FOOD STAMP PROGRAM PARTICIPATION AND FOOD INSECURITY: AN INSTRUMENTAL VARIABLES APPROACH

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Abstract

The relationship between Food Stamp Program participation and household food insecurity is investigated using data from the 1996-97 National Food Stamp Program Survey. Endogeneity of FSP participation is accommodated with an instrumental variables approach. Results suggest participation in the FSP reduces food insecurity, which is in sharp contrast to other findings reported in the literature. Sociodemographic variables also play important roles in FSP participation and food insecurity and have important policy implications.

Key words: food insecurity, food stamp program, instrumental variables, National Food Stamp Program Survey.

JEL classification: I38, C34, C35

The U.S. Department of Agriculture (USDA) implements 16 Food Assistance and Nutrition Programs as a "food safety net" to provide low-income families and children with access to healthy diets. The 16 programs were funded at a level of $42.9 billion in fiscal year (FY) 2004. An estimated one in five Americans participates in one or more programs at some point in a typical year. Still, the most recent food security survey, sponsored by the USDA, indicates that 11.1 percent of U.S. households (12.1 million people) were uncertain of having or unable to acquire sufficient food to meet the nutritional needs of all their members during the year due to lack of financial or other resources (Nord, Andrews, and Carlson 2003; USDA-ERS 2005). Approximately 3.5 percent of U.S. households (3.8 million people) were food insecure with hunger, and about 7.6 percent (8.3 million people) were food insecure without hunger. There were 34.9 million people in 2002 who lived in households where at least one person was food insecure. According to the National Food Stamp Program Survey (NFSPS), a sample containing low-income households (those below 150% of the poverty level) used in the current study, 26.2% of the sample was food insecure during the 30 days prior to the interviews.

The Food Stamp Program (FSP) is designed to provide food assistance via benefits payment to households that meet the eligibility criteria. It is the largest component of the USDA's nutrition program. The FSP budget for FY 2004 was $25.6 billion, comprising nearly 60 percent of the Department's food assistance budget (USDA 2004). Within the food insecure population, there are food stamp eligible households that participate and do not participate in the program. With so much of the nation's food assistance resources distributed by the FSP, it is important that policy makers have improved analytical tools for evaluating program participation and for estimating the impacts of FSP participation on the food security status of program participants.

There is a body of literature pertaining to the determinants of food security status in the U.S., including the role of the FSP. Before the inclusion by USDA's Food and Nutrition Service (FNS) of a set of questions about the adequacy of foods consumed called the "food security module" in the 1995 Current Population Survey (CPS), earlier studies of food insecurity addressed related issues, such as food insufficiency. Rose and Oliveira (1997a, 1997b) used the USDA's 1989-91 Continuing Survey of Food Intakes by Individuals (CSFII) to investigate the association of self-reported household food insufficiency with nutrition under-intakes (below 50% of the recommended daily allowance) using logit analysis. Food insufficiency was significantly associated with under-intakes of a number of nutrients among adult women and the elderly, while there was no evidence of such association among preschoolers.

The above studies addressed food insufficiency for the general U.S. population. Gundersen and Oliveira (2001) investigated food insufficiency and FSP participation using data from the 1991 and 1992 panels of the Survey of Income and Program Participation (SIPP). Using a simultaneous equations probit model, they found that FSP participants had the same probability of food insufficiency as nonparticipants.

More recent studies utilized the concept of food insecurity (FI) instead of food insufficiency. The 1996-97 NFSPS collected data for 18 of the CPS FI module questions, from which FI scores and categories were derived. Based on the NFSPS data, results of logistic analysis by Cohen et al. (1999) found associations between FI and household characteristics similar to those previously found in the literature. For instance, using data from the 1989-91 CSFII and the 1992 SIPP, Rose, Gundersen, and Oliveira (1998) found that households with higher incomes, homeowners, households headed by a high school graduate, and elderly households were less likely to be food insufficient, and that food stamp benefit levels were

inversely associated with food insufficiency. Based on data from the Food Security Supplements to the CPS, Nord (2001) noted that households participating in the FSP registered much higher rates of FI and hunger than nonparticipating low-income households (likely due to self-selection), and that households receiving food stamps registered almost no change in the measured prevalence of FI or hunger between 1995 and 1999.

