IMPACT OF THE NATIONAL SCHOOL LUNCH PROGRAM ON CHILDREN'S FOOD SECURITY

A Thesis

by

XIANG GAO

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

May 2012

Major Subject: Agricultural Economics

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Food Security

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Approved by:

Chair of Committee,	Ariun Ishdorj
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ABSTRACT

Impact of the National School Lunch Program

on Children's Food Security. (May 2012)

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Chair of Advisory Committee: Dr. Ariun Ishdorj

The U.S. is the world's largest economy, accounting for about 20% of world Gross Domestic Product (GDP). With a high income and a mature welfare system, households in the U.S. should have enough food and healthy diets, especially for children. However, the U.S. Department of Agriculture (USDA) reported that 9.8% of households with children were considered food insecure in 2010. The National School Lunch Program (NSLP) is the second largest federally assisted food program and aims to provide nutritious, well-balanced lunches for school-age children. This thesis examined the association between NSLP participation and children's food security, using the third School Nutrition Dietary Assessment study (SNDA-III). An 18-item household module was used to measure the food security status of children. An ordered probit model was estimated using a two-stage instrumental variable approach in order to address the endogeneity of program participation.

We found that students with enough time to eat lunch were 12% more likely to participate in NSLP. Student participation in NSLP was also influenced by the receipt of free/reduced priced meals, being elementary or middle school age, residing in rural area,

parents' having a lower education level and living in a single parent household with one employed parent or in two-parent household with both parents employed.

The second stage of the model indicates that receipt of free/reduce price meals, household structure and employment, school level, race, and education have significant effects on food security status. Moreover, we found that children from marginally food-secure households have characteristics similar to those from food insecure households rather than highly food-secure households. After controlling for the endogeneity of program participation, we could not find evidence to support program participation having a significant effect on children's food security. To confirm our findings we used adult and child food security modules as alternative food security measures. A bivariate probit model was estimated as an alternative model, but there was still no significant association between NSLP and food security status. A possible reason that NSLP has no effect on food security was that participating children did not intake significantly more calories from school lunch.

DEDICATION

I could not use words to express the gratitude to my parents. They gave me continuous encouragement and selfless love. Also, I really appreciated my wife who supported me to overcome the difficulties in my study and life.

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to my advisory committee chair, Dr. Ariun Ishdorj, and my committee members, Drs. David Bessler, Peter Murano and Lindsey Higgins. Writing thesis is not an easy task. Not only did they teach me professional knowledge, but also guided me to be a better researcher. Without their guidance, suggestions and supports, I would not be where I am today.

I wanted to extend my gratitude to Dr. Ximing Wu and Dr. Richard Dunn for their useful comments on the statistical models. I would like to thank Drs. David Leatham, John Penson and Marvin Harris for supporting me to through my financial difficulties at Texas A&M University. I would also like to thank Ms. Jianhong Mu and Mr. Leonardo Sanchez, who spent many hours giving me helpful advice. I would extend my thanks to all the friends at College Station, especially Zhenggang, Xu, Tianyu Deng, Sihong Chen and Yu Zhang.

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CHAPTER I

INTRODUCTION

As the world's largest economy, the United States (U.S.) was responsible for about 20% of the world's total Gross Domestic Product (GDP) in 2010 (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 also developed a mature welfare system, especially for food security. The U.S. Department of Agriculture (USDA) defined "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 provide low-income people access to enough food (USDA 2011a).

Despite the large amount of government's financial support, the number of individuals 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 (9.8% of U.S. households with children) could not provide enough food for their children at times throughout the year (Coleman-Jensen et al. 2011). As the future of this country, children should be safeguard by accessing enough food and avoiding hunger.

Considering children spend over 900 hours at school per year and, on average,

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This thesis follows the style of *American Journal of Agricultural Economics*.

obtain more than one-third of their daily caloric intake while at school, school is a natural place to implement nutrition policies that would improve health and well-being of children (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. In FY 2010, the National School Lunch Program (NSLP) has grown to be the second largest federally assisted food program with spending of $10.5 billion to provide nutritious, well-balanced lunches for children. As a means to helping ensure that children has access to healthy diets, the NSLP serves 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 (USDA 2011b). 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 2011c).

Estimating the effect of the NSLP on children's food security status is important in evaluating program effectiveness and improving students' food security through future policy tools. Currently, the evaluation of the causal relationship between NSLP participation and food security has gone largely unexplored. A few studies (Bartfeld and Dunifon 2006; Nord and Romig 2006) estimated the effect of state-level program participation or availability on the risk or prevalence of food security. Also, existing studies have classified households as being either food secure or food insecure rather than using the relative degrees of food security. But recent research (Potamites and Gordon 2010, Bartfeld et al. 2009) pointed out that different food security groups have their own characteristics. Therefore, this study intended to create a better understanding

of the individual, rather than state-level relationship between NSLP participation and different food security levels with aims to assist policy makers in improving the effectiveness of food assistance programs.

The remainder of this thesis is organized as follows. Chapter II introduces definitions, measurements and background on NSLP and Chapter III reviews the literature of NSLP and food security across food assistance programs. Chapter IV presents a two-stage estimation model for food security and the NSLP participation, while Chapter V briefly describes the third School Nutrition Dietary Assessment study (SNDA-III) and variables. What's more, Chapter VI reports the empirical results and Chapter VII checks the plausibility of the major findings. Finally, Chapter VIII provides discussion and conclusion, and sheds light on future research.

CHAPTER II

BACKGROUND

This chapter consists of three parts. The first part provides an overview of how food security, food insecurity and hunger were defined and measured. The second describes different approaches of measuring household and individual food security and advantages and disadvantages of using these approaches, while the last part provides a brief overview of the National School Lunch program.

2.1 Food Security, Food Insecurity and Hunger

In order to discuss food security issue, we firstly specified the differences between food security, food insecurity and hunger. A clear definition could help us get a better understanding about these three terminologies and lay a good foundation for our further discussion. The USDA cited the definitions from the Life Sciences Research Office (Anderson 1990) as follows:

- Food security: Access by all people at all times to enough food for an active, healthy life. Food security includes at a minimum: (a) the ready availability of nutritionally adequate and safe foods, and (b) an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies).
- Food insecurity: Limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways.

- Hunger: The uneasy or painful sensation caused by a lack of food. The recurrent and involuntary lack of access to food. Hunger may produce malnutrition overtime. Hunger, as the recurrent and involuntary lack of access to food, may produce malnutrition over time.

As a household-level indicator, food security and food insecurity reflected whether a family as a whole had access to enough food or not. As an individual-level indicator, hunger reflected personal physiological condition that may be caused by food insecurity (ERS 2011a). Prior 2006, the USDA used food security, food insecurity without hunger and food insecurity with hunger as labels for the ranges of food security, as exhibited in table 1 (ERS 2011b).

Table 1. USDA's Revised Labels Describe Ranges of Food Security

General categories (old and new labels are the same)	**Detailed categories**		
	Old label	**New label**	**Description of conditions in the household**
Food security	Food security	**High food security**	No reported indications of food-access problems or limitations
		Marginal food security	One or two reported indications—typically of anxiety over food sufficiency or shortage of food in the house. Little or no indication of changes in diets or food intake
Food insecurity	Food insecurity without hunger	**Low food security**	Reports of reduced quality, variety, or desirability of diet. Little or no indication of reduced food intake
	Food insecurity with hunger	**Very low food security**	Reports of multiple indications of disrupted eating patterns and reduced food intake

In 2006, USDA introduced new labels for food security, which included high food security, marginal food security, low food security and very low food security. The high and marginal levels were defined as food security, while low and very low levels were defined as food insecure (ERS 2011b).

2.2 Food Security Measurement

In this section several different survey tools with standardized modules and procedures commonly used in the existing literature are discussed. The proper use of these modules could strengthen validity and reliability of food security measurement.

2.2.1 U.S. Household Food Security Survey Module

Bickel et al. (2000) provided a comprehensive background and guidance for measuring food security as follows. In 1992, U.S. initiated the food security measurement project following with the National Nutrition Monitoring and Related Research Program. Since 1995, the U.S. government began to use the Core Food Security Module (CFSM) with a series of 18 questions in the Current Population Survey (CPS) to measure food security of households with children during the 12 months before conducting the survey. The CFSM covered anxiety of food insufficiency, experience of running out food, financial limitations, etc. Because one indicator could not be able to measure household food security precisely, a three stage assessment tool was developed. In the first stage a test was conducted to measure whether the household generally felt worried about food supply and financial and economic constraints. In the second stage a measurement was done on whether only adults in the household experienced hunger but

not children. And in the third stage a check was done on whether most serious situations happen that children suffer hunger and food insufficiency (Bickel et al. 2000).

