current Population Survey from 2000 to 2007, I use descriptive statistics and logistic regression to investigate the causes of food insecurity. I show that as currently measured food insecurity is largely a function of economic inequalities. Within this broad finding, however, I also show that households in a principal city and nonmetropolitan counties are not more likely than other households to experience food insecurity even when controlling for economic and sociodemographic variables.

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Dedication

My work is dedicated to:

Aunt Mary and Uncle Jay,

You are the source of strength and stability that allowed me to find my way. I am eternally grateful for all of your guidance and love.

Elizabeth,

In our most difficult times, you were the reason I kept going.

Laura Jane,

For letting me be the string to the most beautiful balloon.

CHAPTER 1 - Introduction and Literature Review

The food industry is in fact the largest American industrial sector, even though it doesn't produce food security, as 30 million Americans do not get enough to eat."
-- Philip McMichael, "Global Food Politics"

Food security means getting enough food to reproduce a healthy and active lifestyle (Bickel et al. 2000). This is an important issue in the United States; one that is of growing interest to the U.S. Department of Agriculture (USDA), other governmental programs (such as the Peace Corps), international development agencies, and non-governmental organizations. In 2007, 11 percent of American households reported having experienced food insecurity in the previous twelve months. The rate of food insecurity was higher than the national average for black households (22.2 percent), Hispanic households (20.1 percent), and many other groups that often disproportionately experience inequality (Nord, 2008). Food security is an issue of social justice and inequality. A national rate of 11 percent household food insecurity in the United States means there are people in the richest nation in the world who go hungry.

How do attributes of inequality and spatial location affect household food security? This research intends to answer this question by conducting statistical analysis using the Food Security Supplement (FSS) to the Current Population Survey (CPS). The USDA method for conceptualization and measurement is incorporated into the FSS in conjunction with the Economic Research Service and Census Bureau. The tool has been in use since 1995 and has undergone evaluation of its effectiveness (Bickel et al. 2000).

Food insecurity is an issue of inequality. Inequality is reflected in both the production of food as well as the consumption. There is significant interest in alternative food production, marketing, and consumption that hopes to challenge some of the negative consequences of

concentration in agricultural production. Few of these alternatives have seriously, and directly, taken-on the issue of food insecurity in the United States. In this thesis I use the literature review to link the current system of production and food insecurity with research on the effects that food insecurity has on individuals' health and lives.

Past research that analyzes food security across the duration of the dataset has used descriptive statistical methods (Bickel et al. 1999; Nord, 2002; Nord et al. 2003; Nord et al. 2004; Nord et al. 2005; Nord et al. 2006; Nord et al. 2007; Nord et al. 2008). Little work has been done to statistically analyze the effect of household characteristics on food security. There is research using regression analysis to understand food security, but on an individual level for the sake of understanding the effect of social networks on food security (Morton et al. 2005). There are also a number of articles produced by nutritionists that use logistic regression to show the effect of food insecurity on different aspects of personal health. Understanding how social attributes combine to affect food security is important because it provides a real world application of a measurement tool that can help improve people's lives. The original contribution of this research is the inclusion of a geographic dimension in conjunction with the economic and sociodemographic elements of inequality, and how they affect the likelihood of a household being food insecure.

This paper begins with a literature review. The literature explores several dimensions of agriculture and food beginning with global food production and the localist response. Within this discussion of global and local agriculture there is a focus on food production and food retail. Inequality in food production and retail is used to show how a plentiful system leaves some hungry. Hunger is the most extreme form of food insecurity, which is explained both conceptually and in relation to individual health. Some of the food security is also discussed in

Chapter 2 as it informs my methodological approach. Economic Research Service (ERS) briefings on food security are used to develop the hypotheses as well as explain the dataset. The explanation of the dataset and the research questions inform the methods used to conduct this research.

Chapter 3 states all of the findings of this project. The bulk of the tables used to report findings are located within this chapter, and the information is interpreted. Chapter 4 goes a step further in the interpretation of the findings to try and explain the importance. Particularly, the analysis chapter focuses on explaining the difference between partial regression equations based on a certain dimension of household characteristics, and the full equation.

Finally, Chapter 5 focuses on discussing the importance of the findings from this project. This chapter includes a statement on potential future research into food security. There is also a recommendation for policy that incorporates the teachings of civic agriculture with that of nutritionists' view on food assistance programs.

Literature Review

Three literatures inform and situate this study: concentration of global markets, localism and civic agriculture as a response to corporate-owned food production, and the literature on food security and nutrition. Analysis of the world food system allows us to see how inequality in food access can be created on an international level through large-scale agricultural practices and corporate controlled markets. The concentration of agri-business has been guided by liberalized trade agreements in recent years (McMichael, 1993; McMichael, 2000). Liberalization stresses the importance of free trade on a global scale, but the consequence is often unequal distribution. Food is no exception, and the effects of free trade economics shape the entire world's farms, grocery stores, and dinner tables. There are two main responses to large-scale concentration in

agricultural production discussed in this literature review: localism and civic agriculture. The latter half of this literature review will focus on how we measure food insecurity and some of the consequences of food insecurity for people's health. Initially food security was conceptually developed as a tool for understanding developing countries through geographic distribution and understanding production. More recently the household has been considered as a unit of analysis for self-reported food security (Maxwell and Smith, 1992). Self-reported food security has been of great interest to nutritionists, because poor access to food – food insecurity – has also been shown to have a number of effects on people's individual health. My analysis of the literature is mostly limited to the United States, but these issues could be explored in different locations and on a global scale.

Concentration of Markets

Heffernan (2000) argues that large corporations utilize three methods of business organization that allow them to gain control: horizontal integration, cross-subsidization, and vertical integration. Horizontal integration is when companies place similar operations within the same stage of the food system. For example, Cargill may own broiler-processing facilities in the U.S. as well as Mexico, Japan, and other places. Cross-subsidization takes place when a company has interest, and dominance, in several different types of commodity product. This gives economic power because a large company can subsidize losses in one area with profits in another. Cross-subsidization is not unique to agribusiness. There are many global companies like GE and Phillip Morris that have bought interests in businesses ventures that were not typically thought of as their business-type. For example, Phillip Morris was traditionally a tobacco company, but purchased an interest in Kraft foods. The next type of business organization is vertical integration, which is when a firm attempts to control several different stages of

commodity production (Heffernan, 2000; Lewontin, 2000). Vertical integration gives economic power to the corporation because is allows the control of both the inputs and the outputs of the agriculture process. If a single firm owns the seed the farmers grow, the fertilizer and pesticides used on the crops, and the grain elevators to which the farmers sell, then the farmer does not have many options other than doing business with this firm.

These types of integration often take place within a nation-state as well as across nations. The role and power of transnational corporations (TNC) in the food production process has also increased with the size of farms (Heffernan and Constance, 1994). According to McMichael (2000), the World Trade Organization (WTO) and the West are monopolizing global food trade through liberalized markets that often are enforced in obligated peripheral nations, while the core countries subsidize farms. Production based subsidies encourage overproduction in the United States with resulting surpluses then used for food aid in other countries. This leads to an increased taste for Western food and lower prices of local farmers' goods (Friedmann, 1982; McMichael, 2000). Although Western countries sometimes play by their own rules, the goal of liberalization is the integration of the world-economy. This integration is performed with multi-lateral agreements enforced by global organizations (e.g. GATT, the WTO, IMF). These organizations help establish and enforce binding multinational agreements that tend to benefit transnational corporations at the expense of sovereign national governments. This sets the framework for a nation-state with limited-power to challenge TNCs or multinational trade organizations. According to McMichael, the North gets richer and the rural communities dissolve as a result. Moreover, as farms grow increasingly large, food security is compromised (McMichael, 2000).

Concentration in food production has paralleled concentration in food retail (Kaufman, 2000; Blanchard and Lyson, 2002; Pollack Associates, 2002; Lyson, 2004; Morton et al. 2005; Patel, 2008). Wal-Mart has led the charge of supermarket proliferation and retail concentration. Over 70 percent of Wal-Mart's supercenters are located in rural areas (Blanchard and Lyson, 2002). In rural areas travel expenses for people often outweigh the benefits of going to these supercenters. However, after corporate-owned supermarkets move in, options decrease as the costs to local business increase and smaller retailers are forced to close. Stone (1997) states as "mass merchandisers" operate in an area for an extended period of time people gravitate towards them and away from local retailers, causing a loss in local retail revenues. According to Leland (1987), the reason for this gravitation away from local food retailers is the limited selection that small retailers have to offer, and the higher price that usually comes with the limited selection. Supermarkets help to reveal a discrepancy in what we know about food security. Less cost to the consumer should increase food security as long as it is understood in terms of economics. However, Blanchard and Lyson (2002) argue that supermarket proliferation leads to food desertification. A food desert is an area where there is limited access to food – for Blanchard and Lyson (2002) it is based on the distance from a supermarket (Morton and Blanchard 2007). If food retail concentration by supermarkets leads to food desertification, then it is possible that it also leads to food insecurity for those who cannot make the trip to the supermarket.

Civic Agriculture and Localism

As concentration occurs, farmers lose options for market outlets and consumers lose choices at the grocery store. Localism is an effort to address both of these groups of people. As concentration in production and retail has grown so too have localist options (Kloppenburg et al. 1996). Lyson describes the broader array of these responses as organizational manifestations of

"civic agriculture" (2004). Civic agriculture is a set of responses to large-scale agriculture that promotes the economic and social development of a community-based on a sense of civicness. Building on the work of Robert Putnam and others, Lyson argues that civic agriculture utilizes voluntary, face-to-face organizations to build trust and community cohesion. In this way civic agriculture stands as a "habit of the heart," binding community members together in a mutual quest for improved health, enhanced choice, and improved wellbeing.

A binary of globalism v. localism is often created when activists discuss responses to the global food market. Many researchers have exposed the danger of assuming that localism is a better or even necessarily a "good" response to globalism (McMichael, 1996; Allen, 1999; Hinrichs, 2003; Winter 2003). It is often imagined that because networks of face-to-face interaction lead to trust being invoked, local foods are grown using more eco-friendly and sustainable agriculture; but this is not always the case. Having closer relations between farmer and consumer may lead the farmers to be more conscious of their practices because of easy surveillance or increased accountability, but it should not be assumed (Hinrichs, 2003). Hinrichs (2003) discusses how "local" is a difficult concept that is spatially indistinct from place-to-place. She also states that defensive localism often assumes homogeneity at the exclusion of a perceived outsider, and does little to encourage diversity or address issues of inequality. However, while not all local food is sustainable, not all localism is defensive; some is progressive. For example, Will Allen has won a MacArthur Genius Award for his work incorporating communities of color and for his work on sustainable urban agriculture (Royte, 2009). Hinrichs (2003) states that localizing food systems does not necessarily create enormous progressive societal change, but that they do represent moderate changes in a positive direction. This understanding of localism is important because it shows that local food systems have the

potential to be engines for social change, but only if one persistently asks questions about the relations of production and social justice rather than assuming them. Several types of local food systems with the potential for change are discussed below.

