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Three essays on food security, food demand and welfare program participation

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Three essays on food security, food demand and welfare program participation

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TABLES OF CONTENTS

1. GENERAL INTRODUCTION.....1

Introduction..... 1

Food security measurement..... 2

Social assistance programs after welfare reform..... 5

Participation in social assistance programs..... 7

The controversy..... 9

Food expenditure..... 10

The objective and basic results of the study..... 13

Policy implication..... 15

The organization of the dissertation..... 17

2. FOOD SECURITY AND FOOD STAMP PROGRAM PARTICIPATION.....18

Introduction..... 18

Background..... 21

The Economic Model..... 23

The Econometric Model..... 29

The Data..... 34

Empirical results..... 38

Conclusion and Comments..... 46

3. FOOD SECURITY AND DEMAND FOR FOOD AWAY FROM HOME.....59

Introduction..... 59

The Basic Model 64

Methodology 68

Zero problem issue in FAFH 68

Data and Variable Definitions 75

Empirical Findings 78

Summary 87

4. FAMILY INVESTMENT PROGRM PARTICIPATION 102

Introduction 102

Data 104

Fractional imputation and jackknife variance estimation 105

Descriptive analysis and results from the imputation 108

Economic Model 110

Empirical Specification 112

Empirical results 118

Discussion and Conclusions 126

5. CONCLUSIONS 135

REFERENCES 138

ACKNOWLEDGMENTS 146

1. GENERAL INTRODUCTION

Introduction

The dissertation consists of three essays that analyze welfare program participation, food consumption behavior of low-income households, and food security status. The first two essays consider food stamp program participation and food expenditure. Of specific interest is food stamp program participation and expenditure on food consumption away from home based on different food security status: food secure households and food insecure households (include food insecure without hunger and food insecure with hunger). The analysis is built on the observation that households have different program participation and food consumption behavior when they face different condition of food security. The first two essays consider whether family structure and income sources have different effects on program participation and food consumption behavior related to food security. Both studies use Current Population Survey (CPS)-Food Security Supplement data. The third essay analyzes the effects of demographic variables and income sources (wage income and child support) on Family Investment Program (FIP) participation based on Iowa administrative data. Iowa introduced major changes to its social assistance programs as the FIP in 1993.

These essays are designed to better understand whether program participation and consumption behavior of the low-income families may be explained by different family structure and different income sources. As illustrated below, the behavior of social assistance program recipients is far from completely understood. The analyses provided here focus on the effects of family structure and income sources on program participation and compare the difference between food secure households and food insecure households.

Food security measurement

Food security is widely defined as " access by all people at all times to enough food for an active healthy life" (World Bank, 1986). It is an inherently unobservable concept that has largely eluded precise and operational definition. Based on the Life Sciences Research Office of the Federation of American Societies for Experimental Biology (1990), food security refers to " access by all people at all times to enough food for an active, healthy life. Food security includes at a minimum: (1) the ready availability of nutritionally adequate and safe foods, and (2) an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies)." Food insecurity refers to " limited or uncertain ability to acquire acceptable foods in socially acceptable ways," and hunger refers to " the uneasy or painful sensation caused by a lack of food. The recurrent and involuntary lack of access to food. Hunger may produce malnutrition over time... Hunger ... is a potential, although not necessary, consequence of food insecurity" (Anderson, 1990).

The key factors affecting household food security status are shown in Figure 1.1. They are influenced by the availability of food, the ability and desire of the households to acquire it, its intrahousehold distribution, and the physiological utilization of the ingested nutrients, which both affect and are affected by the person's state of health. The person's nutritional status also has a feedback effect on their productivity, and the ability to acquire food (Senauer and Roe, 1997). Clearly, there is no food availability problem in USA. However, other factors may cause Americans suffer food insecure or even hungry. In general, food insecurity and hunger are primary the result of poverty. For example, households suffer food insecure or hunger because they do not have enough money, adults in the household eat less

than they need due to child support. Other factors such as knowledge of nutrition also affect the food security status.

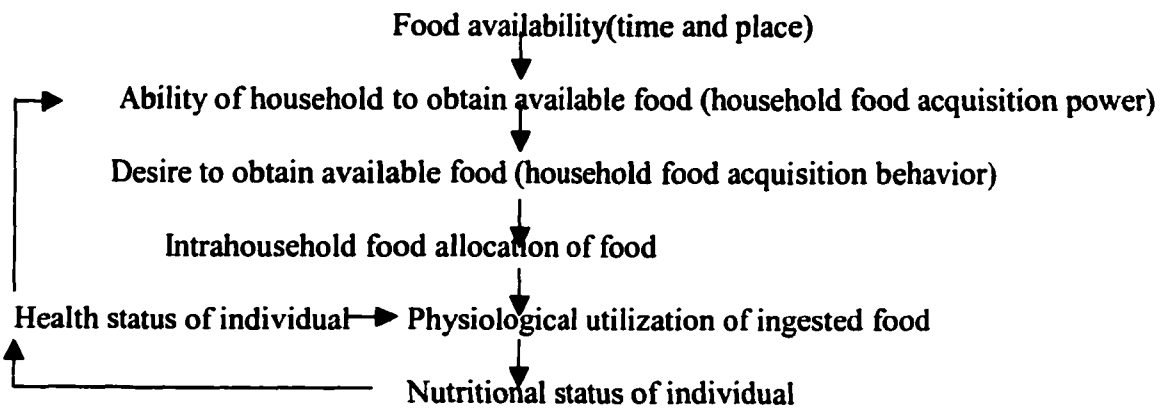

Figure 1.1 Factors Affecting Household Food Security and Individual Nutritional Status (Source: Per Pinstrup-Andersen, 1981)

Although income is one of the main reasons for households to suffer from food insecurity and hunger, food security status is not exactly the same as income categories. According to Bickel et al. (2000), traditional income and poverty measures do not provide clear information about food security. Analysis of food security data shows that many low-income households are food secure, whereas a small percentage of non-poor households are food insecure. A survey of welfare program recipients conducted in California shows that "income, even when adjusted for household need and augmented by the food stamp grant, poorly predicts hunger or overcrowding among respondents. Families with teenage boys report hunger much more often than their incomes would predict, as do families whose finances have recently deteriorated" (Mauldon, 1995). Based on the available literature, measured food security may provide independent and more specific information on the well-being of low income households than can be inferred from income data alone.

The food security measurement used in this study is based on the Food Security module developed by the US Department of Agriculture (Bickel et al., 2000) as implemented in the Current Population Survey (CPS). In April 1995 the U.S. Census Bureau implemented the first Food Security Supplement to its Current Population Surveys. A household's level of food insecurity or hunger is determined by obtaining information on a variety of specific conditions, experiences, and behaviors that serve as indicators of the varying degrees of severity of the condition. The CPS Food Security Supplement asked about household conditions, events, behaviors, and subjective reactions such as anxiety that the household had an insufficient food budget, the experience of running out of food, a food supply inadequate in quality or quantity, adjustments to normal food use, or instances of reduced food intake by adults and children in the household. USDA researchers developed a numerical food security scale and a related categorical food-security-status measure to describe the food security situation of US households during the preceding 12-month period based on detailed analysis from the household interviewed (see Bickel, et al., 2000 for detail).

To measure the food security, hunger scores are estimated by using a Rasch model (Bickel, et al., 2000). The Rasch model is a type of item response theory model developed for the purpose of measuring the ability of individuals based on the answers to a set of questions (Baker, 1982). The model implies the existence of a continuous "scale," on which the items (questions) can be placed based on their difficulty level and individuals can be placed based on their ability levels. In the food security measurement, the "difficulty" is the level of food insecurity it captures, and the "security" is the scale on which household food security is measured. Suppose that a sample of N households was administered a set of m dichotomous items, with each household receiving the whole set of n items. Based on their responses, the

goal is to estimate the severity of each household's food security, as well as each item's inherent difficulty. Let θ_i be the ith individual's ability parameter for $i=1,...,N$ and a_j be the jth item's difficulty parameter for $j=1,...m$. If I_{ij} is an indicator random variable that gives the dichotomous answer of person i to item j, then its distribution is

$$\Pr(I_{ij}=1 \mid \theta_i, \alpha_j) = \frac{\exp(\theta_i - \alpha_j)}{1+\exp(\theta_i - \alpha_j)} \qquad (1.1)$$

The model implies that when $\theta_i = a_j$, the individual has 50% chance of answering question j affirmatively. When $\theta_i > a_j$, the individual is more than 50% likely to answer affirmatively (see Baker, 1992; Opsomer, et al., 2001 for details).

Based on the Current Population Survey data and the estimation by the model, a large majority of households indicated that within the past year (12 months) they did not experience any conditions of food insecurity. However, there are still around 10 percent of the households who report suffering food insecurity or hunger (Andrews, et al., 2000).

The analyses of the first two papers are based on the Current Population Survey's Food Security Supplement data which serves a continuing role as the government's primary measure of the well-being of the U.S. population.

Social assistance programs after welfare reform

One of the purposes of the Personal Responsibility and Work Opportunity Reconciliation Act of 1996, popularly known as welfare reform, was to "end the dependence of needy parents on government benefits by promoting job preparedness, work, and marriage" (USHS, 2000). This federal legislation, along with other changes in state policies before and after passage, has increased incentives and requirements for families receiving

benefits to move into work and eventually off welfare. However, there still exist two major types of welfare program based on program benefits: one is USDA food assistance programs (such as the food stamp; special supplemental nutrition program for woman, infants and children; and school lunch and breakfast programs), and the another one is the cash assistance programs run by the States as Temporary Assistance to Needy Families (TANF).

The food stamp program (FSP) is a central component of food assistance programs and provides benefits through coupons and, more recently, with an ATM-like card and electronic benefit transfer. The program is designed primarily to increase the food purchasing power of eligible low-income households to a point where they can buy a nutritionally adequate low-cost diet. It is designed to help low-income families and individuals meet their basic nutritional needs by ensuring they have the means to purchase a nutritionally adequate and palatable low-cost diet. Although there have been some major changes in the program after welfare reform, it is still the largest public assistance program that has uniform national standards and is available to all households on the basis of financial need, regardless of age, family type or disability. According to the data, during fiscal year 1999, the FSP served approximately 18.2 million people in an average month benefit of $72 per person (Wilder, et al., 2000).

Aid to Families with Dependent Children, renamed under the Personal Responsibility and Work Opportunity Act (PRWOA) as Temporary Assistance for Needy Families (TANF) is a major cash welfare program for families with children. There are several goals of the TANF program: aid needy families so that children may be cared for in their homes or those of relatives; end dependence of needy parents upon government benefits by promoting job preparation, work, and marriage; prevent and reduce out-of-wedlock pregnancies and

establish goals for preventing and reducing their incidence; and encourage formation and maintenance of two-parent families (USHS, 1998).

The Family Investment Program (FIP) is the name of cash assistance program in the State of Iowa which began under waiver on July 1, 1993. The program places less emphasis on maintaining the incomes of client families and more emphasis on increasing their participation in employment and training which was the fundamental shift in welfare policy nationwide that culminated in the passage of the federal Personal Responsibility and Work Opportunity Act of 1996 (PROWA).

Participation in social assistance programs

From September 1994 to September 1999, the number of participants in the FSP fell by 9 million, or 35 percent. Based on data, the number of participating individuals fell by more than the number of eligible individuals from 1994 to 1999, the participation rate decreased from 74 to 57 percent (Wilde, et al., 2000). This means a decreasing percentage of eligible individuals are relying on the FSP for support. More are leaving the FSP, or not participating in the first place, even though they are eligible.

Based on the literature, there are at least two major factors causing program participation rates to decrease:

First, a strong economy helped low-income families find jobs, earn more money, and leave the program or not apply in the first place. The strong economy has moved a large portion of the former welfare caseload into work. Increasing the number of low-income working families reduced the number of households eligible for food stamps and contributed substantially to the decline in food stamp use. The proportion of households with incomes

below 130% of the federal poverty level declined from 24.2% in 1995 to 19.1% in 1999. Adjusted for population growth, this reduction represents a decline of 21.0% in the size of the low-income, generally food stamp eligible population (Nord, 2001).

Second, the 1996 federal welfare reform legislation replaced Aid to Families with Dependent Children (AFDC) with the work-oriented Temporary Assistance to Needy Families (TANF) program. Changes to the welfare system may also have affected many food stamp recipients because of the overlap of the two populations. The food stamp provisions of the 1996 welfare reform legislation restricted the eligibility of many permanent resident aliens and required many able-bodied adults without dependents (ABAWDs) to work in order to continue receiving food stamps. Legislation in 1997 expanded funding for employment and training opportunities for ABAWDs and put in place additional exemptions from the work requirements. Legislation in 1998 restored food stamp eligibility to some noncitizen children, elderly, and disabled individual.

Several other reasons for nonparticipation are also apparent in the literature. As discussed in the testimony of James Ohls (2001), researchers have found that many did not participate in the welfare program even though they were eligible. Some of the answers through interview with the eligible non-recipients mentioned in his testimony included " I always thought that the food stamps were for people on welfare and for people that were very poor....I was not on welfare so I guess I thought I wasn't eligible," " I really prefer not to participate because of the stuff you have to go through," " It's the process that keeps people from going to apply for them. That's the major thing. That and the environment. You go up there and sit for four or five hours, people don't have the patience to do that," " You go down half of the time and you sit up there all day sometimes and they say come back tomorrow."

Although these quotations are not representative, they help illustrate the kinds of experiences which sometimes serve as a deterrent to participation.

The controversy

Although the U.S. economy expanded steadily during the 1990s and the country's nutrition safety net has helped a large majority of American households achieve or maintain food security, there are still around 9.2 million (8.7%) of households, 27 million persons suffering food insecurity or hunger in 1999 (Andrews, et al., 2000). Clearly, many American families and individuals still struggle to meet basic needs. However, despite the households facing problems of food insecurity, the number of welfare program recipients has declined during the past several years. Figure 1.2 shows the trend of the FSP participation rate and the food insecurity and hunger rate. From the graph, the FSP participation rate gradually declines while the share of households suffering food insecurity or hunger did not change much during these years.

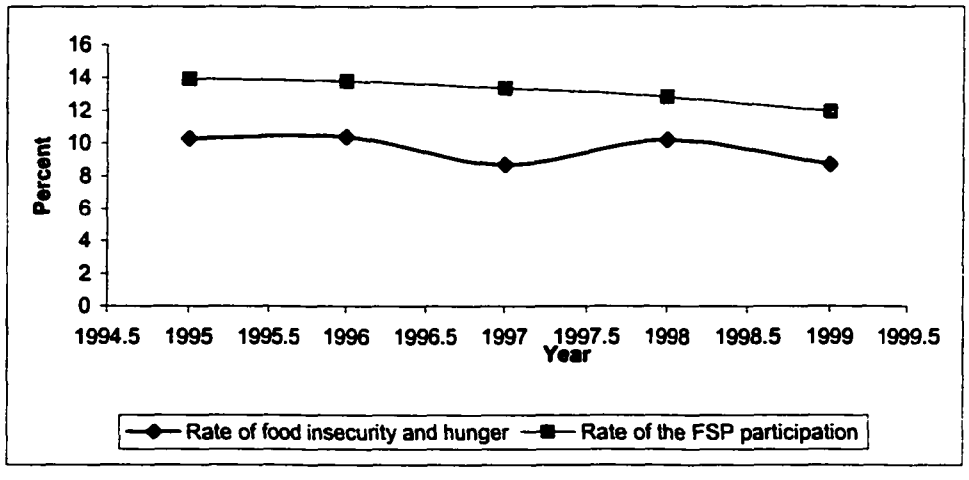

Figure 1.2 A Comparison of FSP Participation and Food Insecurity Rates (% of Households) (Source: Andrews, et al., 2000)

The question of why some households suffer food insecurity or hunger but do not participate in social assistance and food programs has been an interesting topic for both economists and policy makers. Beginning with earlier 1980's, the theory of "welfare stigma" by Moffit (1983) has been one of the major reasons to explain nonparticipation in a welfare program even if the household is eligible. Recently, other reasons such as knowledge, local economic development also have been discussed (e.g. Ohls, 2000). However, economic development, welfare reform (such as terminal time limits, work requirements, and other personal responsibility measures) and other economic and policy changes confound the ability of the researcher to easily decompose the caseload decline. Accounting for the relative contributions of welfare reform and the business cycle to the decline in caseloads has been the focus of much recent research. The Council of Economic Advisors (1997) found that 44% of the 1993 to 1996 decline in AFDC caseloads was due to the macroeconomy, while welfare waivers from the federal government accounted for 31%. Ziliak et al. (2000) reached starkly different conclusions by attributing two-thirds of the decline to the business cycle and little to welfare reform. There is some indication that the recent decline in economic condition has led to increases in welfare rolls. Based on USDA, the households participating in FSP in 2001 increased 1.60% (11,7194 households) from 2000 (USDA, 2002).

Food expenditure

A significant economic trend in the past ten years is the declining share of consumer expenditure on food. Expenditures for food fell steadily from 14.32% of total expenditure in 1991 to 13.51% in 2000. At the same time, Americans are dining out more often than ever, boosting the amount spent on eating out from 37.6% of total food expenditure in 1991 to

41.97% in 2000 (BLS, 1991-2000). A number of factors contribute to the trend of eating out: a growing number of women employed outside the home, more two-earner households, higher incomes, more affordable and convenient fast-food outlets, increased advertising and promotion by large food service chains, and the smaller size of American households (Nayga and Capps, 1994).

The share of spending on food decreases as income increases, both through time and in cross-section. Figure 1.3 shows the share of food expenditure on total food expenditure for households of different income during the past ten years. Based on the graph, the food share is 6% less for households with income per capita greater than $50,000 compared to that of households with income per capita less than $5,000 in 1990. However, the food share difference has decreased over time: the difference is 3.72% in 1999 and 2.28% in 2000. The share decreased dramatically during the past ten years for low-income households but remained relatively stable for high income households.

Figure 1.4 is the share of food expenditure on food away from home (FAFH)in total food expenditure. Although the share is largest in 1990, the share increases gradually from 1991 to 2000. At the same time, the share is relatively large for households with income per person less than $5,000, and it increases from 31.59% in 1991 to 38.98% in 2000. The share of FAFH with food expenditure was lowest for households with income per person between $5,000 and $9,999 (23.51%)and highest for households with income per person more than $50,000 (44.77%) in 1991. The difference between households with income per person between $5,000 and $9,999 and households with income per person more than $50,000 is still relatively large (around 17 percent points in 1999 and 2000).

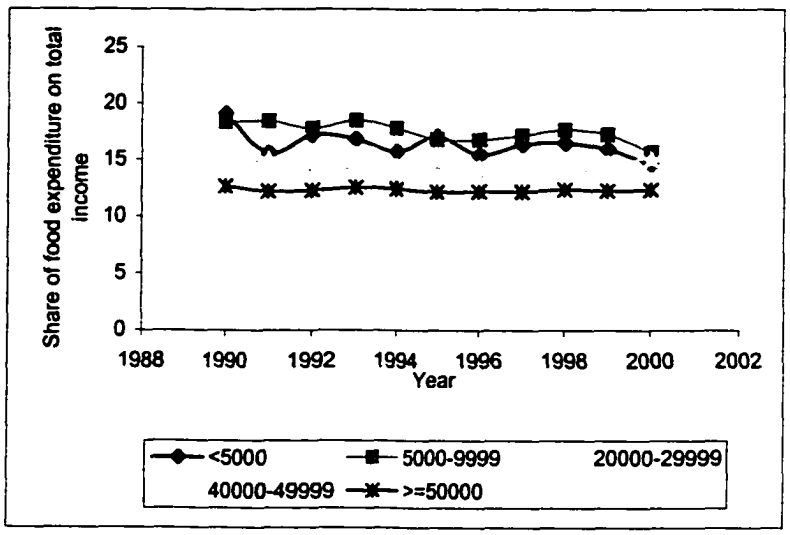

Figure 1.3 Share of Food Expenditure on Total Expenditure at selected Income Levels between 1990 and 2000 (Source: calculated based on Consumer Expenditure Survey, BLS, 1990-2000).

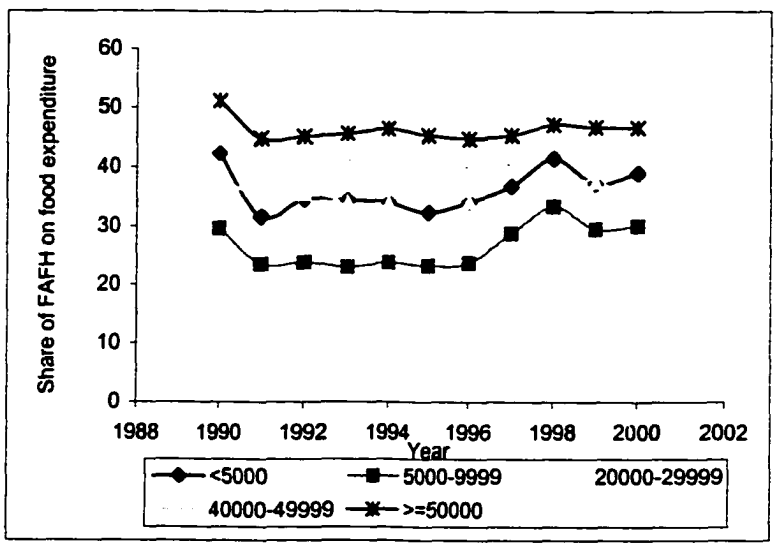

Figure 1.4 Share of Food Away from Home on Total Food Expenditure at selected Income Levels (1990-2000) (Source: calculated based on Consumer Expenditure Survey, BLS, 1990-2000).

In summary, data from the 1990s (BLS, 1990-2000) show that the share of food expenditure in total expenditures has converged among different income groups, because the share for high-income groups was relatively stable, and the share for low-income groups has fallen. At the same time, differences in the share of FAFH in food expenditure across income groups are less pronounced.

Income and food security status are closely associated. Low income families are more likely to suffer food insecurity or hunger than those with high income. At the same time, food security status provides a more direct measure of the well-being of a household with respect to income categories. The increased importance of FAFH has presented some patterns for the design and mechanism of existing food programs. Welfare reform (with work requirement), and improved economic conditions are likely associated with the increasing FAFH expenditure for low income households, though food assistance programs do not provide direct support for FAFH spending.

The objective and basic results of the study

The overall goal of this dissertation is to evaluate the effects of income and family structure, food security status on program participation, and to compare the different effects of local labor market condition on program participation between rural and nonrural areas. The study also includes evaluation of food expenditure and consumption behavior differences between food secure households and food insecure households. Comparison of FAFH based on food security status and work status can provide better understanding of the nature and effects of suffering food insecurity.

The following questions are addressed in the three essays:

1) Do demographic variables have different effects on program participation when households face different food security status? Does an increase in wage rates, working hours (i.e., wage income), and nonwage income have similar effects on food stamp program participation? Does an increase in program benefits increase or decrease the program participation rate?
2) What is the role of FAFH expenditures for low income and food insecure households? Are there any demand difference for food away from home between food secure households and food insecure households? Do income effects differ for food purchases between food insecure households and food secure households? Do working families have different food consumption behaviors compared to families without a job?
3) What factors determine the Family Investment Program participation for households in Iowa? Are there any effects on program participation from migration? How do local labor market conditions affect welfare program participation? Do demographic variables such as education and family structure affect the program participation? Do the effects of child support and wage income on cash assistance program participation differ?

The first essay combines the theoretical approach of the program participation with empirical evidence to analyze the effects of income sources and family structure on food stamp program participation based on food security status. A bivariate ordered probit model is developed and used for the analysis. The results in the paper show that most demographic variables have larger effects on households with food insecurity or hunger than on those who are food secure. The results also show that wage income and having younger children have

significant positive effects on the program participation. At the same time, the effects of wage income are larger than non-wage income on program participation.

The second essay combines an inverse hyperbolic sine (IHS) double hurdle model with demographic translating in an almost ideal demand system (LA/AIDS) to study demand for food away from home based on food security status. The results of the paper not only show that working families are more likely to eat out but also show that households with children between 6 and 13 have the larger possibilities of eating out than other households. The results also show that both food away from home and food at home are normal and necessary goods for both food secure families and food insecure families. However, the analysis finds that food away from home is a luxury good compared to food at home.

In the third essay, we examine the effects of migration and local labor market condition on family investment program participation using Iowa administrative data. The results indicate that migration not only affects the possibility of working but also affects the program participation status. The results of this paper also show that the local labor market situation combined with geographic information has significant effects on program participation. Another interesting finding in the paper is that program participation status is more affected by local labor market situation for rural households than for those living in nonrural areas.

Policy implication

The analysis of program participation and food consumption behaviors based on the food security status in the dissertation provides policy findings, as follows:

First, family structure is vital information in helping poor families. It not only affects the decision on program participation but also affects consumption behavior. The objective of

anti-poverty policy is to achieve the maximum utility based on available budgets. Considering the family structure in the welfare program reform can help to target those who are the poorest.

Second, having a job and keeping the job is also a major factor in determining consumption behavior and participation in the welfare program. Long-term solutions for the low-income households require wages, job training and opportunities for the unskilled, adequate benefits for those unable to work and/or during transition periods, reforms in public assistance and education. Ensuring food security is the first step toward fighting poverty. Helping poor families to get a job and to keep the job will help these families to leave the welfare program and achieve financial independence.

Third, although the income elasticity with respect to food for food insecure households is almost the same as that for food secure households, there exists a significant difference between the expenditure elasticity of food away from home for food secure households compared to that for food insecure households. As food expenditure increases, more households begin to purchase food away from home, their entry into the market causing larger increases in the elasticity of food for food insecure households compared to that implied by food away from home expenditures of food secure households.

