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Does the Food Stamp Program Affect Food Security Status and the Composition of Food Expenditures?

Suwen Pan and Helen H. Jensen

This article considers interaction among participation in the Food Stamp Program (FSP), food security status, and the composition of food expenditures. A quadratic almost ideal demand system with a bootstrapping two-step method of estimation is applied to data from the Current Population Survey–Food Security Supplement data and used to estimate the model and account for endogeneity between the FSP participation and food insecurity. The results show that FSP participation is endogenously related with food security status and significantly affects total food expenditure and food-away-from-home expenditures.

Key Words: food away from home, food insecurity, food stamps

JEL Classifications: Q18, R21, I32

Over four decades, the Food Stamp Program (FSP) has provided a safety net to low-income households in the United States through food assistance designed to protect participants from hunger and encourage consumption of a nutritious diet (Eisinger). Although the food program is designed to help meet the food needs of low-income households and reduce hunger, being food insecure (FI) is not a requirement for participation in the program. For FSP participants, program benefits increase the household budget and thus free resources for expenditures on all goods. For many FSP households, the FSP transfers are less than the household's expenditures on food at home in total, and thus the program benefits are used in full before the month of allocation is over (Gundersen and Oliveira; Wilde and Ranney). However, because the design of the FSP allows benefits to cover only expenditures on food at home (FAH), that is, foods purchased in approved retail grocery stores, the program effectively discourages consumption of food away from home (FAFH).

The main objective of the study is to investigate whether the FSP affects food security status and the composition of food consumption or expenditures (both FAH and FAFH). Although there is evidence that food stamps increase overall food spending (Fox, Hamilton, and Lin), little is known about the program effect on composition of expenditures. Understanding the effect of the FSP on both food security and on the allocation of food expenditures provides basic information useful for evaluating the effectiveness of the program design and improving the well-being of target populations.

Several recent studies consider the effects of the FSP on food consumption and food security status. However, the results vary

Suwen Pan is visiting professor at Huazhong Agricultural University & research scientist at Texas Tech University, and Helen H. Jensen is professor of economics at Iowa State University.

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among the studies because of both data and research design (Wilde), and none examines the outcomes in terms of composition of food expenditures. For example, Gundersen and Oliveira used cross-sectional data from the Survey of Income and Program Participation and a simultaneous equation model with two probits and found that FSP participants had the same probability of food insufficiency as nonparticipants. Huffman and Jensen (2008) and Gibson-Davis and Foster also found no significant relationship between FSP receipts and food insecurity. Jensen found evidence that FSP participation and FI were affected in the same direction by random shocks. Borjas exploited a difference in state policies regarding benefits for immigrant populations after welfare reform along with the Current Population Survey–Food Insecurity data to show that a 10% cut in the fraction of the population that receives public assistance increased the percentage of FI households by about 5%. Yen et al. (2008) found that FSP participation had a negative effect on FI using 1996–1997 National Food Stamp Program Survey data. In sum, without access to experimental data, the challenge is to adequately account for program participation and selection bias in estimating program effects.

Purchases of food for consumption away from home are often necessitated by demands from time spent in the labor force or chosen as preferred sources of food because the FSP increases resources available to the household. Time spent in low-wage occupations and in other (nonfood) household activities competes with time available for at-home food preparation. For working households, both low and higher income, FAFH, including ''fast-food'' options, provides a widely used option for meeting needs of convenience and location of eating. Often fast food offers a less expensive form of calories to meet food needs than do home-prepared meals for low-income households with constraints on time, and cooking and storage facilities (Stewart and Blisard). During the period 1996–1999, spending on FAFH increased 22.4%, and spending on FAH increased 4.1%. In 1999, households with per capita before tax income of less than $5,000 spent 16% of their total expenditure on food and 37.2% of their total food expenditure on FAFH (Bureau of Labor Statistics).

Analysis of whether household FSP participation affects FI status and household food expenditure (at home and away from home) is made possible by the recent collection of data on food security status in the Current Population Survey–Food Security Supplement (CPS–FSS). In the data set, FI is measured by an FI index that is based on responses to 18 core questions (see Nord, Andrews, and Carlson 2002; Opsomer, Jensen, and Pan; and Appendix A for details about the food security measurement). Based on the data, the prevalence of food insecurity was 10.1% in 1999 and 11% in 2005 (Cohen et al.; Nord, Andrews, and Carlson 2002, 2003, 2006).

The endogeneity of FSP participation and the food security status complicates the analysis. To solve the problem of endogeneity, a two-step method is adopted (Shonkwiler and Yen). However, as noted by Tauchmann, it is clear that all two-step estimators are asymptotically inefficient in comparison with the full information maximum likelihood approach. Therefore, we adopt a bootstrapping mechanism to improve the efficiency for the two-step demand estimation.