Community Supported Agriculture

Community supported agriculture (CSA) programs are a specific example of localist response to food insecurity. In this type of arrangement, a community or group of individuals forms a relationship with a farm or small group of farms. The people help take some of the risk of farming off of the shoulders of the farmers themselves. By committing resources, they become shareholders in the farm and split the benefits as well as the risk (Henderson, 2000; Lyson, 2004). Though this may sound like any other small business, and at its core it is, the role of the producer is entwined with face-to-face interaction with the consumers. This is different than farmers who sell to a middleman who then sells a product to consumers. In this case, the farmers are often the coordinators of the CSA, and again, their risk is greatly diminished by cooperation with the community of which their consumers are a part.

Community Gardens

Another form of "civic agriculture" is community gardening. People in a community collectively decide to use a piece of available land to grow produce. This is not a new concept. During World War I and WWII people grew "Liberty Gardens" and "Victory Gardens" to supplement food rations (Lyson, 2004; Patel, 2008). These gardens were often backyard gardens and not community gardens, but both existed. People often grow community gardens for the sake of consumption. In some situations these gardens may limit food insecurity by supplementing

fruits and vegetables in people's diets. Interestingly, community gardens are often in unexpected places such as urban centers. Community gardens in cities are also a case of urban agriculture.

Urban Agriculture

Some strands of urban agriculture stand as examples of civic agriculture with a focus on inequality. Urban agriculture typically strives to provide marginalized people with better access to produce. Many of the fruits and vegetables grown in urban agriculture are often sold at a farmers' market. Farmers' markets and roadside stands are a way for farmers to develop a niche market within a community. The farmers can then cater to people's tastes. Their target market tends to be people with a certain set of tastes or people who enjoy freshness, organics, or sustainability. Most importantly, farmers' markets build trust through face-to face interactions. This form of sale of the agricultural products helps communities keep money within the community, so that it can be recycled and continue to support local families, jobs, and businesses (Lyson, 2004). Farmer's markets are a wonderful way for people to buy fresh produce and serve as an example of the two different ways that civic agriculture may help to limit food insecurity: (1) by providing the producers with a source of income, and (2) by providing consumers with food for their table. The producers may also be consumers.

Lyson does a great service in his work by reintroducing a commitment to social justice. While these food programs are not necessarily intended to help marginalized people gain better access to food, Lyson reminds us that they can be. It was the Walter Goldschmidt's (1978) *As You Sow* report that found that the people working under corporate controlled farming actually had a lower standard of living. C. Wright Mills and Melville Ulmer also wrote a report (*Small Business and Civic Welfare*) at the behest of the U.S. Senate and found that "small-business communities provided their residents with a considerably more balanced economic life than did

the big-business communities . . . [and] the general level of economic opportunity was considerably higher in the small-business communities" (Lyson, 2004:65). More broadly, most localist responses are not explicitly concerned with inequality; rather they are designed to provide an alternative to corporate controlled supermarkets and presumably fresher and healthier produce. Michael Pollan (2008) is a well-known example of the view that civic agriculture promotes nutritional diversity, tasty foods, and an improved environment (Guthman, 2007). Concerning inequality, Guthman critiques Pollan saying he "is too willing to couple ethical judgment with biophysical taste (big organic = bad; little organic = good)" (Guthman, 2007:262). Guthman's point is that it is too simplistic to say that organic food is "good" because it tastes good and is grown locally on small farms.

Concern with hunger is one area of research that has explicit connections with inequality. As part of the anti-hunger movement, food pantries and soup kitchens have increased (Poppendieck, 2000). These are examples of the institutions that are increasingly utilized in a deregulated world with less social welfare for people. Church groups often organize these food pantries and other forms of community outreach (Molnar et al. 2001). As Poppendieck argues, "The issue is not whether people have enough to survive, but how far they are from the median and the mainstream, and that is a matter of how unequal our society has become" (Poppendieck, 2000:200). However, many activists feel that the discussion of hunger has caused the political left to lose sight of the battle against inequality. Nonetheless, these types of organizations exist to help people who are food insecure.

Food Security: Defining a Concept

Unlike the local food literature, the food security literature focuses more explicitly on inequality, however from a largely individualistic perspective. A decades-long discussion about the conceptualization and measurement of food security led to the current USDA definition and Current Population Survey (CPS) measurement tool that focuses on household food security. The USDA definition of food security is adopted from the expert working group of the American Institute of Nutrition that was published in 1990 by the Life Science Research Office (LSRO) (Anderson, 1990; Bickel et al. 2000; Wunderlich et al. 2006; Nord et al. 2008).

Food security means that a household has "access by all members at all times to enough food for an active, healthy life." The USDA definition goes on to say that food security "includes at a minimum (1) the ready availability of nutritionally adequate and safe foods, and (2) an assured ability to acquire acceptable foods in socially acceptable ways" (Nord, 2002). Socially acceptable ways means that the household did not have to resort to different forms of social welfare or theft. Another definition from the Community Food Security Coalition is taken from Hamm and Bellows (2003). They say that community food security is "a condition in which all community residents obtain a safe, culturally acceptable, nutritionally adequate diet through a sustainable food system that maximizes community self-reliance and social justice" (Hamm and Bellows, 2003). There are differences between the two definitions. There is no mention of sustainability or social justice in the USDA definition. The main focus for the USDA definition is that households get the food no matter the food systems or their implications for social justice. The USDA definition of food security emphasizes access and availability. The community food security definition is also interested in the production of food and its embeddedness in a

community. We can see the commonality between definitions in having socially/culturally acceptable access to nutritious food. This project relies on the USDA definition because the dataset being used was designed to measure food security according to that definition.

The LSRO also defines several concepts that are used by the USDA. Food insecurity and hunger are the two important concepts for the sake of this project. Food insecurity is defined as having "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways" (Bickel et al. 2000:6). The definition of hunger is important because it draws criticism that will be discussed in greater detail in the methods chapter. Hunger is "the uneasy or painful sensation caused by a lack of food. The recurrent and involuntary lack of access to food. Hunger may produce malnutrition over time . . . [Hunger] is a *potential, although not necessary, consequence of food insecurity*" (emphasis added. Bickel et al. 2000).

Maxwell and Smith (1992) provide an overview of the household food security concept. The definition listed above is one that is similar to the World Bank (1986) definition of "having enough for an active, healthy life." The concept of food security was originally used at an individual level and took into account caloric intake. This information was used to understand specific geographic areas – particularly developing nations (Reutlinger and Selowsky, 1976). In another article by Maxwell (1996) he discusses how the current self-reporting method of analyzing food security is a product of changes during the 1990s. Measuring food security at the household-level is another change that came during the 1990s. The assumption of this level of measurement is that people in households pool resources, and thus, experience similar outcomes if resources are strained (Maxwell and Smith, 1992).

The Food Security Supplement to the Current Population Survey is a product of all of this discussion on how to conceptualize and measure food security. The FSS is conducted annually and used to produce USDA briefs on food security (Bickel et al. 1999; Nord, 2002; Nord et al. 2003; Nord et al. 2004; Nord et al. 2005; Nord et al. 2006; Nord et al. 2007; Nord et al. 2008). These largely consist of descriptive statistics; however, other researchers have used the dataset to produce their own analyses of the effect of spatial location and social networks on food security (Nord, 2001; Bartfield et al. 2006; Morton et al. 2005). These reports will be discussed in further detail in the methodology section as they inform the hypotheses, the data, and the methods to be used.

Nutrition

The focus on family-level food insufficiency has encouraged research on the health effects of food security (Alaimo et al. 2001; Townsend et al. 2001). A subset of the food security literature concerns nutrition. This literature explores the effect of food insecurity on many facets of individual health. This is an important contribution to the food security discussion because most nutritionists are using a measurement of food insecurity as an independent variable in conjunction with conditioning variables to measure the effect on some aspect of health. Sociologists, and other social scientists, tend to focus on food insecurity as a dependent variable. That is to say, they ask questions about what causes food insecurity. Both are important keys to fully understanding what causes food insecurity. This understanding of potential causes will allow us to formulate solutions, which in turn have a positive effect on the aspects of health with which food insecurity has been associated.

The nutrition literature asks how food insecurity adversely affects people's health while taking into account some of the characteristics of inequality that will be used in the present

analysis. In some of the broader research, Vozoris and Tarasuk (2003) used Canada's National Public Health Survey to examine food insufficiency and found that the individuals in "food insufficient" households were significantly more likely to report self-rated poor health, poor functional health, restricted activity, multiple chronic conditions, major depression, distress, poor social support, heart disease, diabetes, allergies, and blood pressure.

More specifically, there has been a debate about the effect of food insecurity on overweight and the risk of overweight in women and children. Townsend et al. (2001) and Adams et al. (2003) found significant positive correlation between food insecurity and obesity in women. While previous research focused on women, Rose and Bodor (2006) used the Early Childhood Longitudinal Study and found no correlation between food insecurity and increased weight in children. Casey et al. (2006) used a different measurement of child food security, which is more severe than the typical household food security measurement. They found that childhood food insecurity was associated with being at risk of overweight in children even when controlling for poverty level, age, race and gender. Most recently, Gundersen et al. (2009) used multiple measures of obesity (BMI, waist circumference, triceps skin fold thickness, trunk fat mass, and body fat) and found that none of them were significantly associated with food insecurity. As we can see, there is no general consensus. The effect on obesity varies based on certain sociodemographic variables and their intersection with food insecurity. There is not a general agreement about obesity specifically, but nutritionists have looked beyond this specific health issue to try to understand how food insecurity affects other aspects of health.

Research on the effect of food insecurity is not limited to issues of obesity. Alaimo et al. (2001) report that children and teenagers from food insufficient households were more likely to have poorer academic reports and psychosocial behaviors. Longitudinal analysis has also been

done to show that food insecurity is correlated with the academic performance and social skill development of both boys and girls (Jyoti et al. 2005). Most of the results from Jyoti et al. were consistent with previous cross-sectional studies. Negative effects were found in girls' reading performance and social skills. However, boys who became, or remained, food insecure across data collection points were found to have better social skills. This relationship has never been tested in cross-sectional research. Most recently, literature has turned to trying to understand food security relationship to mothers' feeding practices and teenage eating behaviors (Feinberg et al. 2008; Widome et al. 2009).

An area of agreement among the nutrition literature is that food assistance programs help to mitigate some of the negative ramifications of food insecurity. Frongillo (2003) argues that an investigation into the effect of food stamp participation is incomplete unless it takes into account the food security status of the families being studied. Jones et al. (2003) find that participation in food assistance programs helps mediate the effect of being food insecure on the likelihood of children being at risk for overweight in girls but not boys. Food insecure households participating in food assistance are less likely to have at risk of overweight children than are those who do not participate in this program. In more recent research, Kim and Frongillo (2007) used longitudinal data to study the relationship between food insecurity and BMI/depression among elderly people. When food insecure elders participated in food assistance programs food security did not lead to increases in weight or depression.