Fourth, although food at home still accounts for more than half of the food expenditure, FAFH has become more and more important for both food secure households and food insecure households. Based on the literature, FAFH, which offers less good nutritional choice, usually contains more of the nutrients overconsumed (fat and saturated fat) and less of those underconsumed (calcium, fiber, and iron) than home foods (Lin and Frazao, 1999). As a result, the increased FAFH may make it more difficult for Americans to improve the

overall nutritional quality of their diets, particularly reduction in intakes of fat and saturated fat. Because consumers may believe that it is less important to consider the nutritional quality of FAFH, nutrition education and promotion strategies may be required to inform consumers of the effect of FAFH on overall diet. Increased effects to target the messages to low income and food insecure households may be required.

Fifth, local labor markets are major factors in program participation decisions. The results imply that low-income families face more oriblems than higher income families when economic situations become worse. To test whether welfare reform is successful, it will be very useful to consider not only the decline in program participation rates during income expansion periods, but also, maybe more important, is to see how the program participation rates change during an economic recession period. The analysis across counties in Iowa suggests that the participation rates are highly related with local labor market conditions, especially for those living in rural areas.

The organization of the dissertation

The dissertation is organized as follows. Chapters 2 through 4 presents the three studies conducted. Each of the three chapters starts with the research question, followed by the literature review, presentation of models used, and results. The last chapter concludes with discussion and interpretation of findings.

2. FOOD SECURITY AND FOOD STAMP PROGRAM PARTICIPATION

Introduction

Despite the U.S. being one of the wealthiest countries in the world, nearly 10 percent of U.S. households were food insecure during the year ending in April 1999 (Andrews et al., 2000). According to the estimation, about 11 million households were food insecure or hungry; that is, one or more household members were hungry or food insecure because of a lack of money at some time during the year.

Several food programs, both public and private, are designed to alleviate hunger. The major federal food assistance programs include Food Stamp Program (FSP), Special Supplemental Nutrition Program for Woman, Infants, and Children (WIC) and School Lunch and Breakfast Programs (SLBP). The FSP is the largest one among the programs. The major purpose of the program is "to permit low-income households to obtain a more nutritious diet ... by increasing their purchasing power" (Food Stamp Act of 1977, as amended). Today, the FSP remains as the major income assistance program available nationwide to financially needy households after welfare reform. However, FSP participation declined over 37 percent from its peak of 28.0 million people (10.5% of all Americans) in March 1994 to 18.2 million people (6.6% of all Americans) by the end of fiscal year 1999 (Wilde, et al., 2000).

The existence of both food insecurity and the decline in FSP participation rates raises the question of why some food insecure people who are eligible for the FSP, do not participate in the program. Earlier work by Blank and Ruggles (1993) showed that many leaving public assistance programs appear to be eligible to participate. Keane and Moffit (1998) propose that there exist significant numbers of nonparticipating eligibles because

these households are not making marginal changes in their decisions (i.e. they are at a corner solution) and experience disutility in dealing with welfare bureaucracies or from the time and money costs of program participation (also see Moffitt, 1983). Recently, Ohls (2001) has suggested that households may not participate in the FSP, despite being eligible, because they are unaware of their eligibility, face transportation problems or potential embarrassment, or have difficulty with the complexity of the application and administrative requirements.

This paper examines the effects of both wage income (wage rate and working hours) and non-wage income (including expected benefits from program participation and other non-wage income such as child support), and family structure on participation in the FSP based on household food security status. Intuitively, we expect households that are food insecure or hungry to be more likely to participate in food assistance programs. On the other hand, the program may resolve the food insecurity/hunger problem because it provides food aid to the recipients. Therefore the relationship between food security status and program participation is ambiguous. The purpose of the paper is to examine closely differences between program participants who are food insecure or hungry and those who do not participate in the program but are still food insecure or hungry. First, we jointly estimate the program participation and food security status. Based on the results, we examine two questions. The first is whether food security status affects program participation; and the second one is whether and how family structure, income sources (both wage and non-wage income) and expected program benefits affect the program participation.

The measure of food security used in the paper is based on a standardized module developed by the US Department of Agriculture (Bickel, et al. 2000; Andrews, et al. 2000).

The module includes 18 questions (see Table 1.1 for details). Food security status is analyzed using cross-section data from the 1999 Current Population Survey (CPS).

Because the decisions on program participation cannot be assumed to be independent of the food security status in a household, the distribution of program participation and food security status will not be a univariate probit model under the usual normality assumptions. Our econometric approach uses bivariate ordered probit equations to estimate both program participation and food security status, where the distribution of error components may be correlated across equations.

In many respects our model is an extension of the models and econometric techniques that have been developed in past studies of other social assistance programs. However, our model and estimating procedure go beyond earlier work in several respects. Most notably, because we study the effects of food security on program participation, we must model and estimate the joint response of food security status and program participation status, as just noted. The advantage of bivariate ordered probit model used here is that it gains efficiency because it considers the correlation of the disturbances as well as the ordinal nature of the dependent variable (food security status). The multinomial logit or probit models would fail to account for the ordinal nature of the dependent variables and disturbances that are correlated across observations (Green, 1997). In the paper, we introduce our model and jointly estimate program participation and food security equations. This approach allows for testing the correlation between participation and hunger level and for evaluating the marginal effects of independent variables based on the estimation results.

The paper is organized as follows: in the next section, we provide background on the FSP and food security measurement. The following sections cover the economic model;

outline the estimation using maximum likelihood estimation methods and provide the basic formula used in calculating the marginal effects; discuss the data set employed; and present the empirical results. A brief conclusion and discussion are given in the final section.

Background

The first U.S. food assistance programs were established during the depression of the 1930s. The purpose of the programs was to purchase surplus agricultural commodities and distribute them to the poor. In the 1960s, food aid programs began to focus on the food and nutritional needs of society. The Food Stamp Act of 1964 established the first coupon-based system. In 1977, national eligibility standards were established. The Omnibus Budget Reconciliation Act and the Food Stamp and Commodity Distribution Amendments of 1981 applied for the first time gross income eligibility standards to all households, not including aged or disabled members. The Hunger Prevention Act of 1988 raised the maximum food stamp allotment incrementally from 100% to 130% of the Thrifty Food Plan. Today, the FSP remains the largest of USDA's food assistance program (18 million participants and budget of nearly $18 billion in 1999).

In 1996, as a result of the Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA), there were several major changes in the scope and structure of the FSP. Two types of people were affected by the reforms. First, individuals between 18 and 50 years of age who are not mentally or physically disabled or responsible for a dependent are required to work or participate in work-related activities to be eligible for the FSP. Second, most noncitizens were barred from the program. Beginning November 1, 1998, eligibility

was restored to some permanent residence aliens (see Kuhn et al., 1996; Rosso and Fowler, 2000; Wilde et al., 2000 for details).

There is an extensive literature on the determinants of FSP participation. Most studies have found that nonwhite, nonelderly people and those living in low income households that include children, do not own their own house, have a household head that is not well educated, and include members who participate in other welfare programs are responsible for higher FSP participation rates (Rosso and Fowler, 2000). Keane and Moffit (1998) studied the Aid to Families with Dependent Children (AFDC), Food Stamps and subsidized housing program participation decisions and found that children reduce the household's costs associated with welfare for AFDC and FSP (that is, they increase welfare participation), and that women who are older, who have higher levels of education, who are in good health, and who are white usually have lower welfare participation rates. They also found that individuals in states with high AFDC administrative expenses have lower AFDC participation rates but higher FSP participation rates. Zedlewski (1999) showed that households receiving cash welfare left food stamps at higher rates than families who had not been on welfare programs.

In 1995, USDA introduced a standardized module of questions to measure household food security. By applying USDA's food security module, households can be grouped into three food security categories: food secure, food insecure without hunger and food insecure with hunger (including moderate and severe hunger evident) (Bickel et al., 2000). A household is classified into one of the food security status-level categories on the basis of its responses to questions in the food security module. The core set of 18 questions provides the indicator variables that cover the full range of severity observed under current U.S.

conditions for households both with and without children. Table 2.1 presents the 18 questions and the relative item scores for 1999. The questions are ordered here from least severe to most severe of food insecurity. The household hunger score as well as severity score for each item question can be obtained using the Rasch model (Bickel et al., 2000). Households are assigned to categories of food insecurity based on the number of affirmative answers the respondents have given and account for whether the household has children.

The Economic Model

Consider the problem of analyzing FSP participation and food security status. Eligibility for the FSP is determined by income, household composition, and other categorical program requirements. Program benefits are determined based on formulas that account for certain deductible expenses. The unobservable factors affecting program participation are likely to be positively correlated with food insecurity. Those most likely to participate are likely to be those with food insecurity and those with hunger. Therefore, food security should be estimated jointly with the FSP participation equation so that we can have better understanding of the program participation.

Because FSP participation depends on the food security level, the household's utility also depends on food security level. Let there be discrete states for the household food security status indexed by $j=0,1,2$. Each state has an associated food security level F_j, with a probability of t_j that F_j occurs. $\sum_{j=0}^{2} t_j = 1$. Then the general utility maximization problem can be written as

$$\max_{Y,P,L} U(Y,L,t_j,\phi P) \tag{2.2}$$

where U is the individual utility function. We assume

$$\frac{\partial U}{\partial t_0}>0,\frac{\partial U}{\partial t_1}<0,\frac{\partial U}{\partial t_2}<0,\frac{\partial U}{\partial Y}>0,\frac{\partial U}{\partial L}>0 \tag{2.3}$$

The utility function is assumed to be twice differentiable and strictly quasi-concave. L is leisure time. P is a dummy variable equal to 1 if a member of the household participates in the FSP, and 0 if not. The presence of the FSP participation indicator in the function can be interpreted as representing disutility from participation. ϕ is related to the marginal disutility of participating in the FSP. If ϕ is sufficiently large, a household may not participate in the FSP. The disutility comes from the "welfare stigma" from participation (Moffitt, 1983), such as the burden of the application procedure (for example, visiting the welfare office), dealing with welfare bureaucracies, experiencing other requirements from the FSP such as from employment or training-related requirements (utility loss due to the loss of leisure).

Let C be the money cost and opportunity cost of participating, which includes time required for the complicated application processes, intrusive income verification and reporting requirements, and the need to be absent from work in order to apply or be recertified. According to Dion and Pavetti (2000), most participants are required to return to the food stamp office four times a year to be recertified for benefits; moreover, working families, because their income is more likely to change, are required to be recertified more often than those with a fixed income. Because we do not have the money cost information in the data, we only consider the opportunity cost in the empirical study. To simplify the case, we assume households treat the FSP benefits as income. Let L and H be the total time

available and working hours, the time and budget constraints for the household can be represented as

$$L + H = \bar{L}$$

$$Y(H,P)=wH+N+P*(B-C) \tag{2.3}$$

Where N is the nontransfer nonlabor income, w and H is wage rate and working hours, respectively, and B is the benefit from FSP participation. According to the program rules (USHR, 2000) and following Fraker and Moffitt (1988) and Wilde (2001), the benefit formula of FSP for households without elderly or disabled persons can be calculated by the following formula:

$$B = \begin{cases} \max[M, G - 0.3NI] & \text{if } NI \le Y^* \text{ and } wH + N \le 1.3Y^*, \\ 0 & \text{if } NI > Y^* \text{ or } wH + N > 1.3Y^*. \end{cases} \tag{2.4}$$

$$NI=max[0,wH+N-(0.2wH+CS+D+I*DC+S)], \tag{2.5}$$

$$DC = \begin{cases} \min[175, E] \text{ without children under 2}, \\ \min[200, E] \text{ otherwise}, \end{cases} \tag{2.6}$$

$$S = \min[\,250, \max(\,0, R - 0.5C_0)]\,, \tag{2.7}$$

$$C_0 = \max[0, wH + N - (0.2 \times wH + D + CS + DC)] \tag{2.8}$$

where M is the minimum benefit, G is the guarantee amount, NI is the counted monthly income, Y^* is the official government poverty line, D is the FSP standard deduction ($134 per month in 1999), CS is the paid child support amount, I is the number of dependents, DC is the out-of-pocket dependent care expenses deduction, E is actual out-of-pocket dependent care expenses, S is the shelter deduction, R is the household's expenditure on rent or other shelter, and C_0 is the intermediate net income. For households with an elderly or disabled

member, the only difference is that the counted monthly income, *NI*, is calculated according to the following formula:

$$NI=max[0,wH+N-(0.2wH+CS+D+I^{*}DC+SS+M)], \quad (2.5')$$

Where shelter $SS = \max(0, R - 0.5 \times C_0)$ and M is the medical expenses minus 35 ($).

The indirect utility function can be written as the following formula:

$$V = V(wH, N, B, C, P, \phi, t_j) \quad (2.9)$$

The optimality condition of FSP participation requires that the household satisfies

$$V(wH, N, B, C, P, \phi, t_j) > V(wH, N, t_j) \quad (2.10)$$

Equation (2.10) implies that case-heads will choose to participate in the FSP if the utility gained from program participation is larger than the disutility associated with participation. The results can be explained by Figure 2.1, which is similar to that of Moffitt (1983), and Fraker and Moffitt (1988).

Figure 2.1 shows a standard labor leisure diagram with budget constraints ADE (off FSP) and BGFC (on FSP). The kink in the budget constraints comes from the benefit function. In the Figure, a household achieves maximizing utility at D when they are not in the FSP. At this level, hours worked are less than the eligibility hours level H_0. A household would choose to participate in the FSP if the disutility from participation is lower than utility gained which is achieved at the maximization level of utility at point F. (Because the budget constraint is not convex, multiple tangencies are possible. Here we just put one optimum point as an example.) However, if the disutility is relatively large and the utility on FSP (such as the dash curve as drawn) is lower than that for non-participation, the households would in fact choose to stay at D. Thus, a household who is eligible for FSP would not participate if

the additional utility from the extra leisure and program participation is less than the disutility from program participation.

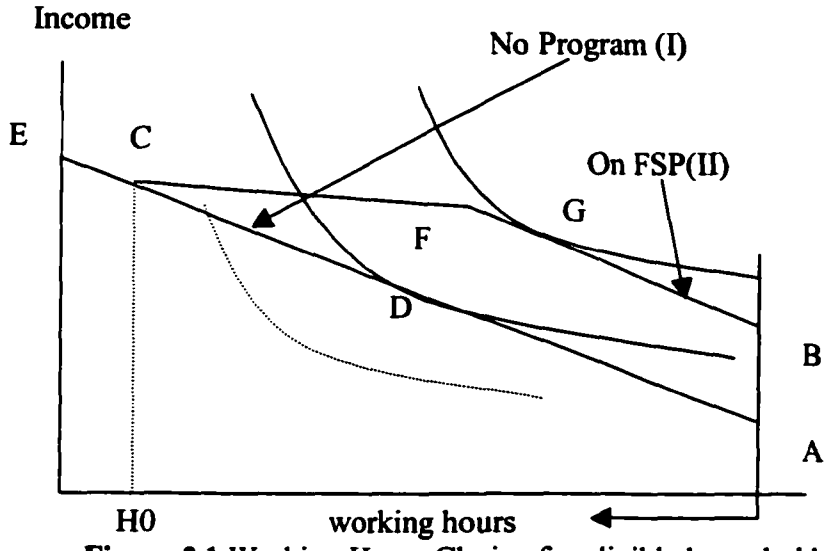

Figure 2.1 Working Hours Choice for eligible households

Based on FSP participation and food security status, all households are classified into six mutually exclusive regimes on the basis of participation in FSP (y_1) and food security status (y_2): (i) not in the FSP and food secure, (ii) not in the FSP and food insecure, (iii) not in the FSP and food insecure with hunger, (iv) in the FSP and food secure, (v) in the FSP and food insecure, and (vi) in the FSP and food insecure with hunger. We use the following notation to represent the six regimes (and as illustrated in Figure 2.2):

R1: $y_1=y_2=0$;

R2: $y_1=0$, $y_2=1$;

R3: $y_1=0$, $y_2=2$;

R4: $y_1=1$, $y_2=0$;

R5: $y_1=1$, $y_2=1$;

R6:$y_1=1$, $y_2=2$.

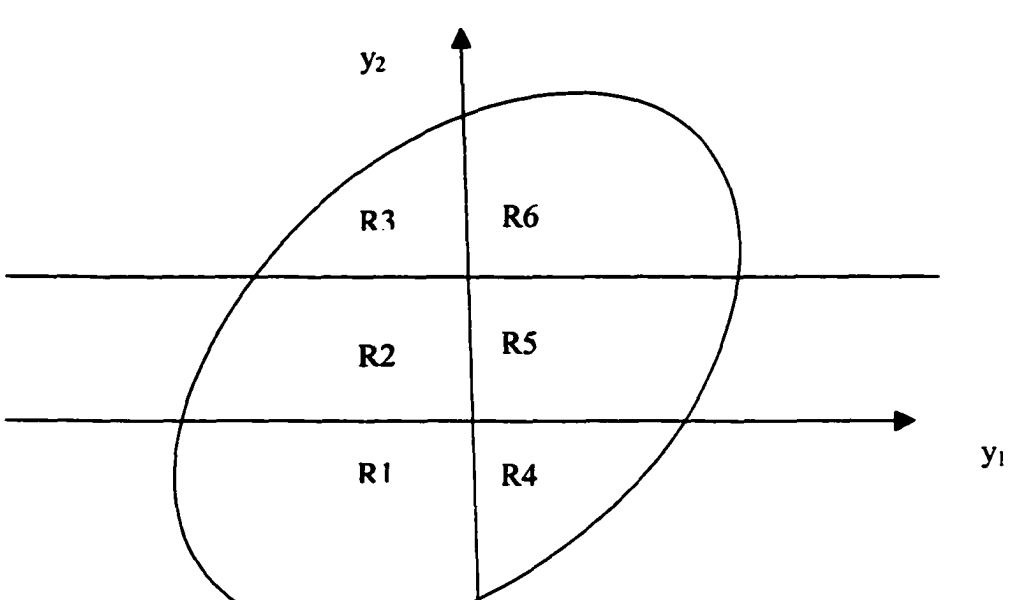

Figure 2.2 A representation of six regimes

The probability of participating in the FSP based on being food secure is

$$\Pr(p_1 = 1 \mid p_2 = 0) = \Pr\{V_4(wH, N, \phi, B, C) > V_1(N, wH) \mid t_0 = 1\} \tag{2.11}$$

The probability of participating FSP based on being food insecure is

$$\Pr(p_1 = 1 \mid p_2 = 1) = \Pr\{V_5(wH, N, \phi, B, C) > V_2(N, wH) \mid t_1 = 1\} \tag{2.12}$$

The probability of participating FSP based on being food insecure with hunger is

$$\Pr(p_1 = 1 \mid p_2 = 2) = \Pr\{V_6(wH, N, \phi, B, C) > V_3(N, wH) \mid t_2 = 1\} \tag{2.13}$$

Where V_k is the indirect utility for the households facing the six regimes and $k=1,2,...,6$.

To operationalize the indirect utility function, we assume the probability of program participation is v and the utility achieved is of linear form

$$V_k = a_w wH + a_n N + t_j + v + \varepsilon, \tag{2.14}$$

where a_w, a_n, are the relative coefficients. The probability of program participation v is assumed to depend on income and family structure, expected benefits from the program, geographic and other demographic variables. At the same time, we also assume the probabilities of household suffering food secure, food insecure and hungry, t_j, are a function of income and expenditure of households, family size and other demographic variables, Z. Therefore the probability of a household in being a different food security status can be represented by the following equation:

$$t_j = t(Y(H, P), f, age, family\ size, Z) + \varepsilon \qquad (2.15)$$

Households can move from being food secure to food insecure or hungry and from being hungry to food insecure or food secure. Also, as we discussed earlier, the error term from the program participation and food security status has a bivariate normal distribution. Therefore a bivariate ordered probit model, as introduced in the next section, is appropriate for the analysis.

The Econometric Model

In order to account for the six regimes, we used a bivariate ordered probit model. Fraker and Moffitt (1988) proposed a model with a bivariate selection model to check the effect of the FSP on labor supply. Our model is an extension of the bivariate probit model and ordered probit model (Poirier, 1980; Maddala, 1983; Green,1997). We assume that program participation and food security are jointly determined. Decisions regarding a household in one or another regime (for example, in a regime with food insecurity and participating in the FSP or a regime with food insecurity and not participating in the FSP) are the results of a family's optimization problem.

The econometric model is described as follows. In order to estimate the program participation and food security equations, it is necessary to account for the fact that the equations are not statistically independent (i.e., they have correlated disturbances). We employ the bivariate ordered probit model. To simplify the equations, we normalize the variances of two disturbances to equal unity. Let $y_{1i}^{*}, y_{2i}^{*}, Z_{1i}, Z_{2i}, \beta_1, \beta_2$ be the dependent, independent variables and parameter coefficients, respectively. The general specification for a two-equation model would be

$$\begin{aligned} y_{1i}^{*} &= Z_{1i}\beta_1 + \varepsilon_1, \\ y_{2i}^{*} &= Z_{2i}\beta_2 + \varepsilon_2, \end{aligned} \tag{2.16}$$

where $E(\varepsilon_1) = E(\varepsilon_2) = 0$, $\text{var}(\varepsilon_1) = \text{var}(\varepsilon_2) = 1$, $\text{cov}(\varepsilon_1, \varepsilon_2) = \rho$.

y_{1i}^{*}, y_{2i}^{*} are unobserved. What we do observe are

$$y_1 = \begin{cases} 0 \text{ if } y_{1i}^{*} \le 0, \\ 1 \text{ if } 0 < y_{1i}^{*} \end{cases} \qquad y_2 = \begin{cases} 0 \text{ if } y_{2i}^{*} \le 0, \\ 1 \text{ if } 0 < y_{2i}^{*} \le T, \\ 2 \text{ if } T < y_{2i}^{*} \end{cases} \tag{2.17}$$

The T's are unknown parameters to be estimated with the β's. There is one cutoff for T's to be estimated in our case. Because y_1, y_2 are observed only as indicator variables, the coefficients are only identified up to a scale, and the error terms are therefore assumed to have a unit bivariate normal distribution with

$$\begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \end{bmatrix} \sim N\left[0, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}\right]. \tag{2.18}$$

All the households are classified into the six mutually exclusive regimes as we mentioned earlier. Let $\Phi(.)$ be the cumulative distribution function and $\phi(.)$ be the probability density

function for the bivariate normal distributions. Under the normality assumption, our likelihood function can be expressed as follows:

$$L^{*} = \log L = \sum_{i=1}^{n_j} \sum_{j=1}^{6} K_{ij} \log P_j \text{ , where } i=0,1,\ldots,n_j \tag{2.19}$$

$$P_1 = P_{00} = \Phi(-Z_1\beta_1, -Z_2\beta_2, \rho) \tag{2.20}$$

$$P_2 = P_{01} = \Phi(-Z_1\beta_1, T - Z_2\beta_2, \rho) - \Phi(-Z_1\beta_1, -Z_2\beta_2, \rho) \tag{2.21}$$

$$P_3 = P_{02} = \Phi(-Z_1\beta_1, -(T - Z_2\beta_2), -\rho) \tag{2.22}$$

$$P_4 = P_{10} = \Phi(Z_1\beta_1, -Z_2\beta_2, -\rho) \tag{2.23}$$

$$P_5 = P_{11} = \Phi(Z_1\beta_1, T - Z_2\beta_2, -\rho) - \Phi(Z_1\beta_1, -Z_2\beta_2, -\rho) \tag{2.24}$$

$$P_6 = P_{12} = \Phi(Z_1\beta_1, -(T - Z_2\beta_2), \rho) \tag{2.25}$$

where P_j is the probability and n_j number of households falling into one of the six regimes, $j=1,2,3,4,5,6$. K_{ij} is a dummy variable equal to 1 if household i belongs to the *j-th* group and 0 if not.