Two measures of households' food security were described and used in previous literature. One of them was a continuous food security scale, ranging from 0 to 10, 0 if a household was fully food security and 10 if a household had all of the food insecurity problems. A household that was coded as 6 was more insecure than a household with the scale of 3 (Bickel et al. 2000). The other method of measuring food security had a scale that was categorical, such as high food security, marginal food security, low food security and very low food security (Bickel et al. 2000; Gordon et al. 2007). This was more convenient form that helps to capture the transitions of different food security levels.

For evaluations of some food assistance programs, the 30-day scale might also be an option if there were some questions about program participation referring to the previous 30 days. The 30-day scale was constructed by changing "last 12 months" to "last 30 days" for every question. Also, it could be used for the analysis of seasonal differences in prevalence of food insecurity. But this module was less reliable than 12-month core module (Nord 2002).

2.2.2 U.S. Adult Food Security Survey Module

Beside a typical 18-question core module for constructing a 12-month measurement scale, the 10 adult-referenced items could also give reliable results with less respondent burden, as sensitive questions about children are avoided. On average, each respondent only answered three questions. The 10-item survey was for households

without children because the module didn't contain questions about children. For some research questions, this measurement scale could be used for households with or without children. The limitation of adult scale was that it could not provide the specific information on children's food security status (ERS 2011c).

2.2.3 Six-item Short Form of the Food Security Survey Module

If respondents still felt burdened to answer 18 or 10 questions, the standard 6-item subset questionnaire generally provided an acceptable substitute with fewer questions for the survey. Although it had been shown to have minimal bias compared with the 18-item measure, the 6-item module still could not directly measure the most severe conditions and children's condition. If the prevalence of food insecurity is much lower or higher than the national average level, six-item scale could have bias (Blumberg et al. 1999).

2.2.4 U.S. Children Food Security Survey Module

There were two modules that helped to assess children food security. One was called Self-Administered Food Security Survey Module for Youth Ages 12. Initial validation had been conducted from a Mississippi school (Connell et al. 2004). It did recommend to be used for older children and 30 days response rather than younger children and 12 month period (ERS 2011c). Another was the 8-item Children's Food Security Scale. Nord and Bickel (2002) proposed this scale in order to measure the prevalence of hunger among children in U.S. households. All 8 questions were from 18-item module to ask about children's food related experiences. The children scale could

avoid the bias resulting from the age of children and provide a more efficient measurement for children's prevalence of hunger (Nord and Hopwood 2007).

2.3 National School Lunch Program

In 1946, the congress approved the National School Lunch Act (NSLA) to establish the National School Lunch Program in order to safeguard children's health and promote the consumption of domestic agricultural commodities (Ralston et al. 2008). Government expenditures on NSLP have grown from $70 million in 1947 to $10.8 billion in FY 2010. Compared to 7.1 million NSLP participants during the first operating year, there were 31.7 million (around 60%) students who participated in the NSLP in FY 2010. So far, the NSLP has become the second largest U.S. food assistance program. More than 101,000 public and non-profit private schools and residential childcare institutions were participating in NSLP in 2010 (USDA 2011b).

In retrospect, the development of school meal program reflected the needs of school-age children. The SBP was a result of the NSLP's expansion (Mirtcheva 2008). The pilot SBP was initiated in 1966 and became permanent in 1975.With a similar operation rule as the NSLP, SBP was the fourth largest program. In FY 2010, there were 11.6 million students who participated in the program with a $2.8 billion government cost (USDA 2011c).

The NSLP is administrated at both federal and state level by the Food and Nutrition Service (FNS) and state agencies. Generally, the federal government provides guidelines and supports for the NSLP through funding and legislation efforts. The State agencies provide technical assistances for local schools.

If districts or schools decided to participate in the NSLP and receive government subsidies, then lunches that met the Federal requirements should be offered to all children attending their school. Also schools and school districts are required to serve meals at free or reduced price to eligible students. A student from a household below 130% of poverty level is eligible to get a free meal. And a student from a household between 130% and 185% of poverty level could get a reduced-price meal. A student from a household above 185% of poverty level purchases the lunch meal at full price which is also subsidized by government (Devaney et al. 1997). The Department of Health and Human Services reports the federal poverty level each year for the determination of eligibility. If schools have participated in the NSLP, government reimburses cash back to school as a subsidy. Table 2 presented the 2010-2011 cash reimbursement rate for school lunch meals (USDA 2011b).

Table 2. 2010-2011 USDA Cash Reimbursement Rate

Free lunches	Reduced-price lunches	Paid lunches
$2.72	$2.32	$0.26
Free snacks	Reduced-price snacks	Paid snacks
$0.74	$0.37	$0.06

Local district or schools make their own decision about what specific foods are offered. But the overall nutrients should meet federal regulations. Also, the school lunch meal has its own requirements based on the guidelines from the Dietary Guidelines for

Americans (DGA). For example, students should consume less than 30 percent of calories from fat. The USDA sponsored organizations to conduct the SNDA survey to evaluate whether local districts or schools meet the nutrition standard.

CHAPTER III

LITERATURE REVIEW

In this chapter, the existing literature on NSLP is described. Previous research on NSLP paid more attention to program participation, dietary intake and health outcome. Very little research focused on the association between food security and NSLP. But if we looked at the field of food security, a large body of literature across other food assistance programs existed. So secondly, we tried to present food security research for food assistance programs in order to shed light on this study.

3.1 National School Lunch Program

The early studies about NSLP estimated the factors of individual participation. Then studies transferred to dietary intakes and health outcomes. It is important to conduct comprehensive literature review about NSLP, in order to lay a solid foundation for this study.

3.1.1 Participation

One of the issues addressed in the literature regarding NSLP was about factors affecting students' program participation. Morcos and Spears (1992) selected studies before 1991 related to NSLP participation and summarized that demographic factors (Akin et al. 1983; Lind et al. 1986), meal price (Akin et al. 1983; Zacchino and Ranney 1990), lunch options (Keyser et al.1983; Hearne 1984), length of meal period (Harper et al. 1980), lunchroom environment (Sullivan and Shanklin 1985) and school characteristics (Akin et al. 1983; Hearne 1984) influenced program participation. Based

on the surveys for Cincinnati public schools, Marples and Spillman (1995) found lunch time period, food quality and variety had significant effects on participation. Gleason (1995) reported that 56% of students participated in school lunch program and that the receipt of meal at free or reduced price significantly increased the participation rate. More recently, Dunifon and Kowaleski-Jones (2003) found that family income and paternal education had a negative effect on the NSLP participation, while the number of siblings, period of receiving food stamps, and being African American had a positive effect. Also, Hofferth and Curtin (2005) found that the enrollment of public school, less food consumption at home, Black and Hispanic race, lower parental education, two parents and neither employed were positively associated with higher participation rate.

Another issue was how to measure and define program participation. Some studies (Price et al. 1978; Schanzenbach 2009) defined NSLP participation based on usual practices. If a student reported to purchase school meal for a minimum number of days during a week, she or he was classified as program participants. Some studies (Wellisch et al. 1983; Devaney et al. 1993; Gleason and Suitor 2001; Gleason and Suitor 2003) defined NSLP participation based on whether a student actually purchased or consumed school lunch meal on the survey day or days. Finally, a more strict definition was that only students who purchased all five school days can be classified as program participants (Campbell et al. 2011).

3.1.2 Dietary Intake

Dietary intake is an important topic for NSLP. Many studies have compared food energy, vitamins, minerals and food consumption between participants and non-

participants. Fox et al. (2004) summarized seven studies related with the impact of NSLP on children's dietary intake and presented confounding results from different studies. As for food energy, some studies (Howe and Vaden 1980; Devaney et al. 1993; Rainville 2001; Gleason and Suitor 2003) did not find a significant effect of NSLP on students' food energy intake, while some studies (Wellisch et al. 1983; Gleason and Suitor 2001) found a positive or negative effect. As for vitamins and minerals, many studies found that NSLP participation has a positive effect on lunch intakes of selected vitamins and minerals (Howe and Vaden 1980; Wellisch et al. 1983; Devaney et al. 1993; Gleason and Suitor 2001; Gleason and Suitor 2003). But other studies found insignificant or negative effect on several nutrients intake (Devaney et al. 1993; Rainville 2001; Gleason and Suitor 2003).

Also, Fox et al. (2004) noted that studies from Devaney et al. (1993) and Gleason and Suitor (2003) provided more reliable results because of solving the selection problem. Both studies found that there was no significant association between NSLP participation and food energy intake, while certain types of vitamins or minerals were significantly increased or decreased by NSLP participation. From SNDA-I study, Devaney et al. (1993) showed that NSLP had a positive effect on students' intake of fat, saturated fat, vitamin A, riboflavin, niacin, vitamin B12, and a negative effect on students intake of vitamin C and carbohydrate, and no significant effect on food energy. Gordon et al. (1995) reported similar results. Using data from the 1994–1996 Continuing Survey of Food Intakes by Individuals (CSFII), Gleason and Suitor (2003) employed a fixed effects approach to control unobservable characteristics, and found that the intake

of calcium, magnesium, phosphorus, zinc, vitamin B12, riboflavin and dietary fiber, fat and saturated fat were increased by NSLP participation.