There are several proposed causal mechanisms for the negative effect that food insecurity has on people's health. These range from purely diet-related to socially constructed. It has been proposed that people who are food insecure may eat less vegetables and other healthy foods and more energy-dense foods, which could potentially lead to negative health impacts (Jyoti et al.

2005; Rose and Bodor, 2006; Casey et al. 2006). Also, there could be some correlation between stress and cortisol-levels or eating habits (Jyoti et al. 2005; Gundersen et al. 2008). Food insecurity could lead to overweight if people overcompensate when food is available (Fisher and Birch, 1999; Wilde and Ranney, 2000; Rose and Bodor, 2006; Casey et al, 2006). Weight cycling may occur where people's bodies become more efficient at using dietary energy (Wing, 1992; Rose and Bodor, 2006; Casey et al. 2006). Lastly, and most related to a sociological study, energy-dense foods are often less expensive, so when food insecure households resort to low-cost food they may also increase their energy intake (Rose and Bodor, 2006).

Conclusions to Literature Review

The literature reviewed helps triangulate on the causes and effects of food insecurity. Food insecurity is largely a product of unequal distribution on a global, community and individual level. At the global level the far reach of transnational corporations and multinational trade organizations affects food security. The presence of supermarkets, the response of civic agriculture and food assistance programs affects community food security. The individual feels food insecure largely because of the economic situation, but we can see now that the effect of the larger forces in food production and distribution may also have an affect on the household.

The concentration of markets occurred in two important parts of the food system: production and retail. The concentration of agriculture has given transnational corporations and multinational trade organizations significant power over nations. This power has been used to further increase the size of the average farm for the sake of industrial efficiency. Goldschmidt (1978) argued that people working under corporate controlled farming have a lower standard of living. McMichael (2000) gives an example when he argues that increasing farm size leads to a compromise in food security.

Retail concentration through supermarkets has a similar effect on small grocers. The smaller stores have a hard time competing with price and selection due to their inability to purchase in high volume, and this can cause them to go out of business. The elimination of food retailers is seen as a cause of food deserts, which are areas of potential food insecurity. The absence of local business may also cause food insecurity by creating economic hardship for some. Mills and Ulmer stated that small business communities created a more balanced economic life (Lyson, 2004). Given that household food security is largely related to economics, this could lead to food insecurity.

Responses to a food system dominated by corporations exist for both production and consumption of food. Localist responses have a tendency to overlook food insecurity in an attempt to protect against a perceived outsider. Civic agriculture, though not exclusively localist, is a response that Lyson (2004) believes can be used to address issues of inequality. They do not inherently address inequality. However, through a process of face-to-face interactions they create a sense of civicness that has the potential to create a more progressive food system that addresses explicit issues of food inequality.

In an attempt to address issues of hunger and inequality, there have been discussions about how to conceptualize and measure food security that have led to the creation of the food security supplement to the CPS. Nutritionists who are trying to understand the effect of food insecurity on aspects of people's health have adopted the self-reported measure of food security. The ramifications on personal health vary based on race, gender, age, and class. Suffice it to say that food insecurity has been correlated with social development and behavioral disorders, obesity, and other aspects of poor health. The benefit of food assistance programs (FAPs) as a policy recommendation is a point of agreement for most nutritionists studying food security.

Food stamps and other FAPs help to mitigate the negative ramifications of food insecurity on personal health.

Nutritionists and other food security researchers have incorporated measures of inequality into their models. One thing that they have not done is to try and understand the role space or place has on affecting food security. Only Nord (2001) incorporated rural and urban or region into his analysis of food security, and he found a high prevalence of food insecurity for households in the South – particularly the rural South. However, he did not control for race or income, which could be the underlying relationship. We know that different communities have different access to food based on spatial facts like distance from grocery stores. So, how does a household's location affect the likelihood of that household being food insecure? In depth spatial analysis is not a method used in this thesis, but geographic variables are part of the logistic regression analysis used to understand whether households in different types of locations are more or less likely to be food insecure.

CHAPTER 2 - Methodology

Questions and Hypotheses

The following are the research questions this project intends to explore: *How do characteristics of inequality affect household food insecurity? How does being located in a certain region of the country affect household food insecurity? And, how is household food insecurity geographically distributed throughout the United States?*

Past research suggests that above average proportions of certain characteristics of state populations' tend to be correlated with higher food insecurity rates (Bartfeld et al. 2006). These characteristics include the following: low income; low education; black, Hispanic, and Native American household heads; renters; living in the central city of a metropolitan area; having three or more children; being a single mother; having no adult in the household employed; having no elderly in household; having a disabled household member; noncitizen household head. *Household Food Security in the United States, 2007* suggests that the variables I have selected have a positive correlation with household food insecurity. It is no surprise that income is negatively correlated with food security given that the measure is developed around the concept of food insecurity caused by financial restraint. The 18-item core module to the FSS heavily emphasizes the importance of being able to afford food (see Appendix A for a complete list of the questions). Age is also negatively correlated with food security (Morton et al. 2005). An age variable is not included in this study because it is an individual-level characteristic.

H_1: Households with an income less than 185% of the poverty line are more likely to be food insecure than are households with an income is above 185% of the poverty line.

H_2: Black headed households are more likely to be food insecure than are white households.

H_3: Hispanic headed households are more likely to be food insecure than are non-Hispanic households.

H_4: Native American headed households are more likely to be food insecure than are white households.

H_5: A household head with high school diploma or less is more likely to be food insecure than a household with a head that has at least some college.

H_6: If a home is not owned or is rented, the household is more likely to be food insecure than if the home is owned.

H_7: A household located in a nonmetropolitan county is more likely to be food insecure than a household not located in a nonmetro county.

H_8: A household that has three or more children is more likely to be food insecure than a household with less than three children.

H_9: A household with an unemployed adult is more likely to be food insecure than a household with zero unemployed adults.

H_{10}: A household with an adult not in the labor force is more likely to be food insecure than a household with zero adults not in the labor force.

Bartfield et al. (2006) and Morton et al. (2005) used smaller state-level populations to develop the models; therefore, it might not be appropriate to generalize those results to national populations. Morton, Bitto, and Oakland's (2005) research did not include race in their model. Also, their research was done on the individual level so that they could analyze the effect of "social connections." The household-level data is theoretically more fitting, because an entire household experiences food insecurity. Additionally, if food security is based on financial constraints, and income is typically measured at a household-level, then it only seems appropriate to measure food security at the household-level. None of these models explained

how much more likely households with the listed characteristics were to experience food insecurity. The models produced by Morton et al. (2005) used OLS regression, so they did not compute odds-ratios. Most of the statistics using this data are descriptive statistics. The annual *Household Food Security* briefings are almost exclusive descriptive statistics. I use logistic regression analysis to analyze the odds ratios.

Table 1. Positive Correlation to Food Insecurity by Reference

	Bartfield et al.	Morton et al.	USDA report, 2007
Low income - income less than poverty line, but also just above (185%)	X	X	X
Low education – particularly, high school or less	X		
Black, Hispanic, and Native American household heads	X		X
Renting their home	X		
Living in the principal city of a metro area	X		X
Three or more children	X		
Single mother with children	X		X
No adult in the household employed	X		
No elderly in household	X		
Disabled household member	X		
Noncitizen household head	X		
Perception of high civic structure		X	
Living in a nonmetropolitan area			X
Women living alone			X
Men living alone			X

X = positive correlation with food insecurity reported by author

The second question focuses on understanding the relationship between region and food insecurity. Nord's (2001) previous research describes how the South has a higher prevalence of food insecurity than any other region. He also found that the prevalence of household food insecurity in the rural South was greater than in the urban South. Based on this research, I expect

to find a higher prevalence of food insecurity in the South than in the Northeast, Midwest, or West regions, and for that relationship to be positively associated with food insecurity.

H_{11}: A household located in a principal city is more likely to be food insecure than is a household not in a principal city.

H_{12}: A household located in the South region is more likely to be food insecure than a household not located in the South region.

H_{13}: A household located in the West region is equally likely to be food insecure as a household not located in the West region.

H_{14}: A household located in the Midwest region is equally likely to be food insecure as a household not located in the Midwest region.

Households are labeled metropolitan or nonmetropolitan using the FIPS county codes and their corresponding definitions based on the ERS 2003 rural-urban continuum codes. The definition changed in 2003. The Office of Management and Budget lumped more counties into the metropolitan categories per their relative closeness to metropolitan areas. The 2003 rural-urban continuum divided counties into a nine-part codification based on county population and whether or not the county is adjacent to a metropolitan area.

Table 2. 2003 Rural-Urban Continuum Codes[1]

Code	Description
Metro counties:	
1	Counties in metro areas of 1 million population or more
2	Counties in metro areas of 250,000 to 1 million population
3	Counties in metro areas of fewer than 250,000 population
Nonmetro counties:	
4	Urban population of 20,000 or more, adjacent to a metro area
5	Urban population of 20,000 or more, not adjacent to a metro area
6	Urban population of 2,500 to 19,999, adjacent to a metro area
7	Urban population of 2,500 to 19,999, not adjacent to a metro area
8	Completely rural or less than 2,500 urban population, adjacent to a metro area
9	Completely rural or less than 2,500 urban population, not adjacent to a metro area

[1] Economic Research Service website (Parker, 2004).

For a county to be classified as "adjacent" it must abut a metropolitan county, and at least two percent of the workforce has to commute to the metro county for work (Parker, 2004). This type of coding originated in 1975 by Brown, Hines, and Zimmer and has been adapted and used

to analyze every census since. Binary variables will be created principal city and nonmetropolitan. In this case, the "balance" cities within a metropolitan area will be the reference category. These are all of the areas within metropolitan counties that are not considered principal cities. In creating these variables the nonmetropolitan will be as close to "rural" as we will be able to understand. This is because the dataset lacks FIPS county codes for the vast majority of cases making further breakdown of nonmetropolitan unfeasible.

The Office of Management and Budget is also responsible for defining principal city. A principal city is either the largest city in a metropolitan statistical area (MSA), or another very large city in that area (Nord, 2008). These cities are not the same as inner cities or urban cores. However, there is a higher rate of food insecurity in these places (Nord, 2008; see also, Table 3).

Data

This research project intends to study the effect of characteristics of inequality on food insecurity by using the monthly conducted Current Population Survey (CPS). Part of this survey is the annually conducted Food Security Supplement (FSS). The National Nutrition Monitoring and Related Research Act of 1990 asserts the need to assess the nutritional state of Americans. At the time the tools did not exist to measure food security so the Food Security Measurement Project was formed in 1992 to develop the needed measures. The measurement tool consists of an 18-item core module (Appendix A) that allows for the creation of a food security scale. This measure has been tested and the stability and robustness have been established across years and major population subgroups (Bickel et al. 2000:5).

