Healthcare and Hunger: Impacts of the Affordable Care Act on Food Insecurity in America

Nicholas Moellman

The University of Kentucky

October 5, 2017

Abstract

I examine the effect of the Patient Protection and Affordable Care Act of 2010 (ACA) on food hardship in US households, utilizing food security information from the Food Security Supplement of the Current Population Survey. Because states adopted the Medicaid expansions provided under the ACA at different times beginning in 2014, the cross-state, over time variation allows me to separate out the impact of the ACA on food hardship using triple difference specifications. The richness of questions in the Food Security Supplement allows me to examine the effect of the ACA across different measures of food hardship, and also examine differential response for households participating in the Supplemental Nutrition Assistance Program (SNAP). I employ a two stage, control function approach to address reverse causality between SNAP and food insecurity, and find that the ACA reduced the probability a household participating in SNAP falls into the two lowest food security categories by 4 percentage points, and reduced the probability of being food insecure by 9 percentage points. Across specifications, I find strong evidence for increasing returns to program participation, and evidence of a differential impact of the ACA across the distribution of food hardship.

JEL: H31, I38

I. Introduction

The Patient Protection and Affordable Care Act (ACA) of 2010 enacted broad reform for healthcare in the United States. The number of Americans lacking health insurance has been a public health issue for policy makers, with 17.5% of non-elderly individuals uninsured in 2009. The ACA implemented large expansions in Medicaid that provided subsidized health insurance coverage for individuals less than 133% of the federal poverty line. However, 19 states chose not to expand Medicaid, leaving residents who did not qualify for Medicaid under previous rules ineligible for increased benefits provided by the ACA.

Alongside the lack of health insurance, food insecurity has emerged as a persistent public health concern facing the nation. From 2008 through 2014, between 14% and 15% of households were food insecure. While food insecurity has been declining in recent years, in 2016 12.3% percent of US households were still defined as food insecure by the U.S. Department of Agriculture, implying 15.6 million households did not have adequate access to the quantity or quality of food necessary for a healthy lifestyle. Moreover, 6.1 million households experienced very low food security, a severe category of food insecurity that often results in families not eating for entire days (Coleman-Jensen et al., 2017).

The health consequences of food insecurity can be dire. Food insecurity has detrimental effects on adult health, and is associated with poor nutritional outcomes, both obesity and low body mass index, less healthy diets, poor mental health outcomes, and various other serious conditions (Cook et al., 2013; Heflin and Ziliak, 2008; Bhattacharya et al., 2004). Children living in food insecure households have also been shown to be negatively affected by food insecurity, being more likely to have poor health (Gundersen et al., 2011; Meyerhoefer and Yang, 2011; Almond et al., 2011; Gundersen and Kreider, 2009; Cook et al., 2004), have poor BMI (Gundersen and Kreider, 2009), experience behavioral issues (Howard, 2011), and experience a host of specific health problems (Chi et al., 2014; Gundersen and Ziliak, 2014). Gundersen and Ziliak (2015) show that these poor outcomes are evident across studies,

countries, data sets, and time period.

Policy makers have many traditional methods of combating food insecurity such as the Supplemental Nutrition Assistance Program (SNAP), one of the largest public assistance programs in the US (5th by expenditure, 3rd by recipients), the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), and school breakfast and lunch programs. As noted by Moffitt (2015), nearly 80% of SNAP recipients also receive Medicaid benefits, however, we know little about how healthcare policy, acting alone or in concert with other food programs, may be able to affect food insecurity. Despite the proliferation of literature on both food insecurity and the ACA, few studies, if any, have yet examined potential links between public healthcare and food insecurity. Public healthcare provides in-kind benefits to at-risk individuals, and while these benefits do not directly address food insecurity, they may free up household income to be redirected toward alleviating food hardship.

I fill this gap in the literature using data from the Current Population Survey (CPS) Food Security Supplement for years 2001-2015 to present the first evidence on the effect of the ACA on food insecurity in America. I contribute to the literature examining the effect of non-food programs on food insecurity, and I extend these studies by analyzing the interaction between the traditional food support system (SNAP) and Medicaid. For my purposes, I limit the impact of the ACA to low-income families less than 185% of the federal poverty line, capturing not only the population most served by Medicaid expansion, but also households who are likely to receive food benefits. I utilize variation across time in the roll-out of Medicaid expansion through the ACA, as well as cross-state variation in Medicaid expansion, to identify the effect of the ACA. This allows me to employ a quasi-experimental design, examining the impact of the ACA across many food insecurity thresholds and varying definitions of food hardship. As many studies have shown (Gregory et al., 2015; Gundersen et al., 2011), reverse causality between SNAP and food insecurity results in the endogeneity of SNAP benefits. Thus, I use a two stage control funtion approach to address the endogeneity of SNAP and its interaction with Medicaid expansions. I find that the ACA had the largest

impact for households already participating in SNAP, reducing the probability that these households fall into the two lowest categories of food security by 4 percentage points. I also find the ACA reduced the probability households participating in SNAP are food insecure by 9 percentage points, and reduced the probability all households report one or more food insecure conditions by 6 percentage points.

The results suggest that while the safety net does affect food insecurity, it does not do so uniformly across the distribution of food hardship. The largest mitigating factor for those experiencing very low food security is SNAP, with little spillover impact from expanded healthcare benefits. However, those experiencing less severe food hardship see relatively large gains in food security from the ACA. I show large, increasing returns to program participation, of particular importance for policy makers and researchers studying safety net programs. By ignoring the positive spillovers from the ACA and SNAP, we risk drastically understating the efficacy of both programs in addressing food insecurity.

II. Background and Motivation

Official food insecurity statistics are reported by the United States Department of Agriculture (USDA) and come from the Food Security Supplement (FSS) in the December Current Population Survey (CPS). Coleman-Jensen et al. (2017) categorize food security as all individuals in a household having enough food for an active, healthy lifestyle. Households are placed into categories of food hardship based on their responses to 18 questions in the FSS, with affirmative responses indicating increased food hardship for the family. The module includes three questions about food conditions of the entire household, seven questions about food security conditions of adults in the household, and eight questions about food conditions of children if they are present.

I use the nomenclature of the USDA and consider four categories of food security—fully food secure, marginally food secure, low food secure, and very low food secure. Households are fully food secure if they report no food insecure conditions, marginally food secure if they

report one or two food insecure conditions, low food secure if they report three to five food insecure conditions with no children (three to seven with children), and very low food secure if they report six or more food insecure conditions (8 or more with children). For some of my analyses, I instead focus on the nonmutually exclusive categories of marginally food insecure, food insecure, and very low food secure. Households are marginally food insecure if they report at least one food insecure conditions, food insecure if they report at least three food insecure conditions, and are very low food secure if they report six or more food insecure conditions (eight or more if children are present in the household). Note that all households that are very low food secure will also be food insecure and marginally food insecure, and all households that are food insecure will also be marginally food insecure.

The questions that characterize food hardship are summarized in table 1. Examples of questions include "We worried whether our food would run out before we got money to buy more." (the least severe); "In the last 12 months, did you lose weight because there wasn't enough money for food?"; or the most severe, "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?" These questions are designed to assess a spectrum of food hardship ranging from stress about the adequacy of food, to monetary concerns associated with food costs, to the lack of meals for members of the family. Each of these questions is also qualified by the stipulation that the food insecure condition be a result of lack of funds, rather than some other reason for the reported hardship. The questions are designed to assess the impact of household financial conditions on the general adequacy of food.

Figure 1 shows response rates to these questions over time. What is immediately apparent is that response rates to questions indicating food hardship for adults are much higher than those indicating food hardship among children. The first panel of figure 1 demonstrates that many households worried about their ability to maintain adequate food in the household (questions 1-3). From 2008 onward, between 16-20% of households worried they would run out of money for food, while roughly 15% of households ran out of money for food or could

not afford to eat balanced meals. A smaller portion of households had to reduce their food intake due to lack of sufficient funds for food (questions 4-10).

The second panel of figure 1 shows that less than 1% of households with children were forced to reduce food intake for children (questions 14-18). However, children were not completely insulated from food hardship, with around 5-6% of households with children forced to reduce the quality of meals for children, and 3-4% of households with children unable to feed the children balanced meals. Taken together, these questions show that many households experience many different kinds of food hardship.

The reforms of the ACA were not designed to directly address food hardship, rather, they focused on decreasing the population of uninsured individuals through the expansion of Medicaid to those below 133% of the federal poverty line (FPL), decreasing the cost of healthcare through additional subsidies, and improving the continuity and quality of care received through new regulations. Health insurance exchanges were established in order to provide a statewide marketplace where consumers could compare competing health plans. Individual mandates required that all individuals obtain a minimum standard of health insurance, and employer mandates required employers with more than 50 employees offer insurance coverage that meets minimum requirements. New regulations were put into place that addressed the price and types of services insurance plans covered, as well as changing how insurance companies delivered and charged for care.

States that expanded Medicaid coverage received additional subsidies from the federal government for doing so, and also had more control over the operation of the state-run health exchanges. Prior to the ACA, the income limit for Medicaid eligibility was 100% FPL. The ACA mandated that those less than 133% FPL[1] be eligible for Medicaid, expanding the population of potential beneficiaries. However, the Supreme Court ruled in National Federation of Independent Business v. Sebelius in 2012 that mandated Medicaid expansions

[1]The law also proposes a 5% income disregard, making the effective income eligibility limit 138% FPL. The Centers for Medicare and Medicaid Services classify the limit as 133% FPL, which I will follow in this paper.

were unconstitutional, and allowed states to opt out of the expansions. Twenty four states and the District of Columbia enacted Medicaid expansion on January 1, 2014. Subsequently, 7 states expanded Medicaid in later years.[2] Figure 2 shows the cross-state and over time variation in Medicaid expansion. Many states on the East and West Coast, as well as Midwestern states, chose to expand Medicaid, while many Southern states did not. However, some Southern states like Kentucky, West Virginia, Arkansas, and Louisiana did choose to expand Medicaid, while some coastal states, like Maine, chose not to, showing the expansion decision was not exclusively regional. These reforms all attempt to reduce the burden of healthcare costs by moderating the price of healthcare and increasing healthcare coverage.

Evidence suggests that the ACA has increased coverage, and benefited individuals who were targeted by the ACA. Black and Cohen (2015) find that not only has the number of uninsured decreased after the implementation of the ACA, but also states that expanded Medicaid saw larger decreases in the uninsured population. Courtemanche et al. (2017) also find that the ACA increased coverage, and note that coverage increased through both public and private markets. Some evidence suggests that the expansion of Medicaid may have crowded out private insurance (Wagner, 2015). Still, the broad impact seems to be that the ACA increased coverage across the population, not only amongst low-income individuals, with overall improvements in health and access (Antwi et al., 2015; Sommers et al., 2012). Hu et al. (2016) have shown the ACA contributed to the financial security of individuals in Medicaid expansion states, decreasing levels of debt and enabling individuals to meet other financial obligations. With evidence suggesting small (if any) negative impacts on employment (Garrett and Kaestner, 2014), and overall decreases in the amount of resources individuals need to devote to healthcare, the ACA could have a potentially large impact on food insecurity by changing the consumer's budget set.

Figure 3 shows average food insecurity across states in 2012-2013 and 2014-2015. In 2013,

[2]Michigan (4/1/2014), New Hampshire (8/15/2014), Pennsylvania (1/1/2015), Indiana (2/1/2015), Alaska (9/1/2015), Montana (1/1/2016), and Louisiana (7/1/2016). The election of Matt Bevin as governor of Kentucky has prompted the state to discuss dismantling the Medicaid expansion in place.

no states had expanded Medicaid, while by 2015, all but two states that ultimately expanded Medicaid had done so. After expanding Medicaid, four states worsened with regard to food insecurity (Alaska, Indiana, New Jersey, and New Mexico), while many others improved. Many states that did not expand Medicaid saw improvements in food insecurity; however, states like Alabama, Nebraska, Maine, and South Carolina saw increases in food insecurity, while others such as Louisiana (which did not expand Medicaid until 2016), Mississippi, and Georgia, saw no change in food insecurity, leaving many residents without access to sufficient food. While the maps are far from definitive regarding the relationship between public healthcare and food insecurity, they do provide some context for further analysis of how healthcare subsidies may affect food insecurity.