More recently, SNDA-III reported that NSLP participants generally consumed significantly more vitamin A, vitamin B12, riboflavin, calcium, phosphorus and potassium than nonparticipants, but not food energy (Gordon et al. 2007). Based on the SNDA-III data, Potamites and Gordon (2010) found that children from insecure households consumed more energy from protein, vitamin B12, calcium, and potassium for lunch. And children from marginal food secure households consume less than food insecure and high food secure children. Campbell et al. (2011) found that the quality of lunch diets consumed by NSLP participants was not higher than nonparticipants.

3.1.3 Health Outcome

Recently, children's obesity is becoming a more severe public health problem in our society. Overconsumption of nutrients and energy indicated that food assistance programs should not only focus on food quantity, but also food quality, in order to reduce children's probability of being obese. Based on the data from Child Development Supplement (CDS) and the Panel Study of Income Dynamics (PSID), Hofferth and Curtin (2005), employing an instrumental variable, found that NSLP participation had no statistically significant contribution to poor children's chance of becoming overweight. Using the data from Early Childhood Longitudinal Study – Kindergarten Cohort (ECLS-K), Schanzenbach (2009) found that eligible students were more likely to be obese. Millimet et al. (2009) found that NSLP has a positive association with obesity but SBP participation reduces the probability of being obese. Gleason et al. (2009) could not

support that NSLP participation was associated with students' body mass index (BMI) or risk of obesity, but SBP did decrease BMI. Relying on an instrumental variable, Hinrichs (2010) found no evidence that NSLP participation had no effect on long-term health based on height and BMI measurement, but positively affected education attainment.

3.2. U.S. Food Assistance Programs and Food Security

It is difficult to estimate the causal relationship between the food assistance programs and food security because there is an endogeneity problem.

3.2.1 NSLP and Food Security

So far, only a few research studies have focused on the effect of NSLP on the food security issue. Gundersen et al. (2011) used a monotone instrumental variables (MIV) assumption and estimated the effect of NSLP on children's health outcomes, including food insecurity. But the results could not reject the hypothesis of the program was inefficient to health outcome under MIV assumption. Only adding the Monotone Treatment Selection (MTS) assumption and Monotone Treatment Response (MTR) assumption could find that NSLP improved health outcomes. This study suggested free and reduced price school lunches reduced the risk of food insecurity, poor health and obesity. Based on a tabular analysis, Potamites and Gordon (2010) noted that children who lived in marginally secure households consumed less than food-insecure and high food secure households. Food insecure and high food secure groups had similar intakes. Relying on a 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 was 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. Nord and Romig (2006) took a state-level approach to analyze the impact of NSLP on food insecurity and found that households with school-age children in summer had a higher prevalence of food insecurity compared with other households. Based on the dose-response approach with longitudinal data, Kabbani and Kemid (2005) found that NSLP participation could decrease the odds of food insecurity for households with school-age children.

3.2.2. Other Food Assistance Programs and Food Security

There were many studies to measure the effect of other food assistance programs on the food security with different approaches. The results were uncertain, including positive, negative or no significant. Wlide (2007) summarized studies about food stamps and food security. Joint models using a system of simultaneous equations were a popular method, relying on either instrumental variables or the assumption about the distribution of error terms. Using the PSID data, Mykerezi and Mills (2010) used state-level instruments to solve the endogeniety problem and found that Food Stamp Program (FSP) participation decreased the probability of being food insecure. Bartfeld et al. (2009) analyzed the data from ECLS for the effect of SBP on food insecurity and marginal food security separately. This study found that the accessibility of SBP has no significant effect on food insecurity, but SBP has a negative effect on marginal food security. Yen et al. (2008), using the 1996–1997 National Food Stamp Program Survey data, found

FSP has a negative and small significant effect on food insecurity through four instrumental variables. A simultaneous equation model with three probit equations was used by Huffman and Jensen (2003), indicating that FSP participation has a negative but not statistically significant effect on food insecurity with hunger. Based on the two-stage analysis of the Current Population Survey data, Kabbani and Kmeid (2005) noted that the effect of food stamp program participation on food insecurity was not significant. But the food stamp benefit decreased the probability of being food insecure in the last thirty days. Jensen (2002) used a bivariate ordered probit model and found a significant and positive correlation between FSP and food security. Gunderson and Oliveria (2001) used a simultaneous equation model and found FSP has no effect on food insufficiency.

Another approach is to use longitudinal or panel data. Hofferth (2004) analyzed the data from the PSID and found that the relationship between FSP participation and food insecurity was from families' unmet food needs but not program participation, For the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), Herman (2004) collected data from three interviews over the period of one year and found WIC program improved participants' food security status. Ribar and Hamrick (2003) used the longitudinal datasets from the Survey of Income and Program Participation (SIPP) and Survey of Program Dynamics (SPD) and found no evidence to support FSP has effect on reducing food insufficiency. Wlide and Nord (2005) used the fixed effects logit model to analyze CPS data for 2001 to 2002 and could not find that FSP participation reduced food insecurity.

Some other researchers focused on the natural experiment. Using hierarchical modeling, Bartfeld and Dunifon (2006) found food stamp participation was associated with lower risk of being food insecure among near-poor households. Borjas (2004) also found that a decreasing of the receipt of public assistance would increase the rate of food insecurity.

Research on the causal effect of NSLP on food security has lagged behind research on other food assistance programs. Gundersen et al. (2011) did not directly focus on food security but recognized it as one of three health outcomes. Potamites and Gordon (2010) compared dietary intakes among groups with different food security status based on descriptive analysis rather than causal effects on food security. Nord and Romig (2006) took state-level analysis rather than individual level. Also, the NSLP is different from FSP or WIC because any students could purchase school lunch meal even for children from high income and high food security households. Understandingly, the NSLP has potential effects on nutrition and health not only for insecure children but also for those who were from high or marginal food security households. So far, the research about NSLP participation and food security is very limited. Despite the millions spent to fund this food assistance program, the impact of NSLP participation on students' food security is still unclear. The primary objective of this study was to measure the association between children's food security and NSLP participation.

CHAPTER IV

ECONOMETRIC MODEL

4.1 Preliminary Model

In order to assess the effect of the NSLP on children's food security status, we began with the specification of a basic ordered probit model without accounting for the potential endogeneity of program participation (equation 1):

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

where FS_i is an ordered categorical variable of food security status for student i as following:

$$FS_i = \begin{cases} 1 & \text{if } 0 < FS_i^* \leq 15 \\ 2 & \text{if } 15 < FS_i^* \leq 17 \\ 3 & \text{if } FS_i^* = 18 \end{cases}$$

where FS_i is observed and FS_i^* is not observed. FS_i is equal to 1 if a child was from food insecure household, 2 when a child was from marginally food-secure household, and 3 when a child was from highly food secure household; and P_i is a program participation dummy. If a student participated in school lunch program on the survey day then P_i =1, otherwise P_i =0, X_i is a vector of explanatory variables and ε_i is the error term.

4.2 Endogeneity of National School Lunch Program Participation

Although all children attending schools are eligible to participate in NSLP, there are many differences between the students who decided to participate in NSLP and those who decided not to. Despite the vector of control variables in the model, we might not be able to account for all of factors between participants and nonparticipants. Other

unobservable factors could affect NSLP participation and children's food security. So, the endogeneity of program participation would result in a serious bias in the estimates of equation. Food security status is a discrete dependent variable with an ordinal nature (Food Insecurity=1, Marginal Food Security=2, High Food Security=3). In this case, the use ordinary least squares (OLS) regression model will treat this categorical dependent variable as a continuous variable and will give a biased result. We employed the ordered probit model to account for the ordinal nature of the dependent variable (Greene 2003, Wooldridge 2010). We estimated this model using the two-stage method with an instrumental variable to handle the endogeineity of program participation. Assume that two variables were determined by:

$$FS_i^* = \beta_1 X_i + \beta_2 P_i + \varepsilon_i \quad (2)$$

$$P_i^* = \alpha_1 X_i + \alpha_2 Z_i + \mu_i \quad (3)$$

Where FS_i^* is the latent variable of food security; P_i^* is the latent variable of NSLP participation and P_i is the observed program participation. Z_i is an instrumental variable indicating that a student had 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 were imposed: (1)E ($\varepsilon_i | X_i$) =0; (2)E ($\mu_i | X_i$) =0; (3)E ($\mu_i | Z_i$) =0; (4) E ($\varepsilon_i | P_i$) $\neq$ 0. Because E ($\varepsilon_i | P_i$) $\neq$ 0, we used the instrumental variable approach to correct this problem.