Only one study has shown a clear positive association between FI and the use of public assistance. Borjas (2004) exploited a difference in state policies regarding benefits for immigrant populations after welfare reform along with the CPS FI data, to show that a 10 percent cut in the fraction of the population that receives public assistance increased the percent of FI households by about 5 percent.

Kabbani and Yazbeck (2004) pooled multiple years of data from the CPS, using a two-stage estimation procedure to control for endogenous program participation. They estimated a linear probability model for FSP participation and a multinomial logit model for FI. Four state-level policy variables, presumed to be associated with the FSP decision but uncorrelated with the error term of the food security equation, were used to identify parameters in the FSP participation equation. Results suggested that participation in the FSP appeared to moderate the observed differences for households with children aged 5 to 18, but not significantly. Using only households that had experienced hunger in the past year and logit analysis, Kabbani and Kmeid (2005) found that the FSP benefit amount and participation in the National School Lunch program reduced the probability of being hungry in the past 30 days. The apparent inconsistency among previous results suggests that a more careful investigation between FSP participation and FI is needed.

This paper presents the results of a study of participation in the FSP and its relationship to

FI, using an instrumental variables approach. The NFSPS data offer a unique opportunity for such a pursuit. Not only do they include the 18 items of the food security module that are used for annual monitoring of FI, they also include follow-up questions that allow the examination of FI status in the 30 days preceding the interviews (Nord 2002). As in other studies FSP participation is measured for the prior month. Measuring FI status based on questions that reference the past 30-days improves estimation of FSP impacts because both endogenous variables are measured over the same time period. Only Kabbani and Yazbeck (2004) and Kabbani and Kmeid (2005) have examined the impact of FSP on FI status over the past 30 days. State-level variations in electronic benefit transfer (EBT) adoption and certification periods provide better instruments than those used in previous studies except Kabbani and Wilde (2003) and Kabbani and Yazbeck (2004). The methodology employed in this paper allows for the endogeneity of FSP participation and in modeling FI status, and the results suggest that participation in the FSP improves FI status.

Econometric Model

In preliminary analyses we estimated simpler models of the FI equation, in which alternative forms (continuous, censored and binary) of FI were used as the dependent variable and FSP as an exogenous variable along with other explanatory variables. Results suggested that the effect of FSP on FI is mostly insignificant. These mixed results prompted a more careful analysis of the relationship between FSP and FI. As an income supplement, the FSP provides additional resources for households to buy food, thereby improving nutritional well being and consequently improving health. Yet, FSP participation is voluntary and is an individual decision. On the one hand, FI may prompt an eligible household to begin receiving food stamps. On the other hand,

FSP participation might improve FI. Clearly, the determination of causality, as opposed to simple correlation, can be quite difficult in the case of these two variables. To confront this important issue, we use an instrumental variables approach with binary FSP participation and a FI outcome which is censored at zero. To motivate such a model, consider first a simple equation for FI (y_2), with observation subscript suppressed,

(1) $$y_2 = \gamma y_1 + \mathbf{x}'\boldsymbol{\beta}_1 + \mathbf{w}'\boldsymbol{\beta}_2 + \mathbf{r}'\boldsymbol{\beta}_3 + v'$$

where y_1 is a binary variable for FS participation, **x** and **w** are vectors of observable traits such that **x** affects both FI and FS, **w** determines FI only, and **r** is a vector of unobservable characteristics which affect both FI and FS; γ is a scalar parameter, $\boldsymbol{\beta}_1$, $\boldsymbol{\beta}_2$ and $\boldsymbol{\beta}_3$ are conformable parameter vectors, and v' is the random error. In a single-equation framework, one would estimate

(2) $$y_2 = \gamma y_1 + \mathbf{x}'\boldsymbol{\beta}_1 + \mathbf{w}'\boldsymbol{\beta}_2 + v$$

with error term

(3) $$v = \mathbf{r}'\boldsymbol{\beta}_3 + v'.$$

OLS estimation of Equation (2) produces a biased estimate for γ, the effect of FS, because $E(v \mid FS, \mathbf{x}) \neq 0$. One remedial measure is to estimate the FI equation with an instrumental variable approach. In addition, to accommodate the discrete nature of the FI and FS variables for the current application, the above FS and FI variables (y_1 and y_2) are more conveniently replaced with their latent counterparts y_1^* and y_2^*, so that