Figures 4-6 present a simple budget constraint analysis to provide intuition about the effect of Medicaid subsidies on food consumption, and how participation in SNAP may affect these outcomes. I assume convex preferences that can be well represented by a generic utility curve. Figure 4 shows how consumption of both food and medical care respond to Medicaid benefits. In the absence of subsidized medical care, a representative consumer would consume some mix of both food and medical care, here represented by (F_0, M_0). The introduction of public health insurance guarantees some base level of medical care, creating a kink in the budget set represented by point D. This causes an outward shift in the budget set, resulting in an increase in consumption of both food and medical care. Figure 5 shows the analogous shift in the budget set from the introduction of SNAP benefits. Once again, we see that the SNAP subsidy increases consumption of both food and medical care. In both cases, consumer preferences may dictate consumption of only the value of the subsidy, consuming at point D in figure 4 or point E in figure 5. Wherry and Miller (2016) show the Medicaid expansions associated with the ACA increased the number of primary care visits, making consumption at point D unlikely. Hoynes et al. (2015) show that, in the case of SNAP, most consumers are inframarginal, consuming more than the cash value of benefits, indicating consumption at point E is unlikely as well.

Figure 6 depicts an individual receiving both Medicaid and SNAP subsidies. In the depicted scenario, consumption of both food and medical care increase from (F_0, M_0) to (F_3, M_3). These three figures show how the introduction of Medicaid benefits may increase consumption of food, thereby reducing food insecurity. However, I also show that the increase in consumption may not be the same for all Medicaid beneficiaries. If an individual does not receive SNAP benefits, they consume the bundle (F_1, M_1) after the expansion of benefits. Individuals participating in SNAP consume (F_3, M_3), which is not necessarily, or likely, equal to (F_1, M_1).

The goal of this paper is to disentangle the effect of ACA Medicaid expansion alone and the effect of ACA Medicaid expansion for individuals also participating in SNAP. This paper fits into the small literature examining the issues associated with the interaction of non-food programs and food insecurity, alongside Borjas (2004) who examines the impact of welfare reform on food insecurity, and Schmidt et al. (2015), who simulate eligibility for many programs, including Medicaid, to determine the effect of cash benefits on food insecurity. Identifying this interaction is difficult. There is a large literature on the effect of nutrition programs on food insecurity; however, reverse causality between SNAP and food insecurity can often severely bias estimates. Overall, after controlling for the endogeneity associated with reverse causality, results suggest that SNAP reduces food insecurity and improves the health outcomes of recipients (Hoynes et al., 2016; Gregory et al., 2015; Hoynes and Schanzenbach, 2015; Gundersen and Ziliak, 2014; Yen, 2010). To understand how the ACA interacts with traditional food programs, I control for the the endogeneity of SNAP. Similar to Borjas (2004), I employ a two stage control function strategy that accounts for the endogeneity of all interactions of the ACA and SNAP.

III. Model

Ordered Probit

Most studies that examine food hardship consider only the most widely reported category, food insecurity. However, it is not immediately apparent that the ACA should have similar effects across the distribution of food insecure households. Moreover, figure 3 suggests differential food insecurity rates across states that expanded Medicaid, with some states showing much larger decreases in food insecurity than others. Thus, I begin by analyzing how the ACA affected the probability a household falls within the mutually exclusive categories of marginally food secure, low food secure, and very low food secure. By establishing an ordering, I'm able to see how the ACA might move families along the distribution of food insecurity.

These categories represent increased levels of food hardship, with very low food security being more severe than low food security, both of which are more severe than being marginally food secure. I employ an ordered probit model that uses these categories as thresholds. My primary specification is

$$\begin{aligned} \text{Food Rank}^*_{ijt} = \beta_1 \text{ACA}_{jt} + \beta_2 \text{SNAP}_{ijt} + \beta_3 (\text{ACA} \times \text{SNAP})_{ijt} \\ + X'_{ijt}\beta_4 + \delta_t + \delta_j + \eta_{ijt} \end{aligned} \tag{1}$$

where, Food Rank^*_{ijt} is a latent variable representing where a household falls on the food security spectrum. As Food Rank^*_{ijt} crosses some unknown thresholds α_l, food hardship increases such that for $\text{Food Rank}^*_{ijt} < \alpha_0$ the household is fully food secure, $\alpha_0 < \text{Food Rank}^*_{ijt} \leq \alpha_1$ the household is marginally food secure, and so on. I let $\text{Food Rank}^*_{ijt} \in \{0, 1, 2, 3\}$, and define Food Rank^*_{ijt} below.

$$\text{Food Rank}^{*}_{ijt} = \begin{cases} 0 & \text{if Fully Food Secure} \\ 1 & \text{if Marginally Food Secure} \\ 2 & \text{if Low Food Secure} \\ 3 & \text{if Very Low Food Secure} \end{cases} \tag{2}$$

Thus, Food Rank^{*}_{ijt} describes household i's food security status in state j at time t, δ_j, δ_t are state and year fixed effects, and X_{ijt} is a vector of state and household demographic characteristics shown to impact food insecurity, including gender, household size, number of children, marital status, age, age squared, disability status, race, education, urban/rural status, number of medicaid beneficiaries in the state, governor party affiliation, and the unemployment rate (Ziliak, 2015; Gundersen and Ribar, 2011; Bartfeld and Dunifon, 2006; Bhattacharya et al., 2004).

Since implementation of the ACA took place at different times across different states, I estimate a continuous measure of the proportion of the year a state had Medicaid reform implemented (ACA_{jt}). This variable holds at zero for states such as South Carolina which never implement Medicaid reform, is a 1 for 2014 onward for states such as Kentucky who implement Medicaid reform at the beginning of 2014, and is some positive fraction for the remaining states. To more accurately capture the treatment population, I limit the impact of the ACA to only those less than 185% of the federal poverty line (FPL). While the ACA extends coverage to those less than 133% of the FPL, special SNAP eligibility requirements for the elderly and disabled, along with provisions for broad based categorical eligibility, make this threshold less clear.[3] This results in an intention to treat estimate, with identification coming from cross-state and over time variation of Medicaid expansion, framed as a triple difference specification.

SNAP_{ijt} is a dichotomous measure of SNAP participation, equal to one if the household participates in SNAP and zero otherwise. Reverse causality between SNAP and food inse-

[3]The binned income data of the December CPS also makes identifying the 133% FPL threshold difficult. 185% of the FPL corresponds to the variable hrpoor in the CPS data, and is a more precise threshold.

curity is a significant issue. Bitler (2015) notes that SNAP use is correlated with observable characteristics regarding health, but also unobserved characteristics such as innate health, health habits, and general self-care that researchers may not observe in the data. Prima facie evidence often seems to suggest that SNAP actually *increases* food insecurity, a result of significantly biased estimates. It is highly unlikely that there is some underlying propensity for food insecurity amongst SNAP recipients, rather, it is more likely that those with strong needs seek food assistance. There have been a variety of approaches to control for this reverse causality (Gregory et al., 2015; Schmeiser, 2012; Gundersen et al., 2011; Meyerhoefer and Yang, 2011; Yen, 2010; Borjas, 2004). Any method employing matching estimators relies crucially on matching on only observed characteristics, which does not address unobserved health conditions. Moreover, the health stock evolves dynamically. This presents challenges in panel settings when trying to account for unobserved selection via a fixed effects approach, which will be insufficient for addressing time variant unobserved heterogeneity.

To address the endogeneity of SNAP as a result of this reverse causality, I instrument for SNAP participation with measures of SNAP access and state level measures of benefit generosity utilizing a control function approach. Ziliak (2015) discusses many state level SNAP eligibility and policy parameters that influence SNAP take-up. I use measures of broad based categorical eligibility, fingerprinting requirements, presence of online applications (and the ability to sign these applications online), presence of vehicle exclusions, state EITC rates, the family specific SNAP benefit, and the log of the prevailing minimum wage as instruments. Letting Z_{jt} be the set of instruments, the requirements for the validity of this control function strategy are that $\mathbb{E}[Z_{jt}\eta_{ijt}] = 0$ and $\mathbb{E}[Z_{jt}\text{SNAP}_{ijt}] \neq 0$, or that the instruments are both orthogonal to individual level health investment decisions and correlated with participation in SNAP. Since these policy variables are set at the state level, it is unlikely that they are determined by individual level health based decisions, lending credence to the exogeneity of the policy variables.

I include the interaction of the ACA and SNAP to examine whether the impact of the

marginal benefit dollar will differentially affect SNAP beneficiaries vs non-participants. In this model, $(\text{ACA} \times \text{SNAP})_{ijt}$ will be endogenous through the endogeneity of SNAP. I instrument for this interaction with the product of the exogenous instruments and the measure of the ACA. Thus, my first stage regressions take the form

$$\text{SNAP}_{ijt} = \gamma_1 \text{ACA}_{jt} + Z'_{jt}\Theta_1 + \text{ACA}_{jt} Z'_{jt}\Gamma_1 + X'_{ijt}\Omega_1 + \delta_{1t} + \delta_{1j} + a_{ijt} \tag{3}$$

$$\text{ACA}_{jt} \times \text{SNAP}_{ijt} = \gamma_2 \text{ACA}_{jt} + Z'_{jt}\Theta_2 + \text{ACA}_{jt} Z'_{jt}\Gamma_2 + X'_{ijt}\Omega_2 + \delta_{2t} + \delta_{2j} + e_{ijt} \tag{4}$$

where all variables are defined as above. I then save the residuals, $\widehat{a_{ijt}}, \widehat{e_{ijt}}$, and include them in my second stage specification. Thus, the final functional form of the ordered probit model is

$$\begin{aligned} \text{Food Rank}^*_{ijt} &= \beta_1 \text{ACA}_{jt} + \beta_2 \text{SNAP}_{ijt} + \beta_3 (\text{ACA} \times \text{SNAP})_{ijt} \\ &\quad + X'_{ijt}\beta_4 + \widehat{a_{ijt}} + \widehat{e_{ijt}} + \delta_t + \delta_j + \eta_{ijt} \\ &= \widetilde{X}\psi + \eta_{ijt} \end{aligned} \tag{5}$$

where the model is simplified to $\widetilde{X}\psi + \eta_{ijt}$ for notational convenience. The functional form of the ordered probit model implies that the probability a household falls into food security category l is defined by

$$\begin{aligned} Pr[\text{Food Rank}_{ijt} = l] &= Pr[\alpha_{l-1} < \text{Food Rank}^*_{ijt} \leq \alpha_l] \\ &= \Phi(\alpha_l - \widetilde{X}\psi) - \Phi(\alpha_{l-1} - \widetilde{X}\psi) \end{aligned}$$

where $\Phi()$ is the standard normal cumulative distribution function. The regression parameters are obtained by maximizing the likelihood for the ordered probit, which involves maximizing the product of the probabilities associated with each discrete outcome. While

the sign of the regressors can be interpreted as determining whether or not the Food Score increases or decreases with the parameter of interest, marginal effects for each associated outcome are defined by

$$\frac{\partial Pr[\text{Food Rank}_{ijt} = l]}{\partial \widetilde{X}} = [\phi(\alpha_{l-1} - \widetilde{X}\psi) - \phi(\alpha_l - \widetilde{X}\psi)]\psi \tag{6}$$

where $\phi() = \Phi'()$.