This article contributes to the economic and empirical literature related to food security in several ways. An economic model of consumer behavior is specified that links FSP participation and food security status to food expenditures (both total food and FAFH). The effects of FSP participation and food security status on food expenditure are both direct and indirect: the direct effects of program participation increase food security and increase total expenditure on food, and the indirect effects reduce expenditure on FAFH through a relative price effect (FAH becomes relatively less expensive). That is, those who spend more on FAH than the amount of their food stamp benefits face the same relative prices for food as nonparticipants. However, for those at the corner solution (i.e., spending FAH = FSP benefit), the relative price of FAH is less than or equal

to the relative market prices. FSP participation and the food security index allow for a comprehensive economic analysis of the own and cross effects from FSP participation on food security status. Results indicate that although FSP participation does not have a significant effect on food security status, it does affect food expenditures and FAFH expenditures.

The organization of the article is as follows. We next present a theoretical model of the simultaneous decision on FSP participation, food security status, and FAFH consumption. Sections follow to present the methodology for dealing with the simultaneous nature of food security status and food consumption decision, describe the data source and sample, provide empirical estimation results, and summarize major findings.

Economic Issues and Estimation Procedures

Economic Issues

We begin with a household food choice between FAH and FAFH based on food security status and FSP participation. Following Gundersen and Oliveira, there exists disutility associated with being food insecure (*FI*), which comes from "the sensation of hunger," "the ramifications" associated with food insecurity, and "the shame" parents feel about their children lacking adequate food. The disutility of being FI ($D(FI)$) is greater than 0 if a household is food insecure. At the same time, there also exists disutility associated with FSP participation, which comes from the transaction costs associated with a family's filing an application, going for interviews, reduced expected future benefits due to a lifetime participation time limit imposed in TANF, and disutility in dealing with welfare bureaucracies and the application procedures (Moffitt). Let ϕ_1 be the marginal utility of FSP participation with undetermined sign; let the consumer's utility function be $U(X_1, X_2, L, \phi_1 F_1) - D(FI)$, in general form. Then the utility maximization problem under the assumption that expenditure on food is weakly separable from expenditures on other goods is

$$(1) \quad \max_{X_1, X_2, L} \{U(F_{FAH}, F_{FAFH}, L, \phi_1 F_1) - D(FI)\}$$

such that

$$(2) \quad \begin{aligned} & L + H = \bar{L} \\ & 0 \leq wH + N + F_1(B - X) \\ & \quad -(F_{FAH} * P_1 + F_{FAFH} * P_2) \end{aligned}$$

where F_{FAH} is the quantity of FAH consumed; F_{FAFH} is the quantity of FAFH consumed; P_1 and P_2 are the prices of FAH and FAFH, respectively; L is the leisure time; F_1 is an indicator of FSP participation; H is hours worked; and $\bar{L}$ is total time available. N is nonlabor income, and $F_1(B - X)$ represents the available FSP benefits calculated based on the maximum program benefit (B) and deductions (X). The solution of the first-order condition gives Marshallian food demands for F_{FAH} and F_{FAFH}, which depend on FSP program participation and the food security status.

Like traditional price and income effects, the effects of food security status and FSP program participation on FAFH consumption can be addressed within a theoretically consistent consumer demand system. We use a standard demand model generalized to include a demographic translation procedure. An almost ideal demand system (AIDS) developed by Deaton and Muellbauer and popular in use with cross-section data is adopted to address our problem. For estimation purposes, we employ a nonlinear quadratic almost ideal demand system (NLQAIDS) in our FAFH and FAH estimation. Existing literature points to several advantages of the NQAIDS over other flexible demand systems. In particular, the system includes nonlinearities and allows interactions with household-specific characteristics in the utility function, both of which are important for household survey data (Blundell, Pashardes, and Weber; Lyssiotou, Pashardes, and Stengos).

Estimation Procedures

The estimation includes four steps: first, a bivariate probit model is used to estimate the

jointly determined probabilities for FSP participation and food security status; second, a food expenditure equation is estimated based on the relationship between food expenditure and income; third, a univariate probit model is used to estimate the effects of FSP participation on the probability of FAFH; and fourth, the expected food expenditure, probability density function (PDF) of FSP participation, and cumulative density function (CDF) and PDF of FAFH participation estimated in the first three steps are included in the censored NLQAIDS model to estimate the shares of FAFH expenditure.

The first step is the bivariate probit model to estimate FSP participation and food security status. The decision for household i to participate in the FSP can be formulated as follows:

$$(3) \quad F_1 = \begin{cases} 1 & \text{if household } i \text{ is in the FSP} \\ 0 & \text{otherwise} \end{cases}$$

The reduced form is

$$(4) \quad P^* = \beta_1 \boldsymbol{X_1} + \varepsilon_1,$$

where P^* is the probability that the household will participate in the FSP and X_1 are factors determining participation.

Although food security status is classified based on the Food Security Index as discussed earlier, it is highly related to having adequate food expenditures, that is, food expenditures that meet the household's needs. The classification on food insecurity is observed through a binary index (FI_i) that indicates whether the household is food secure or not (i.e., food insecure) based on whether the household has a (unobserved) level of food expenditure (y) that meets its food security needs. The discrete model can be represented as follows:

$$(5) \quad FI_i = \begin{cases} 1 & \text{if household } i \text{ is food insecure} \\ 0 & \text{otherwise} \end{cases}$$

The reduced form is

$$(6) \quad y^* = \beta_2 \boldsymbol{X_2} + \varepsilon_2,$$

where $\boldsymbol{X_2}$ is a vector of variables determining food security.