To calculate the marginal effects, one should note that the marginal effects of the independent variables include both direct and indirect effects. Direct effects come from its own equation and indirect effects come from the other equations. Following Green's (1997) notation, the marginal effects of changes in the regressors can be obtained by differentiating the probability of different regimes with respect to the regressors $Z = Z_1 \cup Z_2$. Let $Z_1\beta_1 = Z\gamma_1$ and $Z_2\beta_2 = Z\gamma_2$. γ_k (k=1,2) includes all the nonzero elements of β_k and possibly some zeros in the positions of variables in Z that appear only in the other equation. The marginal effects of changes in Z on the probability of six regimes can be calculated by the following formulas:

$$\delta_{00} = \frac{\partial p_{00}}{\partial Z} = -\phi(-Z_1\gamma_1)\Phi(\frac{-Z_2\gamma_2 + \rho Z_1\gamma_1}{\sqrt{1-\rho^2}})\gamma_1 - \phi(-Z_2\gamma_2)\Phi(\frac{-Z_1\gamma_1 + \rho Z_2\gamma_2}{\sqrt{1-\rho^2}})\gamma_2; \quad (2.26)$$

$$\delta_{01} = \frac{\partial p_{01}}{\partial Z} = -\phi(-Z_1\gamma_1)\Phi(\frac{T - Z_2\gamma_2 + \rho Z_1\gamma_1}{\sqrt{1-\rho^2}})\gamma_1 - \phi(T - Z_2\gamma_2)\Phi(\frac{-Z_1\gamma_1 - \rho(T - Z_2\gamma_2)}{\sqrt{1-\rho^2}})\gamma_2$$

$$+\phi(-Z_1\gamma_1)\Phi(\frac{-Z_2\gamma_2 + \rho Z_1\gamma_1}{\sqrt{1-\rho^2}})\gamma + \phi(-Z_2\gamma_2)\Phi(\frac{-Z_1\gamma_1 + \rho Z_2\gamma_2}{\sqrt{1-\rho^2}})\gamma_2;$$

(2.27)

$$\delta_{02} = \frac{\partial p_{02}}{\partial Z} = -\phi(-Z_1\gamma_1)\Phi(\frac{-T + Z_2\gamma_2 - \rho Z_1\gamma_1}{\sqrt{1-\rho^2}})\gamma_1 + \phi(-T + Z_2\gamma_2)\Phi(\frac{-Z_1\gamma_1 - \rho(T - Z_2\gamma_2)}{\sqrt{1-\rho^2}})\gamma_2; \quad (2.28)$$

$$\delta_{10} = \frac{\partial p_{10}}{\partial Z} = \phi(Z_1\gamma_1)\Phi(\frac{-Z_2\gamma_2 + \rho Z_1\gamma_1}{\sqrt{1-\rho^2}})\gamma_1 - \phi(-Z_2\gamma_2)\Phi(\frac{-Z_1\gamma_1 - \rho Z_2\gamma_2}{\sqrt{1-\rho^2}})\gamma_2; \quad (2.29)$$

$$\delta_{11} = \frac{\partial p_{11}}{\partial Z} = \phi(Z_1\gamma_1)\Phi(\frac{T - Z_2\gamma_2 + \rho Z_1\gamma_1}{\sqrt{1-\rho^2}})\gamma_1 - \phi(T - Z_2\gamma_2)\Phi(\frac{Z_1\gamma_1 + \rho(T - Z_2\gamma_2)}{\sqrt{1-\rho^2}})\gamma_2$$

$$-\phi(Z_1\gamma_1)\Phi(\frac{-Z_2\gamma_2 + \rho Z_1\gamma_1}{\sqrt{1-\rho^2}})\gamma_1 + \phi(-Z_2\gamma_2)\Phi(\frac{Z_1\gamma_1 - \rho Z_2\gamma_2}{\sqrt{1-\rho^2}})\gamma_2; \quad (2.30)$$

$$\delta_{12} = \frac{\partial P_{12}}{\partial Z} = \phi(Z_1\gamma_1)\Phi\Phi\frac{-T + Z_2\gamma_2 - \rho Z_1\gamma_1}{\sqrt{1-\rho^2}})\gamma_1 + \phi(-T + Z_2\gamma_2)\Phi\Phi\frac{Z_1\gamma_1 - \rho(T - Z_2\gamma_2)}{\sqrt{1-\rho^2}})\gamma_2.$$

(2.31)

Let the marginal probability of food security level and FSP participation be $P_{.j} = P_{0j} + P_{1j}$ and $P_{i.} = P_{i0} + P_{i1} + P_{i2}$. Then the conditional mean function for FSP participation and food security can be written as

$$\Pr ob(y_1 = 1 \mid y_2, Z_1, Z_2) = \frac{P_{1j}}{P_{.j}}, j=0,1,2 \quad (2.32)$$

$$\text{Prob}(y_2 = j \mid y_1, Z_1, Z_2) = \frac{P_{ij}}{P_{i.}},\ i=0,1. \tag{2.33}$$

Derivatives of the various functions shown above give the desired marginal effects. By denoting the marginal effects on marginal probability as $\delta_{i.}$ and $\delta_{.j}$, we obtain the vector of marginal effects of FSP participation, conditional on being food insecure or with hunger by the following formulas:

$$\delta_{y_1|y_2=1} = \frac{\delta_{11}P_{.1} - P_{11}\delta_{.1}}{(P_{.1})^2} \tag{2.34}$$

$$\delta_{y_1|y_2=2} = \frac{\delta_{12}P_{.2} - P_{12}\delta_{.2}}{(P_{.2})^2} \tag{2.35}$$

As Green (1997, 2000) suggests, the coefficients in a binary choice model can be misleading. Because the model is actually a probability, the absolute scale of the coefficients gives a distorted picture of the response of the dependent variable to a change in one of the independent variables. Following his suggestion, if the independent variable is a binary variable, we can analyze its effect by comparing the probabilities that result when the variable takes on its two different values, holding the other variables at their sample means (Green, 1997). For example, for the binary variable whether a household head is married (q=1), which appears in both equations, the marginal effects on the probability in the FSP with hunger can be calculated by the following equation:

$$\begin{aligned}\delta_{12} &= (p_{12} \mid q=1) - (p_{12} \mid q=0) = \\ &\{\Phi(Z_1\beta, -(T - Z_2\beta), \rho) \mid q=1\} - \{\Phi(Z_1\beta, -(T - Z_2\beta), \rho) \mid q=0\}.\end{aligned} \tag{2.36}$$

In all cases, the standard errors can be computed using the delta method. Let $\delta_k(\gamma_1, \gamma_2, T, \rho)$ equal the marginal effect, which is computed according to the above equations. Let

$$\Delta = \frac{\partial \delta_k(\gamma_1, \gamma_2, T, \rho)}{\partial(\gamma_1', \gamma_2', T, \rho)} \tag{2.37}$$

and V be the estimated asymptotic covariance matrix of the estimates. An estimate of the asymptotic variance for the estimated marginal effect is

$$Asy.Var.\,\delta_k = \Delta V \Delta' \tag{2.38}.$$

The Data

Data and specification issues

Data on family earnings, income, demographics, program participation and food security status are taken from the 1999 March and April supplement of the Current Population Survey (CPS). The CPS data provide detailed information on demographic characteristics, sources of income and food security status for a large, nationally representative sample of U.S. households. They also provide information on family and individuals and allow us to examine welfare program effects on both families and household heads (Connolly, 2000). We merged the households responding to March and April supplements in order to gain more detailed income, program and labor force participation information from the March Supplement and the food security module information from the April supplement (Nord, 1999).

The CPS survey design interviews a housing unit for 4 consecutive months, then drops the housing unit out of the sample for the next 8 months, and brings back the unit in the

following 4 months. The sample design was accounted for in matching households across March and April. We matched the two-data-sets according to the individual identification number, and whether it was in the same rotation for both months. We dropped households that were in the first and fifth rotations in April as well as eighth rotations due to the sample design. The total number of households after we deleted the observations outside of the universe was 25,611 in 1999. The current period, then, is defined as the March-April combined period.

In order to be eligible for the food stamp program, a household must have a net monthly income at or below 100 percent of the poverty guideline or 130 percent of the gross monthly income poverty guideline, and have countable liquid assets less than $2000 (or $3000 for household with an older member) (USHR, 2000; Rosso and Fowler, 2000; see equation (2.5) for detail). We defined the eligible households as those households participating in a public assistance program (including TANF, General Assistance or SSI) in the preceding year, or households with gross income less than or equal to 130 percent of the poverty threshold (the respective poverty guideline is calculated based on the household's total income in March supplement data and the national poverty line). These cutoffs include most FSP eligible and "near-eligible" households. By applying these criteria, we chose 5,543 households as our sample for analysis.

The dependent variable for the FSP participation was recoded as 1 if a household participated in the program; otherwise zero. Participation indicates any food stamp program receipt in the household in the previous year. As mentioned earlier, the food security levels (food secure, food insecure and food insecure with hunger) were delineated according to the hunger scores on whether the household was food secure, had experienced food insecure, or

had experienced hunger in the past 12 months (Bickel et al., 2000). The three food security levels were coded as 0,1,2, respectively.

According to the FSP rules, the maximum benefits from food stamps are a function of a household's size, its net monthly income, and maximum monthly benefit levels. The benefit is calculated by subtracting the household's expected contribution from its maximum allotment, which equals the difference between the maximum benefit and 30 percent of net income (USHR, 2000). Because we do not have enough information to calculate the exact net income, we calculate the yearly net income (NI) according to the following formula:

NI=gross income –12($134+ number of children less than two years old* $200+number of children between 2 and 18 * $175+0.2*wage income+$275)*

where the value $275 is a periodically adjusted ceiling for shelter expense deduction in 1999.

Based on the net income, we calculated the expected FSP benefits for all households in the sample according to formula (2.4) and use the expected benefits as an independent variable in our FSP participation equation. The average expected benefit per household for the households with expected benefits in the sample was $1879.30 per year. In the sample, 30.06 percent of households had minimal expected benefits.

Although the CPS has the wage rate variable, most persons did not provide the information or give a zero. It is not appropriate for our analysis because those who do not work indeed have an expected wage. The expected wage rate is based on education, working experience, location, and other information. Therefore, we include age, education, and location information in the estimation equation instead of actual wage rate, which would have zero for those who do not work.

Preliminary Results

Table 2.2 provides the means and standard deviation of the variables used in our analysis. As indicated in the Table, 26.9 percent of reference persons (in the CPS, the concept of a household head does not exist. Any of the persons in whose name the residence is rented or owned may be listed as reference person) in the sample had at least a high school degree; over three fourths (77 percent) were white; and 39 percent of the reference persons were male. Of the sample, 10.8 percent participated in public assistance programs which include TANF. Over half of those in this low income sample did not own a home.

We conducted some preliminary analysis on participation and food security. Table 2.3 shows the distribution of the dependent variables---food stamp program participation and food security level. The Table shows that the FSP participation rates increase as the severity level of household food insecurity increases. The participation rate for the whole sample is 23.7 percent. Most households (71.8 percent) are food secure. The program participation rates for those who are food secure, food insecure and food insecure with hunger are 16.58 percent, 39.79 percent and 46.21 percent, respectively. Table 2.3 also shows that 58.1 percent of the households with food insecurity or hunger did not participate in the program.

We also evaluated a measure of the household's use of revenues for food and the household's perception of income deprivation. We make use of information on the household's estimation of minimum food expenditure needed to feed its household divided by gross household income. The average ratio is 35.7 percent. Of the sample, 60.1 percent of households could purchase their estimated minimum food expenditure by using less than 30 percent of their total household income, and nearly 40 percent of households estimated they would use more than the FSP allotment of 30 percent. Table 2.4 also provides the sample

distribution based on the ratio. From the table, one can see that households with the ratio less than 30 percent estimated they would spend less on food than others. The Table also shows that around 24 percent of households suffer food insecurity or hunger in the group with a share less 30 percent compared with 34 percent for the group with share larger than 30 percent.

To determine the household's FSP participation status under different food security levels, a comparison of household characteristics is given in Table 2.5. Differences in the food secure groups by FSP participation versus non FSP participation were denoted for statistical significance. The statistical tests indicate that households who participated in the FSP had relatively lower working hours, had higher expected benefits, had more children and fewer older family members, had higher probability of participating in TANF program, had lower probability of having a head with a high school degree than households who were not in the FSP. The results are true for all three food security status.

Empirical results

Basic Results

Our full information maximum likelihood estimates of the full model, obtained by estimating the FSP participation jointly with the food security equation are shown in Table 2.6. In the first set of the Table, the correlation between the two structural disturbances, ρ, was allowed to vary freely. The estimated value of ρ is 0.30 and the t ratio on the coefficient is 13.75; the results suggest that the effects are correlated. The second set of results was computed with ρ fixed at zero. The two sets of results can be used to carry out a likelihood ratio test of the null hypothesis that ρ equals zero against the alternative that ρ does not equal

zero. The likelihood ratio test statistics, LRT= -2[-6231.07-(-6303.89)]=145.64, is distributed as chi-square with one degree of freedom under the null hypothesis. The value also suggests that the null hypothesis is rejected. The estimated correlation coefficient of the disturbances is positive and statistically different from zero. The estimated coefficient measures the correlation between the disturbances in the equations and the omitted factors. It implies that random error in the determination of food security does indeed appear to be correlated with FSP participation. The significance and positive correlation means that there exists a correlation between the outcomes after the influence of the included factors is accounted for. The results imply: (a) that the random disturbances in food security and FSP participation are affected in the same direction by random shocks or unmeasured effects; (b) that the food security and FSP participation are not statistically independent; and (c) that the bivariate ordered probit estimation of the FSP participation and food insecurity equations is appropriate.

In general, the model performed quite well. Most of the parameters are precisely estimated and correspond well to expectation. Households less likely to be in the FSP are those with adults in the household working more time, and with more nonwage income. Those less likely to participate also include those household-heads that have a high school degree, are male, white, able and those who live in metro area. Higher expected benefits from the program cause households to enter into the program. Household-heads living in the northeast or south part of the country, renting a house, and having more children are more likely to participate in the program.

As summarized recently by Ohls (2001), there is substantial evidence of widespread confusion among both potential program applicants and program workers with respect to FSP

eligibility criteria. Many eligible families are not aware that they qualify for program benefits. For example, some households do not think they are eligible because they own a house, have a job, or have income that is too high to qualify despite the fact their job may be low-paying or the household would meet the income criteria. Although reasons for non-participation among eligibles are complex, most of the results are consistent with many of the suggested reasons.

Households whose heads do not have a high school degree, have more older children, are non-white, and disabled, do not own a house, and have fewer older family members, are more likely to suffer food insecurity or hunger. We expect people to experience food insecurity if the household expects to spend a relatively higher share of income on food. The significance and positive sign of the ratio of minimal food expenditure with total income suggests that households expecting to need more food expenditure (i.e. have a higher ratio) in fact are more likely to be food insecure. Households with higher income (including both working hours and non-wage income) have more opportunity to overcome the food insecurity problem, and are less likely to be food insecure or hungry.

In comparing the two sets of results (food security status and FSP participation), most variables have the same signs. Labor force participation, education achievement, and being white have negative effects on the probability of being food insecure and participating in the food stamp program. Less income, not owning his/her own house, being disabled, and having more children increase the possibility of food insecurity and FSP participation rates. These results are consistent with our expectations. The negative coefficients for households' non-wage and wage income indicate that lower-income households are more likely to be food insecure and participate in the FSP. According to Nord (2000), the recent declines in food

insecurity and the food stamp caseload were due to rising incomes. He also noted that increased food insecurity among low-income households that did not receive food stamps may have resulted from reduced access to food stamps rather than from less need for food assistance. The results show that some variables have different effects on the two probabilities. This is true especially for the family structure, the location (metro) and region variables.

Marginal Effects

Marginal effects of the regressors on the probability of food security and FSP participation are evaluated at the sample means and reported on Table 2.7 and Table 2.8.

Table 2.7 shows the marginal effects of independent variables on FSP participation and food security status. From Table 2.7, most variables have the same sign on both food insecurity and hunger, though the marginal effects are higher for those with hunger than those who are food insecure.

Working hours, and nonwage income in the household effects on food security and being in the FSP. A one hour increase in working hours per week per household decreases the probability of being food insecure by 0.13 percent and of being hungry by 0.14 percent; the added working hour also decreases the probability of FSP participation by 0.50 percent. A one dollar increase in non-wage income per household per week leads to similar decreases in the probability of suffering food insecurity or hunger, and it decreases the probability of FSP participation by 0.04 percent.

A higher ratio of minimal food expenditure to total income decreases the probability of food security. A one percent increase in the ratio increases the probability of suffering food insecurity or hunger by 2.8 and 3.1 percent, respectively. At the same time, a $10 increase in

expected weekly FSP benefits increases the probability of being in the program very little: only 0.26 percent.

Older household-heads are more likely to be food secure. Having additional older family members (age older than 60) increases the probability of being food secure by 4.9 percent. Having more old children increases the probability of being food insecure, although the positive marginal effects are larger for those with hunger than those suffering food insecurity without hunger. Also, an additional child between 14 and 18 has a larger effect on food insecurity status than an additional child between 6 and 13. Although additional children between the age of 6 and 13 have the largest effects on FSP participation status, the effects of the older family members on FSP participation are not statistically significant. The number of children under 6 affects only the program participation.

A household reference person being one year older decreases the household's probability of suffering food insecurity or hunger by 0.15 and 0.17 percent, respectively. And it decreases the probability of FSP participation by 0.25 percent points. At the sample mean, white households have 6.1 percent higher probability of being food secure, and 6.0 percent lower probability of FSP participation than non-white households. A reference person with a high school degree has a 3.6 percent higher probability being food secure and 5.3 percent lower probability of participating in the FSP than a household reference person without a high school degree. A household with being married reference persons is 9.3 percent less likely to participate in the program. Other discrete variables can be explained in a similar manner.

Table 2.8 is the marginal effects of independent variables on program participation conditional on different food security status. The Table shows that most of variables have

larger marginal effects on participating in the FSP for households with food insecurity and with hunger than for those who are food secure, especially for the group with hunger. The larger effects of expected benefits imply that changes in program benefits have less effect on households who are food secure than those with food insecurity or hunger. Based on the results, a one dollar increase in expected benefit increases the probability of program participation 0.23 percent for food secure households, 0.31 percent for food isnecure households, and 0.34 percent for hungry households. Working hours and nonwage income also have significant effects on program participation. A one hour increase in working hours reduces the probability of participation 0.40 percent for food secure households and 0.56 percent for hungry households. A 10 dollar increase in nonwage income decreases the probability 0.33 percent and 0.47 percent for food secure households and hungry households, respectively.

Additional older family members and children older than 13 do not have significant effects on the probability of being in the program. An additional child under 6 increases the probability of participating in the FSP by 7.2 percent for food secure households, 9.5 percent for food insecure households, and 10.5 percent for households with hunger. An additional child between 6 and 13 increases the probability of participating in the FSP by 5.0 percent, 6.4 percent, and 7.2 percent for food secure households, food insecure households, and households with hunger, respectively.

Households with a reference person who is female, nonwhite, disabled, who does not have a high school degree, or who lives in nonmetro area have a higher probability of being in the FSP than others. For food secure households, a household with female reference person has a 3.8 percent larger probability of being in the FSP than a household with a male

reference person. For food insecure households, the difference in the probability of being in the FSP is 5.0 percent; for households with hunger, the difference is 29.7 percent. Table 2.8 also shows that the marital status decreases the probability of FSP participation by 7.9 percent, 10.5 percent, 40.5 percent for the food secure, food insecure, and hungry groups, respectively. Similar explanation can be given to other discrete variables in Table 2.8. One of the interesting results here is that the marginal effects in the group with hunger are much larger than for the other two groups. This result implies that the FSP participation status for households with hunger is more likely to be affected by these demographic variables than for households with food security and food insecurity.

Simulations

From the marginal effects analysis, we know that family structure and working hours have significant effects on food security status and FSP participation status. To further check the effect of adults' working hours for the different family structures, we simulate the working hours and probability of food security and program participation based on different family structure. We consider how the choice of adults' working 0, 20 or 40 hours per week affects program participation based on food security status, and for different family member structures. Because most families in the sample have 2 children, we first simulate the relationship based on households' having 2 children of different ages and compare the effects of labor force participation on food security status and program participation. Then we do the same simulation based on having four children in the family.

Table 2.9 provides our simulation results for the effects of adult working hours (per adult) on the probability of being in the FSP based on age and number of children. From the Table, the probability of being in the FSP decreases as adults' work hours increase from 0 to

40 hours per week. We also can see that the probability of being in the FSP is lowest when households are food secure among the three food security statuses. The results across number of children at different ages are generally consistent. The probability of being in the FSP reaches highest when a household has children under age 6, and is lowest when a household has children between 14 and 18. If adults in the household do not work, work part time or full time, the probability of being in the FSP for the household increases across all food security groups as the number of children in the different age groups increases from 2 to 4.

Given only two children (either under 6 years old, or age between 6 and 13, or age between 14 and 18) in a household, as adults choose a full-time job instead of not working, the probabilities of being in the FSP decrease for all household groups. The greatest relative decrease is for the food secure group. From Table 2.9, one also can see that probabilities of being in the FSP are very high when a household has four children.

Table 2.10 illustrates the implications of other results through simulation. Taking the estimated parameters from Table 2.5, we systematically changed the values of various demographic and benefit variables for each observation in the sample, and calculate the mean of the three conditional probabilities. As Table 2.10 shows, a 10 percent increase in working hours decreases the probability of participating in FSP 1.27 percent for food secure households, 0.93 percent for food insecure households, and 0.73 percent for households with hunger; the decrease in probability due to a 10 percent increase in non-wage income is 2.11 percent, 1.55 percent and 1.22 percent for food secure, food insecure and hungry households, respectively. A 10 percent increase of expected benefit also increases the probabilities of being in the FSP for all three types of households. Most of the variables have the largest

effect when the households are food secure among the three food security status categories because of the relatively lower baseline mean.

One additional younger child increases the probability of participating in FSP: the probability for a household with one more child under 6 has 0.10 larger than the probability of baseline mean; the probability for a households with one more child age between 6 and 13 has 0.07 larger than the value of baseline mean. Families with children usually are likely to have access to fewer non-labor sources of income and need more money to support the family. The results imply that the household's family structure has strong effects on the program participation.

Conclusion and Comments

The paper uses a bivariate ordered probit model applied to the 1999 CPS data to study the jointly determined questions of the food stamp programs participation and food security problem. The joint estimation results show that these two questions are correlated and that the results will be biased if we ignore the correlation. The results tell us that the FSP participation depends on the food security status. The estimation results also show that reference person characteristics such as age, employment status, education, marriage status, disability status, home ownership, number of children, working hours per adult are major factors which all affect a household's FSP participation and food security level. Households experiencing food insecure or food insecure with hunger but not participating in the FSP are likely to be employed, have fewer children, not participating in the TANF, own a house, and have a male and white reference person with higher education achievement. The share of

minimal food expenditure with respect to household income implies that the larger the share is, the more likely to suffer food insecure and hungry.

The results also indicate that some of the demographic variables have different effects on the probability of the FSP participation. Marginal effects of being in the FSP based on food insecurity or hunger status usually have larger values than those observed for food secure households, which imply that households with food insecurity and with hunger are more likely to be affected by demographic information of reference persons than food secure households. Working hours, nonwage income and expected benefits significantly affect FSP participation. The results of marginal effects show that working hour and expected benefit have larger effects than does non-wage income on FSP participation. Simulation of family structure on being in the FSP shows that younger children have significant positive effects on the program participation.

The different effects of household age, disability status, location among different food security status not only suggest that "welfare stigma" is one of the major factors on program participation, but also imply that wage rate is another potential factors which cause the participation behavior difference.

There are many directions for future research suggested by our study. For example, we have ignored many welfare programs in our model, but several programs, such as Medicaid, TANF, and other food assistance programs may affect FSP participation as well as food security status. Our model could, in principle, be extended to any number of programs.

Table 2.1 Ranking of food security items and calibrations

Item	Ranking	Response Item	Calibration
Food security	1	Worried food would run out	1.490
	2	Food bought just did not last	2.790
Food insecurity	3	Few kinds of low-cost food for children	3.270
	4	Could not afford balance meals	3.670
	5	Could not feed children a balanced meal	5.040
	6	Adult cut or skipped meals	5.370
	7	You ate less than felt you should	5.530
Hunger	8	Adult cut or skipped meals, 3+ months	6.420
	9	Children were not eating enough	6.660
	10	You were hungry but did not eat	7.540
	11	You lost weight because not enough food	8.610
	12	Cut size of children's meals	8.790
	13	Adults did not eat for whole day	9.120
	14	Children ever hungry	9.240
	15	Adults did not eat for whole day, 3+months	9.930
	16	Children ever skip meals	9.940
	17	Children ever skip meals, 3+ months	10.630
	18	Children did not eat for whole day	11.940

Source: Guide to Measuring Household Food Security, Bickel, et al. 2000.

Table 2.2 Explanatory Variables

Variable	Variable Description	Mean	Std. Dev
Work hour	Number of Working Hours in the family per week	14.009	19.599
Non-wage	Weekly non-wage income in the family($)	232.477	187.069
Exp	Ratio of minimal food expenditure with total income	0.357	0.530
Exbenefit	Weekly expected benefit for Food Stamps(calculated) ($)	24.172	34.263
# child under 6	Number of children under age 6	0.305	0.655
# child 6-13	Number of children between 6 and 13	0.430	0.846
# child 14-18	Number of children between 14 and 18	0.196	0.514
# older than 60	Number of family members older than 60	0.481	0.649
Rent	Indicator for not-owning a house (0,1)	0.562	0.496
Service	Indicator for working in the service industry(0,1)	0.112	0.320
Age	Reference person age	51.203	20.361
Age square	Square of reference person age	3036.272	2194.549
Male	Indicator for male(0,1)	0.388	0.487
White	Indicator for white(0,1)	0.766	0.424
Hispanic	Indicator for Hispanic(0,1)	0.142	0.349
Education	Whether reference person has at least a high school degree (0,1)	0.269	0.444
Married	Indicator for reference person being marriage	0.316	0.465
Disabled	Indicator for household with disabled member (0,1)	0.112	0.105
TANF	Indicator for participating TANF(0,1)	0.108	0.310
Metro	Whether household lives in metro area (0,1)	0.685	0.465
Northeast	Whether household lives in the Northeast(0,1)	0.195	0.397
Midwest	Whether household Lives in the Midwest(0,1)	0.208	0.406
South	Whether household Lives in South (0,1)	0.355	0.479
FSP(y1)	Indicator for participating FSP, last year (0,1)	0.240	0.437

Note: N=5,543.

Table 2.3 Distribution of the sample across FSP participation and food security status

	In FSP	Not In FSP	Total
Food Secure	660[a]	3320	3980
	(11.907)[b]	(59.895)	(71.802)
	(50.190)[c]	(78.524)	
	(16.583)[d]	(83.417)	
Food Insecure Without Hunger	417	631	1048
	(7.523)	(11.384)	(18.907)
	(31.711)	(14.924)	
	(39.790)	(60.210)	
Food Insecure With Hunger	238	277	515
	(4.294)	(4.997)	(9.291)
	(18.099)	(6.552)	
	(46.214)	(53.786)	
Total	1315	4228	5543

[a] Cell frequency.

[b] Cell percentage.

[c] Column percentage.

[d] Row percentage.

Table 2.4 Sample distribution based on the share of minimum food expenditure with respect to total income

	Total sample	Share<30%	Share ≥30%
Min food exp per capita	24.359	19.227	32.093
Share of food expenditure wrt total income	35.727%	15.514%	66.188%
Total households	5543	3332	2211
Food secure	3980[a] (71.802%)[b]	2530 (75.930%)	1450 (65.58%)
Food insecure	1048 (18.907%)	554 (16.627%)	494 (22.343%)
Food insecure with hunger	515 (9.291%)	248 (7.443%)	267 (12.076%)

[a] Number of observation.
[b] Share of sample size.