There may be additional concern about the endogeneity of Medicaid expansion through the ACA in equation (5), however, this concern should be of second order importance. First, the large literature on food insecurity establishes the large biases associated with the endogeneity of SNAP, requiring that addressing this endogeneity be of primary importance for any estimates of policy on food insecurity. Since I already instrument $\text{ACA}_{jt} \times \text{SNAP}_{ijt}$ with $\text{ACA}_{jt} \times Z_{jt}$, β_3 is biased only if $\mathbb{E}[(\text{ACA}_{jt} \times Z_{jt})\eta_{ijt}] \neq 0$, or the interaction of state level SNAP eligibility parameters and Medicaid expansion must be correlated with both some unobserved propensity for healthcare expansion and food insecurity. Food insecurity was not the primary concern of the ACA; the topic is not even mentioned in the text of the bill. For β_1 to be biased, Medicaid expansion must be correlated with some unobserved heterogeneity that is also correlated with food insecurity. By the arguments above, food insecurity was not only not a driving force in Medicaid expansion, but any political characteristics that might affect both expansion and food insecurity would be captured through controls for governor party affiliation as well as the control function approach taken with food policy. Finally, the intention-to-treat framework mitigates endogeneity through Medicaid take-up since all individuals in Medicaid expansion states are given the same "treatment" value, regardless of actual participation. Thus, bias in β_1 and β_3 resulting from the endogeneity of Medicaid expansion is likely to be small.

Linear Probability Difference-in-Difference-in-Differences

While the ordered probit model is useful in determining how a household moves from one mutually exclusive food security category to another, a large portion of the literature examines the non-mutually exclusive categories of marginally food insecure, food insecure, and very low food secure. Thus, I also employ a linear probability triple difference (difference-in-difference-in-differences) models, which have the benefit of relaxing the functional form assumptions of the ordered probit framework. Similar to the models above, I establish

$$\begin{aligned} \text{food insecure}_{ijt} = \tau_1 \text{ACA}_{jt} + \tau_2 \text{SNAP}_{ijt} + \tau_3 (\text{ACA}_{jt} \times \text{SNAP}_{ijt}) \\ + X'_{ijt}\beta + \mu_t + \mu_j + \nu_{ijt} \end{aligned} \tag{7}$$

where $\text{food insecure}_{ijt} \in \{\text{food marginally food insecure, food insecure, very low food secure}\}$ is an indicator measure of household i's food insecurity status in state j at time t, μ_t is a state fixed effect, μ_j is a time fixed effect, and all other variables are defined as above.

The same caveats about the reverse causality between SNAP and food insecurity hold in this model. Thus, I employ an analogous IV approach as above, instrumenting for both SNAP_{ijt} and $\text{ACA}_{jt} \times \text{SNAP}_{ijt}$. Triple difference specifications also allow me to examine the effect of the ACA across the distribution of food insecurity, and allow me to directly interpret the effect of the ACA on falling in to a given food insecurity category. However, they do not take into account the inherent ordering of food insecurity outcomes. For example, suppose the marginal effect of the ACA on marginal food insecurity in a triple difference model is $\kappa > 0$. This tells us that individuals living in states that enacted Medicaid reform are κ percentage points more likely to be marginally food insecure.

This result could have two possible interpretations. The first is that the ACA actually *increased* food hardship, resulting in more families describing at least one food insecure condition. The other possibility is that the ACA increased the probability a household is marginally food insecure by reducing more severe food deprivation conditions, but not com-

pletely alleviating food hardship all together. Thus, care must be employed when interpreting the coefficients in the linear probability models.

Alternative Measures of Food Hardship

All previously described measures of food insecurity estimate the probability a household falls into a certain category of food insecurity, but fail to take into account the variability of food deprivation within a given category, and fail to fully utilize the richness of the the 18 question food security supplement. Dutta and Gundersen (2007) propose new measures that more strongly weight households that experience severe food deprivation. I consider two measures the authors propose—the food insecurity gap and the square of the food insecurity gap, which are based on similar measures utilized in the income poverty literature. These measures are also utilized in Gundersen (2008).

To compute the food insecurity gap, affirmative answers to the 18 question food security supplement are converted into a single indicator by the Rasch scoring method, which measures the probability a household answers in the affirmative depending on the degree of food insecurity experienced by the household and the extent of food insecurity captured by the question. Using this Rasch score, one can create an index that measures how far a food insecure household is from the food security threshold relative to the maximum distance from the food security threshold (i.e. answering in the affirmative to all 18 questions in the food security supplement.) Letting d_{ijt} be the normalized distance from the food security threshold, the normalized food insecurity gap is measured as:

$$d_{ijt} = \begin{cases} \frac{s_{ijt}-e}{z-e} & \text{if } s_i > e \\ 0 & \text{if } s_i \leq e \end{cases} \tag{8}$$

where s_{ijt} is the Rasch scoring indicator, which depends not only on the number of questions an individual answers affirmatively, but also on family structure. The maxima of the Rasch

scores are represented by z, and are 13.03 for a household with children, and 11.05 for a household without children. e is the minimum value for a household to be food insecure, and is 3.10 for a household with children, and 2.56 for a household without children. Thus, all food secure households obtain a value of zero, and all food insecure households obtain a value between zero and one based on the severity of their food insecurity. The food insecurity gap squared is simply d_{ijt}^2.

Since the food insecurity gap measure is directly dependent on the number of children, including IVs that are dependent on the number of children (EITC rates and the family specific SNAP benefit), along with the number of children directly, violates exclusion restrictions. Thus, when modeling the food insecurity gap, I do not include the number of children in the household as an independent variable. The regression framework takes the form

$$\begin{aligned} d_{ijt} = \pi_1 \text{ACA}_{jt} + \pi_2 \text{SNAP}_{ijt} + \pi_3 (\text{ACA} \times \text{SNAP})_{ijt} \\ + X'_{ijt}\Pi + \omega_{1t} + \omega_{1j} + \varepsilon_{ijt} \end{aligned} \tag{9}$$

where ω_{1t}, ω_{1j} are year and state fixed effects, ε_{ijt} is the error term, and all other variables are defined as above. I also address the endogeneity of SNAP in the same manner as before.

The final measure of food deprivation that I consider is the additional amount of money a household would need to spend each week to purchase enough food to meet household needs, which I term the income gap. This measure directly monetizes the severity of food deprivation, providing a continuous scale of income to needs. However, this is also a subjective measure, requiring both accurate assessment and reporting of the money needed to meet food needs. I model the income gap as

$$\begin{aligned} I_{ijt} = \lambda_1 \text{ACA}_{jt} + \lambda_1 \text{SNAP}_{ijt} + \lambda_1 (\text{ACA} \times \text{SNAP})_{ijt} \\ + X'_{ijt}\Lambda + \omega_{2t} + \omega_{2j} + \xi ijt \end{aligned} \tag{10}$$

where ξ_{ijt} is the error term, and the definition of variables and the description of the endogeneity of SNAP are defined as before.

IV. Data

Individual characteristics, along with food security information, come from the 2001-2015 waves of the Current Population Survey Food Security Supplement, also known as the December CPS. The December CPS asks all 18 questions in the food security module, which determines the household's food security status, with households placed into varying categories of food hardship depending on the number of affirmative responses to the questionnaire. These categories are defined above, and represent a spectrum of food hardship, with marginal food security being the least severe, and having very low food security being the most severe.

Figure 7 depicts rates of food security statistics over time, including marginal food security, low food security, and very low food security. In 2007, coinciding with the Great Recession, we see a large uptick in all categories of food hardship. All categories of food hardship remain persistently high until approximately 2013, with around 8.5% of households experiencing marginal food security, 8.5% of households experiencing low food security, and 5% of households experiencing very low food security. These rates begin to trend downward after 2013, coinciding with the implementation of the ACA. Figure 10 in the appendix details the commonly reported, nonmutually exclusive categories of food insecurity over time, showing similar patterns as figure 7.

The December CPS reports the household's Rasch score, which I use to construct the food insecurity gap (and squared gap) as defined in equation (9). The mean of the food insecurity gap (squared food insecurity gap) is 0.13 (0.98) for the population as a whole. Figure 8 depicts the mean of the food insecurity gap for different subsets of households. We see that poorer households have larger gaps, and that households receiving SNAP benefits and households headed by single mothers have larger gaps than average. Interestingly, households in Medicaid expansion states have slightly lower gaps than the national average.

The December CPS also asks questions about how much more income a household would

need to spend each week to purchase enough food to meet household needs, which I term the income gap. After 2011, this variable is topcoded at $200. Thus, I topcode the entire series for consistency. In each year, the dollar amounts range from $1 to the top value. The mean of the income gap is $3.99 per week for the population as a whole. Figure 9 breaks out the income gap by sub-category. Here, we see SNAP recipients have large income gaps, around $17 per week, with poorer households and single mothers also experiencing larger income gaps.

Table 2 presents weighted summary statistics from the December CPS by Medicaid expansion status as well as SNAP receipt. Medicaid expansion states are similar to states that did not expand Medicaid with regard to poverty, age, education, and household composition. Individuals in Medicaid expansion states are more likely to be black, live in a metro area, and experience higher unemployment rates. Individuals receiving SNAP are more likely to be black or Hispanic, female, and unmarried. SNAP recipients are also younger, have more children, and have lower levels of education on average.

To address endogeneity in equation (7), I instrument for SNAP participation with measures of SNAP access and generosity from the USDA Economic Research Service SNAP policy database, along with other state level measures of benefit generosity. The SNAP policy database documents state policy options for SNAP, and provides these data at a monthly level. While the majority of the data are up to date, the most recent version of the SNAP policy database contains missing data for some variables for 2013-2015. I assume missing values take on the value in the previous year, and if the policy was in effect for a portion of the year, that fraction is represented in the policy variable. Means for these instruments are presented in table A1. Data from the University of Kentucky Center for Poverty Research are used for state level economic data, data on the EITC, and data on SNAP benefits. SNAP benefits are calculated at the national level and adjusted for family size and income, resulting in family size specific SNAP benefits.

V. Results

Main Results

I begin by presenting the ordered probit results examining the mutually exclusive categories of food security, using a two stage control function approach to control for the endogeneity of SNAP. I then present linear probability specifications for the nonmutually exclusive food insecurity categories while instrumenting for the endogeneity of SNAP. Finally, I present other measures of food hardship to assess the robustness of the impact of the ACA on food insecurity. All models control for state and year fixed effects, individual characteristics, and all standard errors are clustered at the state level.

Table A3 presents first stage results from the instrumental variables regressions. Not all of the exogenous, state level policy variables are statistically significant individually, but the policy variables are strongly jointly significant, with F statistics of 52.96 and 54.09, respectively, and p-values for F statistics of 0. Moreover, these policy variables have been shown to be predictive in other contexts, as noted in Ziliak (2015). This suggests the policy variables have predictive power for SNAP receipt.

Table 3 presents the ordered probit results from estimating equation (5). I present coefficients, as well as marginal effects (at means) for the three mutually exclusive categories of households experiencing food hardship. The sign of coefficients in table 3 may be directly interpreted, although the coefficients are not interpretable as marginal effects. Using an ordered probit framework allows me to examine how both SNAP and the ACA move households from more severe food insecurity categories to less severe categories. The primary benefit from this framework is that there is no ambiguity in the transition from threshold to threshold, with each cut point representing transition from less severe food insecurity to more severe food insecurity.

Table A2 in the appendix shows results from a standard ordered probit for reference.

The ordered probit results that do not control for reverse causality with SNAP show large, negative values for the impact of the ACA, but also large positive values for the impact of SNAP on food hardship. The two stage control function approach presented in table 3 removes the bias stemming from economic circumstances and participation in SNAP.

Column (1) from table 3 presents the coefficients from the model. Here, we see that all presented coefficients are negative, implying that both the ACA and SNAP reduced food hardship in U.S. households. The own effect of the ACA is 0, and statistically insignificant, suggesting relatively little impact from the ACA alone. While magnitudes are not directly interpretable from coefficients, we are able to see that not only did SNAP reduce the probability a household experienced food hardship, but also that this probability increased for families living in Medicaid expansion states. This suggests some positive spillover from the ACA, with households participating in both programs experiencing more gains than households treated by SNAP or the ACA alone.