(4) $$y_2^* = \gamma y_1^* + \mathbf{x}'\boldsymbol{\beta}_1 + \mathbf{w}'\boldsymbol{\beta}_2 + u_2$$

and

(5) $$y_1^* = \mathbf{x}'\boldsymbol{\alpha}_1 + \mathbf{z}'\boldsymbol{\alpha}_2 + u_1$$

where **z** is a vector of observable characteristics (instruments) determining FS participation only, $\boldsymbol{\alpha}_1$ and $\boldsymbol{\alpha}_2$ are conformable parameter vectors, and the error terms $[u_1, u_2]'$ reflect stochastic innovations or unmodeled random effects which are assumed to be distributed as bivariate normal with zero means, correlation ρ, variances $[\sigma_1^2, \sigma_2^2]'$, and hence covariance matrix

$$\boldsymbol{\Sigma} = \begin{bmatrix} \sigma_1^2 & \rho\sigma_1\sigma_2 \\ \rho\sigma_1\sigma_2 & \sigma_2^2 \end{bmatrix}. \tag{6}$$

The correlation (ρ) may account for possible omitted common factors in the two equations for which instruments are needed? The reduced form equation system constitutes Equation (5) and

$$y_2^* = \mathbf{x}'(\gamma\boldsymbol{\alpha}_1 + \boldsymbol{\beta}_1) + \mathbf{z}'(\gamma\boldsymbol{\alpha}_2) + \mathbf{w}'\boldsymbol{\beta}_2 + u_2^* \tag{7}$$

where $u_2^* = \gamma u_1 + u_2$ and the error vector $[u_1, u_2^*]'$ is distributed as bivariate normal with zero means and covariance matrix

$$\boldsymbol{\Omega} = \begin{bmatrix} \sigma_1^2 & \beta_1\sigma_1^2 + \rho\sigma_1\sigma_2 \\ \beta_1\sigma_1^2 + \rho\sigma_1\sigma_2 & \beta_1^2\sigma_1^2 + \sigma_2^2 + 2\beta_1\rho\sigma_1\sigma_2 \end{bmatrix} = \begin{bmatrix} \omega_1^2 & \\ \tau\omega_1\omega_2 & \omega_2^2 \end{bmatrix} \tag{8}$$

In our application, FI is censored and FSP participation is binary which, based on the reduced form equations (5) and (7), is characterized as

$$\begin{aligned} y_1 &= 1 \quad \text{if} \quad y_1^* > 0 \\ &= 0 \quad \text{otherwise} \\ y_2 &= y_2^* \quad \text{if} \quad y_2^* > 0 \\ &= 0 \quad \text{otherwise}. \end{aligned} \tag{9}$$

Because outcomes of y_1 are binary, the standard deviation σ_1 is normalized at unity, and therefore, $\omega_1 = \sigma_1 = 1$. The other components of the covariance matrix $\boldsymbol{\Omega}$ in Equation (8) can be simplified as well by dropping ω_1. Maddala (1983, p. 246) discussed a two-step estimation procedure for a similar model in which latent variable y_2^* also appears in the latent equation for y_1^*. We develop a more efficient maximum likelihood (ML) estimation procedure. To construct the sample

likelihood function, denote the deterministic components of the right-hand sides of Equations (5) and (7) as $\mathbf{H}'\Pi_1 + u_1$ and $\mathbf{H}'\Pi_2 + u_2^*$, respectively, where $\mathbf{H} = [\mathbf{x}', \mathbf{z}', \mathbf{w}']'$, $\Pi_1 = [\boldsymbol{\alpha}_1', \boldsymbol{\alpha}_2', 0]'$ and $\Pi_2 = [(\gamma\boldsymbol{\alpha}_1 + \boldsymbol{\beta}_1)', \gamma\boldsymbol{\alpha}_2', \boldsymbol{\beta}_2']'$. In addition, define a dichotomous indicator $\kappa_1 = 2y_1 - 1$, and let $\phi(\cdot)$ and $\Phi(\cdot)$ be the univariate standard normal probability density function (pdf) and cumulative distribution function (cdf), and $\Psi(\cdot,\cdot\,;\tau)$ be the bivariate standard normal cdf with error correlation τ. Then, the sample likelihood function is

$$L = \prod_{y_2=0} \Psi\left(\kappa_1 \mathbf{H}'\Pi_1, \frac{-\mathbf{H}'\Pi_2}{\omega_2}; -\kappa_1\tau\right) \prod_{y_2>0} \frac{1}{\omega_2}\phi\left(\frac{y_2 - \mathbf{H}'\Pi_2}{\omega_2}\right)\Phi\left(\kappa_1 \frac{\mathbf{H}'\Pi_1 + \tau(y_2 - \mathbf{H}'\Pi_2)/\omega_2}{(1-\tau^2)^{1/2}}\right) \tag{10}$$

Data

Data are drawn from the 1996-97 NFSPS, conducted for FNS by Mathematica Policy Research, Inc. The objectives of the survey were to assess the quality of FSP customer service offered to current and potential clients, to gain a perspective on the food shopping opportunities of FSP participants and other low-income households, and to examine food security of FSP participants (Cohen et al. 1999).