Table 2.5 The Mean and standard deviation of Major Variables (Std Dev in the Parenthesis)

	Not in Food Stamp Program			In Food Stamp Program		
Regime	Food Secure	Food Insecure	With hunger	Food Secure	Food Insecure	With hunger
N	3320	631	277	660	417	238
Work hour	14.747	18.176	14.653	10.118***	10.995***	7.996***
	(20.266)	(20.011)	(19.489)	(16.715)	(17.817)	(15.528)
Non-wage	255.661	249.869	200.994	172.427***	179.513***	158.926***
	(199.773)	(191.624)	(157.097)	(136.131)	(144.930)	(121.514)
Exbenefit	15.391	25.272	22.533	46.844***	52.902***	43.292***
	(25.982)	(129.732)	(28.911)	(41.040)	(44.751)	(95.202)
Child age< 6	0.214	0.371	0.199	0.571***	0.573***	0.311***
	(0.551)	(0.685)	(0.518)	(0.853)	(0.863)	(0.646)
Child 6-13	0.312	0.529	0.332	0.642***	0.837***	0.630***
	(0.730)	(0.885)	(0.736)	(1.002)	(1.089)	(1.005)
Child 14-18	0.152	0.261	0.253	0.221***	0.341***	0.265
	(0.470)	(0.537)	(0.609)	(0.519)	(0.672)	(0.505)
Older than 60	0.611	0.319	0.267	0.332***	0.228***	0.202**
	(0.687)	(0.565)	(0.490)	(0.560)	(0.494)	(0.452)
Education	0.283	0.271	0.354	0.220***	0.216**	0.210***
	(0.450)	(0.445)	(0.479)	(0.414)	(0.412)	(0.408)
TANF(%)	3.615	4.437	5.776	32.273***	33.094***	34.874***
	(18.668)	(20.609)	(23.371)	(46.787)	(47.112)	(47.758)

Note: *** difference between those in the FSP and those not in the FSP is significant at 1% ;
** significant at 5%; * significant at 10%.

Table 2.6 Bivariate Ordered Probit Estimate of Food Security and FSP Participation (Standard error in parenthesis)

	With Correlation		Without correlation	
Variables	Food Security Status	FSP Participation	Food Security Status	FSP Participation
Constant	-1.382***	-1.411***	-1.379***	-1.414***
	(0.167)	(0.195)	(0.169)	(0.198)
Work hour	-0.713e-2***	-0.016***	-0.711e-2***	-0.016***
	(0.106e-2)	(0.133e-2)	(0.108e-2)	(0.136e-2)
Non-wage	-0.529e-3***	-0.129e-2***	-0.542e-3***	-0.125e-2***
	(0.122e-3)	(0.134e-3)	(0.125e-3)	(0.138e-3)
Exp	0.159***		0.134**	
	(0.057)		(0.062)	
Exbenefit		0.834e-2***		0.892e-2***
		(0.789e-3)		(0.792e-3)
#Child under 6	0.029	0.266***	0.026	0.254***
	(0.033)	(0.040)	(0.033)	(0.040)
# Child 6-13	0.064***	0.191***	0.064***	0.179***
	(0.024)	(0.030)	(0.024)	(0.031)
# Child 14-18	0.117***	0.078*	0.117***	0.065
	(0.037)	(0.042)	(0.037)	(0.043)
# Older than 60	-0.132**	0.043	-0.133**	0.039
	(0.053)	(0.060)	(0.055)	(0.062)
Rent	0.280***	0.451***	0.276***	0.439***
	(0.042)	(0.050)	(0.043)	(0.051)
Service		0.629e-2		0.011
		(0.066)		(0.068)
Age	0.059***	0.044***	0.060***	0.044***
	(0.608e-2)	(0.681e-2)	(0.616e-2)	(0.692e-2)
Age square	-0.662e-3***	-0.506e-3***	-0.666e-3***	-0.506e-3***
	(0.610e-4)	(0.658e-4)	(0.619e-4)	(0.669e-4)

Table 2.6 *Continued*

	With Correlation		Without Correlation	
Variables	Food Security Status	FSP Participation	Food Security Status	FSP Participation
Male	-0.034	-0.145***	-0.037	-0.147***
	(0.041)	(0.049)	(0.042)	(0.050)
White	-0.162***	-0.185***	-0.159***	-0.184***
	(0.043)	(0.050)	(0.044)	(0.051)
Hispanic	0.050	-0.053	0.042	-0.057
	(0.056)	(0.064)	(0.057)	(0.065)
Education	-0.097**	-0.172***	-0.098**	-0.173***
	(0.042)	(0.050)	(0.042)	(0.051)
Married	-0.055	-0.308***	-0.053	-0.304***
	(0.049)	(0.056)	(0.050)	(0.057)
Disabled	0.276*	0.474***	0.278*	0.476***
	(0.165)	(0.179)	(0.160)	(0.174)
Metro	0.032	-0.145***	0.031	-0.142***
	(0.041)	(0.049)	(0.042)	(0.051)
Northeast	-0.196***	0.213***	-0.196***	0.204***
	(0.056)	(0.068)	(0.057)	(0.069)
Midwest	-0.179***	0.049	-0.177***	0.053
	(0.055)	(-0.066)	(0.056)	(0.067)
South	-0.068	0.123**	-0.078	0.116*
	(0.049)	(0.059)	(0.049)	(0.060)
RHO	0.300***		0	
	(0.024)			
MU	0.815***		0.816***	
	(0.023)		(0.023)	
LOG-LIKELIHOOD	-6231.07		-6303.89	

Note: *** Significant at 1% level; **Significant at 5% level; * significant at 10% level.

Table 2.7 Marginal effects on the probability of being in FSP and food security status

	Marginal effects on the probability of :				
	Participation	Food secure	Food insecure	With hunger	
Variables	(y1=1)	(y2=0)	(y2=1)	(y2=2)	Type (Var)
Work hour	-0.489e-2***	0.265e-2***	-0.125e-2***	-0.139e-2***	Continuous
	(0.420e-3)	(0.394e-3)	(0.191e-3)	(0.214e-3)	
Non-wage income	-0.405e-3***	0.197e-3***	-0.929e-4***	-0.104e-3***	Continuous
	(0.428e-4)	(0.455e-4)	(0.218e-4)	(0.241e-4)	
Minexp/income		-0.059***	0.028***	0.031***	Continuous
		(0.021)	(0.010)	(0.011)	
Expected Benefit	0.262e-2***				Continuous
	(0.251e-3)				
# child under 6	0.084***	-0.011	0.510e-2	0.570e-2	Continuous
	(0.013)	(0.012)	(0.569e-2)	(0.642e-2)	
# child 6-13	0.060***	-0.023***	0.011***	0.013***	Continuous
	(0.951e-2)	(0.874e-2)	(0.415e-2)	(0.463e-2)	
# child 14-18	0.025*	-0.044***	0.021***	0.023***	Continuous
	(0.013)	(0.014)	(0.651e-2)	(0.715e-2)	
# older than 60	0.014	0.049**	-0.023**	-0.026**	Continuous
	(0.019)	(0.020)	(0.955e-2)	(0.010)	
Rent	0.138***	-0.103***	0.049***	0.054***	Binary
	(0.015)	(0.015)	(0.750e-2)	(0.803e-2)	
Service	0.198e-2				Binary
	(0.021)				
Age	-0.246e-2***	0.324e-2***	-0.153e-2***	-0.171e-2***	Continuous
	(0.623e-3)	(0.638e-3)	(0.297e-3)	(0.350e-3)	
Male	-0.045***	0.013	-0.605e-2	-0.671e-2	Binary
	(0.015)	(0.015)	(0.724e-2)	(0.798e-2)	
White	-0.060***	0.061***	-0.028***	-0.033***	Binary
	(0.017)	(0.016)	(0.712e-2)	(0.932e-2)	
Hispanic	-0.017	-0.019	0.860e-2	0.990e-2	Binary
	(0.020)	(0.021)	(0.969e-2)	(0.012)	
Education	-0.053***	0.036**	-0.017**	-0.019**	Binary
	(0.015)	(0.015)	(0.747e-2)	(0.779e-2)	
Married	-0.093***	0.020	-0.962e-2	-0.011	Binary
	(0.016)	(0.028)	(0.878e-2)	(0.946e-2)	
Disabled	-0.169**	-0.106*	0.044*	0.063	Binary
	(0.070)	(0.065)	(0.022)	(0.043)	
Metro	-0.046***	-0.012	0.567e-2	0.626e-2	Binary
	(0.016)	(0.015)	(0.727e-2)	(0.796e-2)	
Northeast	0.069***	0.071***	-0.035***	-0.036***	Binary
	(0.023)	(0.020)	(0.010)	(0.946e-2)	
Midwest	0.016	0.065***	-0.032***	-0.033***	Binary
	(0.021)	(0.020)	(0.010)	(0.955e-2)	
South	0.039**	0.025	-0.012	-0.013	Binary
	(0.019)	(0.028)	(0.865e-2)	(0.932e-2)	

Table 2.8 Marginal effects on Food Stamp Program participation conditional on food security status(standard errors in parenthesis)

	Marginal effects on FSP participation (y1=1) for:			
Variables	Food secure (y2=0)	Food insecure (y2=1)	With hunger (y2=2)	Type (Var)
Work hour	-0.397e-2***	-0.501e-2***	-0.562e-2***	Continuous
	(0.377e-3)	(0.486e-3)	(0.534e-3)	
Non-wage income	-0.332e-3***	-0.422e-3***	-0.472e-3***	Continuous
	(0.387e-4)	(0.516e-4)	(0.560e-4)	
Expected Benefit	0.231e-2***	0.309e-2***	0.340e-2***	Continuous
	(0.229e-3)	(0.293e-3)	(0.320e-3)	
# child under 6	0.072***	0.095***	0.105***	Continuous
	(0.011)	(0.015)	(0.016)	
#child 6-13	0.050***	0.064***	0.072***	Continuous
	(0.832e-2)	(0.011)	(0.012)	
#child 14-18	0.016	0.017	0.020	Continuous
	(0.012)	(0.015)	(0.017)	
#older than 60	0.018	0.03	0.031	Continuous
	(0.017)	(0.023)	(0.025)	
Rent	0.109***	0.135***	0.271e-2	Binary
	(0.013)	(0.018)	(0.028)	
Service	0.175e-2	0.233e-2	0.256e-2	Binary
	(0.018)	(0.025)	(0.027)	
Age	-0.175e-2***	-0.198e-2***	-0.231e-2***	Continuous
	(0.549e-3)	(0.731e-3)	(0.797e-3)	
Male	-0.038***	-0.050***	-0.297***	Binary
	(0.013)	(0.018)	(0.032)	
White	-0.045***	-0.052***	-0.285***	Binary
	(0.015)	(0.029)	(0.028)	
Hispanic	-0.017	-0.025	-0.252***	Binary
	(0.017)	(0.022)	(0.045)	
Education	-0.042***	-0.053***	-0.316***	Binary
	(0.013)	(0.018)	(0.036)	
Married	-0.079***	-0.105***	-0.405***	Binary
	(0.014)	(0.019)	(0.038)	
Disabled	0.138**	0.157**	0.078	Binary
	(0.062)	(0.068)	(0.099)	
Metro	-0.043***	-0.058***	-0.289***	Binary
	(0.014)	(0.019)	(0.028)	
Northeast	0.073***	0.103***	-0.048	Binary
	(0.021)	(0.027)	(0.046)	
Midwest	0.023	0.038	-0.159***	Binary
	(0.019)	(0.025)	(0.046)	
South	0.038**	0.031	-0.128***	Binary
	(0.017)	(0.025)	(0.038)	

Table 2.9 Predicted effects of working hours on FSP participation based on food security status

Status		Probability of participation in FSP for working hours: 0	10	20	30	40
Baseline mean (without children)						
	Food security	0.302	0.253	0.208	0.168	0.134
	Food insecurity	0.450	0.394	0.341	0.291	0.244
	Food insecure with hunger	0.568	0.511	0.454	0.397	0.343
Food security						
	Two children with age 0-5	0.460	0.448	0.391	0.335	0.283
	Two children with age 6-13	0.395	0.384	0.329	0.278	0.230
	Two children with age 14-18	0.301	0.291	0.243	0.200	0.161
	Four children with age 0-5	0.669	0.658	0.602	0.544	0.485
	Four children with age 6-13	0.541	0.530	0.471	0.413	0.357
	Four children with age 14-18	0.342	0.331	0.280	0.233	0.191
Food insecurity						
	Two children with age 0-5	0.618	0.607	0.551	0.495	0.439
	Two children with age 6-13	0.549	0.537	0.481	0.425	0.370
	Two children with age 14-18	0.442	0.430	0.376	0.323	0.274
	Four children with age 0-5	0.799	0.791	0.748	0.701	0.650
	Four children with age 6-13	0.686	0.676	0.623	0.569	0.513
	Four children with age 14-18	0.479	0.467	0.412	0.358	0.306
With hunger						
	Two children with age 0-5	0.724	0.714	0.663	0.610	0.554
	Two children with age 6-13	0.663	0.653	0.598	0.542	0.485
	Two children with age 14-18	0.563	0.552	0.494	0.437	0.381
	Four children with age 0-5	0.871	0.865	0.831	0.793	0.750
	Four children with age 6-13	0.784	0.776	0.730	0.681	0.628
	Four children with age 14-18	0.604	0.593	0.536	0.478	0.421

Table 2.10 Effects of changes in exogenous variables on probability of FSP participation

	Probability of being in FSP		
	Food secure	Food insecure	With hunger
Baseline mean	0.337	0.488	0.606
10% increase in working hour	0.333[a]	0.484	0.601
	(-1.271)[b]	(-0.925)	(-0.731)
10% increase in non-wage income	0.330	0.481	0.598
	(-2.109)	(-1.546)	(-1.221)
10% increase in expected benefit	0.351	0.503	0.620
	(4.056)	(3.087)	(2.373)
One additional child age 0-5	0.439	0.595	0.704
	(30.404)	(21.848)	(16.305)
One additional child age 6-13	0.407	0.560	0.674
	(20.741)	(14.760)	(11.267)
One additional child age 14-18	0.358	0.507	0.625
	(6.392)	(3.816)	(3.244)
One additional older family member	0.362	0.522	0.636
	(7.459)	(6.900)	(4.957)

[a] Cell probability
[b] Cell increase from baseline (in %).

3. FOOD SECURITY AND DEMAND FOR FOOD AWAY FROM HOME

Introduction

One of the most dramatic changes in consumer food demand in the last 25 years is the trend towards greater consumption of food away from home (FAFH). Expenditures on FAFH represented 42 percent of the average household food expenditure in 1999 (BLS, 2001). During 1996-99 period, spending on FAFH increased 22.4%; spending on food at home increased 4.1%. The Consumer Expenditure Survey (CES) data also show that two-person consumer units had the greatest increase in spending on food at home, and four-person consumer units had the greatest increase for FAFH. Although food at home spending still accounts for the larger share of total food expenditure, the consumption of purchased meals away from home has become more and more important relative to food consumed at home. A growing economy, rising numbers of dual-income families and the wide availability of fast-food outlets have led to steady increases in spending on FAFH.

Based on the results from CES in 1999, households with income per capita before tax less than $5000 spent 16% of their total expenditure on food, and spent 37.21% of food expenditure in FAFH; households with income per capita before tax between $10,000 and $29,999 spent around 15% of their total expenditure on food, but with different expenditure on FAFH: 32% for those with per capita income between $10,000 and $14,999, 34% for income per capita between $15,000 and $19,999, 38% for income per capita between $20,000 and $29,999. The share of food expenditure spent on FAFH was 50.41% for those with income per capita larger than $70,000 group. The numbers confirm that the share of food expenditure decreases as income increases but the share of FAFH increases as income

increases. The results imply that consumption behavior is different for the different income groups, yet FAFH is an important component for all income groups. Some authors try to compare spending behavior differences based on income distribution. For example, Share and Abdel-Ghany (1999) found significant spending differences between the poor and nonpoor for food at home, housing, health, transportation, and other expenses. However, they did not find significant differences in spending between poor and non-poor for food away from home.

Based on Bickel, et al. (2000), "traditional income and poverty measures do not provide clear information about food security, even though food insecurity and hunger stem from constrained financial resources." Although being a low-income household does not mean the household is food insecure, income is one of the main factors that cause households suffer food insecure or even hungry. The probability of being food insecure for low-income households is larger than that for high-income households. The consumption behaviors are also likely to be different between households with food insecurity and other households. For the food insecure households, people are first and foremost motivated to satisfy their basic physiological needs for food in the context of the traditional food preferences, the lowest level of the Maslow's hierarchy of needs pyramid. In contrast, people in food secure households are motivated by factors higher on the pyramid. Their attitudes towards food may be understood by considering food choices in the context of safety, belongingness, esteem, and even self-actualization and self-fulfillment needs, which is the top of Maslow's hierarchy (see Belonax, 1997 for detail). The different needs between food secure families and food insecure families imply that choices between consumption at home and away from home may be decided by different factors. FAFH includes meals or snacks where food preparation

is performed by a commercial food facility such as restaurants, fast food places, cafeterias, and vending machines. Households are more likely to chose FAFH if they are food secure, partly because expenditure on FAFH includes a service component (tip) and may involve increased commuting (travel) expenses.

Objectives of this study are to focus attention on the effects of family structure on FAFH, and compare the different roles of family structure, food stamp program participation, price and total food expenditure between food secure households and food insecure households. This focus is made possible by the recent collection of data on the food security status in a large, national survey of households.

A number of studies on food consumption at home and away from home have been conducted. Most of them attempt to figure out the effects of income on food expenditure away from home and food at home (Houthakker and Taylor, 1970; Lamm, 1982; Lee and Brown, 1986). Lamm (1982) estimated income elasticity of FAFH expenditure is 0.11 using the U.S. Department of Commerce data, McCracken and Brandt (1987) estimated income elasticity of probability for FAFH is 0.19 and income elasticity is 0.24 based on the National Wide Food Consumption Survey data in 1977, and Yen (1993) estimated probability elasticity and expenditure elasticity of income is 0.07 and 0.36, respectively. At the same time, Yen (1993) also showed that FAFH probability and expenditure elasticities of household size is 0.02 and 0.24, respectively. Also, Bryne, Capps, and Saha (1996) showed income elasticities to be about 0.20. All in all, these studies have demonstrated through estimating sample expenditure elasticities that FAFH can be classified as a necessity rather than a luxury good. Kinsey (1982) evaluated income elasticities based on different income groups and found that the elasticities increased as income increases. She showed that income

earned by wives working full time did not increase the marginal propensity to consume FAFH, while income earned by part-time working wives and children, asset income increased this propensity. Many studies also checked the effects of demographic, social, and economic factors on FAFH (Prochaska and Schrimper 1973; McCracken and Brandt, 1987; Lee and Brown, 1986 ; Yen, 1993 ; Kinsey, 1982; Nayga and Capps, 1992). These studies also found that female labor participation rate and opportunity cost of time is a driving force behind increased consumption of FAFH. For example, Jensen and Yen (1996) showed that wife's employment has a positive effect on the probability of eating out and level of lunch and dinner FAFH expenditure although not breakfast FAFH expenditures.

Some papers have evaluated the effects of food stamp program participation on food expenditure. Studies (Lee and Brown, 1986; Fraker, Martini, and Ohls, 1995; Deaton and Paxson, 1998) generally found that the food stamp program has strong effects on food expenditure. However, whether food stamps exert more than a standard income effect on food expenditure or not is still less well established. The purpose of FSP is to improve food availability and access so as to enhance food security. The hypothesis here is that the quality, quantity, or both of food consumed by FSP participants should exceed that of nonparticipants. At the same time, because the FSP augments participants' purchasing power through the provision of food benefits (coupons or benefit transfers), it decreases the probability of eating out and consumption of FAFH. Including a food stamp dummy in the analysis allows us to test whether households participating in FSP are more likely to eat at home.

The main difference between this study and others is to compare the effects of family structure, food price and income on FAFH consumption for food secure households with

those of food insecure households. As we discussed earlier, many low-income households are food secure, whereas some non-poor households are food insecure. The reasons may include unexpected changes in circumstances, variations in household decisions about how to handle competing demands for limited resources, and geographic patterns of relative costs and availability of food and other basic necessities. The food security measure provides independent, more specific information on this dimension of well-being than can be inferred from income data alone (Bickel, et al., 2000). The difference between income and food security status provide an opportunity to analysis FAFH based on food security status instead of income levels. We mainly perform two analysis, one focusing on the effects of family structure and market characteristic variables on the share of FAFH expenditure, the other focusing on the effects on probability of eating out. In each case, we segment households by type of food security. To maintain consistency with economic theory, the Almost Ideal Demand System (LA/AIDS) was considered for the study. In addition, translating procedures were used to incorporate demographic variables into the food demand system.

This study uses data from the 1999 CPS-April food security supplement to estimate demand for FAFH, and food at home. The survey data make possible the estimation of disaggregate income and price elasticities for specific population groups, allow the opportunity to analyze the importance of socioeconomic and demographic factors on consumption decisions, and provide a large number of observations so there is not a problem of degrees of freedom. However, because price information is not collected in the survey, estimation of price parameters make use of the Consumer Price Index (CPI) for different regions based on consolidated MSA code. The CPI for each of the above categories was matched with household observations by month and region. Households are classified on the

basis of estimated food security scales. The food security scales are based on a set of 18 survey items included in the CPS Food Security Supplement that ask respondents directly about their behavior and food choices conditioned on financial constraints. Based their responses, households are classified into three categories: food secure, food insecure without hunger, and food insecure with hunger (see Bickel et al., 2000 for details). We combined households in the categories of food insecurity without hunger and food insecurity with hunger as the food insecure group.

The following sections present the economic and the econometric models, describe the data source and sample, provide empirical estimation results, and summarize major findings.

The Basic Model

In studies of food consumption, the assumption of weak separability of the utility function is often invoked, that is, it is assumed that the expenditures of a household can be grouped into two subgroups (expenditures on food and expenditures on nonfood) in such a way that the marginal rate of substitution between food items (food away from home and food at home) is independent of the level of any nonfood demand. This assumption allows the household's utility maximization problem to be decomposed into two separate problems, which can be thought of as two sequential stages of a decision-making process. The first stage is the determination of the broad group expenditure allocation that maximizes utility. Given this expenditure allocation, the second stage determines within the food group allocation by maximization the utility of attaining the overall level of the food demand for that group.

Let the utility function be

$$U = U(Q_{11}, Q_{12}, \ldots, Q_{1,m1}, Q_{21}, Q_{22}, \ldots, Q_{2,m2}) \tag{3.1}$$

Where U is the utility function, Q_{ij} represents the demand level of different food and non-food products. Assume that U is weakly separable with respect to the Q_1 and Q_2, where $Q_t=\{Q_{t1}, Q_{t2}, \ldots, Q_{t,mt}\}$, $t=1,2$. Goldman and Uzawa (1964) have shown that U can then be written as

$$U(\,)=U(U_1(Q_1), U_2(Q_2)) \tag{3.2}$$

It can easily be shown that there exists a group expenditure function $e_t(Q_t, U_t)$ given by

$$e_t(P_t, U_t^*) = \min \sum_{i=1}^{m_t} P_{it} Q_{it} \text{ subject to } U_t(Q_{i1}, \ldots, Q_{i,mi}) \geq U_t^* \tag{3.3}$$

where P_i is the vector $(P_{i1}, P_{i2}, \ldots, P_{i,mi})$ and P_{it} is the price of different products i in group t.

Equation (3.3) allows Hicksian food demand equations to be derived easily using

$$\overline{Q}_{it} = Q_i(P_t, U_t^*) = \frac{\partial e_t}{\partial P_{it}}. \tag{3.4}$$

Since the LA/AIDS can be interpreted as a first-order approximation to any demand system, its use allows tractable estimation of the second stage (i.e. within-group) allocation process without the imposition of restrictive a priori assumption with regard to expenditure effects. Assume that the group food expenditure function satisfy the AIDS formulation, i.e., that they can be written as

$$w_{it} = \alpha_{it} + \beta_{it} \log(\frac{e_t}{P_t}) + \Sigma_j \gamma_{ijt} \log P_{jt}$$

$$\log P_t = \alpha_{0it} + \Sigma_i \alpha_{it} \log P_{it} + \frac{1}{2} \Sigma_i \Sigma_j \gamma_{ijt} \log P_{jt} \log P_{it} \tag{3.5}$$

where w_{it} was the expenditure share of the *ith* commodity in group t, e_t is total food expenditures in group t, P_{it}, P_{jt} is the price of the *ith* and *jth* commodity in group t, respectively.

Differences in household behavior depend not only on prices and income but also on household characteristics and demographic factors. As we discussed earlier, FAFH expenditures made by household members are thought to differ by the age and gender of the household members. Previous studies have used demographic translation for household composition, which yields an estimated parameter for each age-gender classification (Heien and Wessells, 1990; McCracken and Brandt, 1987; Byrne, Capps and Saha, 1996). These relationships can be estimated by adding parameters to the demand system (Pollak and Wales, 1980, 1981; Ray's, 1982; Rossi, 1988).

Because adults, children, and older family members, and adults working status are likely to have different effects on food expenditure, we include these variables as demographic variables.

Let

$$\phi = \sum_j \sum_k (A_{1jk} + \beta_j A_{2j} + \alpha_{1j} K_{1j} + \alpha_{2j} K_{2j} + \alpha_{3j} K_{3j}) \tag{3.6}$$

be the effective household size. Where β_j, α_{ij} is each number between zero and one that indicates the fraction of an adult each child or older family member represents, respectively, $i=1,2,3; j=1,2; k=1,2$.

Here we assume that households include A_{1jk} adults age between 19 and 64, A_{2j} adults older than 64, K_{1j} children at age less than 6, K_{2j} children age between 6 and 13, and K_{3j} age between 14 and 18, where j=1,2 and k=1,2, respectively, and j=1 and 2 refers female and

male, and k=1 and 2 refers to work and non-work. Increases in the fraction of children and substitution of children for adults are likely to decrease food demand per person in the household. We also assume that adults between 19 and 64 are in the working population; being in the labor force will affect the food consumption decision. We enumerate the number of working family members. Households with more working members are likely to have different food expenditure patterns because workers may eat FAFH more often than other non-working families; Expenditure on FAFH are likely to increase both because of a positive "direct" effects as well as increased paymentsfor services in restaurant meal. Restaurant meals include a service component (Beaton and Paxson, 1998).

