Impact of the National School Lunch Program on Children's Food Security

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1. Introduction

As the world's largest economy, the U.S. was responsible for around 20% of the world's total GDP in 2010, leading global development (IMF 2011). High household income in the U.S. brings a high quality of life to many. However, for those on the other end of the spectrum, the U.S. has developed a mature welfare system, especially for food security. The U.S. Department of Agriculture (USDA) defines "food security" as enough food for all household members at all times for an active and healthy life. In fiscal year (FY) 2010, the USDA spent $94.8 billion on 15 food and nutrition assistance programs to support low-income households (USDA 2011).

However despite the large amount of government's financial support, the number of U.S. citizens struggling to feed their families remains high. Based on the latest household food security report, there were still 17.2 million households that could not purchase enough food to lead a healthy lifestyle in 2010. Furthermore, 3.9 million households with children (9.8% of all U.S. households) could not provide enough food for their children at times throughout the year (Coleman-Jensen et.al 2011).

Considering children spend over 900 hours at school per year and, on average, intake more than one-third of their calories while at school, school is a natural place to implement public policy for children's food security improvement (Bhatt 2009; Briefel et.al 2009). Every school day, the school food assistance programs play an important role in offering enough food and nutrients for the U.S. students. The National School Lunch Program (NSLP) is the second largest federally assisted food program with

spending of $10.5 billion in FY 2010 to provide nutritious, well-balanced lunches for children. As a means to helping ensure that children have access to healthy diets, the NSLP served over 101,000 schools and childcare institutions, offering meals free or at a low price to nearly 32 million U.S. children each school day. With a similar format and similar aims to improve children's nutrition, the School Breakfast Program (SBP) is supported by the USDA with 2.8 billion dollars (USDA 2011).

Estimating the effect of the NSLP on children's food security status is important for policymakers to be able to evaluate the program and improve students' food security through future policy tools. Yet, the causal relationship between NSLP and food security is difficult to identify because of an inherent self-selection problem; participation is endogenous because insecure households are more likely to participate in food assistance programs.

In recent years, a large body of literature surrounding the food security issue across other food assistance programs has developed and utilizes a variety of different analysis methods (Bartfeld et al. 2009; Wlide 2007). Despite the breadth of these studies, the results are uncertain, showing positive, negative and no significant relationship between food security and food assistance programs. Joint models using a system of simultaneous equations have been used, relying on either instrumental variables or the assumption about the distribution of error terms (Mykerezi and Mills 2010; Bartfeld et al. 2009; Yen et al. 2008; Huffman and Jensen 2003; Jensen 2002). Another approach used involves longitudinal or panel data to analyze the effect of different food assistance programs on food security status (Wilde and Nord 2005; Kabbani and Kemid 2005; Herman 2004;

Hofferth 2004; Ribar and Hamrick 2003). A third method is a natural experiment (Bartfeld and Dunifon 2006; Borjas 2004). For example, using hierarchical modeling, Bartfeld and Dunifon (2006) show that near-poor households in states with higher food stamp participation rates have a lower risk of food insecurity.

Very little research has focused on the association between food security and school food assistance programs. Bartfeld et al. (2009), using two stages with instrumental variables, found that the accessibility of SBP has no significant effect on food insecurity, but it has a negative and significant association with decreasing the probability of being marginal food secure. Relying on the hierarchical model at the state level, Bartfeld and Dunifon (2006) showed that accessibility of both Summer School Lunch Program and Summer Food Service Program (SFSP is a program that serves school-aged children during the summer) reduced the risk of food insecurity. However, a comparable model to measure the relationship between households without children and food assistance programs indicated that the NSLP participation was still significant. Therefore, the author suggested being cautious to interpret the NSLP's effect. Similarly, Nord and Romig (2006), using a state-level approach, found availability of SFSP and NSLP in summer reduced the seasonal differences of food insecurity. Based on the dose-response approach with longitudinal data, Kabbani and Kemid (2005) found that participation in the NSLP was associated with lower odds of food insecurity for households with school-age children.