The NFSPS conducted computer-assisted telephone interviews (CATI) of FSP participants and income-eligible non-participants from a FSP list frame (n = 1,042) and a random digit dialing (RDD) sample (n = 1,319). After excluding observations with missing information on important variables (e.g., stigma variables), a final sample of 2,179 observations was used for analysis. The FSP list frame included only FSP participants, and the RDD sample included both FSP participants and non-participants.[1] The surveys, conducted between June 1996 and January 1997, collected an array of economic, social and demographic data designed to evaluate the

decision making for FSP participation among income-eligible households.

The first endogenous variable is FSP participation, which is coded as binary, one for households reporting receipt of FSP benefits in the past 30 days and zero otherwise. The other endogenous variable is FI, which was calculated from each respondent's answers to the 30-day follow-up questions to the FI module and contained a large number of zeros. The FI variable is, therefore, treated as a censored variable, with values ranging from 4.92 to 10.85 and a sample means of 7.36 (for FSP non-participants) and 6.88 (for FSP participants) among the food insecure. Accommodating censoring in the FI variable is important because the 30-day FI scale was estimated using the Rasch methodology, and thus, the household scale scores for households that did not respond affirmatively to any of the items in the scale are recorded as (censored at) zeros (David made some changes here. Does this still sound right, Margaret?). For the sample, the weighted mean of FSP participation is 67 percent, which is close to the national FSP participation rate of 64 percent for September 1996 (table 1).

For the current system the nonlinear identification criteria are met even without exclusion restrictions due to the functional form and distributional assumptions for the system, although the non-linear functional form often fails to generate sufficient variation to identify the coefficients. To avoid over-burdening the nonlinear functional forms for parameter identification, some exclusion restrictions are useful. While researchers have struggled with a lack of credible exclusion restrictions, we have some relevant variables that can serve as instruments. Explanatory variables used in both the FSP participation and FI equations include household shopping frequency, marital status of the household head (married, divorced, widowed), gender (female), household type (single), home ownership (homeowner), race (Black, other race), ethnicity (Hispanic), education (high school, more than high school), number of dependent children, presence of an

elderly person, urbanization of residence (urban, rural), gross income, and region (Midwest, South, and West).

Variables used only in the FI equation are travel time to the store where most food shopping is done and a binary indictor of dissatisfaction with shopping in their neighborhoods. These variables are included only in the FI equation because they do not directly affect respondents' FSP decisions but could change their FI status due to access to grocery stores.

Four sets of variables are included in the FSP equation only, the a priori assumption being that these variables do not affect FI, and even if they do, they are more likely to do so by way of participation in FSP. The first variable is a binary indicator of whether the respondent resides in a state with a recertification period shorter than 6 months. Short recertification periods require more frequent recertification of FSP eligibility so they may discourage food stamp participation. The second variable is the percentage of FSP benefits issued by EBT in the respondent's state. The EBT system may help encourage participation by reducing stigma in the use of food stamps, though the system also makes it more difficult for persons unfamiliar with debit cards to access benefits (e.g., Kabbani and Wilde 2003). The third variable used in the FSP equation is the population share of admitted immigrants. Immigrants were qualified for FSP benefits before the Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) of 1996 eliminated food stamp eligibility for approximately 825,000 legal immigrants. Even though the data for this study were collected before the immigrant restrictions went into effect, there may have been a "chilling effect" during the data collection period that inhibited immigrant households from seeking assistance through the FSP. Finally, a set of four stigma variables is included to capture the "disutility from participation in a welfare program" based on responses to a series of items in the NFSPS related to stigma (Moffitt 1983, p. 1023).

These are four dummy variables indicating: “avoid telling people (about receiving food stamps)”, “shop at stores where (they are) unknown”, “(treated with) disrespect shopping (with food stamps)”, and “(treated with) disrespect telling (people about being on food stamps)”. Detailed definitions and sample statistics of all variables are presented in table 1.