In the first stage we estimated a probit model for the NSLP participation including all predetermined demographic variables in the food security equation and the instrumental variable. The instrumental variable (Z_i) was associated with NSLP

participation but not associated with food security. In the second stage we estimated the effect of participation and other explanatory variables on food security. There are two common estimation methods existed, which are two-stage predictor substitution (2SPS) and two-stage residual inclusion (2SRI). Based on simulation results, Terza et al. (2007) concluded that 2SRI could give consistent results for nonlinear models, while 2SPS could not. Therefore, we employed 2SRI in the estimation of ordered probit model with endogenous program participation.

The estimates of vector X_i ($\widehat{X_i}$) and Z_i ($\widehat{Z_i}$) could be obtained in the first stage. Then the "predictor" of $\widehat{P}$ was computed and used in the calculation of the "residual" given by equation (4).

(4) $$v = \widehat{P} - P$$

In the second stage, the actual observed value of P_i was used and the calculated "residual" was added as one of the explanatory variables, as shown in equation (5).

(5) $$FS_i^* = \beta_1 X_i + \beta_2 P_i + \varepsilon_i + v$$

CHAPTER V

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 nationwide sample during the 2004-2005 school year, aiming to provide information on school meal programs. For the student-level data, there were 287 schools (in 94 districts) and 2,314 students who completed an interview about their opinions 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 and cross checking variables in our dataset, our final sample consisted of 2012 observations for the analysis with 30 variables. Descriptions, mean values, and standard deviations of independent and dependent variables were provided in table 3.

5.1 Food Security

Our variable of interest is the household food security status. The USDA defined "food security" as enough food for all household members at all times for an active and healthy life, while "food insecurity" was defined as the limited or uncertain availability of nutritionally adequate and safe foods (Anderson 1990). Food security, as a foundation

of daily life, plays an important role in ensuring school-age children's current health and enhancing their long-term growth and development.

Table 3. Definition, Means and Standard Deviation 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
Rural and Town	School serves rural and town	0.32	0.47
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
Elementary school	=1 if school_type = 1	0.33	0.47
Middle school	=1 if school_type = 2	0.34	0.47
High school	=1 if school_type = 3	0.33	0.47
Food Security - Household Scale	Food Security - Household Scale	2.51	0.80
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

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). In measuring food security status, three scales of measurement were used in SNDA-III, and included an adult food security scale (10 questions), a child food security scale (8 questions) and a household food security scale (18 questions). All scales were a household-level measurement for the past 12 months, suggesting that none of them could directly measure a particular individual household member. For reasons explained below, in this study we used the household food security scale with 18 questions through 3 stages.

With respect to the adult food security scale, the primary limitation was that existing measurement could not provide specific information about children's food security, because there were no questions to directly ask about the conditions and experiences of children in households. With respect to the child food security scale, the 8 questions scale that was introduced by Nord and Bickel (2002) could not fully represent potential and indirect impacts from adults and households. As mentioned above, household level food security measurements fully accounted for the fact that every household member could be influenced by the same living environment. Children living in a food insecure family, whether or not a child herself or himself experienced food insecurity, are associated with a higher risk of hunger and negative health outcomes (Bickel et al. 2001; Dunifon and Kowaleski-Jones 2003). Children might also be affected indirectly by food insecurity and hunger experienced by adults in the household (Nord and Bickel 2002). Furthermore, food shortage and financial constraints might

bring parent stress, which further translate into a source of stress for children (Dunifon and Kowaleski-Jones 2003). Without considering household effects, it would be misleading to simply conclude that a child was really safe, if they were classified as food secure based on child food security scale. Therefore, household food security scale could provide a more comprehensive representation of the actual and potential risks of children's food insecurity.

The series of 18 questions from the CFSM were available in SNDA-III. We used those 18 questions to determine the food security classification for students. Example questions were (1) "In the last 12 months, did (you/you or other adults in your household) ever not eat for a whole day because there wasn't enough money for food?" and (2) "(My/Our child was/The children were) not eating enough because (I/we) just couldn't afford enough food. Was that often, sometimes, or never true for (you/your household) in the last 12 months?" (Gordon et al. 2009). The USDA defines that high and marginal food security are classified as food secure, while low and very low food security are classified as food insecure. Previous literature used the number of affirmative responses to determine the food security status. More specifically, if parents responded affirmatively to 0 of the 18 questions, the household was categorized as having a high level of food security. If parents responded affirmatively to one or two questions, households were 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).

In this study, the food security levels were constructed by using the number of questions that parents did not respond affirmatively. There were three food security levels, including food insecurity (if $0 < FS_i^* \leq 15$), marginal food security (if $15 < FS_i^* \leq 17$) and high food security (if $FS_i^* = 18$). In our data, 19 % of students were food insecure, 10% of students are marginally food secure and 71% of students are highly food secure. The food insecure group consisted of low food security and very low food security individuals. The reason for combining these two levels into one is that there were very few observations in the very low food security groups only, accounting for 6.41% of observations our final sample.

5.2 NSLP Participation

Participation in the NSLP was endogenous, since student's participation in the NSLP was based on individual's decision rather than automatic enrollment. They could choose to participate in the program, bring food from home, purchase food from elsewhere or skip lunch, and participation is potentially correlated with unobservable factors. Therefore, the dummy variable of participation cannot be treated as exogenous due to the endogeneity problem.

All students attending school could purchase a school reimbursable meal through the lunch program, but the price they paid is different depending on if a student was eligible to receive free and/or reduced-priced meal or pay the full price. SNDA-III reported that 62% of students participated in the NSLP on the survey day in 2005, referred to as "target day participation". Approximately 75% of students participated in

the NSLP three or more days per week and is referred to as "usual participation" (Gordon et al. 2007).

This study used target day participation as the indicator of participation. In the survey, there was a question, "Did you eat the regular school lunch (today/yesterday)?" Each student reported whether or not they participated. Students' answers were coded as 1 for "YES", 0 for "NO", d for "DON'T KNOW", and r for "REFUSED". Beside self-report, there were three other sources of information 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 was coded as 1 for participation on the target day and 0 otherwise. In our dataset, the NSLP participation rate on the target day was 61%, which was similar as 62% in the SNDA-III. Among NSLP participants, there were 668 students who actually received free/reduced price and 277 students who also participated in SBP on the survey day (Table 4).

5.3 Free/Reduced Price

Based on the guidelines set forth by NSLP, a student was eligible to receive a free lunch meal if they resided in a household with income at or below 130% of the Federal Poverty Line (FPL). A student could get a meal at a reduced price when their family's income was between 130% and 185% of the FPL. A "full" price meal was provided when household income was over 185% of the FPL (Devaney et al. 1997). In the survey, there was a question that was asked from parents whether their child received

free or reduced price lunches during the past 30 days. Free/reduced price lunches were coded as 1 when students received subsidized price, otherwise coded as 0. In our data, there were 862 students who received free/reduced price lunch in last 30 days (Table 4).

Table 4. Data Summary

		Numbers	Percent
Total sample		2012	
National School Lunch Program			
Participants		1228	61%
	Free/reduced	668	54%
	No free/reduced	560	46%
	SBP	277	23%
	No SBP	951	77%
Nonparticipants		784	39%
School Breakfast Program			
Participants		319	16%
	Free/reduced	243	76%
	No free/reduced	76	24%
	NSLP	277	87%
	No NSLP	42	13%
Nonparticipants		1693	84%
Free/reduced price			
Receive		862	43%
	NSLP	668	54%
	No NSLP	194	46%
	SBP	243	28%
	No SBP	619	72%
Not Receive		1150	57%

Note: SBP= School Breakfast Program; NSLP= National School Lunch Program

5.4 Instrumental Variable

It was difficult to find causal effects of NSLP participation on children's food security due to the endogeneity problem. To solve this problem, this study used an instrumental variable. In the model, the instrumental variable, called "TIME", described whether a student had enough time to have their school lunch. This "TIME" variable was included in the participation equation with the assumption that it had no direct effect on the 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. 2009). This study created the instrumental variable based on these two questions. The variable of TIME was coded as 1 with enough time, and 0 otherwise.

The length of school lunch meal period is associated with NSLP participation. Law et al. (1972) found that waiting in line and insufficient time were major reasons for teenagers not eating school lunch. Harper et al. (1980) found that frequency of participation correlated with time available for lunch. Also, eating time was relevant to the NSLP participation as the SNDA-III reported that 4% of students did not participate in the school lunch because there was not adequate time and 71% of students said they spent too much time waiting in line. Also, parents might 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). Students were recommended by the National Association of State Boards of Education (NASBE) to have at least 20 minutes for eating lunch

(SNA 2005). If time was too tight, children might worry about missing classes. With the anxiety of limited time, students could intend to save time during lunch or accelerate the speed of eating. What's more, limited lunch period could also cut children's socializing time at a lunch table, which further deteriorated their eating experiences. Unsatisfied eating experiences could result in a lower NSLP participation in future as students might ask their parents to prepare home lunch in order to avoid waiting in line and reduce potential fast eating. Also, students might 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 (Bhatt 2009).