The FSS has been annually conducted as part of the CPS since 1995 and consists of more than just the core-module. The FSS contains information on four different areas related to food security: household food expenditures; participation in public food assistance programs; coping

behaviors to augment food supply from emergency sources; and direct indicators of food insecurity and hunger. The latter is the interest of this research project. The 18-item core module is the "statistically strongest set of indicator items for constructing a 12-month measurement scale." (Bickel et al. 2000:19). It is important to note that the data from 1995-2000 displays a seasonal response effect because the survey used to be conducted in April in odd-numbered years and September in even-numbered years. Food insecurity rates are consistently higher in August/September (Nord, 2002). Nord's data shows that both metro and non-metro food insecurity change with the seasonal effect. This is one reason I chose to use the data from 2000-2007 for pooling.

Another reason I chose the years 2000-2007 is because the data collected from 1995-1997 screened households in a way that is different than from 1998-2007. In order to compare the data across time, all households that could have been screened out in 1995-1997 would have to be dropped out of the dataset for every year from 1995-2007 (Nord and Winicki, 2000). The first report produced using this data had to make these screening adjustments and showed that from 1995-98 food insecurity had declined slightly, but for the most part the report is just a test of the measurement tool (Bickel et al. 1999).

This dataset has been used to produce several government briefs and academic reports. Every year that the data has been published there has been a subsequent brief authored by Nord and others of the Economic Research Service (ERS), so there is a history of descriptive statistics that were used to guide the hypotheses presented. The limitations of this dataset have been considered rather thoroughly. The government ordered a review of the measurement tool by the Committee of National Statistics of the National Academies. The Committee of National Statistics of the National Academies produced a largely favorable review of the measure used for

the food security supplement (Wunderlich, 2006). They did offer the suggestion that USDA consider the frequency and duration of food security. The Committee also states that food insecurity is a household-level concept while hunger is an individual-level concept and they "urge USDA to consider alternate labels to convey the severity of food insecurity without the problems inherent in the current labels" (Wunderlich et al. 2006:5). The "current labels" referred to are utilized in the most recent *Household Food Security in the United States, 2007*. Instead of "food insecure without hunger" and "food insecure with hunger," the newest report has taken the advice of the panel and uses the terms "low food security" and "very low food security" in their place. Because the data is collected at the household level it is hard to know which individuals in the household were experiencing hunger (Bickel et al. 2000:13). It is understood that children are typically shielded from hunger except for in the most extreme cases of food insecurity (Nord, 2003). Lastly, the panel discussed the issue of food security only being measured with relation to financial constraint (Wunderlich, 2006). They point out that the measure does not include questions about elements of food security such as nutritional value and safety of food, but the panel then argues that the U.S. food supply is generally safe, and that the nutritional information is collected elsewhere such as the Nutritional Health and Nutrition Examination Survey. The point of this discussion is that the measure has been vetted and that the results from my secondary data analysis should prove both reliable and valid.

Methods

This study will use descriptive statistics followed by logistic regression analysis to test the hypotheses. I will create regression equations to help understand the odds of a group of people being food insecure versus another group. Multivariate logistic regression analysis was chosen because it will give estimates of the odds of the economic, sociodemographic and

geographic characteristics affecting household food security. This method will also test for the significance of the relationship of each variable and overall goodness-of-fit for the entire equation.

Logistic regression analysis provides an alternative to ordinary least squares (OLS) regression analysis, which is widely used in social science. Logistic is used when the dependent variable is dichotomous, and using OLS would violate assumptions of that type of analysis. Typically a variable is dichotomous because it was originally categorical and recoded. That is the case with the dependent variable for food security in this study. Also unlike OLS, logistic regression analysis also does not assume normal distribution or homoscedasticity – both of which are unlikely with dichotomous independent variables.

The following logistic regression equation will be estimated to test the hypotheses:

$$\text{logit}(P) = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} + b_{11}x_{11} + b_{12}x_{12} + b_{13}x_{13} + b_{14}x_{14} + b_{15}x_{15}$$

or

$$P = \frac{1}{1 + e^{-(a + b1x1 + b2x2 + b3x3 + b4x4 + b5x5 + b6x6 + b7x7 + b8x8 + b9x9 + b10x10 + b11x11 + b12x12 + b13x13 + b14x14 + b15x15)}}$$

Where:

P = probability that independent variable will be a 1 – that a household will be food insecure.

a = intercept

b = coefficient to be estimated

x_1 = below 1.85 income-to-poverty ratio

x_2 = do not own home

x_3 = unemployed individual in household

x_4 = not in labor force individual in household

x_5 = black headed household

x_6 = Native American headed household

x_7 = Hispanic headed household

x_8 = high school diploma or less education

x_9 = 3 or more children in household

x_{10} = nonmetropolitan

x_{11} = principal city

x_{12} = South region

x_{13} = West region

x_{14} = Midwest region

After the P is calculated it is then used to calculate the odds ratios using the following formula:

$$\text{odds} = \frac{P}{1 - P}$$

For this equation a binary variable for food insecurity will be created. The categories "low food security" and "very low food security" will be combined to create a food secure/food insecure binary. This variable will serve as the dependent variable. The creation of binary variables for the independent variables will be based on the hypotheses. In the equation above, the label given to the variable is the 1 value (i.e. black headed household = 1).

There are shortcomings to the proposed research. The dataset that I have chosen does not provide information about how people experience food insecurity. Are people physically hungry? If so, who goes without eating? Also, there is no information about how it is that the food insecure households become food insecure. Understanding how food insecurity occurs would be useful in developing policy solutions for prevention. As part of future research, USDA is considering possible ways to measure why it is that households become food insecure. The consequences of food insecurity are not something that can be analyzed with this dataset. It is understood that food insecurity affects nutrition, health, weight, and children's psychosocial development and learning (Nord, 2003:28), but based on the data there is no way for us to tell which of these consequences, if any, may have occurred in the households that are food insecure. Many of these questions and problems have been addressed in other research. I only list them here in and effort to be very clear about the limitations of the data. I do think that a possible

future research project could incorporate food security surveys and qualitative research in urban and rural areas with high levels of food insecurity (possibly food deserts) to try and understand the particular similarities and differences in food insecurity for people occupying minority statuses in society.

These shortcomings should not overshadow the strengths of the data. I have already explained some of the strengths of the data in the process of description. USDA has tested the survey tool for validity and reliability. The Life Science Research Office, as was mentioned previously, has also reviewed the methods for collecting information about food security. As part of the CPS, the sample should be representative and the surveys should have been conducted with the utmost professionalism. There are also a large number of cases in this dataset. The combination of representativeness and a large number of cases should make the results of my statistical analysis generalizable to the population from which the sample was drawn (the United States).

CHAPTER 3 - Findings

Prevalence of Household Food Security

In the dataset for 2007, there are a total of 34,047 households, and of them, 10.65 percent are food insecure (see Table 3). The prevalence of food insecurity varies substantially based on characteristics of the household. Furthermore, there has been little change in the rate of food insecurity for most characteristics since 2000.

The descriptive statistics based on economic characteristics show higher prevalence of food insecurity for people on the lower end of the economic divide. Of the households living below the 1.85 ratio of income-to-poverty in the year 2007, 25.6 percent of them are food insecure. That is compared to only 4.8 percent food insecurity for households above the 1.85 ratio of income-to-poverty. The year 2000 shows little difference to the 2007 data. In 2000, 23.7 percent of households living below 185 percent of the poverty line were food insecure and 4.3 percent of households above 185 percent of the poverty line. The 2003 food insecurity rates are nearly identical to those for 2007.

Table 3. Number and Percentage of Food Insecure Households by Economic Categories, 2000 – 2007

	2007			2003			2000			Pooled 2000-07		
		Food Insecure			Food Insecure			Food Insecure			Food Insecure	
Category	Total	Number	%	Total	Number	%	Total	Number	%	Total	Number	%
Total (n)	34,047	3,628	10.7	46,872	4,990	10.6	40,338	4,146	10.3	360,754	38,288	10.6
Income-to-poverty ratio (hrpoor_d):												
Under 1.85	9,587	2,459	25.6	13,490	3,417	25.3	12,343	2,930	23.7	103,148	25,863	25.1
1.85 and over	24,460	1,169	4.8	33,382	1,573	4.7	27,995	1,216	4.3	257,606	12,425	4.8
Housing tenure (hetenure_d):												
Owned or being bought	24,019	1,494	6.2	33,186	2,048	6.2	27,992	1,752	6.3	254,928	15,989	6.3
Rented	9,543	2,061	21.6	13,009	2,829	21.7	11,725	2,296	19.6	100,549	21,442	21.3
Occupied w/o payment	485	73	15.1	677	113	16.7	621	98	15.8	5,277	857	16.2
Employment:												
Employed	22,000	1,950	8.9	30,085	2,738	9.1	26,683	2,428	9.1	233,634	21,133	9.1
Unemployed (unemploy_d)	917	277	30.2	1,514	438	28.9	833	235	28.2	10,198	3,058	30.0
Not in labor force – discouraged (nilf_d)[1]	31	5	16.1	56	16	28.6	36	10	27.8	376	101	26.9
Not in labor force – other	10,948	1,387	12.7	15,014	1,783	11.9	12,629	1,458	11.5	114,953	13,884	12.1

[1] nilf_d is a dichotmous variable that collapses both not in labor force responses into the affirmative response category.

Housing tenure is largely viewed as a proxy for economic well being because of its correlation to education, income, etc. Renting a home is correlated with food insecurity (Bartfield et al. 2006). Again, in 2007 we see that a larger than average prevalence of food insecurity for people who rent their homes (21.6 percent), and of the households who own their homes, only 6.2 percent are food insecure. The largest variation in housing tenure across years occurs for the occupied without rent category. Occupied without payment of cash rent may include a wide variety of people living with people without paying rent. These may include college students living with their parents or elderly people living with their children. A similar pattern is revealed for other categories with a low number of cases. The independent variable for

housing tenure was created by collapsing the "rented" and "occupied without payment" and designated as a one in a dichotomous variable. People who own their homes are designated zero.

Unemployment within the household is theoretically correlated with food insecurity (Bartfield et al. 2006; Nord, 2008). Only 8.9 percent of the households in 2007 with everyone employed are suffering from food insecurity. Of the households with someone unemployed, 277 (over 30 percent) of them are food insecure. Again, the lower the number of cases the less variation we see in the rate of food insecurity across the years listed. A k-1 approach was used to create dichotomous variables for employment within the house. This means every category in a variable was used to create a dichotomous variable except for one, which serves as a reference category. All categories within a variable cannot be represented by dichotomous variables in the equation because they would be perfectly collinear. The two categories for not in the labor force were collapsed into a dummy variable because of the low number of cases for discouraged people not in the labor force, and because of collinearity. The reference category is everyone being employed.

The hypotheses describe several types of sociodemographic characteristics that are theoretically correlated with food insecurity. Interestingly – although not surprisingly – black headed and Native American headed households are well above average food insecurity (21.8 percent and 19.2 percent respectively), while white headed households are below the average (9.3 percent). In 2000, Native American headed households have a higher rate of food insecurity than in 2007 (23.1 percent) while black headed households show a lower rate of food insecurity (20.6 percnt).