Results

The model is estimated by maximizing the likelihood function (10), weighted by the sample weights.[2] [Margaret to elaborate on the weighting variable if possible, perhaps earlier when the weighted sample statistics were presented.] ML estimates are presented in table 2. One empirical issue is estimates are often not robust with respect to the explanatory variables used. Our use of the four stigma variables in the FSP participation equation is supported by economic theory (Moffitt 1983), and there is no obvious reason why these variables would affect the FI equation directly. The other instruments include three state-level variables (EBT percentage, short recertification, and immigrants). We investigate robustness of the parameter estimates by excluding these state-level variables from the FSP participation equation, but find no discernable differences in parameter estimates. As the stigma and state-level variables are jointly significant in the FSP participation equation, our analysis below is based on this fully-specified model.

The estimated error correlation (ρ) is statistically significant at the 5% level, which suggests that the two structural equations should be estimated jointly because the unobserved factors in the two equations are correlated and affect the propensity to participate in the FSP and FI in the same direction. Of the two variables used in the FI equation only, dissatisfaction about shopping environment in the area is positive and significant at the 1% level, whereas travel time to store (where most shopping is made) is insignificant. FSP has a significant and negative

coefficient in the FI equation at the 1% level, suggesting that participation in the FSP ameliorates food insecurity. This negative effect of FSP participation on FI is in sharp contrast to that reported in a growing body of literature. Huffman and Jensen (2003) and Gundersen and Oliveira (2001), for instance, found that FSP participation did not affect FI.[3] These two sets of results were based on two-step estimates of a simultaneous-equations model with binary FSP and FI (cf. Mallar 1977). Without directly estimating the effect of FSP participation on FI status, Jensen (2002) found evidence that FSP participation and FI were affected in the same direction by random shocks. Gibson-Davis and Foster (2005) used propensity score matching and concluded there was no impact of FSP participation on the likelihood of being food insecure, although they did find a reduction in the level of FI associated with participation in the FSP.

Since we find a very different result in this study, in terms of the effect of FSP on FI, from that reported in the literature, we explored the causes of this difference and summarize the findings here. First, we estimated a few variations of our model with both two-step and ML procedures using the same sample: (1) one with the latent FI variable in the FSP participation equation as well;[4] (2) models in which the FI variable is re-coded as binary and with and without the FI variable in the FSP participation equation; (3) the above models as well as our major model (Equations (4) and (5)) with alternative exclusion restrictions (including one with only one stigma variable in the FSP participation equation as in Gunderson and Oliveira (2001)).[5] We obtained fairly robust estimates — negative effect of FSP participation on FI, which are similar to those reported in this paper. Second, we re-estimated the binary-binary model using a sample similar to that of Gundersen and Oliveira (2001), also from the 1991–92 SIPP, with an identical set of variables but with the ML procedure; we replicated the insignificant effects of FSP participation on FI and FI on FSP participation reported by Gundersen and Oliveira (2001). Such

similar results are not surprising given that two-step estimates are consistent and that ML estimation only increases in statistical efficiency. We conclude from this analysis that our results are fairly robust with respect to specifications, and that our different findings are not simply artifacts of our ML estimation procedure, but rather the results of the unique data we used. We might note that 26.2% of our sample is food insecure, whereas the sample in Gundersen and Oliveira (2001) contains only 5.8% food insufficient individuals.

The definitions of the reduced-form parameters above, the correlation between the error terms in the structural and reduced-form equations, and the very complex forms of the probability, conditional and unconditional mean expressions derived below suggest that the effects of the exogenous explanatory variables cannot be properly quantified and determined without calculating marginal effects. We derive relevant conditional means for the FI variable. Following the conditional moments of the truncated bivariate normal distribution (Rosenbaum 1961), the mean of y_2 conditional on being food insecure ($y_2 > 0$) and on FSP participation ($y_1 = 1$, $\kappa_1 = 1$) or non-participation ($y_1 = 0$, $\kappa_1 = -1$) are