Other studies have analyzed health outcomes or dietary intake related to food security. Gundersen et al. (2011) used monotone instrumental variables and found

evidence that receiving free and reduced-price school lunches improves children's health outcomes, including food insecurity. Based on descriptive analysis, Potamites and Gordon (2010) also analyzed children's intake from school meals among different food security groups. The results noted that children who live in marginally secure and food-insecure households consumed more food and nutrients at school than those from highly secure households. Performing sibling comparison analyses, Dunifon and Kowaleski-Jones (2003) analyzed effects of NSLP participation and food insecurity on children's well-being. But they did not focus on how program participation affects children food security.

The evaluation of the causal relationship between NSLP participation and food security has gone largely unexplored. There is some research that has used state-level program participation or availability rather than individual level participation on food security. Other studies have classified households as being either food secure or food insecure rather than using the relative degrees of food security (high, marginal, low, and very low food security). Recent research (Potamites and Gordon 2010, Bartfeld et al. 2009) points out that different food security groups have their own characteristics. This study intends to create a better understanding of the individual, rather than state-level, relationship between NSLP participation and all four levels food security (high, marginal, low, and very low) with aims to assist policy makers in improving the effectiveness of food assistance programs.

2. Econometric model

The first step is to measure how the household and individual factors influence NSLP participation followed by estimation of the association between the NSLP participation and food security. Household food security status (FS) is a discrete dependent variable with an ordinal nature. FS is coded as 1 when a child is from a high food security household, 2 when a child is from a marginal food security household, 3 when a child is from a low food security household, and 4 when a child is from a very low food security household. In this case, the ordinary least squares (OLS) regression model cannot distinguish the difference between a 1 and a 2, and between a 2 and a 3, instead treating them as a continuous variable (Greene 2002, Wooldridge 2010). Also, the multinomial logit or probit model cannot correctly handle the ordinal nature of dependent variables. Therefore, this study uses the two stages method with an instrumental variable to solve the endogeneity problem. The maximum-likelihood method was used for an ordered probit model for FS and a probit model for the binary participation variable (P).

Assume that two variables are determined by:

$$FS_i = X_i'\beta_1 + P_i'\beta_2 + \varepsilon_i \quad (1)$$

$$P_i = X_i'\alpha_1 + Z_i'\alpha_2 + \mu_i \quad (2)$$

where FS_i is an ordered categorical variable of food security as following:

$$FS_i = \begin{cases} 1 & \text{if} \quad FS_i^* = 0 \\ 2 & \text{if } 0 < FS_i^* \leq 2 \\ 3 & \text{if } 3 < FS_i^* \leq 7 \\ 4 & \text{if } 8 < FS_i^* \leq 18 \end{cases}$$

X_i' is a vector of household characteristics associated with FS_i and P_i. Z_i' is an instrumental variable indicating that a student has enough time to have his or her school lunch (Z_i'=1), otherwise (Z_i'=0). The terms $\beta_1, \beta_2, \alpha_1$and α_2 are vectors of regression parameters, while ε_i and μ_i are random errors. Several assumptions about the error terms are imposed: (1)E $(X_i'\varepsilon_i)$ =0; (2)E $(X_i'\mu_i)$=0 ; (3) E $(Z_i'\mu_i)$=0; (4) E $(\varepsilon_i|\ P_i) \neq 0$. Because E $(\varepsilon_i|\ P_i) \neq 0$, we employ the instrumental variable to solve this problem. Variable FS_i and P_i are replaced with their latent counterparts FS_i^* and P_i^* as follows:

$$FS_i^* = X_i'\beta_1 + P_i'\beta_2 + \varepsilon_i \quad (3)$$

$$P_{is}^* = X_i'\alpha_1 + Z_i'\alpha_2 + \mu_i \quad (4)$$

In order to address endogeneity, we estimate equations (3) and (4) in two stages. The first stage is a probit model for the NSLP participation including all predetermined demographic variables in the food security equation. The instrumental variable Z is correlated with NSLP participation and not correlated with food security. For the estimation of food security, there are two common estimation methods including two-stage predictor substitution (2SPS) and two-stage residual inclusion (2SRI). Based on the simulation results, Terza et al (2007) concluded that 2SRI can get consistent results for nonlinear models, while 2SPS cannot. Therefore, 2SRI was used to solve endogeneity in these nonlinear models.