Columns (2)-(4) show the marginal effects at each threshold of food security. These marginal effects have the same implications as above. SNAP reduced the probability a household was very low food secure by 10 percentage points, the probability a household was low food secure by 11 percentage points, and the probability a household was marginally food secure by 4 percentage points (all statistically significant at the 5% level). These results also suggest that the impact of SNAP is strongest for those households experiencing more severe food insecurity, but further suggest that SNAP alleviates all levels of food hardship, moving households towards full food security. However, households in each of these food secure categories saw additional gains from the ACA. The marginal effects of the interaction between the ACA and SNAP suggest that households participating in SNAP and in Medicaid expansion states saw an additional reduction of 4 percentage points in the probability of being very low food secure (14 percentage points cumulative), an additional 4.3 percentage point reduction in the probability of being low food secure (15 percentage points cumulative), and an additional reduction in the probability of being marginally food secure of 1.7 percentage

points (6 percentage points cumulative). All marginal effects for the interaction of the ACA and SNAP are statistically significant at the 10% level, and while the marginal effects at the low food secure and very low food secure levels are not statistically different from one another, both are statistically different from the marginal effect at the marginally food secure level.

These results suggest large, increasing returns to program participation. Schmidt et al. (2015) found that $1,000 in additional non-food benefits reduced the incidence of food insecurity by roughly 0.9 percentage points. While low food security and food insecurity measure slightly different types of food hardship, a 4 percentage point reduction in the probability of being low food secure is roughly equivalent to $4,000 in additional non-food benefits. The average spending per enrollee in Medicaid was $5,736[4] in 2014, suggesting that the Medicaid expansions increased the value of the benefit for SNAP recipients by nearly 70%.

Table 4 presents the results of estimating equation (7) at different, non mutually exclusive food insecurity thresholds. For reference, I present results from OLS regressions that estimate the impact of the ACA where the endogeneity of SNAP is not accounted for in table A4 in the appendix, once again demonstrating the reverse causality associated with SNAP.

Column (1) shows the impact of the ACA on the commonly reported summary category of food insecurity. Here, we see no statistical relationship between Medicaid expansion alone and food insecurity. However, for households who also participate in SNAP, the ACA further reduced the probability they are food insecure by 9 percentage points. In my sample, 52% of households participating in SNAP are food insecure. This 9 percentage point reduction translates into a 17% decrease in the probability a household is food insecure. Thus, program interaction matters, with increasing returns to program participation for reductions in food insecurity.

Column (2) examines the effect of the ACA on marginal food insecurity. Here, we still see the impact of multiple program participation as well as increasing returns to program par-

[4] http://www.kff.org/medicaid/state-indicator/medicaid-spending-per-enrollee/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D

ticipation, with SNAP households seeing a reduction in the probability of being marginally food insecure of 18.9 percentage points on a basis of 75%, or a 25% reduction in the probability of being marginally food insecure. However, unlike with the food insecure category, we see Medicaid expansion through the ACA reduced the probability of being marginally food insecure, or the probability of reporting at least one food insecure condition, by 6.3 percentage points on a basis of 21%, or a 30% reduction. This implies that the ACA had a differential impact across the food insecurity distribution, more strongly benefiting those experiencing less severe food insecurity.

This is strongly contrasted with results in column (3), where we see no impact of the ACA on the probability of experiencing very low food security, regardless of SNAP participation. However, we see the own effect from SNAP reduces the probability a household experiences very low food security by 76 percentage points. The large coefficient suggests that SNAP strongly reduces the probability individuals experience extreme food hardship, although individuals who leave this category may still be food insecure. This suggests that at the low end of the food security distribution, SNAP does most of the work in alleviating food hardship, with little effect from healthcare programs. These results suggest that the ACA and SNAP assist those at different ends of the food insecurity spectrum, and also present the first IV estimates of SNAP on very low food security that I'm aware of.

I also report first stage statistics to assess the performance of the instruments. The Kleibergen under-identification statistics reject the null hypothesis that the SNAP access measures and state policy variables are only weakly correlated with SNAP participation. Since I have more instruments than endogenous regressors, I also report the Hansen J statistic as a test of overidentifying restrictions. Here, the large p-values result in failing to reject the null hypothesis that the instruments are uncorrelated with the error term at any standard threshold, giving greater confidence in the validity of the instrument set.

While the results in column (1) coincide with the notions of program interaction, some of the results from columns (2) and (3), specifically the coefficients on SNAP, are surprising

in sign and magnitude. Taken at face value, the coefficient on SNAP in column (4) suggests participating in SNAP *increases* the probability an individual is marginally food insecure by 47 percentage points, even when instrumenting for SNAP participation. In column (6), the large, negative coefficient on SNAP suggests a surprisingly large decrease in very low food security. However, the findings in table 3 provide the needed context. Here, it seems that SNAP reduces food hardship at all levels, but does not completely alleviate it, suggesting SNAP increases the probability of being higher on the food security distribution (more food secure), and decreases the probability of being lower on the food insecurity distribution (less food secure).

The key finding of this paper is that the ACA reduces the probability a household experiences food insecurity, but that these reductions are not uniform across the distribution of food insecurity, nor are they uniform across the SNAP benefit population. Tables 3 and 4 together show the interplay of Medicaid expansion through the ACA and SNAP. The ACA complemented the traditional food support system, further reducing food insecurity for those already receiving SNAP benefits. Moreover, the ACA provided the largest reductions for those experiencing less severe food insecurity, with any effect at the high end of the food insecurity distribution dominated by SNAP benefits. Furthermore, I show that SNAP moves people up the food security distribution at all levels.

Additional Measures of Food Hardship

I now turn to other measures of food hardship. Table 5 presents IV results estimating the impact of the ACA on the food insecurity gap, the square of the food insecurity gap, and the income gap as defined in equations (9) and (10). OLS results are available in table A5 in the appendix. Here, I attempt to more fully utilize the entirety of the food security supplement in the December CPS. Regardless of whether we consider only the food insecurity gap (d_{ijt}) in column (1), or the square of the gap (d^2_{ijt}) in column (2), the results are the same. I find that the own effect of the ACA is positive, suggesting that

households in Medicaid expansion states are more likely to be farther from the food security threshold. However, for households participating in SNAP, the ACA reduces the distance to the food security threshold by approximately two percentage points (although statistically insignificant). We also notice that SNAP participation greatly reduces the distance to the food security threshold by approximately 39 percentage points in both columns (1) and (2). The Kleibergen under-identification statistics suggest that the instruments may be weak in this context, not allowing me to fully disentangle the effect of Medicaid expansion and SNAP. While less conclusive than the results from tables 3 and 4, these results still suggest there are increasing returns to program participation, with the ACA and SNAP acting in concert to reduce food hardship.

The income gap provides the benefit of directly monetizing the amount of food hardship experienced by the household, at the expense of potential increases in measurement error. The question as posed by the CPS asks individuals to opine on the amount of money that they would require to meet food needs. The hypothetical nature of the question inherently poses uncertainty in the measure. However, in column (3) I (imprecisely) estimate that the ACA reduces the amount of money a household needs to meet food needs by approximately $5 per week. I once again show increasing returns to program participation, with the magnitude of the effect larger for households participating in SNAP. The coefficient on SNAP is positive. Taken at face value, this suggests SNAP increases the amount of money a household needs to meet food requirements; however, the coefficients on the ACA suggest beneficial effects of Medicaid expansion.

These additional measures are less commonly reported in both the food insecurity literature and policy debates. However, they still suggest that the Medicaid expansions from the ACA and SNAP work together to reduce food insecurity, and are more effective as a pair than either alone. While precise identification of these parameters is difficult, they compliment earlier, more ubiquitous measures of food insecurity.

VI. Conclusion

The focus of the Affordable Care Act was to overhaul the American healthcare system through mandated coverage, subsidized private coverage, reforms in Medicare taxes and spending, and significant expansions in the Medicaid program to low income populations. Gruber (2011) provides an overview of the aims and predicted consequences of the ACA, documenting many of the challenges associated with assessing the impact of the law. However, he does not consider the impact that expanded Medicaid coverage might have on food insecurity, one of the largest public health concerns facing the nation.

Participating in multiple safety net programs is one way households may increase total resources available to alleviate food hardship. This paper examines the effect of the Affordable Care Act, one of the largest increases in Medicaid coverage, on food insecurity. While the primary goal of Medicaid expansion through the ACA was to increase healthcare coverage across America, I find strong evidence that the ACA also reduced food hardship across the spectrum of food security, but that these gains were concentrated among those who also participated in SNAP. I find the ACA reduced the probability a household participating in SNAP falls into the two lowest food security categories by 4 percentage points, and reduced the probability these households were classified as food insecure by 9 percentage points.

One consistent implication of the results implies that the ACA had a differential impact depending on whether the household received SNAP benefits. Despite the reverse causality between SNAP and food security, demonstrated in this work and elsewhere, I show that households that both reside in Medicaid expansion states and receive SNAP benefits experience larger gains in food security than households benefiting from either program alone. Households in Medicaid expansion states see a 40% greater reduction in the probability of being very low food secure or low food secure than households participating in SNAP alone. Households that participate in SNAP and live in Medicaid expansion states see a decrease in the probability of being food insecure, nearly doubling the impact from SNAP alone.

Even under alternative measures of food hardship, I consistently find evidence for increasing returns to food security from program participation; living in a Medicaid expansion state and participating in SNAP have larger benefits for food security than either program alone.

Increasing returns to program participation shows that by analyzing these programs separately, we risk mis-characterizing the benefits of the safety net. Rarely do families participate in only one safety net program. By receiving multiple types of benefits, households may be able to redirect resources in ways that compound gains in resources from a single program. As this study shows, by including multiple benefit types in our analyses, we may be able to get a more complete picture of where policy actually bites. This is especially relevant for researchers studying the impact of the safety net on poverty related issues. By limiting the scope of analysis for safety net issues, researchers narrow the spectrum of results that might otherwise be present. Ultimately, this paper shows that public health insurance has benefits beyond healthcare coverage. While access to quality medical care is crucial for the health of all families, so too is access to food. As many studies have shown, food insecurity can have large, detrimental effects on health. I show that public healthcare can make large strides in alleviating health risks posed by food insecurity.

References

Almond, D., Hoynes, H. W., Schanzenbach, D. W., 2011. Inside the War on Poverty: The Impact of Food Stamps on Birth Outcomes. The Review of Economics and Statistics 93 (2), 387–403.

Antwi, Y. A., Moriya, A. S., Simon, K. I., 2015. Access to Health Insurance and the Use of Inpatient Medical Care: Evidence from the Affordable Care Act Young Adult Mandate. Journal of Health Economics 39, 171–187.

Bartfeld, J., Dunifon, R., 2006. State-Level Predictors of Food Insecurity Among Households With Children. Journal of Policy Analysis and Management 25 (4), 921–942.

Bhattacharya, J., Currie, J., Haider, S., 2004. Poverty, Food Insecurity, and Nutritional Outcomes in Children and Adults. Journal of Health Economics 23 (4), 839–862.

Bitler, M. P., 2015. The Health and Nutrition Effects of SNAP: Selection into the Program and a Review of the Literature on Its Effects. In: Bartfeld, J., Gundersen, C., Smeeding, T., Ziliak, J. P. (Eds.), SNAP Matters: How Food Stamps Affect Health and Well-Being. Stanford University Press.

Black, L. I., Cohen, R. A., 2015. Insurance Status by State Medicaid Expansion Status: Early Release of Estimates from the National Health Interview Survey, 2013–September 2014. National Center for Health Statistics.

Borjas, G. J., 2004. Food Insecurity and Public Assistance. Journal of Public Economics 88 (7), 1421–1443.