$$
\begin{aligned}
&E(y_2 \mid \kappa_1 v_1 > -\kappa_1 \mathbf{H}'\Pi_1, v_2 > -\mathbf{H}'\Pi_2) \\
&= \mathbf{H}'\Pi_2 + \omega_2 \left[\Psi(\kappa_1 \mathbf{H}'\Pi_1, \mathbf{H}'\Pi_2 / \omega_2; \kappa_1 \tau)\right]^{-1} \\
&\times \left\{ \phi(\mathbf{H}'\Pi_2 / \omega_2) \Phi\left(\frac{\kappa_1 \mathbf{H}'\Pi_1 - \kappa_1 \tau \mathbf{H}'\Pi_2 / \omega_2}{(1-\tau^2)^{1/2}} \right) \right. \\
&\left. + \kappa_1 \tau \, \phi(\kappa_1 \mathbf{H}'\Pi_1) \Phi\left(\frac{\mathbf{H}'\Pi_2 / \omega_2 - \tau \mathbf{H}'\Pi_1}{(1-\tau^2)^{1/2}} \right) \right\}.
\end{aligned}
\tag{11}
$$

Based on equation (11), the effects of FSP participation on FI are

$$
\begin{aligned}
\Delta y_2 = \; & E(y_2 \mid \kappa_1 v_1 > -\kappa_1 \mathbf{H}'\Pi_1, v_2 > -\mathbf{H}'\Pi_2) \mid_{\kappa_1 = 1} \\
& - E(y_2 \mid \kappa_1 v_1 > -\kappa_1 \mathbf{H}'\Pi_1, v_2 > -\mathbf{H}'\Pi_2) \mid_{\kappa_1 = -1}
\end{aligned}
\tag{12}
$$

conditional on being food insecure. Evaluated at the weighted sample means of all exogenous variables, results suggest that among the food insecure, the predicted FI score is 5.81 (S.E. = 0.22)

for FSP non-participants and 5.41 (S.E. = 0.19) for participants, suggesting that participation in the FSP decreases the FI score by 0.40 (S.E. = 0.15) among those who are food insecure. This effect of FSP participation is small relative to the mean FI score of 7.05 among the food insecure.

The effects of exogenous variables on the probabilities of FSP participation and FI are calculated by differentiating a number of conditional and marginal probabilities, following a procedure similar to that for the bivariate probit model (Christofides, Stengos, and Swidinsky 1997; Christofides, Hardin, and Stengos 2000*).* Based on the reduced-form equations (5) and (7) and the censoring rule (9), the joint probabilities of alternative outcomes for FSP participation and FI are

$$\Pr[y_1 \in (0,1), d_2 \in (0,1)] = \Psi\left(\kappa_1 \mathbf{H}'\Pi_1, \frac{\kappa_2 \mathbf{H}'\Pi_2}{\omega_2}; \kappa_1\kappa_2\tau\right) \tag{13}$$

where $d_2 = 1(y_2 > 0)$ and $\kappa_2 = 2d_2 - 1$. Alternative conditional and marginal probabilities can be defined using (13). For instance, the marginal probability of FI is $\Phi(\mathbf{H}'\Pi_2 / \omega_2)$, and the probability of being food insecure conditional on FSP non-participation is $\Psi(-\mathbf{H}'\Pi_1, \mathbf{H}'\Pi_2 / \omega_2; -\tau) / \Phi(-\mathbf{H}'\Pi_1)$. The marginal effects of exogenous variables, along with their standard errors derived by the delta method (Rao 1973, p. 388), are presented in table 4. Note that although the stigma variables, EBT percentage, immigrants and short recertification periods are not used in the structural equation for FI, they do appear as exogenous variables in the reduced-form equation for FI. Likewise, travel time to store and dissatisfaction with shopping in the neighborhood, used only in the FI equation, also appear in the reduced form for FSP participation. This highlights the importance of calculating the net marginal effects of exogenous variables from the reduced-form equations.

The marginal effects of most variables on the probability of FSP participation, while

different in magnitudes, are qualitatively consistent in signs and significance whether they are conditional or unconditional on FI. This is also the case with the marginal effects of variables on the probabilities of FI. Higher income discourages participation in the FSP, whereas shopping frequency has a positive effect on FSP participation, conditional or unconditional on FI. Short recertification requirement discourages participation in the FSP.

Among the variables used only in the FI equation, dissatisfaction with shopping environment in the neighborhood contributes to participation in the FSP.

Among the instruments for the FSP participation equation, three of the four stigma variables have significant effects on FSP participation. Surprisingly, individuals who have avoided telling people about being on food stamps are more likely to participate in the FSP, whereas the effects of "shop where they are not likely to be known" and "having experienced disrespect while telling people about being on food stamps" have negative effects on FSP participation. The mixed effects of these component stigma variables suggest stigma effects in FSP participation are likely to be disguised by using a summary stigma index variable (e.g., Gundersen and Oliveira 2001).