In the first stage, a probit model was used to estimate the regression and obtain the constant estimates of vector X_i' ($\widehat{X_i'}$) and Z_i' ($\widehat{Z_i'}$). Then the "predictor" of $\widehat{P}$ is computed and further get the "residual" by equation (5).

$$v = \widehat{P} - P \quad (5)$$

In the second stage, we included the actual observed value of P_i' in the equation and the "residual" were included, as shown in equation (6).

$$FS_i^* = D_i'\beta_1 + P_i'\gamma_1 + \varepsilon_{is} + v \quad (6)$$

3. Data

This study used the third School Nutrition Dietary Assessment study (SNDA-III) sponsored by the Food and Nutrition Service (FNS) of USDA. Mathematica Policy Research, Inc. collected all the data from a nationally representative sample during the 2004-2005 school year, aiming to provide information on the school meal programs. There were 287 schools (in 94 districts) and 2,314 students who completed an interview about their opinion of school lunch and a 24-hour dietary recall interview about the consumption of foods and nutrients on a typical school day. Also, their parents completed another interview on household characteristics, including education, employment, food security, and socioeconomic conditions, among other things (Gordon et al. 2007).

After excluding missing observations in the dataset, a final sample consisted of 2012 observations for the analysis with 35 variables. Descriptions, mean values, and standard deviations of independent and dependent variables are provided in Table 1.

Food security

The USDA defines "food security" as enough food for all household members at all times for an active and healthy life. "Food insecurity" is defined as the limited or uncertain availability of nutritionally adequate and safe foods (Anderson 1990). As a

foundation of daily life, food security plays an important role in ensuring school-age children's current health and enhancing their long-term growth and development. Children who are food insecure or food insufficient are more likely to suffer behavior, academic, psychological, and physical problems (Haering and Syed 2009; Whitaker et al. 2006; Alaimo et al. 2001; Casey et al. 2005). The U.S. government has used the Core Food Security Module (CFSM) with a series 18 questions in the Current Population Survey to measure food security of households with children since 1995 (Bickel et al., 2000). Prior 2006, very low food security was called "food insecure with hunger". In 2006, the USDA introduced new labels to describe the food security status, including high food security, marginal food security, low food security, and very low food security. The high and marginal levels are defined as food security, while low and very low levels are defined as food insecurity. The USDA describes "food security" and "food insecurity" as a household-level economic and social condition of limited access to food, while "hunger" as an individual-level physiological condition that may result from food insecurity.

In this study, the first endogenous variable is household food security status. To determine the food security classification for students, SNDA-III includes the series of 18 questions from the CFSM. If the parents responded affirmatively to 0 of the 18 questions, the household is categorized as having a high level of food security. If parents responded affirmatively to one or two questions, households are categorized as marginally food secure. Three to seven affirmative responses classified households as having low food security and eight or more affirmative responses indicated very low

food security (Eisenmann et al. 2011). Example questions are (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?” and (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?”

NSLP participation

A second endogenous variable is participation in the NSLP. All students at school can purchase a reimbursable meal through the NSLP, but their prices may be different from each other. Based on the guidelines set forth by NSLP, a student is eligible to receive a free lunch meal if they reside in a household with income at or below 130% of the Federal Poverty Line (FPL). A student can get a meal at a reduced price when their family’s income is between 130% and 185% of the FPL. A “full” price meal is provided when household income is over 185% of the FPL (Devaney et al 1997). The SNDA-III data indicated that 62% of students participated in the NSLP on a typical day in the school year 2004-2005, referred to as “target day participation” and defined as participation on the single school day that the student’s dietary intake interview covered. Approximately 75% of students participated in the NSLP three or more days per week and is referred to as “usual participation”.