To estimate the effects of FSP on food security status, a bivariate probit model is used to account for the endogenous relationship between the two bivariate measures: FSP participation and food security status. Note that the residual of the bivariate probit model may be heteroskedastic (Greene, 1996) and that it is likely to be related to household income (Yen, Jensen, and Wang). Assume that both ε_1 and $\varepsilon_2 \sim N(0, (e^{\gamma Z_i})^2)$, $i = 1, 2$, respectively, and denote the standard bivariate normal probability distribution function as Φ_2 and the correlation between ε_1 and ε_2 as ρ. Then the likelihood function (Greene, 1997) for an independent sample of size n is

$$(7) \quad L = \sum_{i=1}^{n} \ln \Phi_2(\beta_1 X_1, \beta_2 X_2, (2F_{1i} - 1)(2FI_i - 1)\rho)$$

The second step is to estimate the food expenditure equation based on the relationship between food expenditure and income. This is estimated in two parts. First, we estimate the effect of FSP participation on food expenditure by using an extension of the Heckman procedure (Cooper and Keim; Tunali). Based on Equation (7), we calculate the predicted probability of FSP participation, $\boldsymbol{\pi_1}$.

And, second, we estimate the food expenditure equation as a linear relationship. Let Exp_i and INC_i represent the ith household's food expenditures and income, respectively. The model to be estimated is

$$(8) \quad \log(Exp_i) = a_0 + \sum_k a_k s_{ki} + b \log(INC_i) + \gamma_1 \boldsymbol{\pi_1} + \varepsilon_i,$$

where the ss are demographic and socioeconomic variables ($k = 1, \ldots, K$); the as, γs, and bs are parameters to be estimated; and ε is the usual disturbance term (the εs are independent $N(0, \sigma^2)$). Note that the residual ε_i may be heteroskedastic, and therefore weighted least squares is used to adjust for the problem (Maddala, pp. 225–226). The expected food expenditure is estimated based on Equation (8).

The third step is to estimate the effects of FSP participation on the probability of FAFH

expenditure. In order to account for zeros in the FAFH share equation, we estimate the likelihood of eating out (I_i) based on a unitary probit model. The effects of FSP participation ($\boldsymbol{\pi_1}$) are included in the probit model as follows:

$$P(I_i = 1) = a_0 + \sum_k a_k s_{ki} + b\log(INC_i) + \gamma_1\pi_1 + \varepsilon_i \tag{9}$$

The fourth and final step is to estimate the effects of FSP participation on the shares of FAFH and FAH expenditures. The estimation includes the expected food expenditure estimated in the second step and the values of the CDF and PDF estimated in the third step. We estimate the demand for FAFH and FAH and incorporate the π_1 and the expected total food expenditure predicted in the first stage. We use the expected total food expenditure instead of the actual expenditure so that we can solve the endogeneity problem between food expenditure and share of FAFH expenditure (Dhar, Chavas, and Gould).

The basic demand equation can be represented as follows:

$$\begin{aligned} y_i = {} & \alpha_i + \beta_i(\ln(\hat{e}) - \ln P) \\ & + \frac{\lambda_i}{\prod_j P_i^{\beta_i}}(\ln(\hat{e}) - \ln P)^2 \\ & + \gamma_{ij}\log\left(\frac{P_{FAFH}}{P_{FAH}}\right) \\ & + \sum\nolimits_s \kappa_{is}N_s + z_1\pi_I + \nu_i, \end{aligned} \tag{10}$$

where

$$\ln P = \alpha_0 + \sum_j \alpha_j \ln P_j + \frac{1}{2}\sum_j\sum_i \gamma_{ij} \ln P_i \ln P_j$$

and y_i is the expenditure share of the FAFH in total food expenditures for household i, $\hat{e}$ is total food expenditures estimated in the first step, P_{FAFH}/P_{FAH} is the ratio of the interarea price indices (IRPI) for FAFH and FAH (which guarantees the estimation satisfies the homogeneity and the symmetry restriction in the AIDS model), N_s includes demographic variables, and the αs, βs, γs, θs, and κs are coefficients to be estimated. As usual, the adding-up restriction is imposed in Equation (10).

However, zero observations in the dependent variable (y_i) present new estimation problems due to the nature of the cross-section survey data. The CPS collected information only for the previous week's expenditures on FAFH and FAH, and hence households may not have the expenditures during this period.