Chi, D. L., Masterson, E. E., Carle, A. C., Mancl, L. A., Coldwell, S. E., 2014. Socioeconomic Status, Food Security, and Dental Caries in US Children: Mediation Analyses of Data from the National Health and Nutrition Examination Survey, 2007–2008. Journal Information 104 (5).

Coleman-Jensen, A., Rabbitt, M. P., Gregory, C., Singh, A., 2017. Household Food Security in the United States in 2016. U.S. Department of Agriculture, Economic Research Service (ERR-237).

Cook, J. T., Black, M., Chilton, M., Cutts, D., de Cuba, S. E., Heeren, T. C., Rose-Jacobs, R., Sandel, M., Casey, P. H., Coleman, S., et al., 2013. Are Food Insecurity's Health Impacts Underestimated in the US population? Marginal Food Security Also Predicts Adverse Health Outcomes in Young US Children and Mothers. Advances in Nutrition: An International Review Journal 4 (1), 51–61.

Cook, J. T., Frank, D. A., Berkowitz, C., Black, M. M., Casey, P. H., Cutts, D. B., Meyers, A. F., Zaldivar, N., Skalicky, A., Levenson, S., et al., 2004. Food Insecurity is Associated With Adverse Health Outcomes Among Human Infants and Toddlers. The Journal of Nutrition 134 (6), 1432–1438.

Courtemanche, C., Marton, J., Ukert, B., Yelowitz, A., Zapata, D., 2017. Impacts of the Affordable Care Act on Health Insurance Coverage in Medicaid Expansion and Non-Expansion States. Journal of Policy Analysis and Management 36 (1), 178–210.

Dutta, I., Gundersen, C., 2007. Measures of Food Insecurity at the Household Level. In: Food Security Indicators, Measurement, and the Impact of Trade Openness: Series: WIDER Studies in Development Economics. Oxford University Press.

Garrett, B., Kaestner, R., 2014. The Best Evidence Suggests the Effects of the ACA on Employment Will Be Small Timely Analysis of Immediate Health Policy Issues. Tech. rep., Urban Institute.

Gregory, C., Rabbitt, M. P., Ribar, D. C., 2015. The Supplemental Nutrition Assistance Program and Food Insecurity. In: Bartfeld, J., Gundersen, C., Smeeding, T., Ziliak, J. P. (Eds.), SNAP Matters: How Food Stamps Affect Health and Well-Being. Stanford University Press.

Gruber, J., 2011. The Impacts of the Affordable Care Act: How Reasonable Are the Projections? Tech. rep., National Bureau of Economic Research.

Gundersen, C., 2008. Measuring the Extent, Depth, and Severity of Food Insecurity: an Application to American Indians in the USA. Journal of Population Economics 21 (1), 191–215.

Gundersen, C., Kreider, B., 2009. Bounding the Effects of Food Insecurity on Childrens Health Outcomes. Journal of Health Economics 28 (5), 971–983.

Gundersen, C., Kreider, B., Pepper, J., 2011. The Economics of Food Insecurity in the United States. Applied Economic Perspectives and Policy.

Gundersen, C., Ribar, D., 2011. Food Insecurity and Insufficiency at Low Levels of Food Expenditures. Review of Income and Wealth 57 (4), 704–726.

Gundersen, C., Ziliak, J. P., 2014. Childhood Food Insecurity in the US: Trends, Causes, and Policy Options. The Future of Children 24 (2), 1–19.

Gundersen, C., Ziliak, J. P., 2015. Food Insecurity and Health Outcomes. Health Affairs.

Heflin, C. M., Ziliak, J. P., 2008. Food Insufficiency, Food Stamp Participation, and Mental Health. Social Science Quarterly 89 (3), 706–727.

Howard, L. L., 2011. Does Food Insecurity at Home Affect Non-Cognitive Performance at School? A Longitudinal Analysis of Elementary Student Classroom Behavior. Economics of Education Review 30 (1), 157–176.

Hoynes, H., Schanzenbach, D. W., 2015. U.S. Food and Nutrition Programs. NBER Working Papers 21057, National Bureau of Economic Research, Inc.

Hoynes, H., Schanzenbach, D. W., Almond, D., 2016. Long-Run Impacts of Childhood Access to the Safety Net. The American Economic Review 106 (4), 903–934.

Hoynes, H. W., McGranahan, L., Schanzenbach, D. W., 2015. SNAP and Food Consumption. In: Bartfeld, J., Gundersen, C., Smeeding, T., Ziliak, J. P. (Eds.), SNAP Matters: How Food Stamps Affect Health and Well-Being. Stanford University Press.

Hu, L., Kaestner, R., Mazumder, B., Miller, S., Wong, A., 2016. The Effect of the Patient Protection and Affordable Care Act Medicaid Expansions on Financial Well-Being. National Bureau of Economic Research Working Paper.

Meyerhoefer, C. D., Yang, M., 2011. The Relationship Between Food Assistance and Health: A Review of the Literature and Empirical Strategies for Identifying Program Effects. Applied Economic Perspectives and Policy.

Moffitt, R., 2015. Multiple Program Participation and the SNAP Program. In: Bartfeld, J., Gundersen, C., Smeeding, T., Ziliak, J. P. (Eds.), SNAP Matters: How Food Stamps Affect Health and Well-Being. Stanford University Press.

Schmeiser, M. D., 2012. The Impact of Long-Term Participation in the Supplemental Nutrition Assistance Program on Child Obesity. Health Economics 21 (4), 386–404.

Schmidt, L., Shore-Sheppard, L., Watson, T., 2015. The Effect of Safety Net Programs on Food Insecurity. Journal of Human Resources.

Sommers, B. D., Baicker, K., Epstein, A. M., 2012. Mortality and Access to Care Among Adults After State Medicaid Expansions. New England Journal of Medicine 367 (11), 1025–1034.

Wagner, K. L., 2015. Medicaid Expansions for the Working Age Disabled: Revisiting the Crowd-Out of Private Health Insurance. Journal of Health Economics 40, 69–82.

Wherry, L. R., Miller, S., 2016. Early Coverage, Access, Utilization, and Health Effects Associated With the Affordable Care Act Medicaid Expansions: A Quasi-experimental Study. Annals of Internal Medicine 164 (12), 795–803.

Yen, S. T., 2010. The Effects of SNAP and WIC Programs on Nutrient Intakes of Children. Food Policy 35 (6), 576–583.

Ziliak, J. P., 2015. Why Are So Many Americans on Food Stamps? The Role of the Economy, Policy, and Demographics. In: Bartfeld, J., Gundersen, C., Smeeding, T., Ziliak, J. P. (Eds.), SNAP Matters: How Food Stamps Affect Health and Well-Being. Stanford University Press.