To check whether food assistance programs exert more than a standard income effect on food expenditure (Moffitt, 1989; Fraker, Martini, and Ohls, 1995), a dummy variable indicating whether any one of the family members participated in the food stamp program in the past year can be included among the demographic and socioeconomic variables. Other dummy variables such as region (Northeast, Midwest, South, and West), urbanization, race, education, hispanic, white, and marriage status and age of male or female heads are used to control for the differences in consumer behavior.

Demographic translating is used to incorporate the demographic and socioeconomic variables into the LA/AIDS model so that

$$\alpha_{it} = \kappa_{i0t} + \sum_{s} \kappa_{ist} N_s, \qquad (3.7)$$

where the N_s are the demographic variables, as described in the previous several paragraphs ($s=1,...,d$).

For estimation purposes, as often done, the price index P was approximated using the Stone's price index,

$$\log P_t^* = \sum_i \overline{w}_{it} \log P_{it}. \tag{3.8}$$

where $\overline{w}_{it}$ is the mean of budget share of different food expenditures in group t. The resulting system is

$$w_{it} = \kappa_{i0t} + \beta_{it} \log(\frac{e_t}{P_t^*}) + \sum_j \gamma_{ijt} \log P_{jt} + \sum_s \kappa_{ist} N_s \tag{3.9}$$

The basic demand restrictions were expressed in terms of the model's coefficients

$$\begin{aligned} &1) \sum_i \kappa_{i0t} = 1; \sum_i \gamma_{ijt} = \sum_i \beta_{it} = \sum_i \kappa_{ist} = 0 \text{ (adding up)} \\ &2) \sum_j \gamma_{ijt} = 0 \qquad \text{(homogeneity)} \\ &3) \gamma_{ijt} = \gamma_{jit} \qquad \text{(symmetry)} \end{aligned} \tag{3.10}$$

The unconditional own, cross-price, and expenditure elasticities for the LA/AIDS system are

$$e_{ij} = \frac{[\gamma_{ijt} - \beta_{it} w_i + \beta_{it} \beta_{jt} \log(\frac{e_t}{P_t^*})]}{w_i} - \delta_{ij}, \text{where } \delta_{ij} = \begin{cases} 1 \text{ if i = j} \\ 0 \text{ o.w.} \end{cases} \tag{3.11}$$

$$e_i = \frac{\beta_{it}}{w_i} + 1. \tag{3.12}$$

Methodology

Zero problem issue in FAFH

The use of CPS data on FAFH allows examination of the effects of detailed demographic variables on consumption decisions. However, zero observations in the dependent variable present new estimation problems with cross-section survey data.

There are several methods used for estimating the demand for FAFH in the presence of a large number of zero observations. These methods include Tobit model (McCracken and Brandt,1987), double-hurdle model (Yen, 1993 and 1996; Jensen and Yen, 1996), Heckman's two-stage procedure (Park and Capps, 1997;), log-linear model (Pol and Pak, 1995), and switching regression analysis (Lee and Brown, 1986; Manrique and Jensen, 1998).

Although the Tobit model has been used broadly in empirical applications and has commonly been estimated with homoskedastic and truncated normal errors, as Lin and Schmidt (1983) mention, the use of the Tobit model is extremely restrictive due to two reasons: first, it assumes that any variables which increase the probability of a non-zero value must also increase the means of the positive values; second, it links the shape of the distribution of the positive observations and the probability of a positive observation. Thus, the assumptions may not be true for the case when some of the zeros are a result of 'nonparticipation' decisions (Cragg, 1971).

Heckman's two-stage estimation assumes that the zero expenditures result from either standard corner solutions or infrequency of purchases (Blundell and Meghir, 1987). Let $y_{t1}=X_1\beta_1+u_{t1}$; $y_{t2}=X_2\beta_2+u_{t2}$.

Here we observed only the sign of y_{t2}, and we observe y_{t1} if and only if $y_{t2}>0$. If $u_{1t}=u_{2t}$ and $\beta_1=\beta_2$, the model is the same as the Tobit model. However, the model does not apply well to data sets with characteristics when: "the observed values of y_{t1} need not be positive, in the sense that the model implies a non-zero probability of observed $y_{t1}<0$; and the unobserved y_{t1}

is literally unobserved, rather than observed as equal to zero" (Lin and Schmit, 1983). Similar comments apply to other models.

In our case, Heckman's model applies when some households' food consumption is literally unknown; The Tobit model or Double-hurdle model applies when, for some households, consumption is known to be zero. Although The Current Population Surveys (CPS) provides only information on expenditures observed for a one-week period, it provides individual intake data and therefore infrequency of purchase is not so much of a problem. Noting the concern with the Tobit model, Heckman's two-stage and other approaches, Cragg's double-hurdle model is the most suitable model for our data set. The model accounts for zero expenditure from purchase infrequency; moreover, it considers zero is a meaningful value of the dependent variable, and allows for different effects of a variable on participation and consumption decisions.

In our FAFH case, the first hurdle arises from the participation in the FAFH market, and the second hurdle comes from whether they indeed consume the food. The double-hurdle model features two stochastic processes that determine the probability and conditional level of consumption, and accounts for zero observations resulting from true nonconsumption determined by economic and market determinants (corner solutions) as well as other factors such as "conscientious abstention" (Pudney, 1988).

Empirical specification

Based on the economic model described in the last section, the demand for FAFH is analyzed in the following two steps:

First, a food expenditure equation is estimated based on a linear Engel relationship. i.e.,

$$Exp_i = a + b \times INC_i,\ I=1,2,\ldots,n \qquad (3.14)$$

where Exp_i and INC_i represent the ith household's food expenditures and income, respectively; and a and b are parameters. To control for differences in family structure and other demographic information that vary across households, a number of variables specified earlier were added to the equation. The completed model estimated was

$$Exp_i = a_0 + \sum_k a_k s_{ki} + b \times INC_i + \varepsilon_i \tag{3.15}$$

where the s's are demographic and socioeconomic variables, the a's and b's are parameters to be estimated, and ε is the usual disturbance term (the ε's are independent $N(0,\sigma^2)$). Note that the residual ε_i may be heteroscedastic (Maddala, 1983, pp. 225-226). Weighted least squares method is used to estimate (3.15).

Second, we estimate the demand for FAFH and food at home based on the total food expenditure. Given the adding-up restriction of the LA/AIDS share equations, it is only necessary to estimate one equation of the two equation system. The food at home equation is dropped from the estimation, with the parameters of the food at home equation estimated from the symmetry and homogeneity conditions.

The double-hurdle model is described here. As we discussed earlier, households have a choice in how they buy food for consumption. For households that consume food away from home, there exist two hurdles: to participate in the market, and to actually consume. The first hurdle is a probit mechanism for the consumption decision and the second hurdle is a Tobit mechanism. Both hurdles are assumed to be linear in their parameters (α,β), with additive disturbance terms u and v randomly distributed with a bivariate normal distribution.

Let X and Z be the regressors that influence participation and consumption. The double hurdle modle, developed by Cragg and Atkinson et al. (1984), can be represented as

$$y = X\beta + v \quad \text{if } Z\alpha + u > 0 \text{ and } X\beta + v > 0$$
$$0 \quad \text{otherwise} \tag{3.16}$$

where y is the share of food expenditure away from home. The error terms u and v are independent and are distributed as $u \sim N(0,\sigma^2)$ and $v \sim N(0,1)$.

The error terms v and u are assumed to be distributed as bivariate normal,

$$(u,v) \sim \begin{bmatrix} 1 & \sigma_{uv} \\ \sigma_{uv} & \sigma^2 \end{bmatrix} \tag{3.17}$$

The double-hurdle model specified above relies crucially on the assumption of bivariate normal errors as mentioned by Yen, Jensen and Wang (1996). To relax the assumption of nomality, Yen and Jensen (1995) applied the inverse hyperbolic sine (IHS) transformation to the double-hurdle model. Based on their suggestion, we also apply the inverse hyperbolic sine (IHS) transformation to the dependent variable so that we can allow for nonnormal errors,

$$y(\theta) = \log[\theta y + (\theta y^2 + 1)^{0.5}]\theta^{-1} = \sinh^{-1}(\theta y)\theta^{-1} \tag{3.18}$$

where θ is an unknown parameter. With the transformation, the error term has a better chance of satisfying the normality and homoscedasticity assumptions. The transformation is linear when θ approaches zero and behaves logarithmically for large values of y for a wide range of values for θ; it is known to be well suited for handling extreme values (Burbidge et al., 1988). Let $\rho = \frac{\sigma 12}{\sigma}$, based on the transformation, the likelihood function for the IHS double-hurdle model is

$$L = \prod_{y=0}\left[1-\Phi(Z\alpha,\frac{X\beta}{\sigma},\rho)\right]\prod_{y>0}\{(1+\theta^2 y^2)^{-0.5} \times\frac{1}{\sigma}\phi\left[\frac{y(\theta)-X\beta}{\sigma}\right]\Phi\left[\frac{Z\alpha+\rho\left(\frac{y(\theta)-X\beta}{\sigma}\right)}{(1-\rho^2)^{0.5}}\right]\} \tag{3.19}$$

where $\Phi(.)$ and $\phi(.)$ are the univariate standard normal distribution and density functions, respectively, and $\Phi(.,.,\rho)$ is the bivariate standard normal distribution function with correlation ρ.

Based on Arabmazar and Schmidt (1981), Yen and Jensen (1995) and others, to overcome the restriction of homoscedasticity, the standard deviation σ is allowed to vary across observations and is specified as a function of exogenous variables n

$$\sigma = \exp(n\gamma), \tag{3.20}$$

where γ is a parameter vector. The parameters of the model are $(\alpha,\beta,\gamma,\rho,\theta)$.

The IHS double-hurdle model can be estimated by maxmizing the logarithm of the likelihood function (3.14). Estimation of the model requires the specification of the participation, consumption, and heteroscedasticity equations.

Based on Yen and Jensen (1996), the probability of a positive observation is

$$P(y>0) = P(\mu > -z\alpha, v > -x\beta) = \Phi(z\alpha,\frac{x\beta}{\sigma},\rho) \tag{3.21}$$

The conditional mean of y is

$$E(y|y>0) = [\Phi(Z\alpha, \frac{X\beta}{\sigma}, \rho]^{-1}$$

$$\int_0^{\infty} y(1+\theta^2 y^2)^{-0.5} \frac{1}{\sigma}\phi[\frac{y-X\beta}{\sigma}]\Phi\left\{\frac{Z\alpha+\rho\left[\frac{y-X\beta}{\sigma}\right]}{(1-\rho^2)^{0.5}}\right\}dy \tag{3.22}$$

The unconditional mean of y follows the property that $E(y)=E(y|y>0)P(y>0)$.

The effects on probability explain the binary decision on consumption, i.e., to eat out or not. The effects on the conditional level explain what makes those eating out spend either more or less. The effects on the unconditional level provide an overall assessment of what contributes to consumption level by increasing either the probability or conditional level. The effects of explanatory variables can be evaluated at the mean of these variables. Although the IHS transformation and the heteroscedasticity specification in the IHS double-hurdle model complicate the expressions for the marginal effects of variables, the marginal effects of continuous variables can be obtained by differentiating the probability, conditional mean, and unconditional mean of consumption. Based on these marginal responses, the elasticities are straightforward. For discrete variables, the marginal effects can be computed as the finite changes in probability, conditional level, and unconditional level resulting from a change in value of these variables from zero to one.

Due to the marginal effects from both FAFH participation and consumption equation, the coefficients γ's, β's and κ's in basic demanding restrictions of adding-up, homogeneity, symmetry in Formula (3.10), and in price and income elasticities (Formula (3.11) and (3.12)) should use relative marginal effects instead of coefficients from the FAFH consumption equation.

Data and Variable Definitions

Data used in this study are compiled directly from the 1999 CPS data. Since 1995, the CPS survey has included a module to collect information on food expenditures, and food security status of households. The data include demographic and income data on the households and allow the study of the relationship between food consumption behavior, household demographic variables and food security status. Households are classified into two categories: food secure and food insecure on the basis of the response to 18 questions related to food security. The CPS data did not provide food quantities and prices, but do provide food expenditure information. We include the CPI as representative of the price for food, FAFH and food at home. The source of price data was the Bureau of Labor Statistics' Consumer Price Indexes (CPI) for total food consumption, food away from home and food at home (U.S. Dept. of Labor, 1999). The regional specification for the CPI includes consolidated MSA code. Because only the CPI for urban consumers is available, we add an indicator of whether the household is living in metro area to capture the shortcoming (the data set only provides metro or non-metro). The sample consists of 45,000 households in April 1999. Information on total food expenditure, food away from home and food at home is provided for the households during the past week. Demographic information includes household size and composition by age and gender, region, state, county, race, income class, population class of metropolitan statistical area, and education and marriage status of reference person.

Income information is reported categorically, rather than by specific level. It includes money from jobs, net income from business, farm or rent, pensions, dividends, interest, social security payments, social assistance cash payments (such as TANF) and any other

money income received by members of this family. Households were categorized into fourteen income ranges. In order to choose the sample of interest, it was necessary to convert the categorical income variable to a continuous measure. Because 8.04% of households did not provide income information, we first imputed categories for those households five times using Rubin's methods (1987).[1] After imputation of the categories, we used the range midpoints as representative of household income.

As suggested by Andrews, Nord and Kabbani (2001), we chose households with income less than four times the poverty line as our sample for analysis. The poverty line for each household in the sample was estimated based on the number of adults and number of children in the household, and the age of the household reference person (older or younger than 65). The relevant poverty line comes from the Census Bureau. Excluding the highest-income extreme values. The total sample in the analysis is 30,280 households, of these households, 10.9% were food insecure. In the sample, households can be distributed in the following income groups: income less than 100% of poverty income (29.6%); between 100% and 130% of poverty income (10.2%); between 130% and 185% of poverty income (10.3%); and between 185% and 400% of poverty income (49.8%).

The dependent variable of the analysis is the share of food expenditure away from home in the total food expenditure, which is calculated from the data. FAFH expenditures include

[1]Income categories are assumed to relate with age, square of age, gender, race, Hispanic, marriage status and education attainment of households, household size, metro or nonmetro, living regions such as midwest, northeast, west and south. We impute the income five times and the results presented in the paper is the average results calculated based on the formula provided by Rubin (Rubin , 1987; Pan, Jensen and Fuller, 2000).

for meals or snacks where food preparation is performed by a commercial food facility. Examples of commercial food facilities are restaurants, fast food places, cafeterias, and vending machines. A food expenditure comparison between food secure households and food insecure households is presented in Table 3.1. The mean of weekly total food expenditure per person in the sample is $42.30; FAFH accounts for 25% of households and food insecure households is presented in Table 3.1. The mean of weekly total food expenditure per person in the sample is $42.30; FAFH accounts for 25% of food expenditures. Nearly 70% of the households in the sample ate out sometime during the survey week. The mean of total food expenditure per person for food secure households was $43.23, these households spent 25% of their food dollar on FAFH and had a 71.1% participation rate for FAFH spending. Households experiencing food insecurity spent on average $35.04 for total food; they spent 18% of their food expenditures on FAFH and 55.5% had FAFH expenditures. Based on Table 3.1, food insecure households have relatively lower income, lower food expenditure, lower FAFH participation rates than those of households with food security. Although many households participating in the FSP suffer food insecurity, those participating in the FSP had lower income, less food expenditure per person, less FAFH expenditure and lower FAFH participation rates; they had more food at home and total food expenditure than was the rate for the food insecure households.

To estimate the food expenditure equation and FAFH expenditure equations, we include explanatory variables such as CPI for food, food away from home and food at home; number of children age less than 6, between 6 and 13, and male and female children older than 13, male and female adults age between 19 and 64, and older than 64; the ratio of food

expenditure with Stone's price index; age of household; an indicator of household education; Hispanic; food stamp receipt; metro or non-metro; and northeast, midwest, south, or west.

The definitions of dependent and independent variables and the corresponding sample statistics are reported in Table 3.2. We also include the mean of different variables based on the two subsamples (food secure and food insecure households).

As discussed earlier, of particular interest is the sample mean of eating out and share of food expenditure away from home. The data show that over half of households with food insecurity eat out (55.5%) and 17% of food expenditure for food insecure households were for FAFH. As expected, a comparison to food secure households, they are less likely to eat out and spend less when they eat out. On average, households with food insecurity have more children, fewer working family members (both male and female), more family adults without jobs, and fewer older family members than those who are food secure. At the same time, the sample means show that the heads of the households with food insecurity are more likely to live in the South and West, have less education, are more likely to be non-white, Hispanic, single parents, and to participate in the food stamp program than those who are food secure.

Empirical Findings

Food Expenditure

Table 3.3 presents the estimated weighted least squares (WLS) results of total food expenditure and associated standard errors. All of variables are significant in the equation of food secure households except the price index; however, only family structure, an indicator of living in a metro area, and income variables are significant at the 10% level for the food insecure equation. The Food Consumer Price Index (FCPI) is not significant in any of the

equations. One of the interesting results is that FSP participation indicator is significant and positive in food secure equation but not significant in food insecure equation.

Given the other factors, food secure households who are Hispanic spend $3.12 less than those who are not Hispanic. A food secure household whose head has a high school degree and is married spends about $7.54 more than those whose head does not have a high school degree and is not married. The results also show food secure white households spend $4.97 more than the non-whites. Among the four regions, food secure households living in west spend more on food than those living in northeast, south or midwest; they also spend $12.03 more for those living in metro area than those who live in non-metro area. However, most of these variables in food insecure equation are not statistically significant. Only significant variables are indicators for living in metro and west area. The results indicate that those living in metro area spend $4.70 more than those living in non metro area; and those who live in west spend $6.38 more than those who live in Midwest area. The results may be related with the family size, living style, and price differences.

Based on the results, one male-child between 14 and 18 increases food expenditure $25.39 and $21.24 per week for food secure and food insecure households, respectively. One female-child between 14 and 18 increases food expenditure $18.89 and $22.07 for food secure and food insecure households, respectively. Children between 14 and 18 have the largest marginal effects on food expenditure among family structure variables, especially for the food insecure households. One working male-adult also increases household food expenditure $19.17 and $15.49 for food secure and food insecure households, respectively. The marginal effect of working female adults is $8.26 and $9.31 for food secure and food insecure households, respectively. The major difference of marginal effects between food

secure households and food insecure households lies on non-working adults. One non-working male adult increases food expenditure $12.80 and one non-working female adult increases food expenditure $8.19 for food secure households. However, there are no statistically significant marginal effects of non-working adults members for food insecure households. The results indicate that food insecure households are very difficult to increase food expenditure even if they have more adults. It also implies that food insecure households face more resources constraints than food secure households.

To further measure the effects of different family structure and income on food consumption, we present the elasticities of food consumption with respect to age of reference person, food price and total income in Table 3.4. With a significant and positive effect on the level of food expenditure, the age variable suggests that food secure households with older head spend more on food than do other average age groups. The effect is negative but insignificant in the food insecure households. The effects of income are similar, and positive for all households. The income elasticity is 0.16 for food secure households and 0.15 for food insecure households. The results imply that a ten percent increase in income increases food consumption 1.61 percent for food secure households and 1.46 percent for food insecure households. The CPIs for food and nonfood are not statistically significant in any of the estimation.

Food Away from Home

The IHS double-hurdle model was estimated by maximizing the logarithm of the likelihood function (Eq3.14). Estimation of the model requires the specification of the participation, consumption, and heteroscedasticity equations. Excluding some variables from the equations is important in an estimation of the double-hurdle model due to the linear

combination $Z\alpha-(\rho/\sigma)X\beta$ (Jones,1992; Yen, Jensen and Wang,1996). As done by Yen, Jensen and Wang (1996), we excluded some insignificant variables from the participation equation based on preliminary analysis. At the same time, we did not include the logarithm of the ratio of food expenditure with the stone price index and price variables in the participation equation to simplify the calculation of elasticities, though the logarithm of the ratio is statistically significant in the equation. To test whether there exists heteroscedasticity, we used Goldfeld-Quandt's test (Green, 1997, pp. 551-552). Based on this test, the samples for the food secure and the total sample groups are indeed heteroscedastic, and heteroscedastic is related with household size. However, the food insecure sample is actually homoscedastic. Based on these preliminary checks, we include a heteroscedasticity equation in the full sample estimation and the food secure household estimation but not in the estimation for food insecure households.

Results of the MLE based on the total sample, food secure sample and food insecure sample are presented in Table 3.5, 3.6 and 3.7. The most notable modeling results are: the IHS parameter (θ) in the food secure and full sample equations are both significant at the 0.10 levels. At the same time, one should notice that the parameters of heteroscedasticity of equations (in both the food secure sample and the whole sample) are statistically significant. The significance of these variables in the two equations leads to rejection of the homoscedasticity assumption. The results suggest that the error variance increases with household size (including number of children at different age groups, number of adults and older family members). Although the correlation (ρ) is significant in both the food security equation and the food insecurity equation, the signs are different. The positive correlation (ρ) in the food security equation means that the random disturbances in FAFH consumption and

participation are affected in the same direction by random shocks or unmeasured effects; while the negative correlation in the food insecure equation means that the random disturbance in the two equations are affected in a different direction.

For the food secure case, most variables seem to affect participation and consumption in the same direction. Education and marriage status of reference persons, region, race, food stamp program participation have the same sign in both equations. The results imply that household with a head with high school degree and who are married, who are white are more likely to eat out and spend more if they eat out. The negative signs on food stamp program participation imply that households participating in the FSP are less likely to eat out and spend less if they eat out. Households with children (either male or female) between 6 and 18 are more likely to eat out, and conditional on participation, to spend more than those at home. Number of working family members (either female and male) increases the probability of eating out and also has larger share of food expenditure away from home. Number of male jobless adults in the family decreases the likelihood of eating out, however households with more male jobless adults have larger share of food expenditure away from home conditional on eating out. Younger children in the family have different effects on participation and consumption equation: the number of children under 6 is positive and significant in the consumption equation, and not statistically significant -though negative- in the participation equation. Price is not significant in the estimation. Number of older female family members is not a significant variable in the participation equation. However, it is significant and positive in the consumption equation.

In the food insecure equation, families with children older than 6 are also more likely to eat out and spend relatively more away from home than others. Families with more working

adults (either male or female) are more likely to eat out and spend larger share of their food expenditure on FAFH than families with fewer working adults. Number of children under age 6, number of female nonworking adults, number of older family members (either female or male) are not significant variables in the participation equation but all of the estimated coefficient are significant and positive in the consumption equation. The effects of reference person with a high school degree, being white and single, not being Hispanic are associated with the probability of households eating out. At the same time, households participating in the food stamp program are less likely to eat out and spend less on FAFH than those who do not participate in the FSP.

Comparing the results of food secure households with those of food insecure households, the number of working adults (male and female), number of male non-working adults, number of children age between 6 and 18, are the family structure variables which are significant and have the same sign on both food secure and food insecure cases. Other variables that have the same sign and are statistically significant in the two cases are the indicator variables of the reference person being Hispanic, living in metro area, and participating in FSP. The coefficient estimate for the food stamp program participation dummy indicates that participants are less likely to eat away from home than nonparticipants, which is consistent with most literatures (e.g. Lee and Brown, 1986).

The sign of the race variable in the participation equation indicates that white households are more likely to eat out than others. Although an indicator of the reference person marital status is statistically significant in the two equations for both food insecure and food secure households, the sign is not the same. The reason that food secure households and married reference persons are more likely to eat out than those households with only a

single head may be because single heads with dependents are more closely tied to home. The negative sign of marriage status variable in the food insecure group implies that for this group, households with both male and female heads tend to spend less away from home than those with only single adult head. This result may be due to better planning for two-head households and different lifestyles in the food insecure households. Number of older children (including the number of children age between 6 and 13, and older than 13) positively affects the participation and the share of food expenditure away from home in both food secure and food insecure cases.

Elasticities

Table 3.8 presents the elasticities of probability with respect to different variables evaluated at the sample means. The elasticities indicate that doubling (a 100 percent increase) in the number of working female adults and working male adults for food insecure households increases the probability of eating out by about 13.7% and 11.6%, respectively. For food secure households, the numbers are similar: 7.4% for working males and 7.9% for working females. The results also show that these two age categories have the largest effects on the probability of eating out among the different family member age groups for both food insecure and food secure households. Also, the results imply that increasing the number of working adults in the family has a greater effect for food insecure households than for food secure households. One of the reasons may be that, as incomes (both wages and salaries) increase, the opportunity cost of time increases. The rising value of time has driven households away from home-cooked meals and to greater demand for convenience. With a significant and negative effect on the probability of eating out, the age variable suggests that older household-heads are less likely to consume FAFH than do other average age groups.

Table 3.8 also shows that a ten percent increases in food expenditure increases the probability of eating out by 9.14 percent for food secure households and 7.85 percent for food insecure households. The elasticities of CPI for FAFH and food at home are not statistically significant here, although we do have negative sign for CPI of FAFH and positive sign for CPI of food at home, as expected. The lack of significance in the price variables may indicate that the CPIs are not good price representatives for the household consumption in the sample.

For the discrete explanatory variables, we calculate the average effects of these variables on the probability of eating out (Table 3.9). In particular, the effects of each variable were calculated as the finite changes in these components of consumption as the value of the variable changes from zero to one, *ceteris paribus*. These results suggest that, for households with food insecurity, relative to other households in the group, household-heads with a high school degree, living in metro areas, and being white are 12.5 percent, 4.3 percent, and 6.2 percent respectively, more likely to consume food away from home than others; households participating in the FSP are 9.1 percent less likely and those who are Hispanic are 21 percent less likely to eat out than others. For food secure households, those participating in the FSP are 14.4% less likely to eat out than those not participating in the FSP. The effects of other variables can be interpreted in the same manner. Among all the discrete variables, being Hispanic, participating in the FSP, living in northeast have the largest different effects on eating out. One interesting results here is that food secure households with married heads in food secure sample are 3.1 percent more likely to eat out than the households with single head. However, food insecure households with married heads are 5.1% less likely to eat out than those with single reference person.