To solve the censored data problem, we adopted the method proposed by Shonkwiler and Yen to adjust our estimation of Equation (10). Based on the FAFH participation Equation (9), we calculated a CDF, $\Phi(Z'_{it}\hat{\alpha}_i)$, and a PDF, $\phi(Z'_{it}\hat{\alpha}_i)$, for eating out and then adjust Equation (10) as follows:

$$\begin{aligned} y_i = {} & \Phi(Z'_{it}\hat{\alpha}_i)\{\alpha_i + \beta_i(\ln(\hat{e}) - \ln P) \\ & + \frac{\lambda_i}{\prod_j P_i^{\beta_i}}(\ln(\hat{e}) - \ln P)^2 \\ & + \gamma_{ij}\log\left(\frac{P_{FAFH}}{P_{FAH}}\right) \\ & + \sum_s \kappa_{is}N_s + z_1\pi_I\} \\ & + \kappa_j\phi(Z'_{it}\hat{\alpha}_i) + \varepsilon_i \end{aligned} \tag{10a}$$

The two-step method is always inefficient (Tauchmann). However, a more serious problem in all the two-stage studies arises from the fact that estimates are serially correlated (Simar and Wilson). To improve the efficiency and solve the serial correlation of the estimation, we adopted a bootstrapping method (Efron and Tibshirani) for the second, third, and fourth steps in estimation. First, 100 subsamples of 10,000 observations are chosen randomly with replacement from the whole sample; second, the 100 subsamples are used to estimate the parameters of Equations (8), (9), and (10a) based on the expected probabilities of FSP participation and FI status of the whole sample; third, the estimated parameters and the asymptotic covariance are estimated by averaging the 100 estimates.

Based on the procedures, determining the effects of FSP participation on food expendi-

ture and FAFH simplifies to that of checking whether the parameters of the πs are significant in Equations (8), (9), and (10).

Elasticity Calculation

Following Pan, Fang, and Malaga and Pofahl, Capps, and Clauson, the uncompensated own-price and cross-price elasticities associated with the NQAIDS are derived using the following expressions:

$$\begin{aligned}\frac{\Phi(Z\alpha)\gamma_{ij}}{w_{21j}} &- \{\Phi(Z\alpha)\beta_i \\ &\times [\Phi(Z\alpha)\alpha \\ &+ \sum_j \gamma_{ij}\Phi(Z\alpha)\ln p_j] \\ &+ \left[\frac{2\lambda_i\Phi(Z\alpha)}{b(p)}(\kappa)\right]\} \\ &\times \frac{1}{w_{21j}} - \delta_{ij},\end{aligned} \tag{11}$$

where

$$b(p) = \prod_j p_{21j}^{\Phi(Z\alpha)\beta_j}, \tag{12a}$$

$$\begin{aligned}\kappa = \ln\, y_{21j} &- \Phi(Z\alpha)\alpha_0 \\ &- \sum_j \alpha_j\Phi(Z\alpha)\ln p_{21j} \\ &- \frac{1}{2}\sum_j\sum_i \gamma_{ij}\Phi(Z\alpha)\ln p_{21i}\ln p_{21j},\end{aligned} \tag{12b}$$

and

$$\delta_{ij} = \begin{cases} 1 & \text{if } i = j \\ 0 & \text{otherwise} \end{cases}. \tag{12c}$$

Expenditure elasticities are computed as

$$\varepsilon_i = 1 + \frac{\Phi(Z\alpha)\beta_i}{w_{21i}} + \frac{2\lambda_i\Phi(Z\alpha)}{w_{21i}b(p)}\log\left(\frac{y_{21}}{P}\right) \tag{13}$$

Data and Variable Definitions

Data used in this study were compiled directly from the 1999 CPS–FSS data. The data include demographic and income data on the households and allow for the study of the relationship between food consumption behavior, household demographic variables, and food security status. Households were classified based on estimated food security scales. (As mentioned earlier, the food security scales are derived from a set of 18 survey items included in the CPS–FSS that ask respondents directly about their behavior and food choices conditioned on financial constraints.) Based on their responses, households were classified into two categories: food secure and food insecure (either with evident hunger or without) (Bickel et al.). Households surveyed also provided information on the previous week's total food expenditure and FAFH and FAH expenditures. Demographic information included household size and composition by age and gender, region, state, race, income class, location by metropolitan statistical area, and education and marital status of the reference person. The total survey sample included 45,000 households.

For our purpose, we chose a sample with income equal to or less than 1.3 times the poverty threshold.[1] This level of income was used to determine basic FSP eligibility for the household. To identify households for the low-income sample, we calculated the poverty threshold income level for each household available for the sample based on the number of adults and number and ages of children in the household and the age of the household reference person (older or younger than 65) according to the relevant poverty threshold income level from the Census Bureau. Households with the highest-income extreme values were excluded. The total low-income sample used in the analysis was 12,071 households. Of these low-income households, 19.03% were food insecure.

There was no food price information available in the CPS data. Therefore, we used the appropriate Consumer Price Indexes (CPI) for the location of the household as the price for

[1] While 1.3 times the poverty threshold is the gross income limit for FSP eligibility, an alternative would be to consider a higher cutoff to be inclusive of those whose income varies month to month. At the same time, one should note that FSP participation in the CPS is underreported by up to 20% to 30% (Taeuber et al.).

food, FAFH, and FAH. The source of price data was the Bureau of Labor Statistics' CPI for total food, FAFH, and FAH (Bureau of Labor Statistics). The regional specification for the CPI included consolidated metropolitan statistics area (MSA) codes and regional identification. Because the expenditure data are observed across regions, an IRPI must be constructed. IRPIs exist for the year of July 1988 and June 1989, based on a special study conducted by Kokoski, Cardiff, and Moulton. To convert the price index to an IRPI in 1999, each of the indices for 1988 was inflated to its 1999 value by the commodity-specific, region-specific CPI:

$$(14) \quad IRPI_{99} = \frac{CPI_{99}}{CPI_{88}} \times (IRPI_{88}).$$

At the same time, product category weights developed by the Bureau of Labor Statistics were used to combine the different prices of goods to the food IRPI, nonfood IRPI, FAH IRPI, and FAFH IRPI in 1999.