Tables and Figures

Figure 1: Response Rates to FI Questions

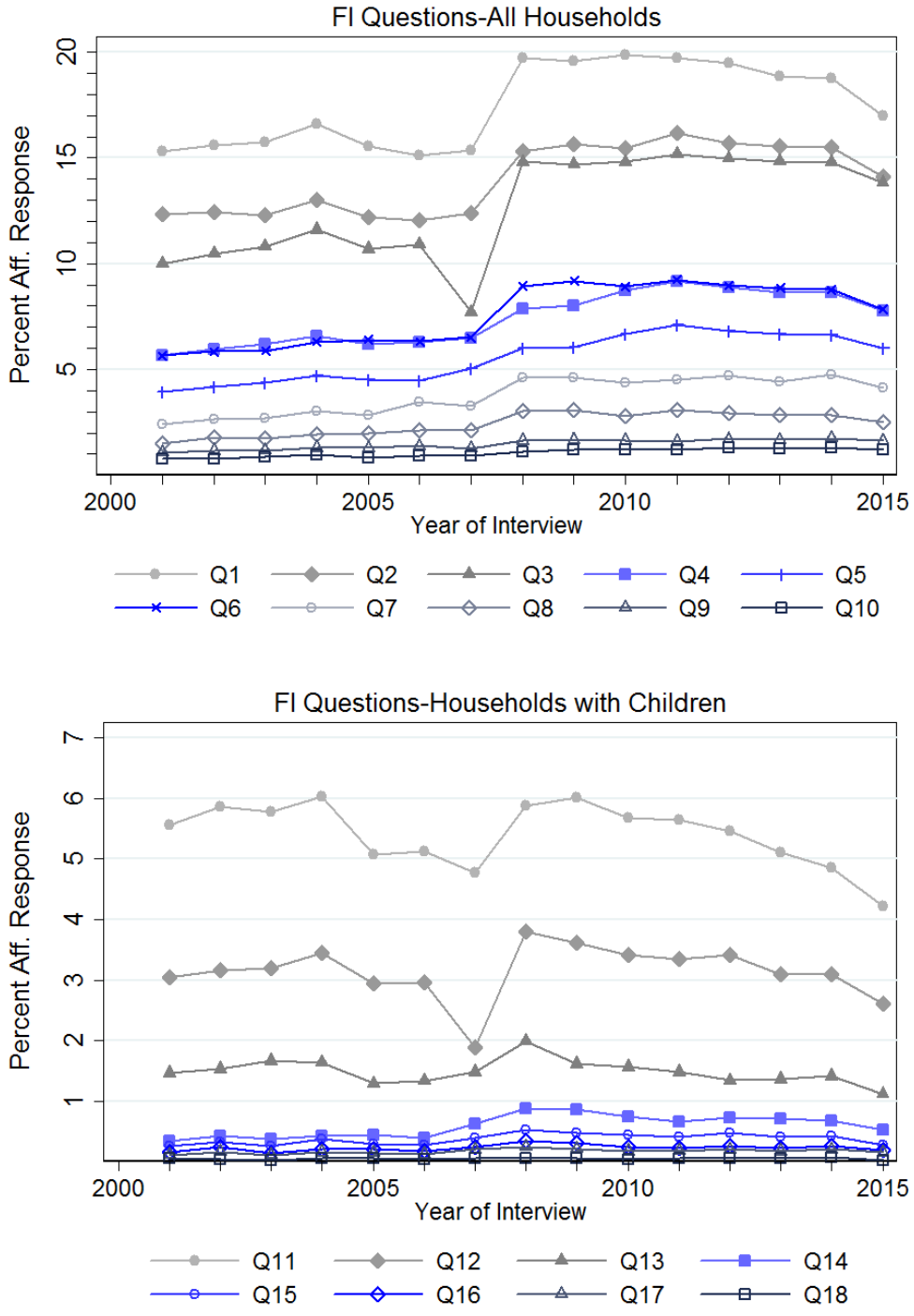

Figure 2: State Medicaid Expansion

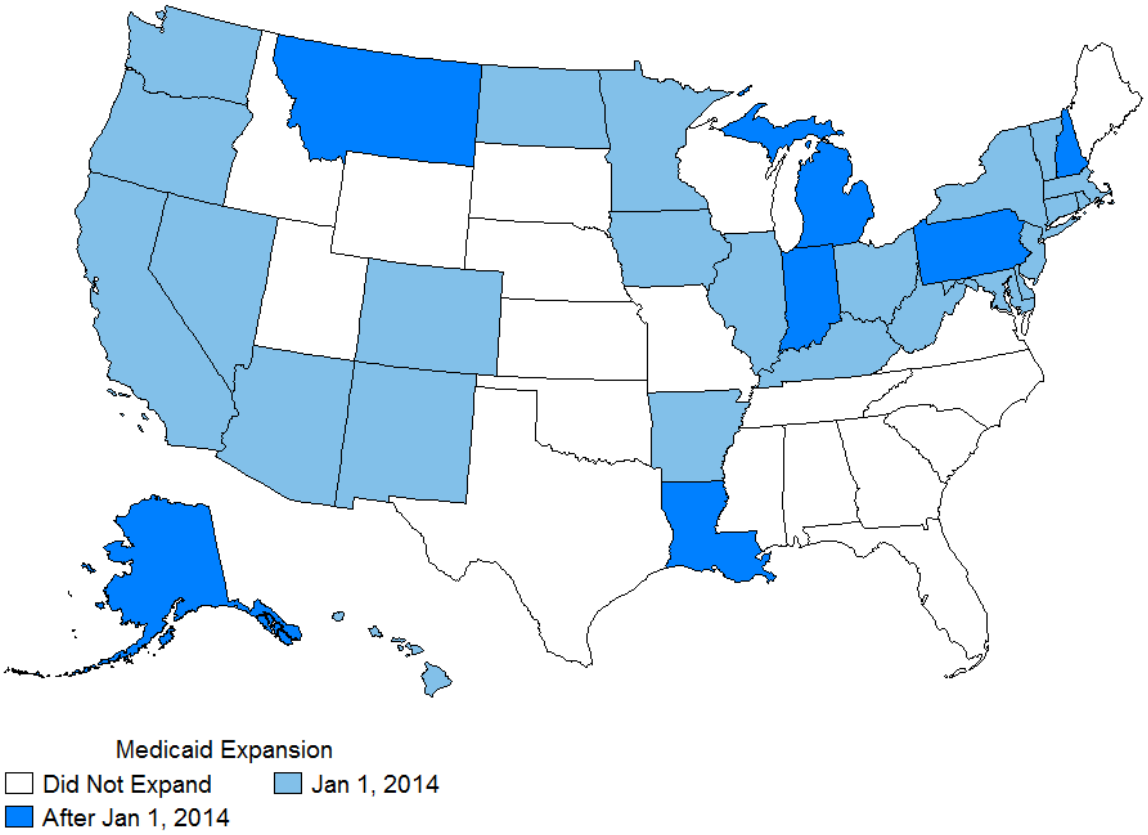

Figure 3: Food Insecurity Rates: 2013

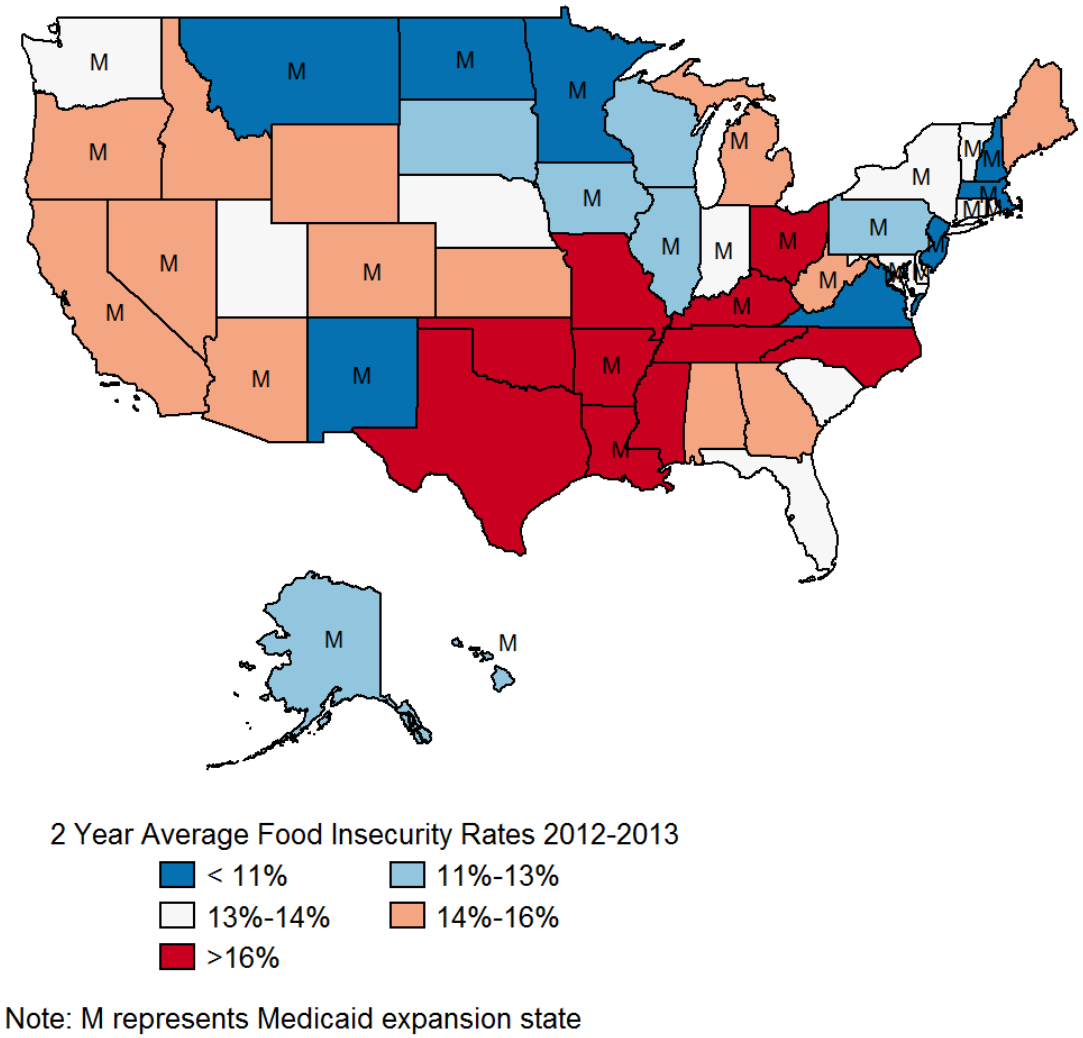

Figure 3 (Cont.): Food Insecurity Rates: 2015

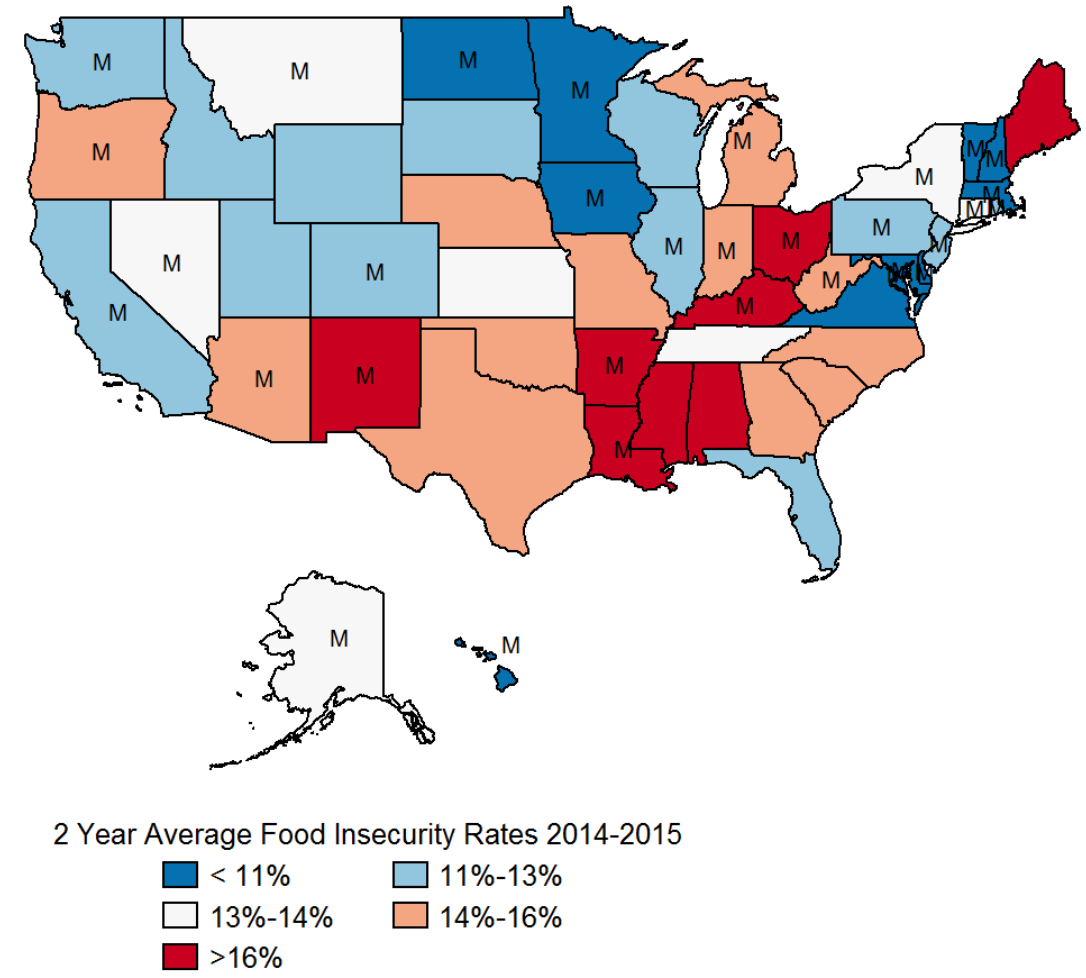

Figure 4: Medicaid Subsidy

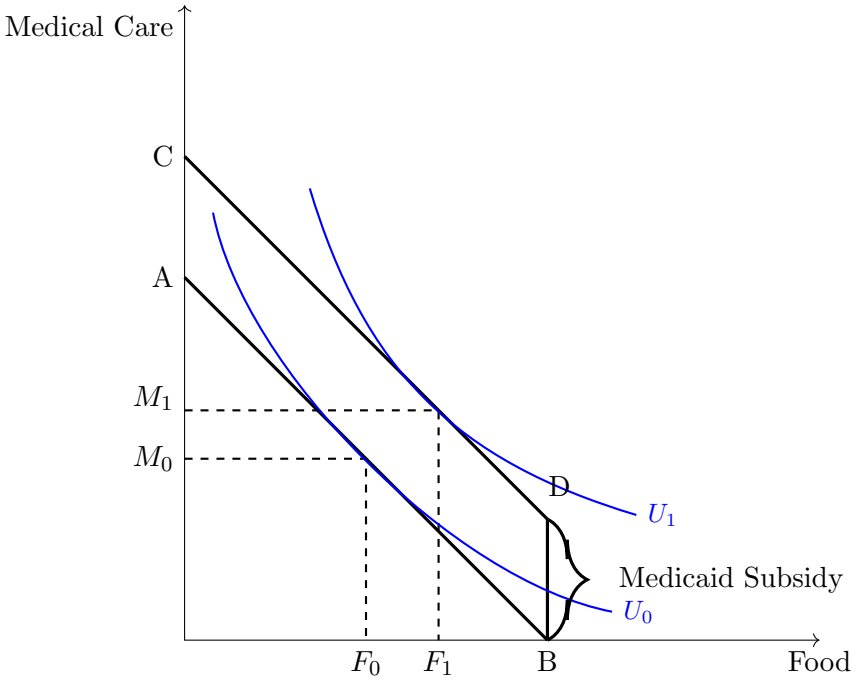

Figure 5: SNAP Subsidy

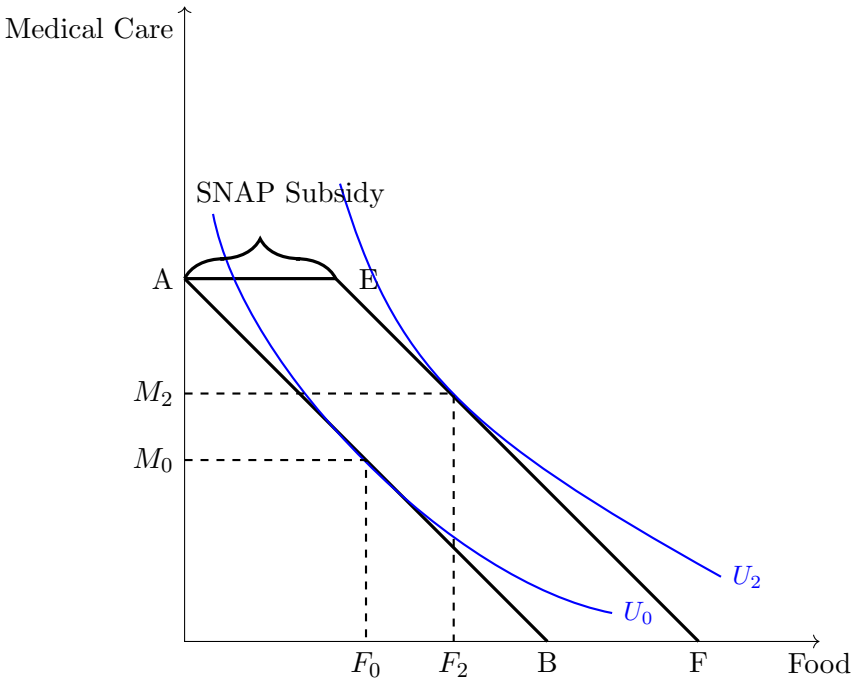

Figure 6: SNAP & Medicaid Subsidies

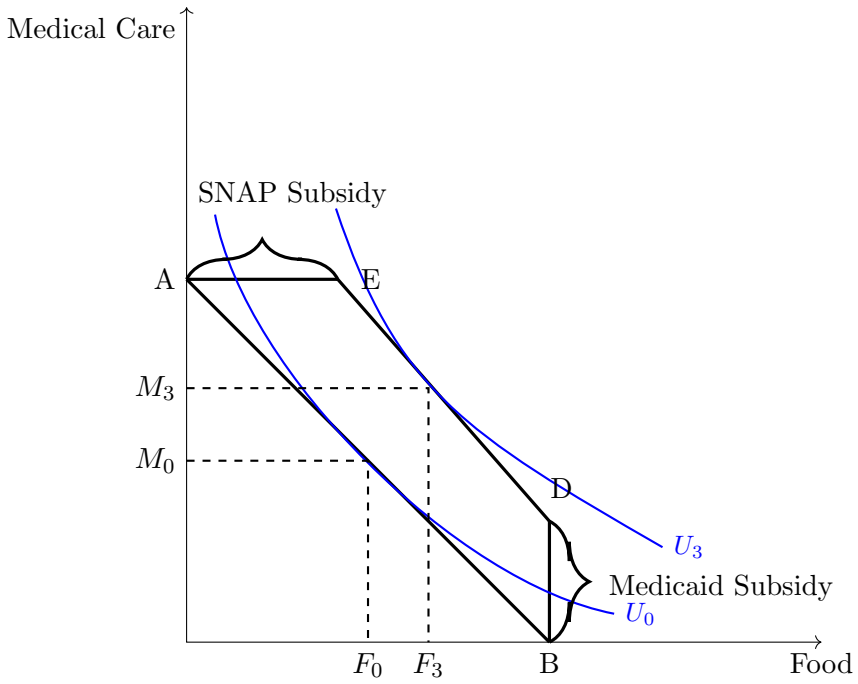

Figure 7

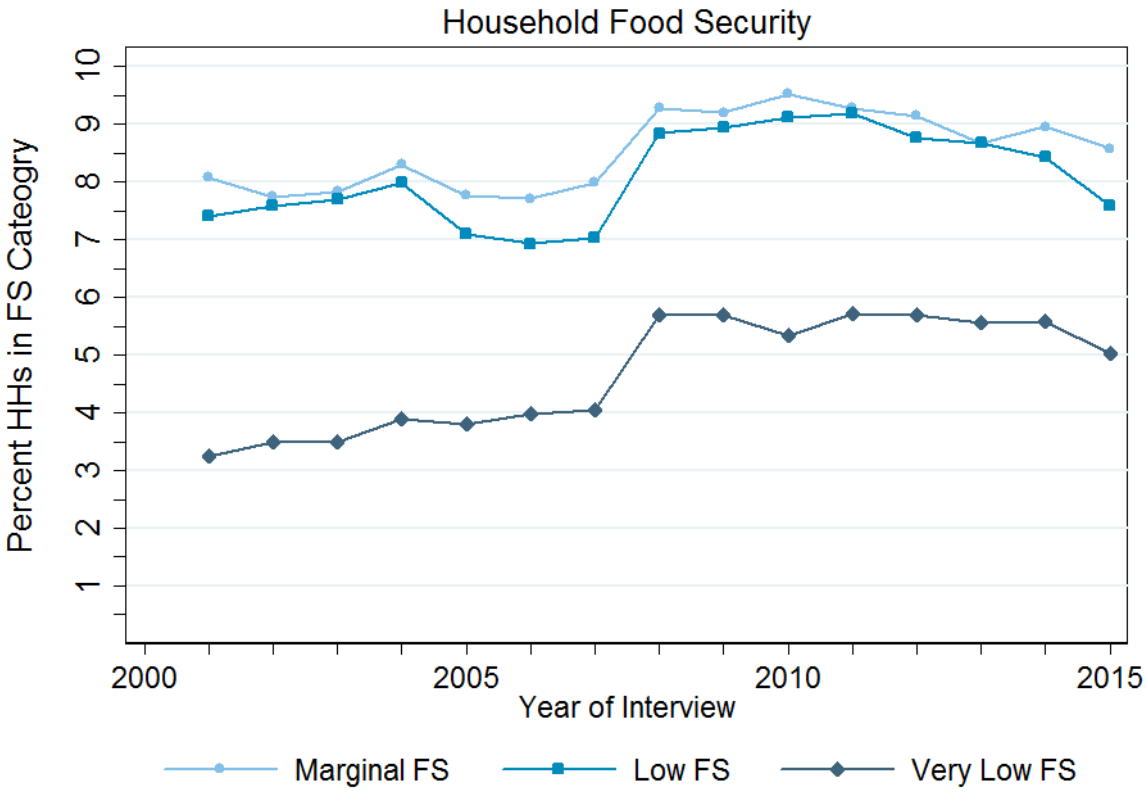
Household Food Security
Percent HHs in FS Cateogry
1
2
3
4
5
6
7
8
9
10
2000
2005
2010
2015
Year of Interview
Marginal FS
Low FS
Very Low FS

Figure 8

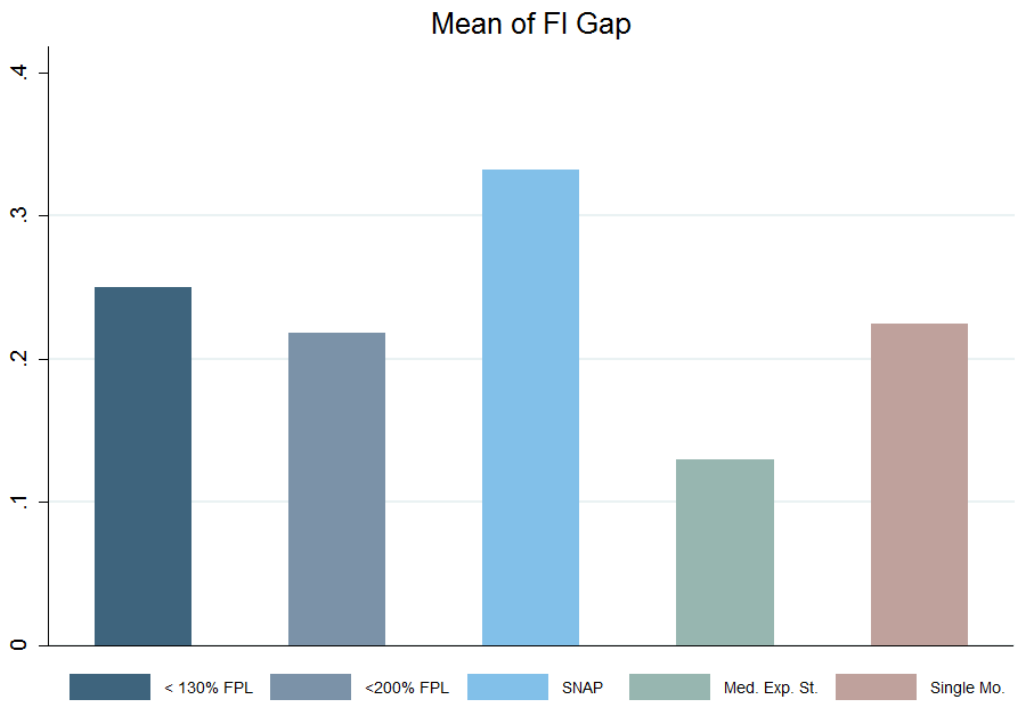

Figure 9

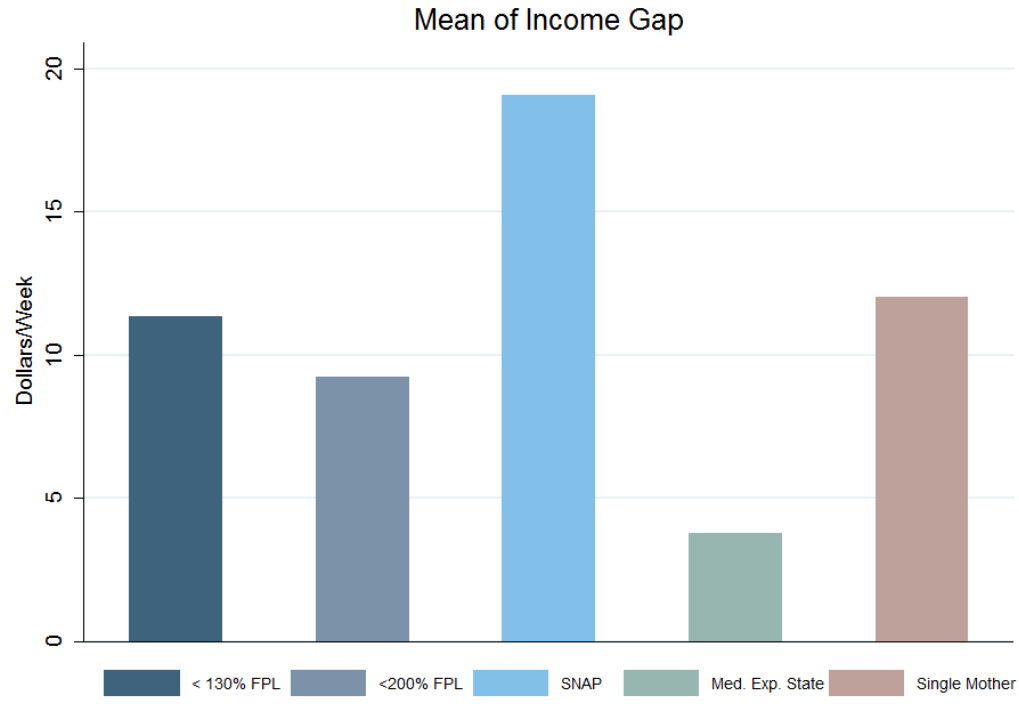

Table 1: Food Insecurity Questions

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 0-17