Table 3.10 provides the elasticities of the conditional level with respect to continuous variables also evaluated at the sample means. Based on the Table, both the number of working female and number of working male adults have the largest elasticities among all the family structure variables. For the whole sample, doubling the number of male adults and number of female adults increases FAFH consumption by 31.6% and 20.2%, respectively. For food secure households, doubling the number of adults leads to increase in FAFH expenditure 32.9% for males and 20.0% for females. The elasticities for food insecure households are quite a bit smaller and similar in size: 8.5% for males and 8.9% for females. One interesting result here is that the FAFH expenditure elasticity with respect to the level of food expenditure for food insecure households is larger than that of food secure households. The result implies that when food insecure households do eat out, they are relatively more response to changes in total food expenditures in spending on FAFH than are food secure households.

Table 3.11 provides the elasticities of unconditional mean evaluated at the sample means of all variables. The individual effects of working male and female are similar for food insecure households. However there exist significant differences for food secure households: the elasticity for working male adults is larger than that for working female adults. Similarly, the effects of other variables for food secure households are greater than those of food insecure households. The elasticities of unconditional mean of food expenditure shows that FAFH is luxury good (with elasticity greater than unity) compared to food at home (with point elasticity estimation 0.63, 0.59 and 0.58 for whole sample, food secure sample and food insecure sample, respectively). The overall effect of food expenditure

is driven by both the positive effect on the probability of consumption and also the positive effect on the conditional level of consumption.

To calculate the income elasticity of FAFH, we need to Combine the elasticites of uncomditional FAFH expenditure in Table 3.11 with income elasticities of food expenditure in Table 3.4, the point estimate of total income elasticities on FAFH is 0.22, 0.22 and 0.21 for whole sample, food secure and food insecure households, respectively. The results for the food secure and the food insecure groups are similar, with the relatively larger elasticity for the food secure group. The sign and magnitude of the income elasticities shows that FAFH is normal and a necessity good for both food secure and food insecure households.

Summary

In this paper we use an IHS double-hurdle model to estimate the consumer demand systems with zero expenditures. The study estimated the effects of family structure and demographic variables on food away from home consumption based on different food security status. The results suggest that interaction between the participation and consumption decisions is important in modeling consumption of food away from home and that the specification of a more flexible error distribution is justified. The double-hurdle estimation shows that family structure and demographic variables play significant roles in the decisions about whether to eat out and how much to spend. Being food insecure limits the consumers' participation and consumption decisions. One interesting result is that FAFH is a normal and necessary good for both food secure and food insecure households, though the income elasticity for food insecure households is lower than that of food secure households.

One of the purposes of this paper was to compare the characteristics and food spending behavior of households classified by food security status. Findings indicate that some difference exist between the two groups. Weighted least squares estimate of food expenditure shows that food secure households who are white, live in metro areas, are married, and participate in the FSP spend more than other food secure households. However, only location variables (such as indicator of living in metro area and west region) make the food expenditure different for food insecure households. The marginal effects of family structure variables based on different age-sex-work status on food expenditure are larger for food secure households than those of food insecure households. Households with food insecurity are less likely to eat out and spend relatively less away from home even if they eat out.

Our results also indicate other important distinguishing features for food away from home expenditure between the different food security levels: first, working status (measured by number of working male and female adults) has a greater effect on expenditures of food secure households than for those of food insecure households; second, although the total income elasticity of FAFH is almost the same between food secure and food insecure groups, the FAFH expenditure elasticity is different: the elasticity of food insecure households has a relatively larger value than food secure households. The difference may relate with the lifestyle, family structure, etc.; third, households participating in the FSP have the significant larger food expenditure than those who are not in the program for food secure sample; however, the difference is not statistically significant in the food insecure sample. At the same time, the results of this study agree fairly closely with the earlier findings about the effects of food stamp program participation. The households participating in the program are less likely to eat out and spend less away from home even if they eat out.

The results in the paper also show that food spending behaviors could be captured in demand analysis with demographic factors, such as region, age, family structure, and food security status.

The study provides important implications to the government and FAFH industry. The results highlights West and Midwest are more likely to eat out than other regions. At the same time, food secure households with married heads are more likely to eat and food insecure households are less likely to eat out than households with single parents. Nonwhites, Hispanic and household heads without a high school degree and living in nonmetro areas continue to less likely to eat out than other households. The industry may make use of the opportunities.

Table 3.1 A comparison between food secure and food insecure households, Food Stamp Program receipts (Mean and standard error in parentheses)

	Total	Food secure households	Food insecure households	FSP receipts
N	30,280	26,978	3,302	2,059
Weekly total income per household (Income)	537.409	562.815	341.540***	205.094***
	(2.410)	(2.496)	(4.829)	(4.086)
Weekly total food expenditure per household (EXP)	98.419	99.999	86.054***	89.762
	(0.463)	(0.498)	(1.214)	(1.953)
Food expenditure per person	42.301	43.229	35.042***	31.276***
	(0.205)	(0.220)	(0.540)	(0.615)
Food at home(FAH):				
Average FAH expenditure	73.830	74.189	71.015***	79.973***
	(0.375)	(0.401)	(1.062)	(1.855)
Average FAH expenditure per person	30.883	31.194	28.452***	27.915
	(0.150)	(0.159)	(0.452)	(0.591)
Average FAH expenditure for those with FAH	77.298	77.690	74.238***	82.705***
	(0.377)	(0.403)	(1.066)	(1.878)
% with FAH	95.513	95.494	95.659	96.697*
	(0.137)	(0.145)	(0.400)	(0.449)
Food away from home (FAFH):				
Average FAFH expenditure	24.589	25.810	15.038***	9.789***
	(0.226)	(0.247)	(0.458)	(0.523)
Average FAFH expenditure per person	11.418	12.035	6.591***	3.362***
	(0.124)	(0.136)	(0.237)	(1.172)
Average FAFH expenditure for those with FAFH	35.459	36.295	27.082***	21.197***
	(0.289)	(0.309)	(0.674)	(0.988)
% with FAFH	69.345	71.112	55.528***	46.179***
	(0.295)	(0.307)	(0.958)	(1.221)

Note: ***difference between food secure and food insecure households, and between food insecure households and FSP receipts significant at 1% level.

Table 3.2 Variable definitions and sample statistics (weighted mean and standard error in parenthesis)

Variables	Definition	Full Sample	Food Secure households	Food Insecure households
S-FAFH	Share of expenditure for FAFH	0.250	0.258	0.175***
		(1.666e-3)	(1.767e-3)	(4.869e-3)
S-FAH	Share of expenditure at home	0.750	0.742	0.825***
		(1.666e-3)	(1.767e-3)	(4.869e-3)
FCPI	Price index for food	165.671	165.673	165.657
		(0.072)	(0.077)	(0.211)
ACPI	Price index for FAFH	169.358	169.367	169.289
		(0.083)	(0.088)	(0.244)
HCPI	Prince index at home	160.781	160.773	160.844
		(0.077)	(0.0812)	(0.230)
EXPP	Weekly food expenditure per person	42.301	43.229	35.042***
		(0.205)	(0.220)	(0.540)
Number of Children:				
Under 6	Number of children under age 6	0.257	0.240	0.387***
		(3.889e-03)	(3.986e-03)	(0.014)
6-13	Number of children less than 14	0.374	0.353	0.544***
	And older than 5	(4.861e-03)	(5.034e-03)	(0.017)
14-18	Number of children between 14	0.203	0.193	0.274***
	And 18	(3.288e-03)	(3.423e-03)	(0.274)
M 14-18	Number of male children older	0.104	0.098	0.147***
	Than 13	(2.231e-03)	(2.311e-03)	(0.147)
F 14-18	Number of female children older	0.099	0.095	0.127***
	Than 13	(2.142e-03)	(2.237e-03)	(7.099e-03)
Number of working-age adults:				
M-w19-64	Number of male and working	0.566	0.580	0.460***
	Adults	(3.866e-03)	(4.084e-03)	(0.012)
M-nw19-64	Number of male and not working	0.025	0.021	0.050***
	Adults	(1.045e-03)	(1.022e-03)	(4.560e-03)
F-w 19-64	Number of female and working	0.521	0.527	0.478***
	Adults	(3.689e-03)	(3.922e-03)	(0.011)
F-nw 19-64	Number of female and not	0.023	0.020	0.054***
	Working adults	(1.005e-03)	(0.974e-03)	(4.480e-03)
Number of the older adults:				
M-older	Number of male older than 64	0.415	0.442	0.208***
		(4.374e-03)	(4.760e-03)	(9.288e-03)
F-older	Number of female older than 64	0.417	0.444	0.209***
		(4.413e-03)	(4.802e-03)	(9.394e-03)
Age	Age of reference persons	48.054	48.785	42.333***
		(0.115)	(0.123)	(0.290)

Table 3.2 *Continued*

Variables	Definition	Full Sample	Food Secure households	Food Insecure households
Dummy variables: yes=1, no=0				
Eat out	Household eats out in the past week	0.693 (2.949e-03)	0.711 (3.072e-03)	0.555*** (9.579e-03)
West	Household resides in the West	0.214 (2.668e-03)	0.208 (2.803e-03)	0.258*** (8.508e-03)
Northeast	Household resides in the Northeast	0.180 (2.303e-03)	0.182 (2.456e-03)	0.160*** (6.606e-03)
South	Household resides in the South	0.365 (3.144e-03)	0.362 (3.329e-03)	0.389*** (9.549e-03)
Metro	Household resides in the metro area	0.776 (2.633e-03)	0.773 (2.809e-03)	0.798*** (7.520e-03)
White	Reference person is White	0.834 (2.490e-03)	0.850 (2.543e-03)	0.711*** (8.950e-03)
Education	Reference person has a high school degree	0.462 (3.206e-03)	0.477 (3.406e-03)	0.341*** (9.201e-03)
Hispanic	Reference person is Hispanic	0.106 (2.083e-03)	0.095 (2.123e-03)	0.19*** (7.112e-03)
Married	Reference person is Married	0.522 (3.214e-03)	0.542 (3.400e-03)	0.362*** (9.274e-03)
FSP Participation	Household is a food-stamp receipt	0.071 (1.674e-03)	0.046 (1.462e-03)	0.269*** (8.500e-03)
N		30280	26978	3302

Note: ***difference between food security and food insecurity is significant at 1% level.

Table 3.3 Weighted Least Square results of food expenditure equation (Independent variable: household food expenditure)

	Total Sample		Food Secure Households		Food Insecure Households	
	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error
Constant	26.225**	10.945	20.039**	11.815	66.031**	27.943
Education	7.334***	0.771	7.544***	0.822	2.291	2.157
Metro	10.791***	0.788	11.601***	0.833	4.696*	2.437
Northeast	7.128***	1.071	7.407***	1.178	3.485	3.245
West	11.172***	1.109	12.030***	1.189	6.378**	3.005
South	3.254***	0.928	3.677***	0.985	-0.369	2.730
White	4.704***	1.109	4.974***	1.247	0.666	2.437
Hispanic	-4.140***	1.454	-3.121*	1.654	-2.298	3.000
Married	8.362***	0.938	8.847***	1.006	1.390	2.684
FSP Participation	1.482	1.585	4.542**	2.178	2.171	2.380
Age	0.476***	0.117	0.573***	0.126	-0.224	0.338
Age square	-0.836e-2***	0.109e-2	-0.959e-2***	0.117e-2	-0.204e-2	0.354e-2
Number of children:						
Under 6	8.422***	0.852	9.259***	0.960	5.037***	1.739
Age 6-13	16.082***	0.678	16.579***	0.754	14.631***	1.566
M age 14-18	24.407***	1.404	25.386***	1.544	21.239***	3.279
F Age 14-18	19.169***	1.438	18.893***	1.580	22.067***	3.378
Number of the older adults:						
M-older	6.907***	2.406	7.287***	2.537	2.386	7.910
F-older	4.981**	2.357	4.677***	2.483	5.831	7.916
Number of working-age adults:						
M-w 19-64	18.803***	0.923	19.171***	1.009	15.487***	2.197
M-nw 19-64	10.165***	2.228	12.800***	2.620	3.415	4.002
F-w 19-64	8.456***	0.832	8.256***	0.899	9.306***	2.235
F-nw 19-64	7.083***	2.603	8.190***	3.129	5.667	4.537
Food CPI	0.217e-2	0.102	-0.046	0.109	0.216	0.289
Non-Food CPI	-0.235	0.182	0.062	0.196	-0.390	0.502
Income	0.030***	0.143e-2	0.028***	0.149e-2	0.037***	0.552e-2
Adjusted R-square	0.256		0.258		0.242	
N	30,280		26,978		3,302	

Note: ***significant at 1% level; **at 5% level; * at 10% level.

Table 3.4 Elasticities of food expenditure for some of the continuous variables in the food expenditure equation

	Total		Food Secure households		Food insecure households	
	Point estimate	Std Error	Point estimate	Std Error	Point estimate	Std Error
Age	0.228***	0.059	0.275***	0.064	-0.109	0.172
Non-food CPI	-0.032	0.249	0.083	0.264	-0.611	0.787
Food CPI	0.368e-2	0.173	-0.077	0.182	0.417	0.558
Income	0.167***	7.888e-3	0.161***	0.847e-2	0.146***	0.021

Note: ***significant at 1% level; **at 5% level; * at 10% level.

Table 3.5 Maximum likelihood estimation of the IHS double-hurdle model for FAFH (Whole Sample)

	Participation		Consumption		Heteroskedasticity	
	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error
Constant	0.056*	0.035	0.244***	0.012	-1.971***	0.029
Education	0.367***	0.017	0.022***	2.605e-3		
Metro	0.092***	0.018	0.019***	2.643e-3		
Northeast	-0.384***	0.024	-0.014***	3.691e-3		
West	-0.152***	0.024	-0.010***	3.212e-3		
South	-0.113***	0.022	4.845e-3*	2.887e-3		
White	0.328***	0.023	8.947e-3**	3.680e-3		
Hispanic	-0.448***	0.029	-0.011**	4.680e-3		
Married	0.074***	0.019	0.041***	3.080e-3		
FSP Participation	-0.435***	0.032	-0.059***	6.908e-3		
Age			-2.111e-3***	4.363e-4		
Age Square			6.41e-6	4.539e-6		
Number of children:						
Under 6	-0.013	0.015	0.028***	2.472e-3	0.033***	8.973e-3
Age 6-13	0.059***	0.012	0.040***	2.181e-3	0.018***	7.348e-3
Age 14-18:					0.019**	0.010
M age 14-18	0.076***	0.025	0.051***	3.743e-3		
F age 14-18	0.066***	0.026	0.056***	3.894e-3		
Number of the older adults:					0.060***	8.676e-3
M-older	-0.145**	0.059	0.024***	9.238e-3		
F-older	-0.059	0.059	0.023***	9.040e-3		
Number of working-age adults:					0.090***	0.019
M-w 19-64	0.163***	0.017	0.065***	3.357e-3		
M-nw 19-64	-0.145***	0.049	0.032***	7.506e-3		
F-w 19-64	0.247***	0.017	0.043***	2.767e-3		
F-nw 19-64	0.020	0.054	0.018***	8.614e-3		
Log(ACPI-HCPI)			-0.024	0.021		
Log(EXP/Stone's price Index)			-0.071***	3.003e-3		
ρ	0.232***	0.032				
θ	3.605***	0.147				
N	30,280					
Log-likelihood	-470655.00					

Note: ***significant at 1% level; **at 5% level; * at 10% level.

Table 3.6 Maximum likelihood estimation of the IHS double-hurdle model for FAFH (food secure sample)

	Participation		Consumption		Heteroskedasticity	
	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error
Constant	0.081**	0.038	0.245***	0.022	-1.937***	0.046
Education	0.366***	0.018	0.024***	5.646e-3		
Metro	0.099***	0.019	0.019***	3.271e-3		
Northeast	-0.389***	0.025	-0.017***	6.564e-3		
West	-0.151***	0.025	-0.012***	4.015e-3		
South	-0.094***	0.023	5.765e-03*	3.471e-3		
White	0.337***	0.025	9.539e-03*	5.868e-3		
Hispanic	-0.394***	0.032	-9.953E-03	7.635e-3		
Married	0.088***	0.020	0.045***	3.559e-3		
FSP Participation	-0.406***	0.042	-0.064***	0.010		
Age			-0.183e-2***	4.598e-4		
Age Square			2.667E-06	4.83174e-6		
Number of children:						
Under 6	-0.021	0.016	0.030***	2.758e-3	0.034***	9.426e-3
Age 6-13	0.058***	0.013	0.044***	2.603e-3	0.015***	6.761e-3
Age 14-18:					0.029***	0.010
M age 14-18	0.075***	0.027	0.056***	4.262e-3		
F age 14-18	0.046***	0.027	0.061***	4.419e-3		
Number of the older adults:					0.071***	8.640e-2
M-older	-0.146***	0.058	0.029***	9.481e-3		
F-older	-0.070	0.058	0.021**	9.096e-3		
Number of the working-age adults:					0.114***	0.020
M-w 19-64	0.143***	0.017	0.069***	3.940e-3		
M-nw 19-64	-0.098*	0.055	0.035***	0.010		
F-w 19-64	0.231***	0.017	0.044***	4.089e-3		
F-nw 19-64	0.107*	0.062	0.015***	9.194e-3		
Log(ACPI-HCPI)			-0.022	0.023		
Log(EXP/Stone's price Index)			-0.070***	3.010e-3		
ρ	0.273*	0.162				
θ	3.358***	0.141				
N	26,978					
Log-likelihood	25661.50					

Note: ***significant at 1% level; **at 5% level; * at 10% level.

Table 3.7 Maximum likelihood estimation of the IHS double-hurdle model for FAFH (food insecure sample)

	Participation		Consumption	
	Coefficient	Std Error	Coefficient	Std Error
Constant	0.030	0.095	0.240***	0.029
Education	0.276***	0.051	-1.091e-02	5.275e-3
Metro	0.231***	0.055	0.015***	5.552e-3
Northeast	-0.336***	0.077	0.010	8.007e-3
West	-0.102	0.070	2.471E-03	6.109e-3
South	-0.214***	0.067	4.18E-03	6.137e-3
White	0.155***	0.057	-3.81E-03	5.515e-3
Hispanic	-0.534***	0.068	0.0121	9.112e-3
Married	-0.128**	0.057	0.010*	5.617e-3
FSP Participation	-0.315***	0.056	-0.016**	7.486e-3
Age			-3.472e-02***	1.005e-3
Age Square			2.926e-05***	1.110e-5
Number of Children:				
Under 6	0.053	0.035	0.011***	3.678e-3
Age 6-13	0.081***	0.027	0.015***	3.758e-3
Age 14-18:				
M age 14-18	0.115**	0.058	0.020***	6.290e-3
F age 14-18	0.169***	0.065	0.018***	6.290e-3
Number of the older adults:				
M-older	-0.277	0.184	-9.845E-03	0.016
F-older	-0.133	0.181	0.031***	0.016
Number of working-age adults:				
M-w 19-64	0.266***	0.043	0.027***	7.019e-3
M-nw 19-64	-0.232**	0.105	0.021*	0.012
F-w 19-64	0.322***	0.043	0.025***	7.276e-3
f-nw 19-64	-0.120	0.097	0.031*	0.012
Log(ACPI-HCPI)			-5.778E-02	0.039
Log(EXP/Stone's price Index)			-0.060***	0.011
Std Deviation	0.088***	0.015		
ρ	-0.381*	0.214		
θ	7.569***	1.389		
N	3,302			
Log-likelihood	-3007.98			

Note: ***significant at 1% level; **at 5% level; * at 10% level.

Table 3.8 Elasticities of probability for FAFH with respect to continuous variables

	Whole Sample		Food Secure households		Food Insecure households	
	Point estimate	Std Error	Point estimate	Std Error	Point estimate	Std Error
Number of Children:						
Under 6	0.637e-2	0.018	0.514e-2	0.165	0.027	0.841
Age 6-13	0.027***	0.227e-2	0.025***	0.208e-2	0.056***	0.010
M age 14-18	0.010***	0.123e-2	0.966e-2***	0.113e-2	0.022***	0.576e-2
F age 14-18	0.010***	0.122e-2	0.899e-2***	0.113e-2	0.022***	0.532e-2
Number of the older adults:						
M-older	-0.011**	0.600e-2	-0.933e-2**	0.491e-2	-0.044	0.026
F-older	0.336e-2	0.011	0.529e-3	0.011	0.569e-2	0.025
Number of working-age adults:						
M-w 19-64	0.085***	0.469e-2	0.079***	0.456e-2	0.116***	0.013
M-nw 19-64	-0.354e-3	0.574e-3	0.124e-03	0.500e-3	-0.348e-2	0.366e-2
F-w 19-64	0.082***	0.381e-2	0.074***	0.361e-2	0.137***	0.013
F-nw 19-64	0.716e-3	0.525e-3	0.106e-2***	0.449e-3	0.190e-2	0.379e-2
AGE	-0.097***	0.010	-0.094***	0.935e-2	-0.148***	0.045
HCPI	0.047	0.029	0.040	0.029	0.043	0.112
ACPI	-0.028	0.028	-0.023	0.029	-0.900e-2	0.116
EXP	0.904***	0.774e-2	0.914***	0.679e-2	0.785***	0.057

Note: ***significant at 1% level; **at 5% level; * at 10% level.

Table 3.9 Marginal effects of probability for FAFH with respect to the discrete variables

	Whole Sample		Food Secure Households		Food Insecure Households	
	Point estimate	Std Error	Point estimate	Std Error	Point estimate	Std Error
Education	0.118***	0.530e-02	0.114***	0.548e-02	0.125***	0.021
Metro	0.061***	0.659e-02	0.066***	0.686e-02	0.043**	0.022
Northeast	-0.138***	0.896e-02	-0.137***	0.310e-02	-0.134***	0.030
West	-0.053***	0.840e-02	-0.052***	0.878e-02	-0.040	0.028
South	-0.039***	0.767e-02	-0.031***	0.793e-02	-0.085***	0.027
White	0.118***	0.842e-02	0.119***	0.918e-02	0.062***	0.023
Hispanic	-0.165***	0.011	-0.142***	0.012	-0.210***	0.026
Married	0.026***	0.642e-02	0.031***	0.669e-02	-0.051**	0.023
FSP Participation	-0.152***	0.012	-0.144***	0.016	-0.091***	0.016

Note: ***significant at 1% level; **at 5% level; * at 10% level.

Table 3.10 Elasticities of conditional consumption for FAFH with respect to continuous variables

	Whole Sample		Food Security		Food Insecurity	
Variable	Point estimate	Std Error	Point estimate	Std Error	Point estimate	Std Error
Number of Children:						
Under 6	0.066***	0.562e-2	0.063***	0.541e-2	0.026***	0.010
Age 6-13	0.119***	0.695e-2	0.115***	0.673e-2	0.053***	0.016
M age 14-18	0.043***	0.327e-2	0.043***	0.322e-2	0.020***	0.648e-2
F age 14-18	0.045***	0.326e-2	0.046***	0.331e-2	0.017***	0.598e-2
Number of the older adults:						
M-older	0.149***	0.030	0.182***	0.033	-0.020	0.020
F-older	0.141***	0.029	0.150***	0.032	0.034*	0.021
Number of working-age adults:						
M-w 19-64	0.316***	0.013	0.329***	0.013	0.085***	0.023
M-nw 19-64	0.885e-2***	0.154e-2	0.794e-2***	0.149e-2	0.455e-2	0.335e-2
F-w 19-64	0.202***	0.011	0.200***	0.011	0.089***	0.025
F-nw 19-64	0.513e-2***	0.131e-2	0.378e-2***	0.121e-2	0.010***	0.406e-2
Age	-0.549***	0.042	-0.561***	0.045	-0.241***	0.075
HCPI	0.265*	0.155	0.234	0.163	0.088	0.220
ACPI	-0.159	0.156	-0.134	0.164	-0.019	0.224
EXP	0.460***	0.010	0.494***	0.011	0.649***	0.123

Note: ***significant at 1% level; **at 5% level; * at 10% level.

Table 3.11 Elasticities of unconditional mean for FAFH with respect to continuous variables

	Whole Sample		Food secure households		Food insecure households	
Variable	Point estimate	Std Error	Point estimate	Std Error	Point estimate	Std Error
Number of Children:						
Under 6	0.073***	7.452E-03	0.068***	7.218E-03	0.054***	1.871E-02
Age 6-13	0.146***	9.229E-03	0.140***	8.999E-03	0.110***	2.613E-02
M age 14-18	0.053***	4.504E-03	0.053***	4.459E-03	0.042***	1.236E-02
F age 14-18	0.055***	4.488E-03	0.055***	4.550E-03	0.038***	1.134E-02
Number of the older adults:						
M-older	0.163***	3.473E-02	0.197***	3.808E-02	-0.064	0.046
F-older	0.154***	3.401E-02	0.161***	3.723E-02	0.040	0.047
Number of working-age adults:						
M-w 19-64	0.401***	1.770E-02	0.408***	1.843E-02	0.201***	0.036
M-nw 19-64	0.847e-2***	2.119E-03	0.804e-2***	2.031E-03	0.107e-2	0.701E-02
F-w 19-64	0.284***	1.497E-02	0.274***	1.534E-02	0.226***	0.038
F-nw 19-64	0.566e-2***	1.539E-03	0.411e-2***	1.411E-03	0.012***	0.785E-02
Age	-0.645***	0.052	-0.654***	0.055	-0.389***	0.120
HCPI	0.311	0.183	0.273	0.192	0.141	0.360
ACPI	-0.186	0.184	-0.121	0.136	-0.389	0.120
EXP	1.366***	0.054	1.409***	0.084	1.434***	0.174

Note: ***significant at 1% level; **at 5% level; * at 10% level.