This study used target day participation as the endogenous participation variable. In the SNDA-III survey, there is a question, “Did you eat the regular school lunch (today/yesterday)?” Each student reported whether or not they participated. Students’ answers are coded as 1 for “YES”, 0 for “NO”, d for “DON’T KNOW”, and r for

"REFUSED". Three other sources of information were used to define the target participation: (1) the type and amount of students' food consumption on the target day, (2) the source of students' food consumption on the target day, and (3) comparison between the students' foods and the school menu (Gordon et al. 2007). For the purposes of this study, the NSLP participation variable is coded as 1 for participation on the target day and 0 otherwise. In our cleaned data, the participation rate is 63%.

Instrumental variable

Following the program's rules, the student's participation in the NSLP is based on individual self-selection rather than automatic enrollment. Therefore, the dummy variable of participation cannot be treated as exogenous. On one hand, marginal or insecure students are more likely to self-select into the NSLP, resulting in a higher participation rate. However, on the other hand, a higher participation rate of insecure students will result in a larger proportion of food and nutrient intake at school than food secure students, which potentially increases food security status (Potamites and Gordon 2010).

To solve the endogeneity problem of variable participation, this study uses an instrumental variable approach with an ordered food security variable and a binary participation variable. In the model, the instrumental variable, called TIME, describes whether a student has enough time to have their school lunch. This TIME variable is included in the participation equation with the assumption that it has no direct effect on food security scale. Every student was asked, "Do you have enough time to eat your lunch after you have your food and you are seated?" Also, the parents answered a

question, “Your child doesn’t have enough time to get and eat lunch in school, yes or no?” (Gordon et al. 2007). This study creates the instrumental variable based on these two questions. The variable of TIME is coded as 1 with enough time, and 0 otherwise.

Eating time is relevant to the NSLP participation as the SNDA-III reported that 4% of students don’t participate in the school lunch because there is not adequate time and 71% of students said they spent too much time waiting in line. Also, parents may determine their child’s participation based on concerns about the time available for the student to eat (Gordon et al. 2007), for the reason that short lunch length has a potential negative effect on children’s health (Bhatt 2009). The National Association of State Boards of Education (NASBE) recommends that students should be provided adequate time to eat lunch, at least 20 minutes for lunch (SNA 2005). If time is too tight, children may worry about missing classes. With the anxiety of limited time, students could think about how to save time during lunch and accelerate the speed of eating, which will absolutely deteriorate the eating experiences. Unsatisfied eating experiences could result in a lower NSLP participation in future as students may ask their parents to prepare lunch in order to avoid waiting in line and reduce potential fast eating. Also, students may skip meals and choose other less nutritious food sources, including competitive foods from vending machines, school stores, and a la carte basis in school cafeterias. Time is believed to be an important variable for student’s decision on participation, while not directly influencing food security level.

Other variables

Previous literature (Gundersen et al. 2011; Mykerezi and Mills 2010; Nord 2009; Bartfeld et al. 2009; Yen et al. 2008) have shown that food security is related with socioeconomic and geographical factors. This study incorporates a set of household characteristic variables expected to influence participation. Household size, parent education, and federal poverty level (FPL), used to represent household condition, are included. The FPL guideline varies by family size and household income to determine financial eligibility for the NSLP program, which reflects household economic condition. The standard FPL in this study is 2004 Federal Poverty Line Guideline. Table 2 presents poverty guideline values corresponding to the household size. For example, annual household income of $9,310 is 100% of FPL for a one-person family in 2004. Race and ethnicity are included to capture the differences of the NSLP participation rates across groups, while parental employment is used to represent the hours of parents' working outside or at home. Also, two series of geographical factors are included, one series representing seven regions from western to southeast and another series representing the school serving area (city, urban fringe, town or rural).

4. Results

The model is estimated by the two stage method to measure the effect of the NSLP on the children's food security. The first stage is a probit model to estimate the factors influencing the NSLP participation. The second stage is an ordered probit model to measure children's food security status.