Hispanic people can be of any race, but again there is a correlation between Hispanic households and food insecurity. The 2007 descriptive statistics support that with 20.4 percent of

Hispanic headed households being food insecure. Only 9.7 percent of non-Hispanic households are food insecure. In 2003, 21.7 percent of Hispanic headed households were food insecure while 9.7 percent of non-Hispanic households were food insecure. The year 2000 is similar to 2003 with 21.7 percent food insecure in Hispanic households and 9.3 percent of non-Hispanic households.

Table 4. Number and Percentage of Food Insecure Households by Sociodemographic Categories, 2000 – 2007

	2007			2003			2000			Pooled 2000-07		
		Food Insecure			Food Insecure			Food Insecure			Food Insecure	
Category	Total	Number	%	Total	Number	%	Total	Number	%	Total	Number	%
Total (n)	34,047	3,628	10.7	46,872	4,990	10.6	40,338	4,146	10.3	360,754	38,288	10.6
Race:												
White	28,750	2,676	9.3	39,917	3,689	9.2	34,569	3,101	9.0	307,567	28,302	9.2
Black (black)	3,203	697	21.8	4,333	951	21.9	4,007	826	20.6	34,158	7,441	21.8
Native American (nativeam)	359	69	19.2	467	103	22.1	494	114	23.1	3,969	939	23.7
Other	1,735	186	10.7	2,155	247	11.5	1,268	105	8.3	15,058	1,605	10.7
Ethnicity:												
Hispanic (hispanic)	3,011	615	20.4	3,849	835	21.7	3,130	680	21.7	29,146	6,119	21.0
non-Hispanic	31,036	3,013	9.7	43,023	4,155	9.7	37,208	3,466	9.3	331,608	32,169	9.7
Education (peeduca_d):												
High school diploma or less	14,035	2,154	15.3	20,832	3,133	15.0	18,686	2,719	14.6	159,140	23,825	15.0
Some college or more	20,010	1,473	7.4	26,040	1,857	7.1	21,652	1,427	6.6	201,612	14,462	7.2
Number of children (prnmchld_d):												
Less than 3	20,664	1,946	9.4	28,916	2,821	9.8	25,104	2,284	9.1	221,821	20,882	9.4
3 or more children	2,047	410	20.0	3,032	612	20.2	2,663	583	21.9	22,937	4,706	20.5

All of these sociodemographic characteristics are closely related to economic standing. Households headed by an individual with a high school diploma or less education are known to have a higher rate of food insecurity (Bartfield et al. 2006; Nord, 2008). According to 2007 statistics, 15.4 percent of households headed by an individual with a high school diploma or less education are food insecure. That is compared to only 7.4 percent food insecurity among

households who are headed by an individual with at least some college education. There is little variation across the three data points. The 2000 food insecurity rate for households with more than a high school education is 6.6 percent.

The increased number of children in a household is known to correlate positively with food insecurity. The previously agreed upon cutoff is for three or more children (Bartfield et al. 2006; Nord, 2008). Of the 2007 sample, 9.4 percent of households with fewer than three children are food insecure, whereas a little over 20 percent of households with three or more children have experienced food insecurity during the past year. The 2000 food insecurity rate for households for three or more children is slightly higher than 2007 but not drastically different.

I expect to find higher rates of food insecurity in principal cities and nonmetropolitan areas (Bartfield et al. 2006; Nord, 2008). In 2007, the principal city has 12.9 percent of its households listed as food insecure. The 2003 data shows the greatest difference in the rate of food insecurity in principal cities at 14.1 percent. Households in nonmetropolitan counties are 10.8 percent food insecure, which is very close to the national average. There is little change in the rate of food insecurity in nonmetropolitan counties over the course of the data. It should be noted that in 2007 6,479 cases were not identified as principal city, balance, or nonmetropolitan. That is about 20 percent of all cases, and those that were not identified also show a higher rate of food insecurity than the national average in 2007, but not in 2003.

Table 5. Number and Percentage of Food Insecure Households by Geographic Categories, 2000 – 2007

	2007			2003			2000			Pooled 2000-07		
		Food Insecure			Food Insecure			Food Insecure			Food Insecure	
Category	Total	Number	%	Total	Number	%	Total	Number	%	Total	Number	%
Total (n)	34,047	3,628	10.7	46,872	4,990	10.6	40,338	4,146	10.3	360,754	38,288	10.6
Area of residence:												
Principal city (pcity_d)	7,887	1,020	12.9	10,232	1,441	14.1	9,469	1,303	13.8	81,596	11,028	13.5
Balance	12,044	1,057	8.8	16,931	1,436	8.5	14,895	1,117	7.5	128,655	10,821	8.4
Nonmetropolitan (nonmetro_d)	7,637	823	10.8	11,829	1,297	11.0	9,698	1,074	11.1	86,851	9,653	11.1
Not Identified	6,479	728	11.2	7,880	816	10.4	6,276	652	10.4	63,652	6,786	10.7
Region												
Northeast	6,609	652	9.9	9,979	910	9.1	8,376	712	8.5	74,336	6,638	8.9
Midwest (midwest_d)	8,338	853	10.2	11,983	1,157	9.7	9,901	861	8.7	90,707	8,794	9.7
South (south_d)	10,830	1,240	11.4	13,600	1,597	11.7	12,443	1,411	11.3	109,347	12,873	11.8
West (west_d)	8,270	883	10.7	11,310	1,326	11.7	9,618	1,162	12.1	86,362	9,982	11.6

Trying to understand the effect of the geographic variables on household food security is an important element of this thesis. Nord (2001) says that there is a higher prevalence of food insecurity in the South (particularly in the rural South) than there is in the rest of the country. We can see here that households in 2007 in the Northeast are only 9.9 percent food insecure, whereas those in the South are 11.5 percent food insecure. The South is also a bit higher than Midwest (10.2 percent) or the West (10.7 percent). However, the other years do not necessarily show similar rates. In 2000, 12.1 percent of households in the West region were food insecure which is higher than the 11.3 percent of the households in the South. The 2003 data shows 11.7 percent food insecurity for both West and South regions. Most importantly, unlike some of the other variables that show variation across data collection points, this cannot be explained by a small number of cases. These dichotomous variables are coded k-1 with the Northeast designated as the reference category.

Table 6. Crosstabulation for Household Food Security Status and Region, 2007

	Region			
	Northeast	**Midwest**	**South**	**West**
Food Secure	5,957	7,485	9,590	7,387
exp.	5,904.8	7,449.5	9,676.0	7,388.8
Food Insecure	652	853	1,240	883
exp.	704.2	888.5	1,154.0	881.2
Chi2 = 13.0967			**P-value** = 0.004	

exp. = expected value

Table 6 is a cross-tabulation from the 2007 data. The table was developed to elaborate on the relationship between region and food insecurity. A chi-square test measures the association between the two variables. For this the expected value is calculated and tested against the actual value of each box in the table. We can see that the values reported for the West region are almost identical to those expected. In the Northeast, the values reported are higher than those expected. In the Midwest both categories show lower reported cases than expected. The South is the only region where there are many more reported cases of food insecurity than expected, and there are many less food secure than are expected. Thus, there is more food insecurity in the South than the numbers should lead us to expect. Overall, the association between the two variables shows to be significant though we cannot test direction because the variables are categorical.

Table 7. Crosstabulation for Region and Poverty Level, 2007

	185% of Poverty-level	
Region	**Below**	**Above**
Northeast	6,644	2,185
%	75.25	24.75
Midwest	8,012	3,180
%	71.59	28.41
South	10,037	4,456
%	69.25	30.75
West	7,997	3,076
%	72.22	27.78
Natl. Avg.	32,690	12,897
%	71.71	28.29

The South region having a higher than average prevalence of food insecurity is not surprising when you consider the above average rate of household living below 185 percent of the poverty line (Table 7) and the above national average percentage of Blacks (Table 8). The same trend exists in the West only instead of being disproportionately black there are an above average number of Hispanic households.

Table 8. Crosstabulation for Region and Race/Ethnicity, 2007

	Race					Ethnicity	
Region	**White**	**Black**	**Native American**	**Asian or P.I.**	**Other**	**Hispanic**	**Non-Hispanic**
Northeast	9,507	814	32	390	106	741	10,108
%	87.63	7.50	0.29	3.59	0.98	6.83	93.17
Midwest	11,496	967	156	203	109	497	12,434
%	88.90	7.48	1.21	1.57	0.84	3.84	96.16
South	13,253	3,204	115	338	214	1,694	15,430
%	77.39	18.71	0.67	1.97	1.25	9.89	90.11
West	10,856	503	240	1,133	324	2,084	10,972
%	83.15	3.85	1.84	8.68	2.48	15.96	84.04
Natl. Avg.	45,112	5,488	543	2,064	753	5,016	48,944
%	83.60	10.17	1.01	3.83	1.40	9.30	90.70

The several data collection points were used to show how little change there has been in the rate of food insecurity and to support pooling the data for the years 2000 to 2007. Pooled data will increase the number of cases for those with a low *n*. In particular, this will help to tighten up the odds ratio confidence intervals for the equations. It will also boost the number of cases for Native American headed households from 359 to 3,969. Before pooling the data (1) a correlation matrix was created for all variables to be used in the multivariate equations, and (2) partial equations, a full equation, and region specific equations were created for the year 2007.

A correlation matrix was calculated to be sure that there are not high levels of correlation between the independent variables as such correlation violates an assumption of regression analysis. The results are displayed in Table 7. These are pairwise correlation coefficients and were tested for significance.

The findings indicate that eleven of the fourteen independent variables had a significant correlation to the dependent variable: below 1.85 income-to-poverty ratio (hrpoor_d); high school diploma or less education (peeduca_d); black headed (black); Native American headed (nativeam); Hispanic headed (hispanic); more than three children (prnmchld_d); home not owned (hetenure_d); unemployed person in household (unemploy_d); not in labor force person in household (nilf_d); principal city (pcity_d); South region (south_d).

All of the significant independent variables showed a positive correlation with the dependent variable. All of the correlation coefficients showed weak strength ranging from 0.0176 (south_d) to 0.3042 (hrpoor_d). Thus, we can conclude that the dependent variable measures a different concept than any of the independent variables, which supports the assumptions of regression analysis.

The correlation analysis also reveals all of the correlations between independent variables. Most of the independent variables are significantly correlated to other independent variables. The variable black was significantly correlated with all other independent variables at the $p<0.001$-level. However, all of the correlations were weak strength. The strongest significant correlations were between the different region variables. Even these were weak-to-moderate correlations. South displayed the most correlated with West (-0.385). South was also correlated with Midwest (-0.3795), and Midwest was correlated with West (-0.3133). None of these correlations indicate collinearity and should not negatively affect the regression equations.