Although TIME was believed to be an important variable for student's decision on participation, it did not directly influencing food security status. So far, there was no supporting evidence to find the length of meal period directly associated with food security. But it was necessary to be cautious about the latent variables, causing the correlation between eating time and children's food security. So, we went through the possible factors that could determine whether students have enough time to eat lunch or not. Conklin et al. (2002) indicated that lunch period consisted of time for travelling from classrooms to cafeterias, time for service, time for organizing and cleaning up, time for socialization and time for actual eating. Obviously, actual eating time could be substantially cut if students spent too much time on other parts. But the way lunch period was allocated does not directly influence food security. Therefore, TIME has no direct effect on food security, given the definition of food security.

CHAPTER VI

RESULTS

The results of the preliminary model are presented in Appendix A. Without accounting for endogeneity of program participation, the association between NSLP participation and food security was statistically significant. However, in this chapter we primarily discuss the results of the two-stage model with instrumental variable that account for the endogenous program participation.

6.1 First Stage: National School Lunch Program Participation

Table 5 provides the coefficients, p-values and marginal effects of the first stage estimation (program participation equation). In general, TIME, free/reduce price, household structure and employment, school level, school location and household highest education had positive effect on the probability of NSLP participation.

Consistent with our expectation, the instrumental variable TIME was statistically significant. There was a positive impact on the NSLP participation, indicating that students who had enough time to eat lunch meals after they got foods and had a seat were more likely to participate in the school lunch program than those who did not have enough time. Gordon et al. (2007) indicated that the range of lunch period was between 15 minutes to 1.5 hours in general. So, some students might not have enough time to eat their lunch.

With regard to free/reduced price meals, children were more likely to purchase school reimbursable lunch meal if they received free or reduced price. In the sample,

Table 5. Coefficients and Marginal Effects of NSLP Participation Equation

	Participation			
Variables	Estimates	Std Dev	Marginal	Std Dev
Free/reduced price	0.773***	0.082	0.253***	0.025
Household structure & employment				
2 parents, both employed FT	0.202**	0.102	0.066**	0.033
2 parents, one employed FT	0.088	0.100	0.029	0.033
1 parent, employed FT	0.256**	0.112	0.084**	0.036
Neither parent employed FT	(omitted)		(omitted)	
School Level				
Elementary	0.658***	0.075	0.216***	0.023
Middle	0.390***	0.074	0.128***	0.024
High	(omitted)		(omitted)	
Household size	0.010	0.019	0.003	0.006
Region				
Mid-Atlantic	0.124	0.126	0.041	0.041
Midwest	0.283**	0.113	0.093**	0.037
Mountain-Plains	0.238*	0.133	0.078*	0.044
Northeast	-0.055	0.131	-0.018	0.043
Southeast	0.536***	0.110	0.176***	0.035
Southwest	0.216**	0.104	0.071**	0.034
Western	(omitted)		(omitted)	
Race				
Hispanic	0.071	0.091	0.023	0.030
Black	-0.130	0.098	-0.043	0.032
Other race	0.021	0.134	0.007	0.044
White	(omitted)		(omitted)	
Urban vs. Rural Status				
City	-0.019	0.076	-0.006	0.025
Rural and Town	0.311***	0.080	0.102***	0.026
Urban fringe of city	(omitted)		(omitted)	
Highest education in household				
Less than high school	0.165	0.123	0.054	0.040
High school or GED	0.297***	0.090	0.097***	0.029
Some college or postsecondary	0.201***	0.076	0.066***	0.025
College graduate	(omitted)		(omitted)	
Instrumental variable				
Time	0.363***	0.086	0.119***	0.028

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

56.38% of students who actually received free/reduced price meal on the survey day were food insecure or marginal food secure, compared with 29% in the whole sample. Obviously, the policy of price differentiation for different groups worked well to attract more students who were really in need. Participation varied among groups with different household structures and employment. Compared with students with neither parents employed, students with two employed parents or only one employed parent out of one parent were more likely to participate in lunch program, reflecting the time constraint for a parent or parents who worked outside the home. Participation was more likely among elementary or middle school students, compared with high school students. Also, a student whose parent held a high school diploma was 9.7% more likely to participate in NSLP than students whose parents had a college degree or more. At the same time, a student whose parent had some college or postsecondary education was only 6.6% more likely to participate in NSLP. The results confirmed 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 participate in NSLP. Students from the Midwest, Mountain-plains, Southeast and Southwest were more likely to participate in the NSLP. Also, participation was more common for schools serving the rural area compared with those schools served urban of fringe. However, there was no significant difference among races.

6.2 Second Stage: Food Security

In the second stage we estimated the effect of NSLP participation on food security status. Based on the assumption of an ordered probit model, we got one group of coefficient results for all food security levels and three groups of marginal effects for each food security level (Table 6 and Table 7). The estimated coefficients itself provided limited information, while marginal effects were more informative. The marginal effects sum to zero.

Based on the results, we found that there was no significant association between NSLP and children's food security. In addition to running our model on the whole sample of students attending school we estimated a model using the sample of students from household with income less than 185% of poverty line. In this subgroup, all students were eligible for either free lunch or reduced price lunch. We found no significant association between NSLP and food security for students living in low-income households, which is consistent to what we found when we used the whole sample. What's more, the plausibility of this finding through alternative models, different food security measurements and dietary intake analysis is discussed in Chapter VII.

The discussion of significant variables in the second stage is provided below. Generally, free/reduce price, household structure and employment, school level, race, region, school location and household highest education had significant effects on food security status, while there was no significant association between NSLP participation and food security.

Table 6. Coefficients of Ordered Probit Estimation of Food Security

	Food security status	
Variables	Estimates	Std Dev
NSLP Participation	-0.361	0.686
Residual	0.198	0.689
Free/reduced price	-1.071***	0.196
Household structure & employment		
2 parents, both employed FT	0.522***	0.116
2 parents, one employed FT	0.331***	0.103
1 parent, employed FT	-0.065	0.119
Neither parent employed FT	(omitted)	(omitted)
School Level		
Elementary	0.568***	0.171
Middle	0.136	0.122
High	(omitted)	(omitted)
Household size	-0.043	0.028
Region		
Mid-Atlantic	0.106	0.142
Midwest	0.178	0.147
Mountain-Plains	-0.013	0.172
Northeast	0.142	0.152
Southeast	-0.011	0.166
Southwest	0.015	0.121
Western	(omitted)	(omitted)
Race		
Hispanic	-0.312***	0.098
Black	0.153	0.104
Other race	-0.094	0.151
White	(omitted)	(omitted)
Urban vs. Rural Status		
City	-0.089	0.082
Rural and Town	0.108	0.108
Urban fringe of city	(omitted)	(omitted)
Highest education in household		
Less than high school	-0.835***	0.136
High school or GED	-0.454***	0.128
Some college or postsecondary	-0.389***	0.114
College graduate	(omitted)	(omitted)

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

Table 7. Marginal Effects of Ordered Probit Estimation of Household Food Security Status

	Food Insecurity		Marginal Food Security		High Food Security	
Variables	Marginal	Std Dev	Marginal	Std Dev	Marginal	Std Dev
Participation of NSLP	0.070	0.132	0.016	0.030	-0.086	0.163
Residual	-0.038	0.133	-0.009	0.031	0.047	0.164
Free/reduced price	0.207***	0.038	0.047***	0.009	-0.254***	0.046
Household structure & employment						
2 parents, both employed FT	-0.101***	0.022	-0.023***	0.005	0.124***	0.027
2 parents, one employed FT	-0.064***	0.020	-0.015***	0.005	0.079***	0.024
1 parent, employed FT	0.013	0.023	0.003	0.005	-0.016	0.028
Neither parent employed FT	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
School Level						
Elementary	-0.110***	0.033	-0.025***	0.008	0.135***	0.040
Middle	-0.026	0.024	-0.006	0.005	0.032	0.029
High	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Household size	0.008	0.005	0.002	0.001	-0.010	0.007
Region						
Mid-Atlantic	-0.020	0.027	-0.005	0.006	0.025	0.034
Midwest	-0.034	0.028	-0.008	0.007	0.042	0.035
Mountain-Plains	0.002	0.033	0.001	0.008	-0.003	0.041
Northeast	-0.027	0.029	-0.006	0.007	0.034	0.036

Table 7. Continued

Variables	Food Insecurity		Marginal Food Security		High Food Security	
	Marginal	Std Dev	Marginal	Std Dev	Marginal	Std Dev
Southeast	0.002	0.032	0.000	0.007	-0.003	0.039
Southwest	-0.003	0.023	-0.001	0.005	0.003	0.029
Western	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Race						
Hispanic	0.060***	0.019	0.014***	0.004	-0.074***	0.023
Other race	-0.030	0.020	-0.007	0.005	0.036	0.025
Black	0.018	0.029	0.004	0.007	-0.022	0.036
White	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Urban vs. Rural Status						
City	0.017	0.016	0.004	0.004	-0.021	0.020
Rural area and Town	-0.021	0.021	-0.005	0.005	0.026	0.026
Urban fringe of city	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Highest education in household						
Less than high school	0.161***	0.026	0.037***	0.007	-0.198***	0.032
High school or GED	0.088***	0.025	0.020***	0.006	-0.108***	0.030
Some college or postsecondary	0.075***	0.022	0.017***	0.005	-0.092***	0.027
College graduate	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)

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

More specifically, students who received free or reduced price lunches were more likely to be food insecure. With worse financial conditions, these children had higher risks to suffer food shortage. Compared with households with neither parent employed, students with two employed parents were less likely to be food insecure, because higher total income could ensure food supply. Similarly, students living in household with two parents and one employed parent were also less likely to be food insecure, but the magnitude was smaller. Children living in households with one parent employed full time in a two parent household were only 6% less likely to be food insecure compared to10% less for two employed parents' household. Compared with high school students, elementary school age students were less likely to be food insecure. This could be explained by the fact that young children required less food compared to older children and were often times protected by adult members of the household. Perhaps parents are saving food for their young children if a food shortage happened.