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 the family. Households were categorized into 14 income ranges. In order to choose the sample of interest, it was necessary to convert the categorical income variable to a continuous measure. We used the range midpoints as representative of household income.

The dependent variable of the analysis is the share of FAFH in the total food expenditure, which was calculated from the data. Table 1 presents a comparison of food expenditures between food-secure households and food-insecure households with means and standards errors. In Table 1, the indicators (a), (b), and (c) identify whether the difference between food-secure and food-insecure households (a), difference between food-secure FSP recipients and non-FSP recipients (b), and difference between food-insecure FSP recipients and non-FSP recipients (c) are statistically significant. A two-sample *t*-test was used and 10% significance level was adopted.[2] Based on results (Table 1), food-insecure households had relatively lower income per capita, lower food expenditures per capita, and lower FAFH participation rates than did households that were food secure. Because the household size was relatively large for the food-insecure households, it is understandable that there was a relatively larger income and food expenditure per household for those food insecure than for those food secure. In both food-insecure and food-secure households, those participating in the FSP had smaller income per capita, food expenditure per capita, and FAFH expenditures per capita than those not in the program.

Results and Discussion

The results of bivariate probit estimation of FSP participation and food security status (Table 2) indicate that FSP participation and food security status are endogenous based on the statistical significance of ρ. This suggests that there may be unobserved factors that affect both the FSP participation and food security status. Hence, our use of a bivariate probit model to estimate the two equations is warranted.

The statistically significant variables that affect FSP participation are metro, northeast, west, education, white, Hispanic, married, number of children under 6, number of children between 6 and 13, number of children between 14 and 17, number of working adults (both male and female), and number of nonworking adults (both female and male). Most of the variables are also significant in the food security equation; the indicator for FSP participation is not statistically significant. The sociodemographic variables have the following effects on FSP participation and food security status. The household head's

[2] *Proc surveymeans* in SAS was used to account for complex survey design of the CPS sampling procedure in the weights; however, the sample design was not accounted for in the estimation standard errors for our sample of low-income households. Thus, the statistical significance of differences in Table 1 is overstated.

Table 1. Comparison between Food-Secure, Food-Insecure, and Food Stamp Program Recipients (standard errors in parentheses)

	Food-Secure Households						Food-Insecure Households					
	Subtotal		With FSP		Without FSP		Subtotal		With FSP		Without FSP	
Sample size (N)	9,774		1,077		8,697		2,297		860		1,437	
Household size	2.40	(0.02)	3.15	(0.06)	2.31*(b)	(0.02)	2.85*(a)	(0.04)	3.14	(0.07)	2.68*(c)	(0.04)
Weekly total income per household ($ income)	185.82	(1.33)	182.58	(3.60)	186.23	(1.43)	198.68*(a)	(2.69)	169.14	(3.98)	216.36*(c)	(3.50)
Weekly total income per person	105.70	(0.84)	71.46	(1.15)	109.63*(b)	(0.92)	89.22*(a)	(1.33)	68.33	(1.64)	101.73*(c)	(1.80)
Weekly total food expenditure per household ($ exp)	82.80	(0.66)	89.62	(2.39)	81.95*(b)	(0.68)	78.33*(a)	(1.27)	80.79	(2.24)	76.86	(1.53)
Food expenditure per person ($)	39.22	(0.31)	31.48	(0.72)	40.18*(b)	(0.34)	32.48*(a)	(0.53)	30.52	(0.84)	33.67*(c)	(0.67)
Average FAH expenditure ($)	65.27	(0.54)	80.50	(2.23)	63.38*(b)	(0.54)	67.29	(1.18)	73.12	(2.16)	64.44*(c)	(1.37)
Average FAH expenditure per person ($)	30.27	(0.24)	28.37	(0.68)	30.51*(b)	(0.14)	27.70*(a)	(0.48)	27.59	(0.82)	27.77	(0.58)
Average FAH expenditure for those with FAH ($)	68.36	(0.55)	82.65	(2.25)	66.55*(b)	(0.55)	70.32	(1.19)	75.76	(2.18)	67.05*(c)	(1.38)
% with FAH	95.48	(0.21)	97.40	(0.49)	95.24*(b)	(0.23)	96.26	(0.40)	96.51	(0.26)	96.10	(0.51)
Average FAFH expenditure ($) per household	17.53	(0.31)	9.12	(0.66)	18.57*(b)	(0.23)	10.65*(a)	(0.38)	7.68	(0.45)	12.42*(c)	(0.55)
Average FAFH expenditure per person ($)	8.95	(0.18)	3.11	(0.20)	9.68*(b)	(0.20)	4.78*(a)	(0.21)	2.93	(0.23)	5.88*(c)	(0.29)
Average FAFH expenditure for those with FAFH ($)	30.39	(0.46)	19.81	(0.28)	31.41*(b)	(0.49)	22.50*(a)	(0.65)	17.94	(0.77)	24.83*(c)	(0.88)
% with FAFH	57.67	(0.50)	46.05	(1.52)	59.11*(b)	(0.53)	47.33*(a)	(1.04)	42.79	(1.69)	50.03*(c)	(1.32)

Note: *(a), (b), and (c) represent differences between food-secure and food-insecure households (a), between food-secure FSP recipients and not FSP recipients (b), and between food-insecure FSP recipients and not FSP recipients (c), respectively. The significance level is at the 5% level. Estimation of means and standard errors used *Proc surveymeans* in SAS.