First stage: National School Lunch Program Participation

The results are presented in Table 3. Consistent with expectations, the instrumental variable TIME is statistically significant. TIME shows a positive impact on NSLP participation, indicating that students who have enough time to eat lunch meals after they get their food are 11.3% more likely to participate in the school lunch program than those who do have not enough time.

In general, FPL, household structure and employment, children's age and household highest education have positive effects on the probability of NSLP participation, while urban and rural status are negatively associated with NSLP participation. With regard to household economic conditions, FPL shows a positive association with the probability of participation, except at the 301- 400% level. As expected, eligibility for free or reduced price appears to attract more students to participate in NSLP. Participation varies among groups with different household structures and employment. Participation in NSLP is more likely among students with at least one employed parent, reflecting the time constraint for parents who work outside the home. Compared with elementary students, older children in middle or high school are more independent and more likely to choose lunch from alternative options. Hence, children from 6 to 10 years old are more likely than older children to eat a school lunch meal. A student whose parent holds a less than high school education is 11.6% more likely to participate in NSLP than those parents with other education backgrounds. At the same time, a student whose parent has some college or postsecondary education is only 8.3% more likely to participate in NSLP than those parents with other education

background. The results confirm expectations about relative higher education level among parents (e.g. some college or above) associating with higher incomes, and thus affording parents with more resources to make alternative choices for their child's lunch rather than only participate in NSLP. Students from the Midwest, Southeast and Southwest are more likely to participate in the NSLP. Also, participation is 14.1% less common for schools serving the city compared with those schools served urban of fringe, town and rural area. Participation rates in urban fringe of city and town are 12.8% and 11% respectively less than other areas. However, there is no significant difference among races.

Second stage: Household Food Security Status

The second stage estimated the effect of NSLP participation on food security status using an ordered probit model. Table 4 and Table 5 provide coefficient results and marginal effects for the four food security levels.

In the ordered probit model, the estimated coefficients itself provides limited information, while marginal effects are good approximation. Discussion of the marginal effects for those significant variables is provided below. Generally, the signs of marginal effects for the marginal, low, and very low food security groups are the same as the corresponding coefficients. However, the signs of marginal effects for high food security group are opposite with the other three groups.

The associations between food security status and FPL are statistically significant. For students who are eligible for free or reduced price lunches, they are less likely to be high food security but more likely to be marginal, low, and very low food security

compared to those who are not eligible. Students whose household income is less than 185% FPL need more assistance to remain high food security or to improve their security status.

Although race, region, and race groups were not statistically significant, interesting and significant results related to poverty level, parental employment, and parental education level were found. Compared to other household structures and employment, a child with one employed parent out of one parent was 7.2% less likely to be considered high food security, 1.2% more likely to being marginal food secure, 2.9% more likely to having low food security, and 3.2% more likely to having very low food security. Children between 6 to 10 years old are 10.6% more likely to be highly food secure, and 1.7%, 4.2% and 4.7% less likely to be considered marginal, low, and very low food security, respectively. A parent's education level is positively associated with food security. As an example, parents with less than a high school education are 13.3% less likely to have high food security compared to those with other education background. At the same time, parents with "some college" are only 6.4% less likely to be highly food secure compared to those who are without "some college" degrees.

5. Discussion and Conclusion

The previous literature has addressed the association between food security and other food assistance programs, including food Stamp, WIC, and SBP. Using a two stage method with an instrumental variable, our analysis adds to this body of work by estimating the impact of NSLP on children's food security.

The results from the ordered probit model indicate that the household income relative to the Federal Poverty Level (FPL), household structure and employment, age, and education have significant effects on food security, which is consistent with existing research on food security.

However, individual NSLP participation has no statistically significant effect on children's food security. There are a number of reasons NSLP participation may not translate into the improvement of food security. Children being safeguarded by their household members could be one such reason. Even when a household has low or very low food security, the parents may save food for their children, resulting in higher food security status for the child, relative to the household itself. In addition, the NSLP meal is only a part of an individual's daily food and nutrient intake, which may not be enough to improve a child's food security. It is also possible that the NSLP plays an important role in improving children's food security, but the inadequacy of food intake at home may offset this effect. What's more, the data in this study used the target day participation, which may not fully represent the actual contribution of NSLP over a longer timeframe. Also, the majority of children in our data are considered high or marginal food security, indicating that the small percentage of low and very low food security may be creating a problem. And finally, the respondents may only recall recent food security conditions rather than the comprehensive status during the past 12 months.