Compared with white students, Hispanic students were more likely to be food insecure with higher risk of not having enough food. Coleman-Jensen (2011) reported that 26.2% of Hispanic households were food insecure in 2010, in contrast to 10.8% in white households. Parent's education level was positively associated with food security. As an example, parents with less than a high school education were more likely to face food insecurity compared to those with college degree or above.

With respect to the marginal food security group we expected to find results similar to highly food-secure group. The USDA defines that high food security and marginal food security as both being food secure. However, in this study, the interesting

finding was that all the signs of marginal effects for the marginal food security group were the same as food insecure group rather than high food security group. The magnitude of each control variable in marginal food security was much less than that for food insecurity group. This suggests that students who were marginally food secure shared more characteristics with those who were food insecure but with less severity. With respect to the highly food secure group we found that that all the signs of the marginal effect were opposite compared with food insecure and marginally secure groups. Students who received free/reduced price were less likely to be highly food secure. Compared with students with neither employed parents, students with two parents and either two employed or one employed were more likely to be highly food secure. Stable employment leads to a stable income and further to ensure food supply. Elementary school age had positive effect while Hispanic race and lower education in the household had negative effects on the probability of being highly food secure. For instance, students whose parents had less than high school education are 19.9% less likely to be highly food secure compared with students whose parents had a college degree or above.

CHAPTER VII

PLAUSIBILITY

Without considering endogeneity problem, the single ordered probit model found that NSLP participation had a negative and significant effect on children's food security. After solving endogeneity with an instrumental variable, we found NSLP's effect disappeared, indicating that there was no statistically significant relationship between NSLP participation and children's food security. In this chapter, we used different methods to check the plausibility of the estimations, including an alternative model, different food security measurements and dietary intake analysis.

7.1 Alternative Model

In order to check our finding, we employed the bivariate probit model as an alternative, as shown in equation 6 and 7. Compared with three food security levels, we used food security (coded as 1) and food insecurity (coded as 0) instead. Food security was combined with high food security and marginal food security while food insecurity remained same. The assumption of ε_1 and ε_2 are random errors that are assumed to approximate a joint normal distribution.

(6) $$FS_i^* = \beta_1 X_i + \beta_2 P_i + \varepsilon_1$$

(7) $$P_i^* = \alpha_1 X_i + \alpha_2 Z_i + \varepsilon_2$$

The results of the bivariate probit model indicated that NSLP participation also had no significant effect on children's food security (Appendix A).

7.2 Validation of Instrumental Variable

There are two requirements for a valid instrumental variable. First, the instrumental variable needs to be correlated with the included endogenous variable, called "instrument relevance". Second, the instrumental variable needs to have no direct effect on the variable of interest and should not be correlated with error terms, called "instrument exogeneity". In this study, we used a binary variable indicating of whether a student had enough time to eat lunch, denoted as TIME in our analysis, as an instrumental variable and checks were done to see if this variable meets both assumptions mentioned above.

For the instrument relevance, previous literature found that eating time was an important factor to determine program participation (Law et al. 1972; Harper et al. 1980; Gordon et al. 2007). Based on our results, we could also see that t-value for TIME was greater than 4.2 and the corresponding p-value was below 0.001. Wooldridge (2009) mentioned that we could be fairly confident about instrument relevance if we were able to reject the null hypothesis (the parameter was equal to zero) at a sufficiently small significance level (1% or 5%). So, the previous literature and our test in the first stage provide supporting evidences about the relevance of TIME.

For the instrument exogeneity, most of previous literature in the field of food assistance programs and food security relied on theoretical argument and justification (Mykerezi and Mills 2011; Yen et al. 2009). The assumption was that the instrumental variable should be exogenous in second stage with no correlation with error terms and no direct effects on the outcome variable.

As we discussed in Chapter V, lunch eating time is determined by the time for travelling from classrooms to cafeterias, time for service, time for organizing and cleaning up, time for socialization. But food security is defined to measure the adequacy of food. Based on the definition, the way lunch period is allocated did not directly influence food security. If we looked at the error terms, the possible unobservable factors are parent health, parent alcohol consumption, macroeconomic environment, etc. But actual eating time is not directly associated with those unobservable factors in the error terms. What's more, we excluded TIME in the first stage and put it in the second stage as shown in equation 8 and 9. Based on 2SRI method, the results indicated that TIME had no significant effect on food security (Appendix A). This is evidence to further support that the instrumental variable was valid.

(8) $$FS_i^* = \beta_1 X_i + \beta_2 P_i + \beta_3 Z_i + \varepsilon_1$$

(9) $$P_i^* = \alpha_1 X_i + \varepsilon_2$$

We compared another available instrumental variable in our data, called "Enough". "Enough" was defined as whether parents had enough information about NSLP or not. "Enough" was significant at 5% in the first stage. But we still could not find that NSLP had a significant effect on children's food security.

In sum, the instrumental variable "TIME" in this study was qualified with "instrument relevance" and "instrument exogeneity" assumptions.

7.3 Alternative Food Security Measurements

As discussed in Chapter II, there were several different ways to assess food security status. The reason we chose household food security was that it could reflect

household effects on children. If adult had to share foods with their children, children, whether or not they experienced food insecurity now, might still worry about food supply and become food insecure soon. In this part, we wanted to make sure whether the food security measurements caused bias by comparing results from the household food security scale, to the adult food security scale and the child food security scale. Both the household and adult scales had high, marginal, low and very low food secure. And we combined low and very low as food insecure. So the household and adult scales had the same food security levels. Based on the results, we found that there were no significant differences for household and adult measurements (Appendix A). For child food security scale, the data could only provide food secure, low food secure and very low food secure. Although we could not directly compare with the other two scales, the NSLP participation was still insignificant (Appendix A).

7.4 Dietary Intake Checks

In this part, we used 24-hours recall data to conduct the analysis of variance (ANOVA) between groups. We chose food energy and other 17 micronutrients. Food energy was more important here because food security primarily measured adequacy of food.

First, we wanted to know whether the contribution of NSLP in 24 hours was large enough to improve children's food security. NSLP was only the school reimbursable lunch meal, not including other food intakes at school (e.g. school breakfast or competitive foods). The major source of participants' lunches was supposed to be lunch meal, while nonparticipants primarily chose other sources. So, we only chose

NSLP participants to analyze the contribution of reimbursable lunch meal. In table 8, we could find that there were not significant differences for food energy intake from reimbursable lunch meal among food insecure, marginal food secure and high food secure participants.

Table 8. Intake from Reimbursable Lunch Meal

	NSLP Participants		
Nutrients	High	Marginal	Insecure
Food energy	576	543	552
Total fat (g)	22	21	21
Saturated fat (g)	7.5	7.0	7.2
Protein (g)	24	24	24
Carbohydrate (g)	71*	67*	67*
Vitamin A(mcg RAE)	180	161	173
Vitamin C (mg)	16***	23***	18***
Vitamin E (mg)	1.7	1.5	1.6
Vitamin B6 (mg)	0.4	0.4	0.4
Vitamin B12 (mcg)	1.4	1.3	1.4
Calcium (mg)	383	352	372
Iron (mg)	3.5	3.4	3.4
Magnesium (mg)	74	71	73
Potassium (mg)	806	768	816
Sodium (mg)	1057	988	1045
Zinc	3.1	3.0	3.2
Folate	112	107	109
Dietary fiber	4.3	4.2	4.3

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

For nutrients, only Carbohydrate and Vitamin C were different among three food security groups. Generally, participants in lower food security levels did not intake more food energy and nutrients significantly (similar results for nonparticipants sample and all students sample). Without substantial more intakes, it was difficult for NSLP to improve

participants' food security by itself. What's more, we compared the percentage of reimbursable lunch meal out of 24 hour intakes (Table 9).