The other contributing factors to FSP participation are the number of dependent children, shopping frequency, being female, residing in a single-headed household, being black and dissatisfaction with the shopping environment in the neighborhood. Higher income, owning a home and residing in an urban area all discourage participation in the FSP, as do residing in the Midwest, being married and being widowed. Surprisingly, presence of the elderly has no effect on FSP participation. While simple bivariate comparisons have consistently shown that FSP participation and FI are particularly low for this age group, Gundersen and Oliveira (2001) found that after controlling for FI, the coefficient of elderly became insignificant, i.e., households with

an elderly present were no less likely to participate in FSP than other households.

The more notable effects on FI are seen in income, with an increase of $10,000 increasing the probability of FI by 0.32 and 0.34, conditional on FSP participation and non-participation respectively, all else equal.[6] The positive effect of income on the probability of FI is somewhat counter-intuitive [Eastwood comments: Could this be due to having to drop out because the household is less likely to meet the income eligibility criterion?].

Other variables that have positive effects on the probability of FI are stigma variables "shop where unknown" and "disrespect-telling", being separated or divorced, being widowed, of the other races, short recertification requirement and dissatisfaction about the shopping environment. Factors that decrease the probability of FI are avoid telling people about receiving food stamps, presence of the elderly, residing in the rural area, being a homeowner, being married, residing in a single-headed household, being Asian, and being Hispanic. Negative effects of the presence of an elderly person in the household on the probability of FI were also reported by Gundersen and Oliveira (2001).

We also calculate the marginal effects of exogenous variables on FI based on a number of conditional and unconditional means. Using (11) and noting that

$$\Pr(\kappa_1 v_1 > -\kappa_1 \mathbf{H}'\Pi_1, v_2 > -\mathbf{H}'\Pi_2) = \Psi(\kappa_1 \mathbf{H}'\Pi_1, \mathbf{H}'\Pi_2 / \omega_2; \kappa_1 \tau)$$

$$E(y_2 \mid v_1 \le -\mathbf{H}'\Pi_1, v_2 \le -\mathbf{H}'\Pi_2) = E(y_2 \mid v_1 > -\mathbf{H}'\Pi_1, v_2 \le -\mathbf{H}'\Pi_2) = 0$$

which follow from the censoring rules in equation (9), the unconditional mean of y_2 is

$$\begin{aligned} E(y_2) = \quad & \Psi(- \ \mathbf{H}'\Pi_1, \mathbf{H}'\Pi_2 / \omega_2; \tau) E(y_2 \mid v_1 \le -\mathbf{H}'\Pi_1, v_2 > -\mathbf{H}'\Pi_2) \\ & + \Psi(\quad \mathbf{H}'\Pi_1, \mathbf{H}'\Pi_2 / \omega_2; \tau) E(y_2 \mid v_1 > -\mathbf{H}'\Pi_1, v_2 > -\mathbf{H}'\Pi_2). \end{aligned} \tag{14}$$

Using (14) and noting that $\Pr(y_2 > 0) = \Phi(\mathbf{H}'\Pi_2 / \omega_2)$, the mean of y_2 conditional on food insecurity is

(15) $$E(y_2 \mid y_2 > 0) = E(y_2) / \Pr(v_2 > -\mathbf{H}'\Pi_2) = E(y_2) / \Phi(\mathbf{H}'\Pi_2 / \omega_2) .$$

Marginal effects are obtained by differentiating equations (11), (14) and (15) and the results are presented in table 5.

An examination of the marginal effects in table 5 suggests that the effects of variables on FI are qualitatively similar whether conditional or unconditional on FSP participation and/or FI, and that these effects differ only by magnitudes. All else equal, as gross household income increases by $10,000, the FI level increases by between 2.24 (conditional on FSP participation and food insecurity) and 2.70 (unconditional), whereas presence of an elderly person contributes to an FI score of between 0.9 and 1.0. Other variables that contribute to FI are separated or divorced, widowed, shop where unknown, disrespect telling, short recertification and dissatisfaction about shopping environment. Factors that ameliorate FI are home ownership, being married, single-headed household, of the other races, being Hispanic, and avoiding telling people.