Nevertheless, a major strength of this study was the analysis of four food security levels (high food security=1, marginal food security=2, low food security=3 and very low food security=4). The results indicated that the impacts of NSLP on the four food

security levels are different. The signs of high effect for high food security are opposite with other three status. Although USDA defines that marginal food security as belonging to food security, the results indicated that marginal food security group shares more similar characteristics with the low and very low food security groups rather than high food security group. At the same time, the magnitudes of marginal food security group were much less than low and very low groups.

Based on the analysis of this study, we provide two recommendations for further analysis. First, future study on the source of children's nutrients intake for four groups might provide additional evidence about the effect of the NSLP on food security. For example, we can get a deeper understanding of the NSLP contribution by comparing children's nutrients consumption from school reimbursable lunch and other food sources. Second, combining the NSLP and SBP for analysis could provide more information about the contribution of school assistance programs on children's food security, because the majority of SBP participants also purchase lunch meal.

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Table 1. Description of variables

Variables	Description	Mean	Std Dev
Household size	Number of people living in household	4.47	1.81
Hispanic	=1 if Hispanic, any race	0.23	0.42
White	=1 if White, Non-Hispanic	0.53	0.50
Black	=1 if Black, Non-Hispanic	0.18	0.38
Other Race	=1 if Other Race, Non-Hispanic	0.06	0.24
City	School serves city	0.35	0.48
Urban fringe of city	School serves urban fringe of city	0.33	0.47
Town	School serves town	0.08	0.27
Rural area	School serves rural area	0.24	0.43
Mid-Atlantic	=1 if Mid-Atlantic	0.10	0.30
Midwest	=1 if Midwest	0.17	0.37
Mountain-Plains	=1 if Mountain	0.08	0.27
Northeast	=1 if Northeast	0.09	0.29
Southeast	=1 if Southeast	0.21	0.41
Southwest	=1 if Southwest	0.18	0.39
Western	=1 if Western	0.16	0.37
Less than high school	=1 if p_high_ed = 1	0.12	0.32
High school or GED	=1 if p_high_ed = 2	0.24	0.43
Some college or postsecondary	=1 if p_high_ed = 3	0.34	0.48
College graduate	=1 if p_high_ed = 4	0.30	0.46
Participation	Child Participation Status - NSLP	0.61	0.49
6 to 10 years old	agecat==6-10	0.28	0.45
11 to 14 years old	agecat==11-14	0.42	0.49
15-18 years old	agecat==15-18	0.30	0.46
No more than 130%	<= 130 pov line	0.31	0.46
131 to 185%	<=185 pov line	0.12	0.33
185 to 300%	<=300 pov line	0.18	0.38
301 to 400%	<=400 pov line	0.14	0.35
More than 400%	> 400 pov line	0.25	0.43
Food Security - Household Scale	Food Security - Household Scale	1.55	0.94
2 parents, both employed FT	=1 if 2 parents, both employed FT	0.32	0.47
2 parents, one employed FT	=1 if 2 parents, one employed FT	0.36	0.48
Neither parent employed FT	=1 if Neither parent employed FT	0.15	0.36
1 parent, employed FT	=1 if 1 parent, employed FT	0.16	0.37
Time	=1 if enough time to eat	0.86	0.35

Table 2. 2004 HHS Poverty Guidelines

Size of Family Unit	48 Contiguous States and D.C.	Alaska	Hawaii
1	$ 9,310	$11,630	$10,700
2	12,490	15,610	14,360
3	15,670	19,590	18,020
4	18,850	23,570	21,680
5	22,030	27,550	25,340
6	25,210	31,530	29,000
7	28,390	35,510	32,660
8	31,570	39,490	36,320
For each additional person, add	3,180	3,980	3,660