Table 9. Correlation Coefficients for Independent Variables

	rehrfs12m1	hpoor_d	peeduca_d	black	nativeam	hispanic	prnmchld_d	hetenure_d	unemploy_d	nilf_d	nonmetro_d	pcity_d	south_d	west_d	midwest_d
Food insecurity (rehrfs12m1)	1														
Income-to-poverty ratio (hrpoor_d)	0.304^	1													
Education (peeduca_d):	0.127^	0.274^	1												
Black (black)	0.116^	0.109^	0.071^	1											
Native American (nativeam)	0.029^	0.047^	0.029^	-0.034^	1										
Hispanic (hispanic)	0.099^	0.148^	0.149^	-0.082^	0.024^	1									
Number of children (prnmchld_d)	0.1^	0.152^	0.006	0.029^	0.020^	0.095^	1								
Housing tenure (hetenure_d)	0.223^	0.283^	0.101^	0.147^	0.027^	0.147^	0.073^	1							
Unemployed (unemploy_d)	0.106^	0.081^	0.034^	0.042^	0.011*	0.032^	0.019^	0.081^	1						
Not in labor force (nilf_d)	0.045^	0.201^	0.195^	0.021^	0.008	-0.043^	-0.056^	-0.023^	-0.115^	1					
Nonmetropolitan (nonmetro_d)	0.002	0.091^	0.099^	-0.088^	0.075^	-0.098^	-0.008	-0.070^	-0.007°	0.049^	1				
Principal city (pcity_d)	0.041^	0.038^	-0.024^	0.188^	-0.019^	0.132^	0.005	0.194^	0.024^	-0.007	-0.312^	1			
South (south_d)	0.018°	0.037^	0.049^	0.193^	-0.023^	0.014°	-0.017°	-0.016^	-0.002	0.023^	-0.029^	0.028^	1		
West (west_d)	0.001	-0.006	-0.051^	-0.118^	0.047^	0.130^	0.021^	0.046^	0.002	-0.017^	-0.052^	0.089^	-0.385^	1	
Midwest (midwest_d)	-0.008	0.002	-0.005	-0.050^	0.011°	-0.105^	0.012	-0.037^	0.008	-0.019^	0.092^	-0.080^	-0.380^	-0.313^	1

^ Significant p<0.001 ° Significant p<0.1 * Significant p<0.05

Logistic Regression for Partial Equations

Logistic regression was conducted to assess the independent effects of each group of independent variables upon the dependent variable. Stata was used to run the equations. The results consist of three equations concerning geographic characteristics, sociodemographic characteristics, and economic characteristics.

Table 10 displays the results for Equation 1, which shows the partial equation for the geographic characteristics. Chi-square was run to test the goodness of fit of the equation to the sample data and was found to be 72.94 which is significant at the $p<0.001$ level. Based on the hypotheses, I expect to find positive coefficients for nearly all of the variables other than Midwest and West. A positive coefficient means an odds ratio of one or higher. Conversely, an odds ratio less than one will be a negative coefficient. This equation shows that none of the variables are negative correlations. This means households in all regions are more likely to be food insecure. However, both the West and Midwest variables are insignificant. The other three variables in this partial equation show a significant association. Households in the principal city, nonmetropolitan counties, and South region are positively correlated with food insecurity. In this equation, households in a principal city are 1.45 times more likely to be food insecure than are people who do not live in a principal city. Nonmetropolitan households are 1.23 times more likely to be food insecure than those not in nonmetro counties, and a household in the South is 1.161 times more likely to be food insecure than those in the Northeast.

Table 10. Logistic Regression for Geographic Dimension, 2007 (Equation 1)

Variable	Coeff.	Odds Ratio	P>|z|	OR (95% CI)
(nonmetro_d) Nonmetropolitan	0.207	1.229	0.000***	(1.108 - 1.365)
(pcity_d) Principal city	0.372	1.451	0.000***	(1.320 - 1.594)
(south_d) South Region	0.149	1.161	0.016*	(1.028 - 1.310)
(west_d) West region	0.039	1.040	0.561	(0.911 - 1.188)
(midwest_d) Midwest region	0.049	1.050	0.463	(0.921 - 1.198)
_constant	-2.304		0.000***	
Equation:		**ChiSq**	**Pr> ChiSq**	**Pseudo r^2**
		72.94	0.000***	0.0043

*p<.05 **p<.01 ***p<.001

Table 11 displays the results for Equation 2, which shows the partial equation for the sociodemographic characteristics. A chi-square test was run to analyze the goodness of fit. The equation is significant at the p<0.001 level with a chi-square of 841.9.

Table 11. Logistic Regression for Sociodemographic Dimension, 2007 (Equation 2)

Variable	Coeff.	Odds Ratio	P>|z|	OR (95% CI)
(black) Black headed household	1.104	3.016	0.000***	(2.618 - 3.474)
(nativeam) Native American headed household	0.812	2.252	0.000***	(1.516 - 3.343)
(hispanic) Hispanic headed household	0.840	2.317	0.000***	(2.033 - 2.640)
(peeduca_d) High school diploma or less education	0.756	2.129	0.000***	(1.913 - 2.369)
(prnmchld_d) 3 or more children in household	0.718	2.051	0.000***	(1.775 - 2.370)
_constant	-2.918		0.000***	
Equation:		**ChiSq**	**Pr> ChiSq**	**Pseudo r^2**
		841.9	0.000***	0.0746

*p<.05 **p<.01 ***p<.001

More so than the last equation, I expect all of these variables to have a significant positive correlation to food insecurity, and that is the case in Equation 2. This means that for all given categories a household is more likely to be food insecure. A black-headed household is about three times as likely to be food insecure as a non-black-headed household. Even on the low end of the 95 percent confidence interval is an odds ratio of 2.618. The lowest significant odds ratio for this equation is 2.051. Households with three or more children are 2.051 times more

likely to be food insecure than those with less than three children. Hispanic-headed households are 2.317 times more likely to be food insecure than non-Hispanic households. Native American-headed households are 2.252 times more likely to be food insecure than non-Native American-headed households. Lastly, a household headed by someone with a high school diploma or less education is 2.129 times more likely to be food insecure than a household with at least some college education.

Table 12. Logistic Regression for Economic Dimension, 2007 (Equation 3)

Variable	Coeff.	Odds Ratio	P>|z|	OR (95% CI)
(hrpoor_d) Less than 1.85 income-to-poverty ratio	1.603	4.967	0.000***	(4.505 – 5.476)
(hetenure_d) Do not own home	0.978	2.658	0.000***	(2.425 – 2.914)
(unemploy_d) Unemployed individual in household	0.915	2.497	0.000***	(2.039 – 3.059)
(nilf_d) Not in labor force individual in household	0.112	1.118	0.022*	(1.017 – 1.230)
_constant	-3.279		0.000***	
Equation:		**ChiSq**	**Pr> ChiSq**	**Pseudo r^2**
		2,454.76	0.000***	0.1532

*p<.05 **p<.01 ***p<.001

Table 12 displays the results for Equation 3, which shows the partial equation for the economic characteristics. A chi-square test was run to analyze the goodness of fit. The equation is significant at the $p<0.001$ level with a chi-square of 2,454.76. As was the case with the previous equation, I expect all of these variables to have a significant positive correlation to food insecurity. The variable for not in labor force in significant at the $p<0.05$ level. A household with a person "not in labor force" is 1.118 times more likely to be food insecure than a household without anyone not in labor force. All other variables are significant at the $p<0.001$ level and show an odds ratio greater than two. Most important, and not unexpectedly, a household living below 185 percent of the poverty line is nearly five times as likely to be food insecure than a household living above 185 percent of the poverty line. Notably, the low end of the 95 percent confidence interval is still an odds ratio of 4.505. A household that is not an owned home is

2.658 times more likely to be food insecure than a household that is owned. Those households with at least one person unemployed are nearly 2.5 times as likely to be food insecure than a household with all members employed.

Logistic Regression for Full Equation

Logistic regression was conducted to assess the independent effects of each group of independent variables upon the dependent variable. Stata was used to run the equations. The full equation consists of the geographic characteristics, sociodemographic characteristics, and economic characteristics. The results of the full equation are presented in Table 13.

Table 13. Logistic Regression for Full Equation, 2007 (Equation 4)

Variable	Coeff.	Odds Ratio	P>|z|	OR (95% CI)
(hrpoor_d) Less than 1.85 income-to-poverty ratio	1.564	4.779	0.000***	(4.182 - 5.460)
(hetenure_d) Do not own home	0.905	2.473	0.000***	(2.182 - 2.802)
(unemploy_d) Unemployed individual in household	0.778	2.178	0.000***	(1.679 - 2.824)
(nilf_d) Not in labor force individual in household	0.093	1.098	0.131	(0.973 - 1.239)
(black) Black headed household	0.628	1.875	0.000***	(1.584 - 2.219)
(nativeam) Native American headed household	0.702	2.017	0.006**	(1.227 - 3.317)
(hispanic) Hispanic headed household	0.371	1.450	0.000***	(1.239 - 1.697)
(peeduca_d) High school diploma or less education	0.273	1.313	0.000***	(1.164 - 1.482)
(prnmchld_d) 3 or more children in household	0.346	1.413	0.000***	(1.198 - 1.666)
(nonmetro_d) Nonmetropolitan	-0.048	0.953	0.511	(0.827 - 1.099)
(pcity_d) Principal city	-0.118	0.889	0.096	(0.774 - 1.021)
(south_d) South Region	0.000	1.000	1	(0.843 - 1.187)
(west_d) West region	-0.028	0.972	0.761	(0.811 - 1.166)
(midwest_d) Midwest region	0.061	1.062	0.519	(0.884 - 1.277)
_constant	-3.495		0.000***	
Equation:		**ChiSq**	**Pr> ChiSq**	**Pseudo r^2**
		2,038.98	0.000***	0.1894

*p<.05 **p<.01 ***p<.001

The equation was found to fit the sample data with a chi-square of 2,038.98 that is significant at the p<0.001 level. Out of the hypothesized variables eight of them were found to be significant at the p<0.01 level. The significant variables are poverty level (hrpoor_d), home

tenure (hetenure_d), unemployment (unemploy_d), black household head (black), Native American household head (nativeam), Hispanic household head (hispanic), level of education (peeduca_d), and number of children (prnmchld_d). When controlling for other dimensions none of the geographic variables are significant. However, it should be noted that the principal city variable (pcity_d) has an odds ration of 0.889 and the p-value was 0.096, which only means that instead of having 95 percent confidence the odds ratio is in the 90 percent confidence interval. Contrary to the hypothesis the odds ratio for principal city is below one. A household in a principal city is 11 percent less likely to be food insecure than a household not located in a principal city.

Region specific full equations were also created for the sake of testing to see if there were any significant differences. These equations were created using the 2007 data, but they are not presented in this paper because they were very similar for all regions. The nonmetropolitan variable was insignificant in all equations, and the principal city variable was significant at the $p<0.05$ level in only the Northeast, but the odds ratio was still close to one (1.02). The other variables were relatively consistent across the equations and seem to be properly reported in the larger nation-wide equations.