Table 9. Lunch Reimbursable Meal Intake vs 24 Hours Intake

	NSLP Participants		
Nutrients	High	Marginal	Insecure
Food energy	28.6%	29.3%	28.6%
Total fat (g)	31.2%	31.3%	31.1%
Saturated fat (g)	30.5%	31.7%	31.1%
Protein (g)	33.6%	34.2%	34.4%
Carbohydrate (g)	26.4%	27.6%	26.3%
Vitamin A(mcg RAE)	32.3%*	35.0%*	35.7%*
Vitamin C (mg)	26.6%	29.0%	27.1%
Vitamin E (mg)	30.9%	32.3%	30.3%
Vitamin B6 (mg)	27.2%*	28.7%*	29.5%*
Vitamin B12 (mcg)	31.7%	32.4%	32.7%
Calcium (mg)	36.2%	38.0%	37.5%
Iron (mg)	26.5%	27.8%	26.7%
Magnesium (mg)	31.2%	32.8%	32.1%
Potassium (mg)	33.8%	34.7%	35.2%
Sodium (mg)	32.4%	32.1%	33.6%
Zinc	29.3%	30.5%	31.3%
Folate	24.3%	25.7%	25.8%
Dietary fiber	33.3%	33.5%	33.4%

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

For food energy, NSLP contributed about 30% in a day, indicating that the majority of energy intake was from other sources. School reimbursable lunch meal was only a part of full day intake, which might not be enough to transfer children from lower food security levels to higher levels.

Second, we wanted to compare participants and nonparticipants. Only comparing reimbursable lunch meal, the results could be bias because nonparticipants did not primarily intake from NSLP and participants might also intake foods from other sources during the lunch. So, we chose all the food reported as lunch including reimbursable meal and foods from other sources. The results are presented in table 10. Consistent with previous literature, NSLP improved target micronutrients intakes among participants. However, there were no statistically significant differences about food energy intakes between participants and nonparticipants in all three food security levels. Several other studies (Gordon et al. 2007; Gleason and Suitor 2003) also found a similar result about food energy intake. What's more, the contribution of participants' food energy intakes during lunch was also similar as nonparticipants around 30% out of 24 hours intakes (Table 11).

So, NSLP participation did increase target micronutrients intake but not food energy intake significantly. That suggested participants' food energy intakes were not significantly higher than nonparticipants, although participants intake several more key nutrients. Also, the NSLP reimbursable meal was only a part of daily intakes, contributing about 30% of students' food energy intake per day.

Table 10. Total Nutrients Intake from Lunch

	High		Marginal		Insecure	
Nutrients	Pa	Non	Pa	Non	Pa	Non
Food Energy	609	612	603	525	593	587
Total fat (g)	23	25	23	20	23	24
Saturated fat (g)	7.9	7.7	7.6	6.1**	7.7	7.8
Protein (g)	25	21***	26	19**	25	22*
Carbohydrate (g)	76	78	75	67	73	72
Vitamin A(mcg RAE)	186	94***	168	82***	181	82***
Vitamin C (mg)	17	19	26	13**	20	30**
Vitamin E (mg)	1.8	2.2***	1.8	1.5	1.8	1.7
Vitamin B6 (mg)	0.4	0.4*	0.4	0.4	0.4	0.4
Vitamin B12 (mcg)	1.5	0.9***	1.4	1.0**	1.4	1.0***
Calcium (mg)	397	242***	373	216***	384	262***
Iron (mg)	3.7	3.5**	3.7	2.8**	3.6	3.5
Magnesium (mg)	77	71**	77	54***	78	59***
Potassium (mg)	840	615***	832	580***	861	636***
Sodium (mg)	1100	1032*	1077	858**	1086	1026
Zinc	3.2	2.7***	3.3	2.3***	3.3	3.0
Folate	118	120	118	92*	116	114
Dietary fiber	4.5	4.1	4.6	2.7***	4.6	3.2***

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

Table 11. Total Lunch Intake vs 24 Hours Intake

	High		Marginal		Insecure	
Nutrients	Pa	Non	Pa	Non	Pa	Non
Food energy	30.2%	29.2%	31.9%	29.1%	30.5%	28.4%
Total fat (g)	32.7%	31.9%	34.0%	32.8%	33.0%	30.9%
Saturated fat (g)	32.0%	29.5%***	34.1%	30.8%	32.7%	29.9%
Protein (g)	34.8%	28.9%***	36.2%	31.3%	35.7%	28.4%***
Carbohydrate (g)	28.2%	28.0%	30.4%	26.9%	28.4%	26.8%
Vitamin A(mcg RAE)	33.2%	18.0%***	36.6%	20.2%***	36.9%	21.9%***
Vitamin C (mg)	28.1%	24.4%**	31.7%	20.4%**	29.3%	35.8%*
Vitamin E (mg)	32.7%	32.9%	35.2%	30.6%	32.8%	28.2%*
Vitamin B6 (mg)	28.3%	23.9%***	30.4%	26.5%	31.1%	25.0%***
Vitamin B12 (mcg)	32.5%	20.4%***	34.0%	24.0%**	33.6%	21.6%***
Calcium (mg)	37.4%	25.2%***	40.1%	26.8%***	38.7%	26.8%***
Iron (mg)	27.7%	24.9%***	29.6%	26.4%	28.0%	23.8%**
Magnesium (mg)	32.7%	28.2%***	35.1%	26.8%***	34.1%	26.5%***
Potassium (mg)	35.1%	26.5%***	36.8%	27.7%***	36.9%	28.3%***
Sodium (mg)	33.7%	30.8%***	35.0%	31.1%	35.0%	30.9%*
Zinc	30.5%	25.0%***	32.5%	29.3%	32.7%	26.2%***
Folate	25.4%	23.9%*	27.4%	26.5%	27.2%	22.8%*
Dietary fiber	34.8%	30.1%***	35.9%	31.1%	35.4%	26.8%***

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

CHAPTER VIII

DISCUSSION AND CONCLUSION

Previous literature addressed the association between food security and other food assistance programs, including FSP, WIC, and SBP. Our research adds to this body of literate by estimating the effect of NSLP on children's food security and accounting for endogeneity of program participation. We estimate an ordered probit model using two-stage instrumental variables approach.

In the first stage, we found that having enough time eat school lunch had a positive and significant effect on program participation. More specifically, students who had enough time to eat lunch are 12% more likely to purchase school lunch. This means that by increasing the number of lunch lines or having fewer classes eat lunches per lunch period can lead to increased program participation. Other factors that influence student's participation in school meal program are the receipt of free/reduced priced meals, attending elementary or middle school age, rural area, lower parents' education and only one employed parent out of one parent or two employed parents.

In the second stage, we did the analysis for three food security levels (food insecure=1, marginal food security=2, high food security=3). The results from the ordered probit model indicate that receipt of free/reduce priced meals, household structure and employment, being in elementary or middle school, race, and parents' education level have significant effects on all three food security groups. For food insecure and marginally secure group, the signs of those significant factors were same.

Although USDA defines marginal food security as belonging to food security, our results indicated that marginally secure group shared more similar characteristics with food insecure group rather than with high food secure group.

After accounting for the potential endogeneity of program participation, we did not find statistically significant association between individual NSLP participation and children's food security. To explain the findings of our empirical model we looked at the children's nutrient intake and conducted some descriptive analysis testing. Based on the dietary intake analysis we found that NSLP participants did not intake more food energy from lunch than nonparticipants. Gordon et al. (2007) reported that food energy consumed by NSLP participants were similar as nonparticipants. Based on the fixed effects model, Gleason and Suitor (2003) also noted that NSLP participation had no significant effect on children's overall food energy intake from lunch. Therefore, the possible reason that NSLP had no significant effect was that participants did not have significant more calories intake from school lunch.

Compared with the model without instrumental variable, the negative and significant effect of NSLP participation disappeared in our two stage model. Most previous literature constructed a binary variable for food security. So, we also used bivariate probit model to analyze the NSLP's effect on children food security. However, we still could not find the significant association between NSLP and food security. To check the validity of our instrument we removed the instrumental variable from the first stage estimation and included the instrumental variable into the second stage. We found that TIME had no significant effect on food security level.

Although participation in SBP might affect food security of children in our current analysis we did not include SBP participation as one of the explanatory variables. In our final sample SBP participants were almost a perfect subset of NSLP participants, i.e. about 90% of SBP participants in our sample were also participating in NSLP. A free/reduced price meal was one of the important control variables in the first and second stage of estimation. However, almost 80% of SBP participants also received free/reduced price meal. The inclusion of SBP participation variable in our estimation may lead to a near multicollinearity problem. However, it would of interest to look at the effect of SBP alone or joint effect of SBP and NSLP participation on children's food security status.

We found no evidence that NSLP participation had significant effect on children's food security status. One of the reasons could be that we used 24 hour recall intake data in our analysis and considered only target day participation. Also, SNDA-III is cross-sectional data and the use of longitudinal data might be preferred to fully capture the long term effect of the program.

Beside the NSLP, students could also receive public supports from other food assistance programs. For instance, FSP is the largest program and WIC is the third largest program, which potentially have effects on children's food security. Our sample has too many missing observations about the receipt of other food assistance program benefits, because the survey was designed for evaluating the NSLP. In future, it would be interest to design a new survey to control the benefits from other programs.