Source: The Department of Health and Human Services

Table 3. Coefficients and Marginal Effects of Probit Estimation of the NSLP participation

	Participation			
Variables	Estimates	Std Dev	Marginal	Std Dev
Poverty Line				
No more than 130%	0.482*	0.105	0.163*	0.035
131 to 185%	0.402*	0.116	0.136*	0.039
185 to 300%	0.179***	0.095	0.061***	0.032
301 to 400%	-0.011	0.098	-0.004	0.033
More than 400 pov line	(omitted)		(omitted)	
Household structure & employment				
2 parents, both employed FT	0.125***	0.074	0.042***	0.025
2 parents, one employed FT	-0.046	0.101	-0.016	0.034
1 parent, employed FT	0.193**	0.096	0.065**	0.032
Neither parent employed FT	(omitted)		(omitted)	
Age				
6 to 10 years old	0.725*	0.079	0.245*	0.025
11 to 14 years old	0.438*	0.071	0.148*	0.023
15 to 18 years old	(omitted)		(omitted)	
Household size	0.016	0.020	0.005	0.007
Region				
Mid-Atlantic	0.077	0.126	0.026	0.043
Midwest	0.329*	0.112	0.111*	0.038
Mountain-Plains	0.149	0.131	0.050	0.044
Northeast	-0.040	0.129	-0.013	0.044
Southeast	0.503*	0.108	0.170*	0.036
Southwest	0.245**	0.103	0.083**	0.035
Western	(omitted)		(omitted)	
Race				
Hispanic	0.071	0.143	0.024	0.048
White	-0.095	0.133	-0.032	0.045
Black	-0.007	0.148	-0.002	0.050
Other race	(omitted)		(omitted)	

Urban vs. Rural Status				
City	-0.417*	0.089	-0.141*	0.030
Urban fringe of city	-0.379*	0.086	-0.128*	0.029
Town	-0.325*	0.127	-0.110*	0.043
Rural	(omitted)		(omitted)	
Highest education in household				
Less than high school	0.343*	0.122	0.116*	0.041
High school or GED	0.404*	0.092	0.137*	0.031
Some college or postsecondary	0.247*	0.077	0.083*	0.026
College graduate	(omitted)		(omitted)	
Instrumental variable				
Time	0.334*	0.084	0.113*	0.028

Note: Asterisks indicate levels of significance: *= 1%, **= 5%, ***= 10%.

Table 4. Coefficients of Ordered Probit Estimation of Household Food Security Status

	Food Security	
Variables	Estimates	Std Dev
Participation of NSLP	0.302	0.732
Residual	-0.021	0.734
Poverty Line		
No more than 130%	1.729**	0.210
131 to 185%	1.549**	0.200
185 to 300%	0.486**	0.170
301 to 400%	0.095	0.180
More than 400 pov line	(omitted)	(omitted)
Household structure & employment		
2 parents, both employed FT	-0.047	0.094
2 parents, one employed FT	0.154***	0.092
1 parent, employed FT	0.322**	0.101
Neither parent employed FT	(omitted)	(omitted)
Age		
6 to 10 years old	-0.474**	0.201
11 to 14 years old	-0.171	0.139
15 to 18 years old	(omitted)	(omitted)
Household size	0.018	0.019
Region		
Mid-Atlantic	-0.043	0.131
Midwest	-0.047	0.153
Mountain-Plains	0.039	0.166
Northeast	0.038	0.145
Southeast	0.098	0.172
Southwest	0.066	0.124
Western	(omitted)	(omitted)
Race		
Hispanic	0.130	0.151
White	-0.074	0.147
Black	-0.160	0.157
Other race	(omitted)	(omitted)
Urban vs. Rural Status		
City	0.177	0.129
Urban fringe of city	0.168	0.127
Town	-0.049	0.164
Rural	(omitted)	(omitted)

Highest education in household		
Less than high school	0.595*****	0.160
High school or GED	0.322******	0.152
Some college	0.287******	0.126
College graduate	(omitted)	(omitted)

Note: Asterisks indicate levels of significance: ∗= 1%, ∗∗= 5%, ∗∗∗= 10%.