Logistic Regression – Partial Equations for Pooled Data

Table 14. Logistic Regression for Geographic Dimension, 2000 - 2007 (Equation 5)

Variable	Coeff.	Odds Ratio	P>|z|	OR (95% CI)
(nonmetro_d) Nonmetropolitan	0.213	1.237	0.000***	(1.205 - 1.270)
(pcity_d) Principal city	0.422	1.525	0.000***	(1.486 - 1.564)
(south_d) South region	0.289	1.335	0.000***	(1.294 - 1.377)
(west_d) West region	0.241	1.272	0.000***	(1.231 - 1.315)
(midwest_d) Midwest region	0.073	1.076	0.000***	(1.041 - 1.113)
_constant	-2.459		0.000***	
Equation:		**ChiSq**	**Pr> ChiSq**	**Pseudo r^2**
		1,599.96	0.000***	0.0066

*p<.05 **p<.01 ***p<.001

Table 14 displays the results for Equation 5, which shows the partial equation for the geographic characteristics for the pooled data. Chi-square was run to test the goodness of fit of the equation to the sample data and was found to be 1,599.96 which is significant at the $p<0.001$ level. Because of the large number of observations in the pooled data the chi-square test will almost certainly be significant for all equations. This equation shows that all variables are significant with positive correlations. This means households in each region are more likely to be food insecure than if the household was located in the Northeast region. It should be remembered that the Northeast region is the reference category for k-1 binary variables. In this equation, households in a principal city are 1.53 times more likely to be food insecure than are people who do not live in a principal city. The nonmetropolitan households are 1.24 times more likely to be food insecure than households not located in nonmetropolitan counties.

Table 15 displays the results for Equation 6, which shows the partial equation for the sociodemographic dimension for the pooled data. A chi-square test was run to analyze the

goodness of fit. The equation is significant at the p<0.001 level with a chi-square of 11,749.69. The chi-square is probably inflated because of the large number of cases in the pooled data.

Table 15. Logistic Regression for Sociodemographic Dimension, 2000 - 2007 (Equation 6)

Variable	Coeff.	Odds Ratio	P>|z|	OR (95% CI)
(black) Black headed household	1.090	2.974	0.000***	(2.868 – 3.083)
(nativeam) Native American headed household	1.016	2.762	0.000***	(2.523 – 3.023)
(hispanic) Hispanic headed household	0.862	2.368	0.000***	(2.284 – 2.456)
(peeduca_d) High school diploma or less education	0.777	2.175	0.000***	(2.116 – 2.236)
(prnmchld_d) 3 or more children in household	0.810	2.249	0.000***	(2.168 – 2.333)
_constant	-2.934		0.000***	
Equation:		**ChiSq**	**Pr> ChiSq**	**Pseudo r^2**
		11,747.69	0.000***	0.0716

*p<.05 **p<.01 ***p<.001

I expect all of these sociodemographic variables to have a significant positive correlation with food insecurity, because they were all significant in the 2007 equation and the number of cases increased. This means that for all given categories a household is more likely to be food insecure. A black-headed household is nearly three times as likely to be food insecure than a non-black headed household. Even on the low end of the 95 percent confidence interval still is an odds ratio of 2.868. The lowest significant odds ratio for this partial equation is 2.175. A household headed by someone with a high school diploma or less education is 2.175 times less likely to be food insecure than a household with at least some college education. Native American-headed-households are 2.762 times more likely to be food insecure than non-Native American-headed household. Hispanic-headed households are 2.368 times more likely to be food insecure than non-Hispanic households. A household with three or more children is 2.249 times more likely to be food insecure than a household with less than three children.

Table 16. Logistic Regression for Economic Dimension, 2000 - 2007 (Equation 7)

Variable	Coeff.	Odds Ratio	P>|z|	OR (95% CI)
(hrpoor_d) Less than 1.85 income-to-poverty ratio	1.631	5.107	0.000***	(4.982 – 5.234)
(hetenure_d) Do not own home	0.935	2.548	0.000***	(2.489 – 2.608)
(unemploy_d) Unemployed individual in household	0.902	2.465	0.000***	(2.346 – 2.589)
(nilf_d) Not in labor force individual in household	-0.059	0.942	0.000***	(0.919 – 0.966)
_constant	-3.269		0.000***	
Equation:		**ChiSq**	**Pr> ChiSq**	**Pseudo r^2**
		36,263.79	0.000***	0.1491

*p<.05 **p<.01 ***p<.001

Table 16 displays the results for Equation 7, which shows the partial equation for the economic dimension. The equation is significant at the p<0.001 level with a chi-square of 36,267.79. As was the case with the previous equation, I expect all of these variables to have a significant positive correlation to food insecurity. The variable for households with a person not in the labor force shows a negative correlation. In other words, a household with someone not in the labor force is six percent less likely to be food insecure than a household without someone not in the labor force. All other variables are significant at the p<0.001 level and show an odds ratio greater than two. The variable with the highest odds ratio is the poverty variable. A household living below 185 percent of the poverty line is over five times as likely to be food insecure than a household living above 185 percent of the poverty line. The low end of the 95 percent confidence interval is still an odds ratio of 4.982. A household that is not an owned home is 2.548 times more likely to be food insecure than a household that is owned. Those households with at least one person unemployed are about 2.5 times as likely to be food insecure than a household with all members employed.

Logistic Regression – Full Equation for Pooled Data

Logistic regression was conducted to assess the independent effects of each group of independent variables upon the dependent variable for the pooled data. Stata was used to run the equations. The full equation consists of the geographic characteristics, sociodemographic characteristics, and economic characteristics. The results of the full equation are presented in Table 17.

Table 17. Logistic Regression Full Equation, 2000 - 2007 (Equation 8)

Variable	Coeff.	Odds Ratio	P>|z|	OR (95% CI)
(hrpoor_d) Less than 1.85 income-to-poverty ratio	1.556	4.741	0.000***	(4.590 - 4.896)
(hetenure_d) Do not own home	0.975	2.652	0.000***	(2.571 - 2.735)
(unemploy_d) Unemployed individual in household	0.736	2.088	0.000***	(1.963 - 2.222)
(nilf_d) Not in labor force individual in household	-0.009	0.991	0.572	(0.960 - 1.023)
(black) Black headed household	0.540	1.716	0.000***	(1.644 - 1.790)
(nativeam) Native American headed household	0.524	1.689	0.000***	(1.532 - 1.861)
(hispanic) Hispanic headed household	0.279	1.322	0.000***	(1.268 - 1.378)
(peeduca_d) High school diploma or less education	0.318	1.375	0.000***	(1.333 - 1.418)
(prnmchld_d) 3 or more children in household	0.407	1.502	0.000***	(1.443 - 1.564)
(nonmetro_d) Nonmetropolitan	0.008	1.008	0.675	(0.972 - 1.044)
(pcity_d) Principal city	0.015	1.015	0.418	(0.979 - 1.053)
(south_d) South region	0.132	1.142	0.000***	(1.094 - 1.191)
(west_d) West region	0.155	1.168	0.000***	(1.117 - 1.221)
(midwest_d) Midwest region	0.073	1.075	0.002**	(1.027 - 1.125)
_constant	-3.615		0.000***	
Equation:		**ChiSq**	**Pr> ChiSq**	**Pseudo r^2**
		30,951.94	0.000***	0.1897

*p<.05 **p<.01 ***p<.001

The equation was found to fit the sample data with a chi-square of 30.951.94 that is significant at the p<0.001 level. I expect to find all variables significant because of the large *n*, but three of them are not significant. Out of the fourteen hypothesized variables eleven of them were found to be significant at the p<0.01 level. The significant variables are poverty level

(hrpoor_d), home tenure (hetenure_d), unemployment (unemploy_d), black household head (black), Native American household head (nativeam), Hispanic household head (hispanic), level of education (peeduca_d), number of children (prnmchld_d), South region (south_d), West region (west_d), and Midwest region (midwest_d). The geographic variables are now all significant with positive correlations. It should be noted that one reason for pooling the data was to get narrower confidence intervals, and all variables report a much tighter interval than before pooling. The principal city variable went from being nearly significant to $p = 0.418$. The relationship is insignificant.

CHAPTER 4 - Analysis

In this chapter the partial equations will be compared to the full equations, then the two full equations for 2007 and for the pooled data will be compared. The hypotheses will be assessed based on the full equation for the pooled data. The pooled data equation was chosen to assess the hypotheses because all of the variables have a large enough *n* to trust the significance tests of the equation.

The pooled data partial equation (Table 16) for the economic dimension shows all of the variables as significant correlations. The variable for not in labor force (nilf_d) is the only one that shows a negative correlation, and according to this equation a household with a person not in the labor force is two percent less likely to be food insecure. In the partial equation for 2007, the full equation for 2007, and the full equation for the pooled data all of the economic variables are significant except for the variable for not in labor force. There is not a lot of variation in the odds ratios across the equations. The largest difference in odds ratio between equations is in the poverty (hrpoor_d) variable for the pooled data. In the partial equation of the pooled data the odds ratio is 5.108, but it drops substantially in the full equation (Table 17) to 4.741.

An r^2 in multivariate logistic regression analysis is not the same as in OLS regression analysis. In OLS the r^2 explains the percent of the variation in the dependent variable that is explained by the equation. However, the pseudo-r^2 is not the equivalent of the r^2. A pseudo-r^2 is best understood as a test of goodness-of-fit that does not explain variance. Instead, the closer a pseudo-r^2 is to 1 the better the fit of the equation. The statistic is particularly useful when comparing different equations for the same data. The economic partial equation for the pooled

data had a pseudo-r^2 of 0.149. The full equation gives a pseudo-r^2 of 0.190, and is a better fit, as will become clear with the reporting of the pseudo-r^2s for the other two partials. The relative similarity in the economic partial equation and the full equation means that the economic partial equation is responsible for the bulk of the goodness-of-fit of the full equation. These findings support the expected importance of economics as an indicator of food security.

The most interesting finding about the sociodemographic dimension is that all of the variables are significant in the partial and full equations of both the 2007 and the pooled data. However, in the pooled data we see a sizable difference in the odds ratios in the partial equation and the full equation. For example, in the partial equation (Table 15) the odds ratio for black-headed households is 2.974 and in the full equation is 1.716. The change in the odds ratios is evidence that the relationships in sociodemographic dimension are best understood in conjunction with some of the other variables in the full equation. This makes sense because we know that people of color are more likely to live below 185 percent of the poverty line, so when they are controlled for simultaneously in the equation, a decrease in the odds ratio is expected. The same is true for people with less education. It also makes sense that having more children would put a greater economic strain on a household. The sociodemographic partial equation for the pooled data had a pseudo-r^2 of 0.072. The full equation gives a pseudo-r^2 of 0.190, and is much better equation than the equation using sociodemographic variables alone.