In future, policymakers could encourage local districts to (1) providing more lunch lines, tables and seats; (2) training more skilled employees for dining service (3) having fewer classes in the same lunch period. By increasing eating time, more students would participate in the NSLP. Also, marginal food security group share more characteristics with food insecurity group. It is important for us to explore the reason and provide further support for those children through the public policy tools.

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APPENDIX A

SUPPLEMENTARY TABLES

Table A1. Coefficients of Ordered Probit Estimation without IV

Variables	Estimates	Std Dev
NSLP Participation	-0.165***	0.074
Free/reduced price	-1.121***	0.087
2 parents, both employed FT	0.509***	0.107
2 parents, one employed FT	0.325***	0.100
1 parent, employed FT	-0.081	0.105
Neither parent employed FT	(omitted)	(omitted)
School Level		
Elementary	0.525***	0.087
Middle	0.109	0.079
High	(omitted)	(omitted)
Household size	-0.044	0.028
Region		
Mid-Atlantic	0.096	0.137
Midwest	0.158	0.125
Mountain-Plains	-0.027	0.167
Northeast	0.144	0.152
Southeast	-0.044	0.118
Southwest	0.001	0.109
Western	(omitted)	(omitted)
Race		
Hispanic	-0.317***	0.096
Black	0.161	0.100
Other race	-0.095	0.150
White	(omitted)	(omitted)
Urban vs. Rural Status		
City	-0.088	0.082
Rural and Town	0.089	0.091
Urban fringe of city	(omitted)	(omitted)
Highest education in household		
Less than high school	-0.847***	0.128
High school or GED	-0.473***	0.107
Some college or postsecondary	-0.403***	0.101
College graduate	(omitted)	(omitted)

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

Table A-2. Coefficients of the bivariate probit model

	Participation		Food security	
Variables	Estimates	Std Dev	Estimates	Std Dev
NSLP Participation			0.802	0.612
Free/reduced price	0.784***	0.083	-1.187***	0.098
2 parents, both employed FT	0.211**	0.102	0.331**	0.135
2 parents, one employed FT	0.092	0.100	0.285**	0.124
1 parent, employed FT	0.258**	0.111	-0.136	0.116
Neither parent employed FT	(omitted)		(omitted)	
School Level				
Elementary	0.654***	0.075	0.230	0.198
Middle	0.388***	0.074	0.025	0.139
High	(omitted)		(omitted)	
Household size	0.011	0.017	-0.040	0.025
Region				
Mid-Atlantic	0.118	0.125	0.076	0.155
Midwest	0.281**	0.112	0.041	0.158
Mountain-Plains	0.223*	0.134	-0.083	0.182
Northeast	-0.058	0.132	0.087	0.159
Southeast	0.527***	0.109	-0.197	0.152
Southwest	0.209**	0.104	-0.069	0.121
Western	(omitted)		(omitted)	
Race				
Hispanic	0.053	0.093	-0.337***	0.105
Black	-0.153	0.102	0.165	0.107
Other race	0.020	0.133	-0.155	0.146
White	(omitted)		(omitted)	
Urban vs. Rural Status				
City	-0.020	0.075	-0.038	0.089
Rural and Town	0.320***	0.081	-0.036	0.109
Urban fringe of city	(omitted)		(omitted)	
Highest education in household				
Less than high school	0.174	0.122	-0.712***	0.144
High school or GED	0.301***	0.090	-0.408***	0.118
Some college or postsecondary	0.202***	0.076	-0.388***	0.109
College graduate	(omitted)		(omitted)	
Time	0.338***	0.093		

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

Table A-3. Validation of IV

Variables	Estimates	Std Dev
NSLP Participation	-0.495	1.364
Time	-0.011	0.094
Free/reduced price	-1.036***	0.364
2 parents, both employed FT	0.531***	0.141
2 parents, one employed FT	0.335***	0.110
1 parent, employed FT	-0.054	0.154
Neither parent employed FT	(omitted)	(omitted)
School Level		
Elementary	0.598*	0.312
Middle	0.155	0.204
High	(omitted)	(omitted)
Household size	-0.043	0.029
Region		
Mid-Atlantic	0.113	0.153
Midwest	0.192	0.191
Mountain-Plains	-0.003	0.191
Northeast	0.141	0.152
Southeast	0.012	0.257
Southwest	0.024	0.145
Western	(omitted)	(omitted)
Race		
Hispanic	-0.307***	0.105
Black	0.147	0.112
Other race	-0.092	0.151
White	(omitted)	(omitted)
Urban vs. Rural Status		
City	-0.090	0.083
Rural and Town	0.122	0.161
Urban fringe of city	(omitted)	(omitted)
Highest education in household		
Less than high school	-0.827***	0.155
High school or GED	-0.441**	0.174
Some college or postsecondary	-0.380***	0.140
College graduate	(omitted)	(omitted)

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

Table A-4. Coefficients of the Estimation of Adult Food Security Scale

	Adult Food Security Scale			
	1st Stage		2nd Stage	
Variables	Estimates	Std Dev	Estimates	Std Dev
NSLP Participation			-0.677	0.691
Residual			0.565	0.695
Free/reduced price	0.776***	0.082	-0.957***	0.199
Household structure & employment				
2 parents, both employed FT	0.206***	0.102	0.517***	0.117
2 parents, one employed FT	0.090	0.100	0.352***	0.102
1 parent, employed FT	0.250***	0.111	-0.051	0.116
Neither parent employed FT	(omitted)		(omitted)	
School Level				
Elementary	0.654***	0.075	0.611***	0.173
Middle	0.391***	0.074	0.189	0.123
High	(omitted)		(omitted)	
Household size	0.010	0.019	-0.032	0.024
Region				
Mid-Atlantic	0.122	0.126	0.177	0.138
Midwest	0.280**	0.113	0.231	0.145
Mountain-Plains	0.235*	0.133	0.031	0.166
Northeast	-0.048	0.131	0.114	0.146
Southeast	0.532***	0.110	0.073	0.163

Table A-4. Continued

	Adult Food Security Scale			
	1st Stage		2nd Stage	
Variables	Estimates	0.3498692	Estimates	Std Dev
Southwest	0.208**	0.104	0.074	0.119
Western	(omitted)		(omitted)	
Race				
Hispanic	0.064	0.091	-0.296***	0.097
Black	-0.132	0.098	0.102	0.106
Other race	0.020	0.134	-0.083	0.154
White	(omitted)		(omitted)	
Urban vs. Rural Status				
City	-0.016	0.076	-0.078	0.083
Rural and Town	0.316***	0.080	0.133	0.111
Urban fringe of city	(omitted)		(omitted)	
Highest education in household				
Less than high school	0.169	0.123	-0.784***	0.134
High school or GED	0.298***	0.090	-0.396***	0.125
Some college or postsecondary	0.201***	0.076	-0.334***	0.113
College graduate	(omitted)		(omitted)	
Instrumental variable				
Time	0.355***	0.086		

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

Table A-5. Coefficients of the Child food security scale

	1st Stage		2nd Stage	
Variables	Estimates	Std Dev	Estimates	Std Dev
NSLP Participation			-0.861	0.906
Residual			0.678	0.908
Free/reduced price	0.757***	0.083	-0.900***	0.264
2 parents, both employed FT	0.214**	0.103	0.246*	0.137
2 parents, one employed FT	0.087	0.101	0.183	0.117
1 parent, employed FT	0.275**	0.113	-0.043	0.141
Neither parent employed FT	(omitted)		(omitted)	
School Level				
Elementary	0.643***	0.076	0.844***	0.214
Middle	0.372***	0.075	0.321**	0.148
High	(omitted)		(omitted)	
Household size	0.009	0.019	-0.021	0.016
Region				
Mid-Atlantic	0.115	0.127	0.168	0.177
Midwest	0.283**	0.115	0.044	0.181
Mountain-Plains	0.236*	0.134	0.315	0.233
Northeast	-0.065	0.132	-0.072	0.171
Southeast	0.536***	0.111	0.143	0.202
Southwest	0.215**	0.105	0.008	0.143
Western	(omitted)		(omitted)	
Race				
Hispanic	0.060	0.093	-0.403***	0.117
Black	-0.149	0.099	-0.190	0.125
Other race	-0.017	0.135	-0.280	0.179
White	(omitted)		(omitted)	
Urban vs. Rural Status				
City	-0.026	0.077	-0.013	0.099
Rural and Town	0.304***	0.081	0.063	0.135
Urban fringe of city	(omitted)		(omitted)	
Highest education in household				
Less than high school	0.180	0.125	-0.499***	0.173
High school or GED	0.297***	0.091	-0.158	0.169
Some college or postsecondary	0.187**	0.077	-0.219	0.152
College graduate	(omitted)		(omitted)	
Time	0.349***	0.088		

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

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