Table 2. Bivariate Probit Results of FSP Participation and Food Security Status

	FSP Participation (FSP = 1)				Food Security Status (Food Insecure = 1)			
	Coefficient	SE	Het[a]	SE	Status	SE	Het[a]	SE
Intercept	−0.55*	(0.05)[b]			−2.90*	(0.57)[b]		
Metro	−0.13*	(0.03)			0.08	(0.13)		
Northeast	0.11*	(0.05)			−0.29	(0.19)		
West	−0.01	(0.05)			0.60*	(0.19)		
South	0.02	(0.04)			0.36*	(0.16)		
Education	−0.22*	(0.03)			−0.49*	(0.14)		
White	−0.37*	(0.04)			−1.24*	(0.23)		
Hispanic	0.24*	(0.05)			1.51*	(0.28)		
Married	−0.52*	(0.04)			−1.48*	(0.25)		
Number of								
Children under 6	0.51*	(0.02)			0.64*	(0.14)		
Children between 6 and 13	0.38*	(0.02)			0.60*	(0.12)		
Children between 13 and 17	0.22*	(0.02)			0.52*	(0.13)		
Working male adults	−0.49*	(0.03)			−0.36*	(0.13)		
Nonworking male adults	0.17*	(0.08)			1.34*	(0.35)		
Working female adults	−0.33*	(0.03)			−0.18	(0.12)		
Nonworking female adults	0.35*	(0.07)			1.20*	(0.32)		
FSP participation					0.58	(0.67)		
Income			−1.26	(2.05)[b]			0.30*	(0.04)[b]
Correlation (ρ)			0.34*	(0.04)				
Log likelihood			−9,555					

[a] Heteroscedasticity-estimated coefficients.
[b] Standard errors (SE) in parentheses.
* Indicates significance at the 5% level.

having higher education, being white, and being married significantly decrease the probability of FSP participation and being food insecure. Being Hispanic and having a greater number of children (of all ages) increase the likelihood of FSP participation and being food insecure. The effect of younger children is greater than that of the older children. At the same time, the working status of male adults (being employed) significantly improves the household food security status as well as decreases FSP participation. The effect of female adults' working status on food security status is not significant, although working status does have a significant and negative effect in the FSP participation equation. All the signs are as expected.

These results are consistent with earlier findings: McKernan and Ratcliffe found a strong relationship between FSP participation and employment characteristics in both the pre– and the post–welfare reform periods based on the 1990 and 1996 panels of the Survey of Income and Program Participation data. They and others (such as Smallwood and Blaylock) also found that household composition, number of adults and children in the household, and economic conditions are important determinants of FSP participation.

The finding that FSP participation is endogenously related with food security status supports our conjecture that the two are affected by similar random shocks. After accounting for endogeneity, the estimated

coefficient on FSP participation is not statistically significant in its effect on the likelihood of being food insecure. This result is consistent with the earlier estimation of Gundersen and Oliveira and of Jensen. The lack of statistical significance in the independent effect of FSP participation on FI status indicates that FSP participation itself does not reduce food insecurity. Gundersen and Oliveira suggest that this finding may result from three possible factors: unobserved variables that affect both the decision to participate in the FSP and the propensity to receive food stamps, overreporting of food insufficiency by food stamp participants, and underreporting of food stamp participation by households that feel they have adequate food supplies. The significance of household income in the FI equation confirms that heteroscedasticity exists in the data; heteroscedasticity increases as income increases.

Table 3 presents the effects of FSP on total food expenditures. The variable π_1 is the variable of most interest. The statistical significance and positive sign of this variable indicates that FSP participation does increase total food expenditures of low-income households. As expected, income and relative prices (the food IPRI and nonfood IPRI), location, family structure, and other socioeconomic variables are statistically significant in the food expenditures equation. The marginal effects of one extra child on household food expenditure increase with the age of children and are largest for a child between 13 and 18 years of age. These results are also consistent with other literature. A consistent finding of previous research based on household food use data is that household size and composition have important effects on food expenditures. Larger households and households with certain types of members (e.g., teenage males) have been found to consume greater quantities of food, leading to higher food expenditures than is found for households of other sizes and/or compositions (Fraker).