Table 5. Marginal Effects of Ordered Probit Estimation of Household Food Security Status

Variables	High Food Security		Marginal Food Security		Low Food Security		Very Low Security	
	ME	Std Dev	ME	Std Dev	ME	Std Dev	ME	Std Dev
Participation of NSLP	-0.068	0.164	0.011	0.026	0.027	0.065	0.030	0.072
Residual	0.005	0.164	-0.001	0.026	-0.002	0.065	-0.002	0.072
Poverty Line								
No more than 130%	-0.386*	-0.386	0.062*	0.008	0.154*	0.021	0.170*	0.022
131 to 185%	-0.346*	0.042	0.056*	0.007	0.138*	0.020	0.152*	0.021
185 to 300%	-0.109*	0.038	0.018*	0.006	0.043*	0.016	0.048*	0.017
301 to 400%	-0.021	0.040	0.003	0.006	0.008	0.016	0.009	0.018
More than 400 pov line	(omitted)				(omitted)			
Household structure & employment								
2 parents, both employed FT	0.011	0.021	-0.002	0.003	-0.004	0.008	-0.005	0.009
2 parents, one employed FT	-0.034***	0.021	0.006***	0.003	0.014***	0.008	0.015***	0.009
1 parent, employed FT	-0.072*	0.023	0.012*	0.004	0.029*	0.009	0.032*	0.010
Neither parent employed FT	(omitted)				(omitted)			
Age								
6 to 10 years old	0.106**	0.045	-0.017**	0.007	-0.042**	0.018	-0.047**	0.020
11 to 14 years old	0.038	0.031	-0.006	0.005	-0.015	0.012	-0.017	0.014
15 to 18 years old	(omitted)				(omitted)			
Household size	-0.004	0.004	0.001	0.001	0.002	0.002	0.002	0.002

(Continued)

Table 5. Marginal Effects of Ordered Probit Estimation of Household Food Security Status

Variables	High Food Security		Marginal Food Security		Low Food Security		Very Low Security	
	ME	Std Dev	ME	Std Dev	ME	Std Dev	ME	Std Dev
Region								
Mid-Atlantic	0.010	0.029	-0.002	0.005	-0.004	0.012	-0.004	0.013
Midwest	0.011	0.034	-0.002	0.006	-0.004	0.014	-0.005	0.015
Mountain-Plains	-0.009	0.037	0.001	0.006	0.004	0.015	0.004	0.016
Northeast	-0.009	0.032	0.001	0.005	0.003	0.013	0.004	0.014
Southeast	-0.022	0.038	0.004	0.006	0.009	0.015	0.010	0.017
Southwest	-0.015	0.028	0.002	0.004	0.006	0.011	0.006	0.012
Western	(omitted)				(omitted)			
Race								
Hispanic	-0.029	0.034	0.005	0.005	0.012	0.013	0.013	0.015
White	0.017	0.033	-0.003	0.005	-0.007	0.013	-0.007	0.014
Black	0.036	0.035	-0.006	0.006	-0.014	0.014	-0.016	0.015
Other race	(omitted)				(omitted)			
Urban vs. Rural Status								
City	-0.040	0.029	0.006	0.005	0.016	0.012	0.017	0.013
Urban fringe of city	-0.037	0.028	0.006	0.005	0.015	0.011	0.016	0.013
Town	0.011	0.037	-0.002	0.006	-0.004	0.015	-0.005	0.016
Rural	(omitted)				(omitted)			
Highest education in household								
Less than high school	-0.133*	0.036	0.021*	0.006	0.053*	0.015	0.058*	0.016
High school or GED	-0.072**	0.034	0.012**	0.006	0.029**	0.014	0.032**	0.015
Some college	-0.064**	0.028	0.010**	0.005	0.026**	0.026	0.028**	0.012
College graduate	(omitted)				(omitted)			

Note: Asterisks indicate levels of significance: *= 1%, **= 5%, ***= 10%