11	"We relied on only a few kinds of low-cost food to feed our children because we were running out of money to buy food." Was that often, sometimes, or never true for you in the last 12 months?
12	"We couldnt 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 childrens 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 happenalmost 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)

Table 2: Summary Statistics by Medicaid Expansion and SNAP Receipt

	ACA		No ACA	
	SNAP	No SNAP	SNAP	No SNAP
<130% Pov. Line	0.75	0.13	0.76	0.15
<185% Pov. Line	0.85	0.22	0.87	0.26
<200% Pov. Line	0.88	0.24	0.89	0.28
WIC	0.29	0.08	0.28	0.08
Free Lunch	0.83	0.35	0.83	0.36
Free Break.	0.81	0.69	0.86	0.77
Age	43.93	50.35	43.73	49.86
High School	0.36	0.28	0.36	0.29
Some College	0.26	0.28	0.26	0.29
College	0.06	0.34	0.05	0.30
Hisp	0.21	0.11	0.19	0.11
White	0.67	0.83	0.61	0.82
Black	0.26	0.10	0.34	0.14
Unemp.	7.01	6.66	6.57	6.15
Num. in HH	3.05	2.49	3.09	2.43
Num. Child	1.07	0.52	1.06	0.51
Female	0.68	0.48	0.69	0.47
Married	0.26	0.53	0.27	0.54
Metro	0.82	0.87	0.74	0.80
Obs.	31,757	399,276	19,932	217,359

Note: Household survey weights used.