The effects of FSP participation on the likelihood of eating out are presented in Table 4. The effect of FSP (π_1) on the probability of eating out is statistically significant. The significant and negative effect of π_1 indicates that households that participate in the FSP are less likely to eat out. The marginal effects of working adults are statistically significant and positive in determining the likelihood of eating out, especially for female working adults. Other variables significant in the equation include location, marriage status, race, and education. Previous studies have shown consistently that FSP participation decreases and employment status increases the possibility of eating out (e.g., Nayga and Capps). For this low-income population, the results are also consistent with the design of the FSP that encourages consumption of FAH, as discussed in the introduction.

Table 5 presents the results of FAFH based on NQAIDS. The parameter estimation of the FAH share equation can be derived based on the adding-up property. The probability of eating out (see PDF), food expendi-

Table 3. Effects of FSP on Total Food Expenditure

	Estimated Coefficient	Standard Error
Intercept	2.88*	(0.07)
Metro	0.054*	(0.01)
Northeast	0.07*	(0.01)
West	0.02	(0.01)
South	0.03*	(0.01)
Education	0.004	(0.01)
White	−0.0001	(0.01)
Hispanic	−0.02*	(0.10)
Married	0.36*	(0.01)
Number of		
Children under 6	0.18*	(0.01)
Children between 6 and 12	0.20*	(0.01)
Children between 13 and 18	0.21*	(0.01)
Male working adults	0.15*	(0.01)
Male nonworking adults	0.16*	(0.02)
Female working adults	0.13*	(0.01)
Female nonworking adults	0.15*	(0.02)
Food IPRI	−0.0005*	(0.0002)
Nonfood IPRI	0.0007*	(0.0003)
Log(Income)	0.10*	(0.005)
π_1	0.55*	(0.09)
R^2	0.40	

Note: Dependent variable: log (Total Food Expenditure), weighted least squares.
* Indicates significance at the 5% level.

Table 4. Estimated Effects on Likelihood of Eating Out

	Estimated Coefficient	Standard Error
Intercept	−0.26*	(0.11)
Metro	0.08*	(0.03)
Northeast	−0.35*	(0.04)
West	−0.15*	(0.04)
South	−0.16*	(0.03)
Education	0.39*	(0.03)
White	0.22*	(0.03)
Hispanic	−0.38*	(0.04)
Married	−0.08*	(0.03)
Number of	0.06*	(0.03)
Children under 6		
Children between 6 and 12	0.05*	(0.02)
Children between 13 and 18	0.10*	(0.03)
Male working adults	0.22*	(0.03)
Male nonworking adults	0.01	(0.07)
Female working adults	0.37*	(0.07)
Female nonworking adults	0.07	(0.07)
Log(Income)	0.02	(0.01)
π_1	−0.52*	(0.25)
Log likelihood	−7,691.33	

* Indicates significance at the 5% level.

Table 5. Estimated Effects on the Share of Food-Away-from-Home Expenditures

	Estimated Coefficient	Standard Error
CDF*Intercept	2.65*	(0.22)
CDF*Metro	0.02	(0.01)
CDF*Northeast	0.06*	(0.02)
CDF*West	0.03*	(0.02)
CDF*South	0.017	(0.016)
CDF*Education	0.07*	(0.015)
CDF*White	0.03	(0.03)
CDF*Hispanic	−0.05*	(0.02)
CDF*Married	−0.06*	(0.02)
CDF*No. of children between 6 and 12	0.01	(0.01)
CDF*No. of children between 13 and 18	0.08	(0.01)
CDF*No. of male working adults	0.07*	(0.01)
CDF*No. of male nonworking adults	0.04	(0.04)
CDF*No. of female working adults	0.03*	(0.01)
No. of female nonworking adults	−0.02	(0.04)
CDF*FAFH IPRI/FAH IPRI	0.004	(0.003)
CDF*(LEXP-LNP)	−0.74*	(0.09)
CDF*(LEXP-LNP)^2	0.19*	(0.03)
CDF*π_1	−0.55*	(0.13)
PDF	0.09*	(0.04)
Log likelihood	1,677	

Note: CDF and PDF refer to the cumulative density function and the probability density functions in Equation (10').
* Indicates significance at the 5% level.

tures (LEXP), and FSP participation (π_1) variables are significant in the FAFH expenditures equation. The significance of π_1 indicates that FSP participation does decrease the share of FAFH expenditure conditioned on whether the household does eat out. The probability of eating out has a positive and statistically significant effect on the share of FAFH in total food expenditures. Other significant variables, such as working adults (both male and female working adults), also have a significant effect on the share of FAFH.

Table 6 provides income and price elasticities based on results presented in Tables 3 and 5. Because of limited data, we can provide only the elasticities of IRPIs, values that indicate the effect of a 1% difference in the relative price indices between region A and region B on food expenditures, and income elasticities for the total food expenditure. Both income and price elasticities for total food are statistically significant, although relatively small—especially for the nonfood price index. The calculated income elasticity shows that a 1% increase in income would lead to an increase of 0.1% in total food expenditures.