The 2007 partial equation (Table 10) for the geographic dimension had three significant variables. All of which were insignificant in the full equation for 2007. In the 2007 partial equation a household in a principal city was 1.451 times more likely to be food insecure than a household not in a principal city, and the relationship was significant at the $p < 0.001$ level. However, in the full equation for 2007 (Table 13) the variable for principal city is no longer

significant ($p < 0.096$). The same was true for the pooled data equations. The partial equation (Table 14) shows principal city significant ($p < 0.000$), then in the full equation (Table 17) the principal city variable is insignificant ($p < 0.418$). A principal city includes the largest city in each metropolitan statistical areas (MSAs) as well as other cities in an MSA that reach certain population requirements. One explanation for the change in significance for the principal city variables is that the relationship between principal city and food insecurity is spurious, and that the other variables in the full equation are better fit to explain the variation in food security status. This makes logical sense too, because I expect that certain racial characteristics and income levels would be overrepresented in principal cities.

All of the geographic variables are insignificant for the 2007 full equation (Table 13). Similarly to the 2007 partial equation, all of the geographic variables are significant in the partial equation for the pooled data (Table 14), but only the region variables are significant in the full equation for the pooled data (Table 17). However, the odds ratios decrease slightly for all of the geographic variables in the full equations. Again, this makes sense because certain areas have higher rates of people of color and people living in poverty which are uncontrolled for in the partial equations but controlled for in the full equation. The geographic partial equation for the pooled data had a pseudo-r^2 of 0.007. The full equation gives a pseudo-r^2 of 0.1897, and is a much better equation than the equation using geographic variables alone.

Another assumption of logistic regression is that the equation is properly specified. This means that all relevant variables are included in the equation without irrelevant variables. Tests were run on the full equation to understand the specification. The final equations for 2007 and for the pooled data both contain some specification error. Typically, the way to correct specification error is to power transform the variables within the equation. I did not present

equations with power transformed variables because the goal of this research project is to test hypotheses and not to develop equations. However, the specification error found might suggest the need to use different variables or a different form of regression analysis. The low pseudo-r^2 for the geographic partial equations suggests that they are not

Hypotheses Tests

Table 18. Hypotheses Outcomes

Hypotheses	Result
H_1: Households with an income less than 185% of the poverty line are more likely to be food insecure than are households with an income is above 185% of the poverty line.	Supported
H_2: Black headed households are more likely to be food insecure than are white households.	Supported
H_3: Hispanic headed households are more likely to be food insecure than are non-Hispanic households.	Supported
H_4: Native American headed households are more likely to be food insecure than are white households.	Supported
H_5: A household head with high school diploma or less is more likely to be food insecure than a household with a head that has at least some college.	Supported
H_6: If a home is not owned or is rented, the household is more likely to be food insecure than if the home is owned.	Supported
H_7: A household located in a nonmetropolitan county is more likely to be food insecure than a household not located in a nonmetro county.	Not Supported
H_8: A household that has three or more children is more likely to be food insecure than a household with less than three children.	Supported
H_9: A household with an unemployed adult is more likely to be food insecure than a household with zero unemployed adults.	Supported
H_{10}: A household with an adult not in the labor force is more likely to be food insecure than a household with zero adults not in the labor force.	Not Supported
H_{11}: A household located in a principal city is more likely to be food insecure than is a household not in a principal city.	Not Supported
H_{12}: A household located in the South region is more likely to be food insecure than a household not located in the South region.	Supported
H_{13}: A household located in the West region is equally likely to be food insecure as a household not located in the West region.	Not Supported
H_{14}: A household located in the Midwest region is equally likely to be food insecure as a household not located in the Midwest region.	Not Supported

Ten of the study hypotheses – H_1, H_2, H_3, H_4, H_5, H_6, H_8, H_9, and H_{12} – are supported by the empirical findings of this research (see Table 17). One of the hypotheses (H_{12}) based on geographic variables were supported. Households in the South region are significantly more likely to be food insecure. Four other hypotheses (H_7, H_{11}, H_{13}, and H_{14}) based on geographic

variables were not supported. All region variables showed significant positive correlation to food insecurity. The principal city variable showed an insignificant negative correlation to food insecurity. Lastly, the variable for nonmetropolitan households was an insignificant correlation. Other than the variable for not in labor force, all of the economic and sociodemographic variables were supported giving further support to previous research.

CHAPTER 5 - Discussion, Conclusion and Recommendations for Future Research

Discussion

The independent variables for the economic dimension were consistently significant and showed high odds ratios. This was expected, as the measure for food security is conceptualized around the ability to purchase food. This is reflected in many of the module questions that question worries about running out of money or ability to afford food. Nord (2008) and Bartfield et al. (2006) would both predict the findings on poverty level, unemployment, and home tenure.

Given that I expected to find higher rates of poverty and lower class among communities of color, it is no surprise that more black people and Native Americans are food insecure than are white people. In the full equations the economic variables are simultaneously controlled for and allow us to know the odds a black-headed household will be food insecure compared to a white-headed household. However, given the structural inequality in the United States, the findings about sociodemographics may not be shocking. It is interesting to know that households with less education are more likely to be food insecure, and that it is not solely a function of people with less education having less money. Previous research by Nord et al. (2008) leads us to expect these findings because of the high rates of food insecurity for the sociodemographic characteristics.

The most interesting and surprising findings come from the geographic dimension. If we reflect on the hypotheses and literature, it is theorized that households in principal cities and nonmetropolitan areas are more likely to be food insecure. This research does not support this

assumption. There are a few reasons that households in principal cities might not be more likely to be food insecure: (1) The relationship is spurious and the other variables in the full equation help to explain the above average rate of food insecurity in principal cities; (2) The concept of principal city is not limited to urban cores and only measures the largest city(s) in an MSA, which may consist of higher income households than would be expected in an urban core or inner city; (3) The data is collected in a way that overlooks people in principal cities that have low or no income and are a hard-to-reach population (i.e. homeless people); (4) The pooled data spans the change in definition of geographic location by the Office of Management and Budget in 2003, and the new definition not being precisely comparable to the old has created flawed findings. However, in response to the last point, the findings for the 2007 data alone are similar in that the odds ratio for principal cities is below one and the number of cases (n = 7,887) is large enough that the findings can be trusted. Bartfield et al. (2006) claim that states with above average proportions of households living in the central city of a metropolitan area were more likely to have higher rates of food security, when controlling for many of same independent variables used in this project. This may be true for state-level data, but at the household level it is not.

The significance of all of the region variables was unexpected. Nord (2001) reports a higher prevalence of food insecurity in the South. He goes on to state that the rural-South has a higher rate of food insecurity than does the urban-South. Households in the South were more likely to be food insecure than households not in the South. However, this was also true for the Midwest and West regions. All region variables reported an odds ratio greater than one for the pooled data full equation, and somewhat surprisingly the West region had the highest odds ratio (1.168). The equations control for sociodemographic and economic variables simultaneously, so

the results reflect the effect of being located in a certain region while race, ethnicity, and poverty are controlled. Households in the Midwest region have a slightly greater probability of being food insecure than those households in the reference category (Northeast). This is particularly interesting because the Midwest region of the United States is commonly referred to as the "breadbasket of the world." It is the region of the country responsible for most of the food production but households there are still at a slightly increased risk of food insecurity. However, it should be noted that these finding could be affected by the lack of weighting. The pooled equations could not be run with properly specified weights that are provided by the ERS for each year of data because the weights are year specific. The 2007 equations are weighted properly, and thus, the conflict between the full equations means it is possible that the region findings from the pooled data are invalid.

Rural counties are the place of production of food, so it is perplexing to know that it is also a place where households in nonmetropolitan counties have a higher rate of food insecurity than those households in metropolitan counties. The fact that the nonmetropolitan variable is insignificant an correlation in the equations could be because of a couple of reasons: (1) the lack of specification of nonmetropolitan counties prohibits teasing out more rural areas from those that are quite urban, or (2) the above average rate of food insecurity in nonmetropolitan counties is a spurious relationship explained away by the other sociodemographic and economic variables in the equations. There is no measure of "rural" in this equation, but nonmetropolitan is often used as a proxy for rural (Nord, 2001; Nord et al. 2008). The previous research lumped both nonmetro categories into "rural." I assume it was done that way for the same reasons as in this research. There is no feasible way to break down nonmetropolitan into more specific subcategories to help better understand rurality. On the rural-urban continuum those counties not

adjacent to metropolitan counties are the more "rural." If sampling rural counties (8 and 9 on the rural-urban continuum) is not feasible, then it would be helpful if future Food Security Supplement surveys at least included a breakdown of nonmetropolitan households into the subcategories nonmetropolitan counties adjacent to a metropolitan county and nonmetropolitan counties not adjacent to a metropolitan county. This would allow for a better understanding of food insecurity in the more rural areas of the country.

Conclusion

Food insecurity is undesirable, it is a shame, and it is the goal of the United States to reduce food insecurity in this country before the year 2015 (Bickel et al. 2000; Nord, 2002). The nutrition literature on food security encourages the continuation of food stamps and other public food assistance programs (Frongillo, 2003; Jones et al. 2003; Kim and Frongillo, 2007). Several of these nutritionists have found evidence that food assistance programs help to mitigate the effect of food insecurity on certain aspects of people's health (i.e. obesity).

I propose a modification of the same policy suggestion. We need to continue food stamps and food assistance programs, but we need to change some of them to be civic food assistance programs rather than public food assistance programs. The primary difference between the two is an attention towards civicness as encouraged by both Putnam and Lyson. New programs should also focus on social justice. By definition people that are food insecure are less likely to have access to healthy foods. That access can be created through face-to-face programs that help introduce low-income households to the benefits of healthy foods. For example, Jones et al. (2003) recommend the continuation of free school lunch programs because they help food insecure children have access to food options that may be healthier than their other options and thus they have better health. As part of that program, the school could reach out into the

community with an eye towards social justice and interact with farmers to gain access to direct channels for healthy food grown under civically responsible conditions. It is through these types of programs that the systemic causes of food insecurity may be negated.

Based on this thesis and previous research, we know that living above 185% of the poverty line is the best way to limit food insecurity. Policy targeted at increasing peoples' economic well being should be effective in relieving food insecurity. In smaller communities, the combination of agriculture with local business and schools could help to improve the local economic standing. This suggestion is in line with Mills and Ulmer, who found that the level of economic opportunity and stability was better in small business communities. On a national level, programs that help provide people with jobs paying living wages should help decrease poverty and consequently reduce food insecurity.

In the future researchers may benefit from in-depth case analysis of how households experience food insecurity in specific geographic locations. It should also be kept in mind that food insecurity is a product of inequality, and thus is an issue of social justice. Sociologists may benefit from working with nutritionists to help understand both what causes food insecurity as well as the ramifications of said food insecurity. Lastly, researchers in the future could benefit from doing public sociology that teams with elements of a community to address issues of food insecurity.

The findings of this project support the belief that food security is largely tied to economic security. I also found support for many other assumptions about household characteristics including that black and Native American households are more likely to be food insecure than white households. All regions of the country that are not the Northeast are significantly correlated with food insecurity. Most importantly, this research provided evidence

that household in principal cities and nonmetropolitan counties are not more likely to be food insecure even when controlling for the other economic and sociodemographic variables.

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Appendix A - 18 Question Core Module to Food Security Supplement

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 2 months?

(Questions 11-18 were asked only if the household included children age 0-18)

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)