Table 3: Ordered Probit Coefficients and Marginal Effects: Two-Stage

	Coeffs. (1)	Marginal FS (2)	Low FS (3)	Very Low FS (4)
ACA	−0.000	−0.000	−0.000	−0.000
	(0.051)	(0.003)	(0.009)	(0.008)
SNAP	−0.626**	−0.043**	−0.107**	−0.099**
	(0.264)	(0.018)	(0.045)	(0.042)
ACA × SNAP	−0.254*	−0.017*	−0.043*	−0.040*
	(0.148)	(0.010)	(0.025)	(0.023)
Obs.	269,208	269,208	269,208	269,208

Note: standard errors clustered at the state level, * p <0.10, ** p <0.05, *** p <0.01. Ordering for probit is 0—fully food secure, 1—marginal food security, 2—low food security, 3—very low food security. Household survey weights used. Controls include gender, household size, number of children, marital status, age, age squared, disability status, race, education, urban/rural status, number of medicaid beneficiaries in the state, governor party affiliation, and the unemployment rate

Table 4: Triple Difference LPM: IV

	Food Insecure (1)	Marginal FI (2)	Very Low FI (3)
ACA	0.011	−0.063***	0.031
	(0.020)	(0.023)	(0.027)
SNAP	−0.136*	0.472***	−0.759***
	(0.080)	(0.103)	(0.080)
ACA × SNAP	−0.101**	−0.126**	0.042
	(0.048)	(0.062)	(0.080)
Under ID Kleibergen	27.2610	27.2610	27.2610
	(0.0387)	(0.0387)	(0.0387)
Hansen J	18.7623	16.8340	16.1946
	(0.2247)	(0.3289)	(0.3692)
Obs.	269,208	269,208	269,208

Note: standard errors clustered at the state level, * p <0.10, ** p <0.05, *** p <0.01. P-values in parentheses for first stage statistics. Household survey weights used. Controls include gender, household size, number of children, marital status, age, age squared, disability status, race, education, urban/rural status, number of medicaid beneficiaries in the state, governor party affiliation, and the unemployment rate

Table 5: Alternative Measures of Food Hardship

	FI Gap (1)	FI Gap Squared (2)	Inc. Gap (3)
ACA	0.034*	0.048**	−0.533
	(0.020)	(0.020)	(1.543)
SNAP	−0.391***	−0.399***	14.109*
	(0.046)	(0.042)	(7.885)
ACA × SNAP	−0.052	−0.078	−4.060
	(0.049)	(0.052)	(5.327)
Under ID Kleibergen	22.8925	22.8925	27.7759
	(0.1166)	(0.1166)	(0.0336)
Hansen J	16.8694	18.6967	20.9851
	(0.3267)	(0.2278)	(20.9851)
Obs.	178,969	178,969	248,851

Note: standard errors clustered at the state level, * p <0.10, ** p <0.05, *** p <0.01. P-values in parentheses for first stage statistics. Household survey weights used. Controls include gender, household size, number of children, marital status, age, age squared, disability status, race, education, urban/rural status, number of medicaid beneficiaries in the state, governor party affiliation, and the unemployment rate

Appendix A.-Additional Tables and Figures

Figure 10

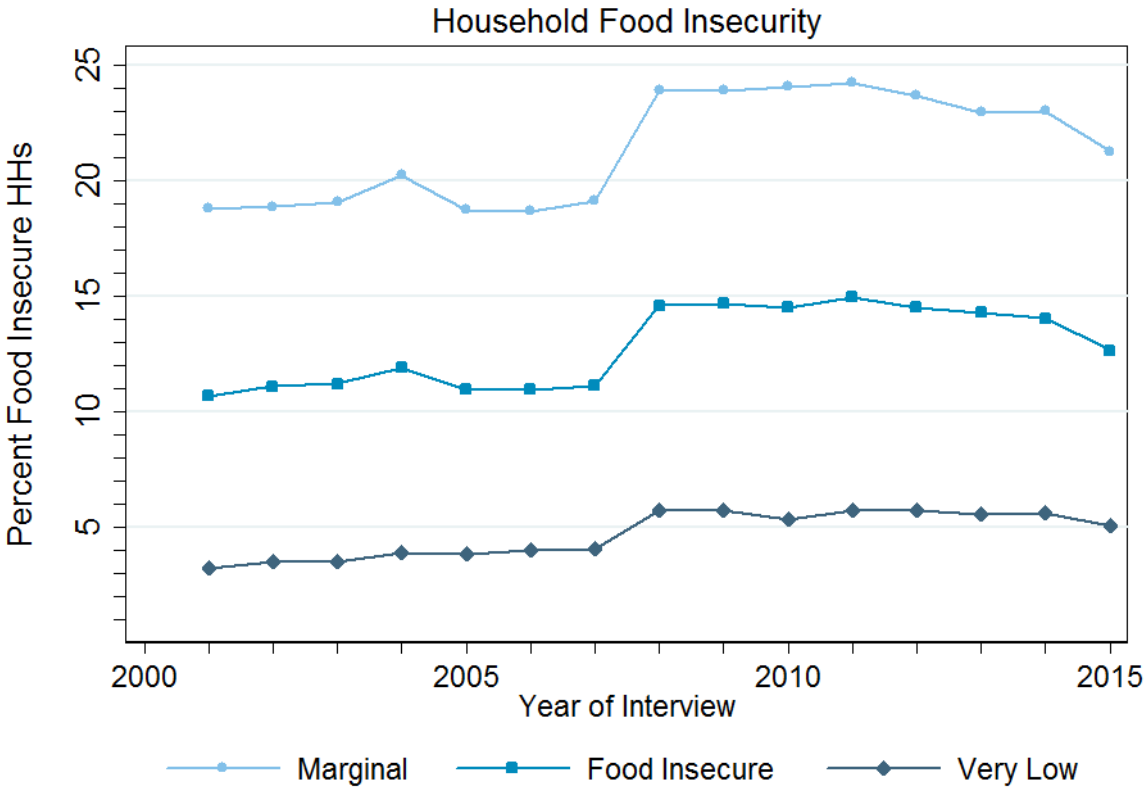

Table A1: IV Summary by Medicaid Expansion

	Medicaid Expansion	Non-Expansion
Broad Based Categorical Eligibility	0.53	0.48
	(0.49)	(0.49)
Excl. All Vehicles	0.71	0.55
	(0.44)	(0.49)
Higher Vehicle Exemption	0.03	0.30
	(0.16)	(0.45)
Requires Fingerprinting	0.25	0.14
	(0.43)	(0.34)
Online Application	0.54	0.52
	(0.49)	(0.49)
Digital Signiture	0.39	0.47
	(0.48)	(0.49)
Max SNAP Benefit	3.60	3.56
	(1.55)	(1.51)
ln(Min. Wage)	1.94	1.86
	(0.12)	(0.09)
Max EITC	15.58	15.51
	(17.85)	(17.79)

Note: Household survey weights used.

Table A2: Ordered Probit Coefficients and Marginal Effects

	Coeffs.	Marginal FS	Low FS	Very Low FS
	(1)	(2)	(3)	(4)
ACA	-0.208^{***}	-0.014^{***}	-0.035^{***}	-0.033^{***}
	(0.033)	(0.002)	(0.006)	(0.005)
SNAP	0.612^{***}	0.042^{***}	0.104^{***}	0.097^{***}
	(0.011)	(0.001)	(0.001)	(0.002)
ACA × SNAP	0.125^{***}	0.009^{***}	0.021^{***}	0.020^{***}
	(0.030)	(0.002)	(0.005)	(0.005)
Obs.	269,208	269,208	269,208	269,208

Note: standard errors clustered at the state level, * p <0.10, ** p <0.05, *** p <0.01. Ordering for probit is 0—fully food secure, 1—marginal food security, 2—low food security, 3—very low food security. Household survey weights used. Controls include gender, household size, number of children, marital status, age, age squared, disability status, race, education, urban/rural status, number of medicaid beneficiaries in the state, governor party affiliation, and the unemployment rate

Table A3: First Stage Results, Food Rank Second Stage Dependent Variable

	SNAP (1)	ACA × SNAP (2)
Broad Based Categorical Eligibility	0.007	−0.005**
	(0.006)	(0.002)
Excl. All Vehicles	−0.001	0.001
	(0.007)	(0.002)
Higher Vehicle Exemption	−0.002	0.003*
	(0.012)	(0.002)
Requires Fingerprinting	−0.009	0.012*
	(0.008)	(0.007)
Online Application	0.001	−0.005**
	(0.006)	(0.002)
Digital Signiture	0.006	0.001
	(0.008)	(0.002)
Max SNAP Benefit	0.015***	−0.000
	(0.003)	(0.000)
ln(Min. Wage)	−0.021	−0.006
	(0.029)	(0.011)
Max EITC	0.000	−0.000**
	(0.000)	(0.000)
ACA × BBCE	−0.014	0.014
	(0.009)	(0.010)
ACA × Excl. All Vehicles	0.013	0.002
	(0.015)	(0.020)
ACA × Fingerprint	0.003	−0.026
	(0.016)	(0.025)
ACA × Online App.	0.041	−0.091
	(0.046)	(0.066)
ACA × Digital Sig.	0.016	−0.011
	(0.023)	(0.035)
ACA × Max SNAP Benefit	−0.006***	0.001
	(0.002)	(0.005)
ACA × ln(Min. Wage)	0.051	0.148***
	(0.080)	(0.038)
ACA × Max EITC	−0.003***	0.004***
	(0.000)	(0.000)
F Stat.	52.26	54.09
	(0.000)	(0.000)
Obs.	275,030	275,030

Note: standard errors clustered at the state level, * p <0.10, ** p <0.05, *** p <0.01. Household survey weights used. Controls include gender, household size, number of children, marital status, age, age squared, disability status, race, education, urban/rural status, number of medicaid beneficiaries in the state, governor party affiliation, and the unemployment rate. p-value for F statistic in parentheses.

Table A4: Triple Differece: LPM

	Food Insecure (1)	Marginal FI (2)	Very Low FI (3)
ACA	−0.057***	−0.105***	−0.021***
	(0.010)	(0.013)	(0.005)
SNAP	0.220***	0.242***	0.118***
	(0.003)	(0.003)	(0.003)
ACA × SNAP	0.039***	0.063***	0.010
	(0.012)	(0.014)	(0.009)
Obs.	269,208	269,208	269,208

Note: standard errors clustered at the state level, * p <0.10, ** p <0.05, *** p <0.01. Household survey weights used. Controls include gender, household size, number of children, marital status, age, age squared, disability status, race, education, urban/rural status, number of medicaid beneficiaries in the state, governor party affiliation, and the unemployment rate

Table A5: Alternative Measures of Food Hardship: LPM

	FI Gap (1)	FI Gap Squared (2)	Inc. Gap (3)
ACA	−0.014*	0.000	−1.720***
	(0.007)	(0.006)	(0.459)
SNAP	0.112***	0.090***	8.767***
	(0.004)	(0.003)	(0.283)
ACA × SNAP	−0.011*	−0.035***	1.067
	(0.006)	(0.005)	(0.771)
Obs.	178,969	178,969	248,851

Note: standard errors clustered at the state level, * p <0.10, ** p <0.05, *** p <0.01. Household survey weights used. Controls include gender, household size, number of children, marital status, age, age squared, disability status, race, education, urban/rural status, number of medicaid beneficiaries in the state, governor party affiliation, and the unemployment rate