4. FAMILY INVESTMENT PROGRM PARTICIPATION

Introduction

Although federal welfare reform legislation (the Personal Responsibility and Work Opportunity Reconciliation Act—PRWORA) was passed in August 1996, 43 states experimented with welfare reform under waivers from Aid to Families with Dependent Children (AFDC) and Food Stamp Program rules between 1993 and 1996. Iowa was one of these earliest welfare reform states. On October 1, 1993, Iowa implemented the Family Investment Program (FIP) and a slightly revised Food Stamp Program (FSP) in 90 of the 99 counties in the state. In the remaining nine counties, both pre-reform and reform programs operated concurrently. Iowa joined Oregon as one of the first two states to launch major changes in its social assistance programs (Prindle et al., 1999). The goals of FIP were to help the recipients experience significant financial benefits from employment; to move toward self-sufficiency while discouraging behavior that increases dependence (that is, shift responsibility for the long-term well-being of low-income families from the state to the parents in those families); and to foster the formation and maintenance of two-parent families (Gordon and Martin, 1999).

In 1995, Iowa launched a project to develop a linked administrative data system in order to evaluate the effects of FIP and other social assistance reforms. Because of greater attention to program participation and usage, there has been increased interest in the use of administrative data for social science research. Two recent evaluations note the strengths of administrative databases: the data are relatively inexpensive, and the databases are generally longitudinal and can be linked with other administrative data sets to create a comprehensive representation of program use and client outcomes (Hotz et al., 1998; UC DATA, 1999).

We used Iowa administrative data to analyze the relationship between FIP and employment. These data were linked for all FIP recipients in April 1993. The data set includes detailed information on child support collections, FIP participation, quarterly wage earnings, household variables, and demographic variables. Because the administrative records did not require reporting on education when the individuals applied for FIP, about 50 percent of the observations are missing data on education. However, education is a major indicator of personal skills and hence the relationship between welfare reform and employment. Therefore, a major challenge of the study was to address the issue of nonresponse, or missing data.

There are several ways to deal with the missing data problem. Little and Rubin (1987) discuss several traditional approaches for incomplete data analysis. These approaches include using only complete cases, using available cases, and imputing missing values. However, the first two methods result in a loss of statistical power because partially complete cases typically are discarded from the analysis. Rubin (1987) advocates the use of multiple imputations, the method used by Keng, Garasky, and Jensen (2000). We used an alternative approach—fractional imputation as described in Kim (2000)—to compensate for missing educational attainment. The approach is at least as powerful as Rubin's multiple imputation method (see Kim, 2000; and Pan, Fuller, and Jensen, 2001 for more details).

Our study examined factors that affect the possibility of working and the potential wage for FIP recipients in order to better understand program and labor force participation for low-income households, including differences in rural and non-rural location. The paper is organized as follows: First, we discuss the data and outline the distribution of the education variable available in the data set. Then, we describe briefly the procedure of fractional imputation and jackknife variance estimation. Next, we give the demographic characteristics of the reference persons, followed by a discussion of the estimation procedures and a presentation of the numerical results. The final section includes a brief conclusion.

Data

The FIP data are structured as a two-year quarterly panel, beginning with October 1993, the start of the FIP program, and ending in September 1995 (Keng, Garasky, and Jensen, 2000). Most data are from the linked administrative record data for cases active in April 1993. Additional variables provide information on the economic and social conditions in the local geographic area. These variables include the poverty population as a fraction of the total population in the county, and the working age population (between ages 18 and 64) as a fraction of the total population, employment ratio, and its increase. The total number of observations used in the empirical analysis is 32,783.

Iowa can be classified into 10 metropolitan counties (Beale codes 0-3), 9 urban nonmetro (large city urban) counties (Beale codes 4 and 5), 35 "rural" adjacent counties (adjacent to a metro area, rural and small-city urban counties, Beale codes 6 and 8), and 45 "rural" nonadjacent counties (non-adjacent small-city urban and rural counties, Beale codes 7 and 9) (Butler and Beale, 1994). Metropolitan counties are referred to as the "metro" area. The "urban" areas are urban nonmetro counties that have a city with at least 20,000 in population. The "rural" area includes small cities (less than 20,000 in population), rural adjacent counties, and rural non-adjacent counties. In some of the analysis, we combine the metro and urban areas and refer to them as "non-rural."

The education variables presented a challenge. For the 32,783 cases, each with eight quarters of data, there are 23 different patterns of reported educational attainment across the eight quarters. Of the total cases, 16,010 (48.80% of the total) cases have educational attainment information in all eight quarters; 14,674 observations do not have any education information. These two groups account for 93.60% of the sample. Another 2,099 (6.40%) cases provide educational attainment in some quarters. The imputation base is chosen from

the 16,010 complete-data observations. For example, there are 110 observations without education information in the first year but with at least a high school degree in the second year. The number of individuals from the complete-data set with at least a high school degree in the second year is 10,652 observations. Therefore, these 10,652 observations are chosen as the imputation base for the pattern observed for the 110 observations with no education information in the first year.

The rate of reporting educational attainment ranges between 52.89% and 54.48% in the total cases for the eight quarters. Cases reporting at least a high school degree increased from 31.21% to 35.20% of the total sample. For the 16,010 cases with complete data, the share with at least a high school degree increased from 63.90% to 66.98%. Of the complete cases (n=16,010), 63.90% (10,230) had at least a high school degree in October 1993, the beginning of the period, and 33.02% (5,286) cases did not have a high school degree at the end of the two years. Thus, 96.92% of the individuals did not change education category during the two-year period. There are twice as many individuals with a high school degree as those without one in the group that did not change. A total of 363 (2.27%) and 131 (0.82%) cases attained a high school degree in the first and second year, respectively.

Fractional imputation and jackknife variance estimation

To impute the educational attainment, we used the fractional imputation method described in Kim (2000). We assumed that educational attainment is related to gender, race, marital status, an indicator for a metro county, the number of children in the household, quarterly wage income, total number of months on FIP, the amount of child support received, the county unemployment rate, and county income per capita. For some variables, such as marital status and quarterly wage income, the value varies by quarter. We calculated the different parameters using the appropriate quarter's value.

We calculated the predicted values for educational attainment based on the models for both respondents and non-respondents. We used the model based on quarter 1 data to compute the probability of a high school degree for patterns with missing data in quarter 1; the model based on quarter 2 to compute the probability of high school degree for additional missing data in quarter 2, etc.

The respondents were ordered on the probability of educational attainment in a specific quarter computed from the estimated model. Then the respondents were divided into groups of size 10. We call these groups "cells." The boundary between the groups is the probability value midway between the largest probability value in one group and the smallest probability value in the next group.

The non-respondents are assigned to cells based on their model-estimated probability values. Every non-respondent with a probability value that falls within the boundary of a cell is assigned to that cell. A set of the 10 respondent educational attainments is given ("donated") to each non-respondent in the cell. The educational attainment is imputed for each of the quarters for which data are missing. Each of the ten imputed vectors is given a weight equal to the original weight divided by ten. Given that one is the original weight in this data set, we assign 0.1 as the weight for the imputed data. By using fractional imputation, the educational values imputed for the non-respondents contain the actual education of the respondents in the cell (and hence presume the distribution of these data). The method has the benefit of multiple imputation as well as having smaller variation than the Rubin (1987) method.

The sample number of observations for each quarter with at least a high school degree after imputation for the whole data set, Y, is

$$Y = \sum_{i=1}^{n} \sum_{j \in \vartheta_i} y_{ij}^{\bullet} w_{ij}, \tag{4.1}$$

where

ϑ_i is the set of donors for individual i. If i is a respondent then $\vartheta_i = i$; if i is a non-respondents then ϑ_i contains ten donors;

w_{ij} is the imputed weight of donor j for individual i. If i is a nonrespondent, then there are ten donors and $w_{ij}=0.1$ for each of the j; if i is a respondent, then $w_{ii}=1$;

y_{ij}^{*} is the imputed value from donor j to recipient i. If i is a respondent then $y_{ij}^{*} = y_{ii}^{*} = y_i^{*}$ is the original observation;

n is the total number of individuals in the sample, which equals 32,783 for the total sample.

The imputed sample mean of educational attainment is

$$\hat{\bar{y}} = \frac{Y}{\sum_{i=1}^{n} w_i} = \left(\sum_{i=1}^{n} \sum_{j \in \vartheta_i} w_{ij} \right)^{-1} y_{ij}^{*} \tag{4.2}$$

We treat the whole data set as a simple random sample. The variances of the survey statistics are calculated using jackknife variance estimation based on replicate weights (Westat, 1998). The jackknife variance estimator of a statistic H is

$$\hat{\text{var}}(H) = \frac{G-1}{G} \sum_{k} (H(k) - H)(H(k) - H)'. \tag{4.3}$$

where G is the number of replicate weights. G=100 in our case (see Pan, Fuller, and Jensen, 2000 for details) and $H(k)$ is the k-th replicate estimate of H, k=1,2,...,G.

Note the Jackknife method we used has a 10% error in the imputation component of the variance estimator. This is because there are ten respondents in each cell, but the total number of replicates is 100. There is a $(G-1)G^{-1}$ adjustment in the Jackknife computations. The 10% bias comes from the difference between 0.9 and 0.99. An adjusted standard error of

imputed educational achievement is calculated as the standard error multiplied by the square root of 0.9 (0.948).

Descriptive analysis and results from the imputation

Table 4.1 gives the mean and standard error of education for quarters 1 and 8 for our imputed data set. The mean and variance are calculated by the equations (4.2) and (4.3), respectively. As shown in the table, the estimated share with education of at least a high school degree is 62.14% in October 1993 (Q1) and 65.12% in September 1995 (Q8). Compared to data for the complete data set, there are 1.76 percentage points more in the first quarter and 1.86 percentage points fewer in the last quarter with at least a high school degree. There are 3.08% for the complete data set and 2.98% for the whole data set (including both complete data and missing data with imputed educational achievement) who earned at least a high school degree at some time in the two-year period.

The full data set including imputed values was used for the subsequent analysis and estimation. As shown in Table 4.1, for all cases (n=32,783), 62.14% of case heads have some high school education (the high-skilled group) in the first quarter and 65.12% of case heads have some high school education at the end of the two-year period. Following Hoynes's (1999) definition, low-skilled workers are defined as case heads without a high school degree, and high-skilled workers are defined as case heads with at least a high school degree. The higher-skilled group (those with high school education) has an almost 6% larger share of whites; the higher-skilled group also has a 1.58% larger share of disabled cases. In addition, the higher-skilled group has more married cases, and more cases with one or two children.

As shown in Table 4.1, in total, nearly 95% of the cases were outside of a rural area in October 1993: 53.06% of the cases were in metro areas and 41.95% were in urban areas in October 1993. The quarterly wage income and child support were the two major sources of

income for the cases in the data set, in addition to FIP. There were 51.11% cases that received child support in quarter 1 (100%-46.89%) and 49.41% received the child support in quarter 8. The average amount of quarterly child support received for a family with child support was $727.16 in the first year and $1,246.28 in the second year.

Although most of cases did not earn very high wage income in the whole sample, the share of cases without wage income fell from 45.13% in the first quarter to 30.49% in the last quarter. The share with both child support and wage income in the two years was 36.61% and 37.15%, respectively. Some economic patterns emerged across time periods: during the second quarter (January to March) of each year the unemployment rate is the highest and the share without wage income in that quarter is also the highest.

The average time cases stayed in the FIP and Food Stamp Program during the two-year period was about 17 months. Nearly 45% of FIP cases and 42% of food stamp cases left the programs some time during the two-year period. The low-skilled group stayed in the programs a little longer than did the high-skilled group.

Table 4.2 gives more detailed information about the cases with children. The sample number of observations is calculated according to formula (4.1). The table shows the working participation rates for the low-skilled and high-skilled cases with children. There exist significant differences between the two skilled groups for the single females. For the single females, cases in the high-skilled group have higher labor force participation rates. Although the differences between the high-skilled and the low-skilled married groups are small, there are differences between single females and married females. Married females with children have higher working participation rates than do single females with children. The differences in labor participation rate for men in the four groups are not statistically different from each other. The participation rates for the females are higher than those for males except for the single low-skilled group.

As Jensen, Keng, and Garasky (2000) mentioned, all nonmetro areas (urban, rural-adjacent, and rural non-adjacent) had higher rates of unemployment compared to the metro areas, and the urban areas had the highest unemployment rates. They also showed that wage income percentages, average wage income, child support percentages, child support levels, and FIP or FSP participation were all higher in rural areas.

Mobility is defined as location change from one county to another county, whether the destination is rural, urban, or metro area. According to the data, there are 2,075 and 1,855 reference persons moving at least once in the first year and in the second year, respectively. Table 4.3 shows the mean of the demographic variables according to three mobility patterns. As illustrated in the table, the proportion of working for the case heads who move is lower than for the case heads who do not move; however, the average wage income is almost the same for both categories. These results indicate that case heads who move once actually have higher wage income if they get a job. However, the results also indicate that case heads who move more than once are not guaranteed a higher wage even if they get a job. Table 4.3 also illustrates that case heads who move more than once usually have lower educational achievement than do the other two patterns.

Economic Model

To serve as a basis for specifying an empirical model, we develop a simple model for labor force participation and FIP participation. Low-income households choose whether to participate in FIP or not and they simultaneously decide whether to move and participate in the labor force. To model the decision, we assume all cases are risk-averse and the utility function can be assumed as follows:

$$U(L, C, \phi P, \gamma M) \tag{4.4}$$

where L is leisure time, C is consumption goods, P is an indicator equal to 1 if the household participates in FIP and 0 if not, and ϕ is the marginal disutility of FIP participation. The disutility comes from transaction costs associated with a family filing an application, going for interviews, reduced expected future benefits due to a lifetime time limit imposed in FIP, and disutility of dealing with welfare bureaucracies and the application procedure (Moffitt, 1983). M is an indicator equal to 1 if the reference person moves and 0 if not; γ includes both disutility from mobility such as foregone earnings, the "psychic" costs of changing one's environment, and utility gains from moving such as returns from the earning differentials between places, increased efficiency in consumption, and place preference. As usual, we assume the marginal utility of leisure time and consumption is positive. However, the signs for marginal utility of program participation and migration are not clear. Case heads may leave FIP even if they are eligible for the program if the disutility from participation is higher than utility gain. They also prefer stay to move if the disutility from migration is large.

The time and income budget constraints for a family are given as follows:

$$\begin{aligned} &L + H = \overline{L} \\ &C \le (w + M\kappa)H + N + P(B - X) - MS \end{aligned} \tag{4.5}$$

where H is the working time and $\overline{L}$ is the total available time; w is the wage rate; κ is the change (increase) in wage because of mobility; N is the nonlabor income; X is the cost associated with FIP program participation; S is the money cost of mobility, which includes increases in expenditure for food, lodging, transportation, and costs of driving (In actual practice, the cost of mobility may be quite different from one case to another due to the personal skills and location); and B is the benefit from the FIP participation.

The family chooses H, P,M to maximize utility (4.4) subject to the constraints (4.5). Because our data only includes cases eligible for the FIP (specifically, those both eligible and who participated in October 1993), the family faces the following set of alternatives at some time during the year:

(1)not employed, moving or not moving, in the FIP,

(2)employed, moving or not moving, in the FIP,

(3)not employed, moving or not moving, not in the FIP,

(4)employed, moving or not moving, not in the FIP.

Let V_1, V_2, V_3, V_4 are the indirect utility functions associated with the alternatives (1), (2), (3) and (4). The value of receiving FIP in the model is

$$V(P=1) = \max\{V_1(N,B,\phi,X,S,\kappa,\gamma,M), V_2(N,B,w,H,X,S,\phi,\kappa,\gamma,M)\} \tag{4.6}$$

The value of not receiving FIP is

$$V(P=0) = \max\{V_3(N,S,\kappa,\gamma,M), V_4(N,w,H,S,\kappa,\gamma,M)\}. \tag{4.7}$$

The probability of employment is

$$\begin{aligned}\Pr(H>0) = {} & \Pr\{V_2(N,B,w,H,X,\phi S,\kappa,\gamma,M) > V_1(N,B,X,\phi,\kappa,\gamma,M)\} \\ & + \Pr\{V_4(N,w,H,S,\kappa,\gamma,M) > V_3(N,S,\kappa,\gamma,M)\}\end{aligned} \tag{4.8}$$

The probability of FIP exit is

$$\begin{aligned}\Pr(P=0) = {} & \Pr\{V_1(N,B,\phi,X,S,\kappa,\gamma,M) < V_3(N,S,\kappa,\gamma,M)\} \\ & + \Pr\{V_2(N,w,H,S,\kappa,\gamma,M) < V_4(N,w,H,S,\kappa,\gamma,M)\}\end{aligned} \tag{4.9}$$

Empirical Specification

Variable Definition

Definitions and sample mean values of the variables used in the empirical analysis are presented in Table 4.4. More details are presented below on the derivation of selected variables.

We derived several local labor market conditions and all individuals who have the same county of residence are assigned the same local labor market variables. The county-level social-economic characteristics include the following variables:

(1) Expected and unexpected unemployment rates (*PU* and *DU*). Following Tokle and Huffman (1991), we derived both predicted and unpredicted unemployment rates to measure the local labor market situation, based on the following model:

$$E(U_t)=0.585 -0.059*time+0.397*U_{t-1}+0.03*U_{t-2}+0.401*U_{t-3} \quad (4.10)$$

$$(0.012)\ (0.296e\text{-}2)\ \ (0.372e\text{-}2)\ \ (0.343e\text{-}2)\ \ (0.224e\text{-}2)$$

where time refers to a time trend, which is equal to 1 if the maximum wage quarter is the first quarter, 2 if it is the second quarter, 3 if it is the third quarter. U_i is the relative unemployment rate at quarter t. The equation was fit with OLS as the Durbin h test showed no evidence of autocorrelation (Johnston, 1984 p. 318). The unpredicted unemployment rate is derived from the difference between actual unemployment rate at time t and the expected unemployment rate $E(U_t)$.

(2) The change in the share of the county's employment in the service sector (DSER). This variable indicates changes in the occupational mix of local labor demand. It is defined as the share in t minus share in time t-1. The service category includes employment in transportation, finance, insurance and real estate, government, service, and wholesale and retail trade.

(3) Recent job growth in the county (EMPLL). This is measured by logarithm of the ratio of share of employment with total labor force in year t with that in year $t-1$ in the county.

(4) County poverty level (POVER). The indication is measured by the share of population under the poverty line in the county.

Econometric Specification

As discussed above, the utility of a particular choice depends on the consumption that is available if that choice is made. Wage and child support are two of the major sources of income in the model. To operationalize the indirect utility function V_1, V_2, V_3, V_4, let $W_j=wH$ be wage income and N_j be non-wage income (excluding the program benefit. Because of the limited data availability, we use child support as a representative of the non-wage income in the analysis. Child support is major nonwage income for the population who have been on the FIP program) at choice j, we assume indirect utility of case i facing one of the four regimes j have the linear form

$$V_{ij} = \alpha_w W_j + \alpha_c N_j + \beta_p P + \beta_m M + e_{ij}. \quad (4.11)$$

Migration within states is one method by which households can take advantage of different employment (economic) opportunities. Case-heads will only choose migration if they differ in impact across the two areas. The effect of the local economic situation (A_1), such as predicted and unpredicted unemployment rate, and income per capita are some reasons that lead to migration. We expect cases to move from low-income to high-income counties and from higher unemployment rate areas to lower unemployment rate areas so that they can find a job, earn more wage income and finally leave the FIP. Other demographic variables (B_1), such as case head's gender, race, marriage status at time t, educational

achievement at time *t*, indicator of children younger than six are some of the migration control variables, which affect case head's disutility and utility gained from migration. Given these specifications, the predicted probability of mobility *(PSTAT)* is assumed to be of the form

$$PSTAT=f(A_I, B_I)^2. \tag{4.12}$$

A case head participates in work when his or her reservation wage is less than the anticipated market wage. A change in variables that raises the market wage will increase the probability of work, and variables that increase the reservation wage will decrease the probability of work. For example, Tokle and Huffman (1991) found a strong positive effect of an individual's schooling on the probability of work for married farm and nonfarm males and females. However, as they mentioned, the effects of local labor market conditions depend partially upon expectations. The net effects of anticipated unemployment on the probability of wage work depends on change in the individual reservation wage or market wage. If expected wage decreases as the unemployment rate increases, the case head will

[2]The logistic estimation of migration is shown in the following equation:

E(PSTAT)=-10.322 -11.456Rural+0.405Income per Capita –0.551Rural×Income per
(1.028) (1.077) (0.045) (0.047)
Capita-0.439Predicted Unemp. Rate-0.642Pred. Unemp. Rate×Rural +0.126Unpred.
(0.077) (0.088) 0.094)
Unemp. Rate-0.572Unpred Unemp. Rate×Rural-0.065Age+2.672e-4Age^2 -
(0.141) (0.014) (2.32e-4)
0.017Education+0.801White-0.405Male+0.134Married+ 0.438White×Male
(0.041) (0.104) (0.402) (0.060) (0.401)
+0.066Households with child under 6.
(0.054)

The predicted results show that households are more likely to move into nonrural, high income per capita, low predicted unemployment rate counties. The results also show that those with reference persons who are younger, who do not have a high school degree, who are white, who are female, who are married, who have a younger child are more likely to move.

choose more leisure time and thus increase the reservation wage; on the other hand, firms that have higher expected unemployment rates will pay higher wage rates if unemployment hurts workers rather than firms.

The probability of working is assumed to depend on the local economic situations (A_2), such as PU, DU, DSER, EMPLL and demographic variables (B_2), such as case-heads' education, white, disability, number of children, marriage status. Working might be expected to be more difficult if the case-head is single, non-white, and disabled. Children, especially younger children, make working more costly because of child-care and job responsibilities. The inclusion of number of children in our labor supply model is motivated by the empirical findings that the number and age distribution of children have a significant effect on welfare recipients' labor supply behavior. As Kim, Orazem and Otto (2001) note, education should be positively related to the ease of obtaining information on job openings across labor markets. The assumed functional form for the probability of working, is the logistic model with Jackknife variance estimation, and is specified as

$$Pr(H>0)=f(A_2,B_2,PSTAT). \tag{4.13}$$

The potential wage one can earn is measured by the predicted maximum wage, or max-wage. We choose the max-wage as a measure of labor market opportunities because labor force and FIP participation are jointly determined. The max-wage is computed for the year using the quarterly wages for the individual. The quarter in which max-wage occurs is called *the max-wage quarter*. For those who did not work when we collected the data, we chose quarter three (April-June) as a representative quarter because this quarter is the one where most of the max-wage cases occurred (40.11% in quarter three and 36.03% in quarter four).

The max-wage quarter indicator is used to choose the independent and dependent variables for the model. The predicted potential wage also depends on local economic variables (A_3), which include location (METUR), EMPLL, PU, DU, DSER, individual demographic variables (B_3) such as case head age, gender, race, education, and the Inverse Mills Ratio (C_1) which captures the data selection effects (Green, 1997). The local economic variables are used to represent local labor market conditions. The unemployment rate, current job growth rate influences bargaining power in wage negotiations. Age, gender, disability, education, and other demographic variables represent the individual working experience and personal skills. Because the data contain wages of only those case heads who choose to work, Heckman's (1979) two-stage method is employed to correct for the resulting selection bias. The wage equation conditional on working can be estimated according to the following equation:

$$Log(W_j|H>0)=\gamma_0+\gamma_1 A_3+\gamma_2 B_3+ \gamma_3 C_1. \tag{4.14}$$

An exit is said to occur for the year when an FIP recipient leaves (or is out of) the program for at least two months consecutively in a year, which is defined as

$$P_1 = \begin{cases} 1 & \text{if household leaves FIP during the year} \\ 0 & \text{otherwise} \end{cases} \tag{4.15}$$

Selective variables are examined for their effects on the probability of exit. Local employment opportunity (A_4) such as predicted and unpredicted unemployment rate, local poverty measurement, current job growth rate, and individual variables (B_4) such as case heads' age (working experience), educational achievement, white, gender, mobility (*PSTAT*) will increase the possibility of working and also will increase wage income. The possibilities of working make households more eligible to stay in the FIP program. However, increases in

wage income make households less eligible for the program. The net effect of working on program exit status is, *a priori,* ambiguous. Wage income and non-wage income (exclude the program benefit) both make the households less likely to participate the program. However, because wage income is more related to program participation than non-wage income, we expect that wage income have larger effects on program participation. To solve the endogenous of wage and program participation, we used predicted potential wage instead of the real wage income in the exit equation. To estimate the effects of local economic situation and individual information on program exit status, which we use a logistic model with jackknife variance estimation, the following equation can be used to specify the model:

$$Pr(P_I=1)=f(A_4,B_4,\ W,N,\ PSTAT). \tag{4.16}$$

Empirical results

The estimated coefficients for the probability of working, potential wage, and being off FIP in the next quarter are reported in Table 4.5. The first stage (the first column in the Table) indicates the predicted coefficients on the case head's relative utility from selecting working versus not working option. Results that allow differential utility across the FIP whether exiting or staying are presented in the third column.