Because the price index was not statistically significant in the FAFH equation, the price elasticities were not estimated. However, elasticities for both total food expenditures and the probability of FSP participation on FAFH and FAH shares are available. The estimated values of the food expenditure elasticities show that, conditional on eating out, a 1% increase in total food expenditures leads to an increase in both the FAH and the FAFH expenditures; FAH expenditures increase less than 1%, and FAFH expenditures

Table 6. Elasticities with Respect to Total Food Expenditure and Expenditures on FAFH and FAH

Variable	Total Food Expenditure	Standard Error	FAFH Expenditure	Standard Error	FAH Expenditure	Standard Error
Food IPRI	−0.04*	(0.01)				
Nonfood IPRI	0.05*	(0.02)				
Income	0.10*	(0.005)				
Food expenditure			1.48*	(0.19)	0.51*	(0.10)
Probability of FSP participation			−0.34*	(0.08)	0.29*	(0.07)

* Indicates significance at the 5% level (standard errors in parentheses).

increase more than 1%. Results in Table 6 also show that, conditional on eating out, a 1% increase in the probability of being an FSP recipient would lead to a decrease of 0.34% in FAFH expenditures and to an increase of about 0.29% in FAH expenditures. These results on FAH are also consistent with the range of estimates available from previous empirical studies (Fox, Hamilton, and Lin; Fraker).

Conclusions

Following the approach used by Gundersen and Oliveira, we accounted for the problem of endogeneity between FSP participation and food security status by using a bivariate probit model. Consistent with Gundersen and Oliveira, Jensen, and most of the recent studies, we did not find any significant effect of the FSP on food security status. However, we do find a positive relationship between food security status and FSP participation through random shocks, which suggests that FSP receipt is related with food security status. Both Nord, Andrews, and Carlson (2002, 2003, 2006) and Wilde caution that the relationship between food assistance programs and FI is complex because of the two-way causality and the dependence on data sets and estimation methods. Our results also show that FSP participation affects total food expenditures and that participation in the FSP reduces the likelihood of eating out among low-income households. Participation in the FSP does have a significant effect on FAFH consumption—both the probability and the expenditures on FAFH if the household eats out.

These results point to several potential policy implications. First, the association among FSP participation, food security status, food expenditure, working status, and FAFH consumption should be taken into consideration when FSP policies are being reviewed. As a program that provides resources to low-income households, the FSP leads to increases in expenditures on food. Although we find no evidence that the FSP reduces food insecurity, being in the FSP does increase food expenditures and does reduce the share of food expenditures on FAFH. A program directed to providing food at home does indeed help meet the needs of those who are insecure in accessing food.

Second, the results show that working status (the number of working males and females in the household) leads to higher food expenditures, more likely eating out and higher expenditures on FAFH. These findings confirm that working status entails higher food expenditures for these low-income households. For the working poor, recognition of the role of FAFH in meeting household food requirements would make the FSP more responsive to the needs of this target program group. The predicted effects suggest that some allowance for these higher costs would better meet the needs of working, low-income households and, for those making the transition from welfare to work, ease the transition.

Third, the cross-regional price elasticities and income elasticities provided in the article remind us that the effects of FSP on food

security status and food expenditures are different among regions. The elasticity differences estimated from this article can be used in various analytical procedures (i.e., simulation models) to evaluate the welfare effects of changes in domestic food program policies. Quantification of the welfare impacts of domestic food policies would be more meaningful by accounting for the cross-regional differences.

Fourth, our findings on the other determinants of FSP participation, FI, FAFH, and FAFH expenditures also have important policy implications. For instance, the fact that being married has negative effects on both the FSP participation and the FI status and a negative overall unconditional effect on the FAFH suggests that there could be food sharing within the family that helps reduce FI or economies of size in purchases of FAFH.

The economic significance of the food demand response to FSP participation provides an important message for policymakers: the FSP increases FAH spending. At the same time, FAFH is also an important food source for low-income families, and the FSP has a positive effect on food expenditures as well.

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APPENDIX

In the Rasch model, the probability of a specified response (e.g., right/wrong answer) is modeled as a function of person and item parameters. Specifically, in the simple Rasch model, the probability of a correct response is modeled as a logistic function of the difference between the person and item parameter. See Cohen et al. for details.

	Core Food Security Module Questions
1	Worried whether food would run out before got money to buy more.
2	The food that bought just did not last and did not have money to get more.
3	Could not afford to eat balanced meals.
4	Relied on only a few kinds of low-cost food to feed my child(ren) because running out of money to buy food.
5	Did you ever cut the size of your meals or skip meals because there was not money for food?
6	Could not feed my child(ren) a balanced meal because could not afford it.
7	Did you ever eat less than you felt you should because there was not enough money for food?
8	How often did you cut the size of your meals or skip meals because there was not enough money for food?
9	The child(ren) not eating enough because just could not afford enough food.
10	Were you ever hungry but did not eat because you could not afford enough food?
11	Did you lose weight because you did not have enough money for food?
12	Did you ever cut the size of your children's meals because there was not enough money for food?
13	Did you not eat for a whole day because there was not enough money for food?
14	Was your child ever hungry but you just could not afford more food?
15	How often did you or other adults in your household not eat for a whole day because there was not enough money for food?
16	Did your child(ren) ever skip a meal because there was not enough money for food?
17	How often did your child(ren) skip a meal because there was not enough money for food?
18	Did your child(ren) ever not eat for a whole day because there was not enough money for food?