Probability of labor participation

We include several county variables in the model of probability of working. The location is statistically significant at the 1% level. The result indicates that people living in the non-rural areas (i.e., metro and urban areas) are more likely to have a job than those living in rural areas. Many observers have suggested that low unemployment rates in an expanding economy indicate that welfare recipients who are able and who want to work

should be able to find a job (Goetz et al. 1999), not surprisingly, our results show that in an expanding economy welfare recipients who are able and who want to work should be able to find a job. The effect of expected unemployment rate in the county is negative and statistically significant at the 1% level and unexpected unemployment rate is positive related to the probability of working. These results can be explained by the individuals' reservation wage and the relatively low unemployment rate in Iowa during this time period. The negative expected unemployment rate effect suggests that cases are relatively more likely to lose their jobs (or not find jobs) when the local labor force market becomes worse. The significant unexpected unemployment rate may be related with the lag effects for the unexpected local labor market changes. Also the positive and significant effect of an increase locally of the share of service jobs implies that cases are more likely in the area to get service jobs. The result also implies that job training is needed to create the incentives for cases to invest in skills and change occupations. Although service jobs includes a wide range of skills from motel and restaurant staff to investment bankers, many of the jobs are low paying and low skill jobs.

Gender and race were evaluated for the four combinations (white and male, white and female, nonwhite and male, nonwhite and female). The results show that those who are male and those who are white are most likely to work; whites have the highest probability of working. Female nonwhite case heads is the group least likely to be working. For those who are disabled, it is more difficult (and not required under FIP regulation) to get a job. Our results show consistently that the probability of working is lower for disabled persons than for able-bodied persons.

Being married and having a larger number of children in the family both increase the probability of working. Parents with a larger number of children have more pressure to earn money so that they can support their family. However, the probability of working will decrease if the case heads have children younger than 6 years old. The results relate to the fact that childcare costs are relatively higher for children under age 6 and may exceed possible earnings.

For a long time, policymakers and economists have considered education a major factor in determining success in finding a job. Not surprisingly, the positive effects education show that the probabilities of working for low-skilled cases are lower than those for the high-skilled cases. At the same time, we expect mobility and change of location also to be associated with obtaining a job. The positive sign for the (predicted) probability of mobility (between counties) in the equation indeed shows that this is the case. The negative sign of the coefficient on the number of active months in FIP during the last two quarters indicates that these persistent welfare cases are less likely to get a job.

Potential wage prediction

We include several county-level variables in the model for predicted wage in order to capture the effects of the local economic environment. Both the predicted and unpredicted unemployment rate are negative and statistically significant at 1% level. Evaluated at sample mean, the point estimator of elasticities of predicted unemployment rate is –0.63 and unpredicted unemployment rate is –0.11 for nonrural areas. And the point estimators for rural areas are a bit larger: -0.78 for predicted employment rate and -0.16 for the unpredicted unemployment rate. The results imply that a 1% increase in a county's predicted unemployment rate was associated with a 0.63% decline in wage income in non-rural areas

and a 0.78% decrease in rural areas. A 1% increase in unpredicted employment rate would cause a 0.11% and 0.16% decrease in wage income in nonrural areas and rural areas, respectively. The results show that the predicted unemployment rate has a larger effect on wage income than that from the unexpected unemployment rate. At the same time, both predicted unemployment and predicted unemployment rates have larger effects on the wage income of rural households than those of nonrural households.

The effects of individual characteristic (gender and race) can be determined from the direct and indirect terms. Among individual characteristics, the results show that being white is positively related to higher potential wages. The results indicate that the potential wage for a white male (in the FIP population) is 158.33% that of a nonwhite male. Nonwhite females earn the lowest wage in the four groups. The results also show that males earn higher wages than females. The results are consistent with those of Waldfogel and Mayer (1999). In their study they evaluate gender differentials in employment, annual earnings, hours worked, and hourly wages.

Age is one of the significant variables in the wage model. The results show that potential wage increases as the age of the case heads approaches 62 years old and decrease after age 62. These results indicate that FIP recipients who remain employed before the age of 62 can indeed expect steady wage growth, a result expected as wages grow with job experience.

One of the objectives of welfare reform is to encourage financial independence and self-sufficiency for recipients. It is reasonable to assume that the participants will leave the program if they achieve these goals. The negative sign for the number of active months they

stayed in the program in the last six months shows that it is difficult to achieve these objectives: people with relatively more FIP support receive lower wages.

The statistical significance of the inverse Mill's ratio shows that the selection problem on labor market participation is important here. The results suggest that we need to consider the problem of selection when predicting the max-wage; otherwise the results are biased to the fact that we only observe those who work when we collect the data on wages.

Indicator variables for the max-wage quarter and year are all statistically significant. The results show that the potential wage is lower than other times if the max-wage quarter is between October and December. At the same time, the wage at the end of the two-year period was higher than that between October 1993 and September 1994 (the first year).

Probability of FIP exit

The county variables that are statistically significant in the equation predicted FIP exit are the expected and unexpected unemployment rate, the ratio of the population in poverty, and an interaction term between location (non-rural) and the county employment share of service industry. The effect of the county predicted unemployment rate in non-rural areas is negative and statistically significant at the 1% level in predicting being out of FIP during the year. The negative sign shows that individuals are more likely to stay in FIP in the counties with higher predicted (expected) unemployment rates than in other counties with lower unemployment rates. However, the effect of the unexpected unemployment rate on FIP exit is positive. Once again, it suggests that the unexpected unemployment rate increase has a lagged effect on program participation. The change in the county's share of employment in the service industry is also a significant variable in non-rural areas: cases are more likely to leave the program if the county has a relatively higher share of the increase in new service

industry job opportunities. The results also show that the possibility of staying in the FIP is higher in the poorer counties than that in relatively richer counties.

Not surprisingly, the positive sign for predicted max-wage shows that the higher the potential wage made by the case heads, the more likely the case head is to leave FIP. However, given the potential wage and other factors, education does not significantly affect the FIP status though it has the positive sign. The results showed that cases with male and white heads are more likely leave the FIP than cases with nonwhite and female heads. These results are considered with previous studies on welfare participation that find that higher wage income, being male, and being white are characteristics related to higher exit rates. For example, Brandon (1995) and Sandefur and Cook (1997) found that important determinants of recidivism (returning to welfare) include having fewer years of education, not being married, and having little job experience.

The effect of child support on the FIP status is a little different from that of wage income. The results show that there are significant differences between low-skilled and high-skilled groups related to child support, but there is no significant difference between rural and non-rural areas. A case head with a high school degree, higher child support, and living in a non-rural area is more likely to leave the FIP.

We expected that FIP participants would move to obtain a job and that along with the change in location would come a change in FIP status. Results show that the predicted probability of moving has a statistically significant effect on the FIP exit. As expected, case heads who move are more likely to leave FIP.

Marginal Effects

Marginal effects of the continuous regressors on the probability of wage work and being FIP leaver are evaluated at the sample mean and reported in Table 4.6.

The upper half of the Table includes the marginal effects of variables on the probability of leaving FIP. The marginal effects of predicted and unpredicted unemployment rate on the probability of leaving FIP are larger when individuals live in rural areas than that in nonrural areas. The results show that the probability of leaving FIP decreases 0.08 percent for rural cases and 0.07 percent for nonrural cases if expected unemployment rate increases by 1 percent; the probability of leaving FIP increases 0.02 percent for non-rural cases and 0.04 percent for rural cases if the unexpected unemployment rate increases by 1 percent. The share of employment in the service industry has larger effects on both probability of work and leaving the FIP in nonrural areas than that in rural areas. The results show that a yearly double increase in the county's share of service industry employment increases the probability of leaving FIP 2 percent for non-rural cases and decreases 0.06 percent for rural area. It implies that case heads are more likely to work in the service industry when they live in metro or urban areas than when they live in rural areas. The results may relate with the fact that case heads living in rural area may have more stable jobs than those living in nonrural areas. The share of poverty population in the county's total population almost has the same effect on the probability of leaving FIP. The elasticity of job growth rate is not statistically significant.

The elasticities of predicted wage income imply that double increase in wage income increases the probability of leaving FIP by 0.85 percent for nonrural, high-skilled cases; 0.82 percent for nonrural, low-skilled cases; 0.93 percent for rural, high-skilled cases; and 0.90

percent for rural, low-skilled cases. Similarly, the elasticities of child support imply that double increase in child support increases the probability of leaving FIP 0.07 percent for nonrural, high-skilled cases; 0.04 percent for nonrural, low-skilled cases; 0.09 for rural, high-skilled cases; 0.06 for rural, low-skilled cases. The results imply that wage income has a larger effect on program participation than do the effects of non-wage income such as child support; the effects of income are different between cases in rural areas and those in non-rural areas. The effects of child support are also different between cases with a high school degree and cases without a high school degree. However, the elasticity difference of wage income between cases with high school degree and those without are small.

The lower part of the Table provides the marginal effects of some regressors on the probability of working. The results show that the probability of being jobless increase 0.002 percentage for rural households and 0.001 percentage for non-rural households if expected unemployment rate double increases. However, double increasing unexpected unemployment rate increases the probability of having a job 0.03 percent for non-rural case heads and 0.13 percent for rural case heads. The effect of an increase in the share of service industry on nonrural cases is more than two times of that on rural cases. The effect of a growth in wage and salary jobs in a nonrural county is not statistically significant.

The Table also provides marginal effects of other variables. The results show that increase one child in the household can increase the case head's working probability 1.28e-4 percent; one month increase in the last half year FIP participation increases the probability of working by 2.21e-5 percent. The results also show that one unit increase in the probability of migration can increase probability of working 9.40e-7 percent and the probability of leaving FIP by 1.35e-3 percent.

Discussion and Conclusions

In the study, we use fractional imputation to fill in the missing educational status in the data set and examine the relationship between welfare participation and employment to evaluate the factors that affect labor participation, potential wage, and FIP participation. The evidence shows declining caseloads and increasing work effort among single mothers. Those who are nonwhite are less likely to work and when working, receive lower wages.

Educational attainment (of a high school degree) is one of the major factors determining labor participation, especially for single parents. We find that the unemployment rate, unemployment shocks, the share increase of service employment, the job growth rate are some of the significant variables for low-income family labor participation. Our results also show that labor force mobility is one method for welfare recipients to get a job. These results indicate that local economic conditions do indeed affect labor force participation of low-income families.

Analysis of potential wages shows those who are white, who are married, and who have higher education have a higher potential wage. Local labor markets, as indicated by predicted and unpredicted unemployment rate, also affect the potential wage.

The analysis of the FIP exit shows that higher potential wage income has a significant and positive effect on FIP status. The results suggest that the objectives of welfare reform should not only include getting a job but also should support earning more wage income. Change in wage income has a greater effect on FIP status than does child support. Assistance with moving may help recipients to achieve the aim of self-sufficiency. The results indicate that wage incentives are likely to be particularly effective in reducing the welfare program participation. At the same time, it is important to recognize that barriers to employment, such

as having young children at home, limit these low-income individuals' move into the labor market.

Location is one of the variables that affect the labor force participation, potential wage, and the FIP status. In general, cases living in non-rural counties are more likely to find a job but earn a lower potential wage. The results presented here suggest that local socioeconomic situation have the larger effects on probability of working in nonrural households than rural households. However, the results suggest that local socioeconomic situation have the larger effects on welfare program participation and wage income for rural households than those of nonrural households. The results imply that wage income is more related with program participation than the probability of working. Exiting from FIP will be limited in areas with high unemployment rates, especially for those living in rural areas. Relatively more service job opportunities increase the possibility of getting a job, especially for those living in non-rural area. The results provide evidence that job holding and benefits (wage) could be better for FIP residents in some areas than others and indicate the importance of demographic and other factors in determining the economic outcomes for these low-income cases.

Findings related to education show that those with higher education are more likely to get a job and to earn higher wages. The benefits of higher education also magnify the positive effects of higher child support and higher wage income in leaving FIP. It is difficult for low-skilled people to achieve the goals of welfare reform. The findings on the effect of education reiterate the need to train the low-skilled group so that they can acquire skills to get a job and earn more income. The different prospects for high-skilled and low-skilled welfare recipients remind us that the design of welfare policy programs should consider the characteristics of the welfare recipients and the nature of jobs available to less-skilled workers.

The empirical analyses presented here provide an indication of the effects of welfare reform, observed in a state that adopted a welfare share similar to those later adopted when

national rules changed. Because we cannot separate economic growth factors from program and policy effects by using the administrative data during this short time period, we do not know whether the behavior of the FIP recipients will change if they face a more difficult economic climate. We do find evidence that some programs for education, job training, and assistance with mobility will have positive returns relative to the objectives of welfare reform.

Table 4.1 Family Investment Program caseload statistics

Demographic Variable	Quarter 1	Quarter 8
Total Caseloads	32,783	32,783
Educational Attainment:		
With a high school degree	0.621	0.651
(Standard. error)	(0.004)	(0.004)
Areas of Residence:		
Metro	0.531	0.565
Urban	0.042	0.393
Rural	0.050	0.042
Number of Children	2.171	2.272
(Standard. error)	(1.311)	(1.312)
No Child	0.320e-2	1.080e-2
Less than Three Children	0.685	0.649
Married	0.195	0.234
Single Father	0.391	0.415
Family Quarterly Wage Earnings:($100)	16.472	26.981
(Standard error)	(14.911)	(18.971)
No Wage Income (%)	45.132	30.492
Mean Child Support	313.952	583.472
(Standard error)	(14.4322)	(7.032)
No Child Support (%)	46.892	50.591
Local Quarterly Unemployment Rate (%)	3.741	3.262
Gender and Ethnicity:		
White	0.846	
Female	0.907	
Disabled	0.236	
Male × Disabled	0.322	
Female × Disabled	0.204	
Male ×Disabled ×White	0.027	
White × Female	0.766	
White × Male	0.080	
Months Stayed in FIP	17.140	
(Standard error)	(0.040)	
1-6 Months (%)	13.333	
7-12 Months (%)	15.981	
13-18 Months (%)	15.731	
19-24 Months (%)	54.955	
Months Stayed in the Food Stamp	16.99	
(Standard error)	(0.051)	
0 Months (%)	7.611	
1-6 Months (%)	8.852	
7-12 Months (%)	12.231	
13-18 Months (%)	13.501	
19-24 Months (%)	57.809	

Table 4.2 Labor force participation for cases with children

	Single				Married			
	Low-skilled		High-skilled		Low-skilled		High-skilled	
Quarters	Total	Ratio(%)	Total	Ratio(%)	Total	Ratio(%)	Total	Ratio(%)
Male:								
Quarter 1	654.300	55.831	1089.100	53.864	443.900	52.351	828.900	55.582
Quarter 2	602.900	51.652	1085.100	50.471	429.600	52.844	890.400	52.791
Quarter 3	591.100	60.111	1071.900	57.812	428.700	60.043	893.300	60.744
Quarter 4	583.700	65.441	1070.800	63.882	434.900	62.910	906.100	66.483
Quarter 5	593.300	65.033	1137.700	64.892	403.500	62.351	858.500	64.581
Quarter 6	572.800	61.854	1073.200	61.383	418.700	63.122	919.300	64.800
Quarter 7	566.600	66.132	1073.400	65.522	420.400	65.203	923.600	67.010
Quarter 8	561.800	67.522	1074.200	66.633	420.800	67.322	924.200	69.322
Female:								
Quarter 1	9415.300	51.061	15143.000	54.354*	1864.700	63.422	3239.800	63.822
Quarter 2	8755.900	48.522	14992.100	52.701*	1961.500	61.584	3875.500	63.301
Quarter 3	8648.700	54.622	14928.300	58.383*	1970.700	66.962	3895.300	67.713
Quarter 4	8582.000	59.551	14977.500	62.822*	2019.200	71.623	3971.800	70.822
Quarter 5	8714.100	61.491	15515.900	64.811*	1794.600	71.171	3517.400	70.562
Quarter 6	8392.900	60.102	14996.100	63.901*	2039.700	70.792	4079.300	71.889
Quarter 7	8350.100	64.033	14955.900	67.542*	2047.200	73.160	4127.800	75.300
Quarter 8	8270.900	66.081	14924.100	69.221*	2068.700	74.891	4183.300	76.011

Note: *Participation rates between high and low skilled group are significant at 1% level.

Table 4.3 Comparison of selected demographic variables among mobility patterns (standard deviation in parenthesis)

	Mobility Pattern					
	Zero Moves Per Year		One Move Per Year		More Than One Move Per Year	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Variable	N=30,708	N=30,928	N=1,787	N=1,596	N=288	N=259
Number of children	2.178	2.243	2.121	2.249	1.879	2.301
	(1.301)	(1.321)	(1.209)	(1.209)	(1.070)	(1.379)
Month in FIP	10.060	7.032	10.221	7.658	10.396	7.880
	(3.231)	(5.145)	(2.874)	(4.567)	(2.499)	(4.287)
Proportion of working	25.713	20.237	18.858	13.597	14.931	13.514
	(43.706)	(40.178)	(39.129)	(34.286)	(35.701)	(34.253)
Annual wage income	14674.952	17215.049	14742.120	16448.644	12083.102	17120.556
	(13763.047)	(15126.480)	(13221.600)	(14602.452)	(12110)	(16906.324)
Proportion with high school degree	63.858	65.055	64.533	64.493	60.243	55.753
	(48.042)	(47.681)	(47.855)	(47.869)	(49.025)	(49.764)

Table 4.4. Descriptive statistics for variables used in the regression

Variable	Description	Mean	Std. Error
Dependent Variables			
Move	Indicator for the case head moving in the quarter before the max-wage quarter	0.334	0.080
Work	Indicator for the case head working or not working in the year	0.226	0.206e-03
Log(wage)	Wage & salary earnings in the max-wage quarter for the case head (log)	0.889	6.412e-03
FIP Leaver	Indicator for FIP exit during the year	0.219	1.894e-03
Independent Variables			
County Characteristics			
Predicted Unemployment	Predicted unemployment rate in the max-wage quarter (%)	3.571	4.343e-03
Unpredicted Unemployment	Unpredicted unemployment rate in the max-wage quarter(%)	-0.575	1.507e-03
LOG(job growth)	Growth in wage and salary jobs (log) over last year	2.155e-02	7.832e-05
Service job growth	County's share of increase of service industry employment in year (%)	5.666e-03	3.470e-03
Poverty population share	Share of poverty population in county's total population per year (%)	10.926	1.154e-02
Rural	Rural and non-rural indicator (non-rural=1)	0.950	0.120
Individual Characteristics			
Age	Age of case head	31.360	5.209e-02
Education	Indicator of whether case head has a high school degree (Yes=1)	0.644	4.258e-03
White	Indicator of case-head is white (Yes=1)	0.845	1.910e-03
Male	Indicator of male case-head (Yes=1)	9.150e-02	1.633e-03
Disable	Indicator for disabled case-head (Yes=1)	0.236	2.401e-03
Number of children	Number of children in the family	2.208	7.179e-03
With child less 6	Indicator for having a child younger than six	0.430	2.779e-03
Married	Indicator of being married (Yes=1)	0.224	2.392e-03
Child support	Child support received for the max-wage quarter ($)	125.583	0.151
Months in FIP	Number of active months in FIP in six months preceding max-wage quarter	4.599	9.994e-03
Prob. of moving	Predicted probability of moving	3.132e-03	2.424e-05
Log(Predicted wage)	Predicted max-wage (log)	0.883	1.779e-03
Quarter 2	Indicator for max-wage quarter in second quarter	0.882	1.108e-03
Quarter 3	Indicator for max-wage quarter in third quarter	0.388	2.288e-03
Quarter 4	Indicator for max-wage quarter in forth quarter	0.337	1.683e-03
Year93	Indicator for the sample between Oct. 1993 and Sep. 1994	0.500	2.762e-3

Table 4.5 Regression results for working, wage income and FIP participation

	Dependent Variables					
	Work		Log(wage)		FIP leaver	
Independent Variables	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error
Intercept	2.540***	0.248	1.900***	0.121	5.663***	0.523
County Characteristics						
Predicted Unemp	-0.373***	0.058[e]	-0.177***	0.025	-0.478***	0.075
Unpredicted Unemp	0.267***	0.046	-0.195***	0.022	0.237***	0.062
Service job growth	6.828e-2**	0.034	2.171[e]-3	1.645e-2	0.036	0.040
LOG(job growth)	1.476	1.924	4.727e-3	0.868	0.430	2.357
Rural	0.649**	0.248	0.166*	0.097	1.129***	0.520
Poverty population share					-0.144***	0.026
Rural× Predicted Unemp	0.103*	0.060	-0.041*	0.024	9.240e-3	8.057e-2
Rural×Unpredicted Unemp	0.289***	0.049	-0.076***	0.023	-8.729e-2	6.138e-2
Rural× Service job growth	0.091	0.035	-7.658e-3	0.016	0.094**	0.043
Rural× Log(job growth)	2.769	1.962	1.097	0.911	0.672	2.363
Rural× Poverty pop share					-5.631e-3	2.749e-2
Individual Characteristics						
Age			0.029***	2.829e-3		
Age×Age			-2.320e-3***	0.404e-4		
Education	0.125***	0.027	0.032***	0.012	0.169	0.112
White	0.425***	0.033	0.193***	0.018	1.415***	0.046
Male	0.122	0.108	0.121**	0.059	0.550***	0.133
White×Male	0.239**	0.116	-0.115*	0.064	-0.757***	0.130
Disable	-0.274***	0.028				
Number of children	0.264***	0.011				
With child less than six	-0.265***	0.011				
Married	0.268***	0.030				
Months in FIP	-0.045***	5.40e-03	-0.052***	0.262e-2		
Prob. of moving	1.938***	2.149e-4			8.629e-3***	4.827e-4
Log(Predicted wage)					5.770***	0.321
Educ× Log(Predicted wage)					0.183**	0.088
Rural× Log(Predicted wage)					-0.537*	0.312
Log(child support)					0.038***	0.011
Educ× Log(child support)					0.018***	4.403e-3
Rural× Log(child support)					-0.013	0.011
Quarter 2			0.127***	2.764e-2		
Quarter 3			0.107***	1.468e-2		
Quarter 4			0.162***	0.015		
Year93	-0.153***	0.027	-0.123***	0.014	-0.142***	0.030
Inverse Mills Ratio			-6.193***	0.186		
R-square			0.078			
-2Likelihood	7000.444				68930.803	
Method	Logit		Linear		Logit	

Note: *** significant at 1% level; ** at 5% level and * at 10% level.

Table 4.6 Marginal effects of continuous variables of leaving FIP and working

	Whole	Non-rural	Rural
Effects on FIP leaver:			
Predicted unemployment		-0.734e-3	-0.803e-3
Unpredicted unemployment		0.230e-3	0.398e-3
Service job growth		0.153e-3	0.612e-5*
Log(job growth)		0.173e-3*	0.724e-3*
Poverty population share		-0.234e-3	-0.242e-3
Probability of moving	1.352e-5		
Log(predicted wage):			0.929e-2
High-skilled		0.848e-2	0.904e-2
Low-skilled		0.820e-2	
Log(child support):			
High-skilled		6.561e-5	8.647e-5
Low-skilled		3.815e-5	5.901e-5
Effects on working:			
Predicted unemployment		-1.296e-6	-1.794e-6
Unpredicted unemployment		2.711e-6	1.309e-6
Service job growth		7.710e-7	3.312e-7
Log(job growth)		2.059e-5*	7.159e-6*
Number of children	1.278e-6		
Months in FIP	2.205e-7		
Probability of moving	9.399e-9		

Note: * not significant at 10%.

5. CONCLUSIONS

The three dissertation essays investigate the relationship among food security status, welfare program participation and food away from home consumption. The first two studies examine the effects of family structure and income sources on FSP participation and food away from home based on different food security status. The third paper analyzes the effects of local labor market and migration on FIP participation.

The findings obtained here help to explain the different consumption and program participation behavior for households in different food security status. Number of children in the household and wage income (working hours) have the strongest effects on FSP participation. Relatively larger marginal effects on FSP participation for households with food insecurity or hunger than those of food secure households imply that younger children (under 14) and working possibility are more important to the decision to leave the FSP for food insecure or hungry households than for food secure households. Family structure also has strong effects on food away from home. For the food secure households, working families and families with older children (older than 6) have strong possibility of eating out. Families with more older family members do not eat out very often but spend more than families with fewer older family members if they do indeed eat out. These results are all consistent with the expectation. For the households with food insecurity, the consumption behavior is not as clear as for those with food security. However, those households with more older children (older than 6) and working family members still have the high possibility of eating out.

Local labor market and migration have the strong effects on FIP participation. Econometric analysis showed that there are different effects of local economic situation on

program participation for the households living in rural area compared to those living in non-rural areas. Migration not only helps low-income families to get a job, but also forces them to make a choice between participating in the welfare program and leaving or not even participating in the program in the first place. The effects of local labor market on FIP participation tells us that participation rates will increase when the local economic situation becomes worse, especially for those living in rural areas. The results also imply that the declining trends of welfare program participation are caused at least partly by the policy changes.

The issue of food security and welfare program participation is an interesting policy issue in poverty analysis. Currently, the USA has experienced recession after more than ten years growth. There is great need for research to guide policymakers in understanding the reasons for and consequences of the welfare program participation behavior. The first two studies identified the importance of family structure and income sources on FSP participation and food consumption behavior. The findings of the third study point to local labor market effects and migration status as important determinants of cash assistance program (one of them is FIP) participation. The results highlight the importance of local economic development, family structure and income source considerations when designing policies to support the low-income households.

The results also emphasize the importance of other demographic variables. The findings of the three papers show that education not only affects welfare program participation, but also affects the consumer's food consumption behavior. Other variables such as location, race, gender, disability, marriage status, and age of reference persons also affect the low-income households program participation and consumption decisions. One explanation for

the importance of these variables is due to different lifestyles and ability to manage household resources. These results also suggest that the welfare program design and change at least should consider the effects of demographic differences.

Despite considerable and careful research that has significantly advanced our understanding of food security and welfare program participation, that understanding remains limited in several important respects. First, the dissertation did not consider the important of dynamics and uncertainty in the effects of welfare program participation and food consumption behavior. Also, because the motivations and modalities of welfare programs have been changing rapidly over the past decade and they will change again when the environment changes, historical experience may not be an especially accurate predictor of future performance. Second, the results provided here are based on the measurement of food security. However, the measurement method is still developing based on research to date, however, we expect the food secure measurement based on Rasch model to be a valid and useful measure of food security status.

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