Concluding Remarks

We find that participation in the FSP reduces FI. Our results are in sharp contrast to findings reported in the existing empirical literature, which suggests predominantly insignificant or non-existent relationships between FSP and FI (e.g., Gundersen and Oliveira 2001; Gibson-Davis and Foster 2005; Huffman and Jensen 2003; Jensen 2002). It was, perhaps, due to this controversial set of findings that Nord, Andrews, and Carlson (2004) cautioned that the relationship between food assistance programs and FI is complex due to the two-way causality. The causality issue was examined in the present study by estimating an instrumental variables model of FSP participation and FI. The results we find suggest that the lack of association between FSP

participation and FI in previous studies (and in our preliminary analysis) is likely due to the failure to accommodate reversed causality, sampling weights, and the error covariance structure.

On the empirical front, as in Borjas (2004), the state-level FSP policy variables used in this study have greatly improved the quality of instruments for a model which would have been difficult to estimate without them, and enabled us to draw more policy-relevant conclusions. We conclude that a short recertification period reduces an FSP eligible individual's likelihood to participate in the FSP because of increased transaction costs. However, no significant effect was found for EBT implementation, which may be related to the combined effect of reduced stigma and reticence to use them due to less or no experience with debit or credit cards.

The other determinants of FSP participation and FI have important policy implications as well. For instance, the fact that individuals residing in households with an elderly person present and children under 18 years of age who are food insecure have lower FSP participation rates than others suggests that these segments of the population can be targeted for promotion of FSP participation which, in reference to the negative effect of FSP participation on FI, in turn can help reduce food insecurity among these individuals. Being married and owning a home both have negative effects on both the FSP participation, the FI status, and the conditional and unconditional FI scores, which suggest that there could be food sharing within the family that helps to reduce FI. The results suggest that the government would have a good reason to encourage marriage and home buying as a means of reducing food insecurity. Establishment of more easily accessible and friendly shopping facilities may also improve consumer satisfaction with shopping experiences in their neighborhoods, which will help reduce food insecurity.

Footnotes

1 All sample statistics and empirical estimation were weighted to correct for different sample designs and ratios of sampling in the FSP list frame and the RDD sample. [I see that we do have a statement about sample weight; maybe this is good enough.]

2 The model was estimated with alternative initial values, including single-equation OLS, probit and Tobit estimates for the exogenous model (i.e., with observed FSP in the FI equation) and two-step estimates for the system, and all converged to the same estimates.

3 The model used in Gundersen and Oliveira (2001) and Huffman and Jensen (2003) was based only on binary FI (and FSP) information and was estimated with a two-step procedure suggested by Mallar (1977), which is less efficient than the maximum likelihood procedure developed here.

4 A model with FI in the FSP participation equation relates better to the simultaneous-equations models estimated in other studies (Gundersen and Oliveira 2001; Huffman and Jensen 2003), although a more appropriate FI variable to explain FSP participation would be a lagged variable which is not available in our single cross section. Including FI in the FSP participation equation complicates the reduced form equations (5) and (7) and the error covariance matrix (8) only slightly. In fact, our model can be viewed as a restricted version of this model in which coefficient of FI in the FSP participation equation is zero.

5 Sample likelihood function for the binary-binary model can be constructed from the sample reduced form equations and is available upon request.

6 Note that these marginal effects of income do not vary with income. A squared term of income was included in both the FSP and FI equations but was insignificant.

References

Borjas, G.J. 2004. "Food Insecurity and Public Assistance." *Journal of Public Economics* 88(7-8):1421−43.

Christofides, L.N., T. Stengos, and R. Swidinsky. 1997. "On the Calculation of Marginal Effects in the Bivariate Probit Model." *Economics Letters* 54(3):203−8.

Christofides, L.N., J.W. Hardin, and T. Stengos. 2000. "Corrigendum to 'On the calculation of marginal effects in the bivariate probit model'." *Economics Letters* 68(3):339.

Cohen, B., J. Ohls, M. Andrews, M. Ponza, L. Moreno, A. Zambrowski, and R. Cohen. 1999. "*Food Stamp Participants' Food Security and Nutrient Availability*." Washington DC, Mathematica Policy Research, Final Report submitted to USDA's Food and Nutrition Service.

Gibson-Davis, C.M., and E.M. Foster. 2005. "A Cautionary Tale: Using Propensity Scores to Estimate the Effect of Food Stamps on Food Insecurity." Institute for Research on Poverty Discussion Paper No. 1293-05, University of Wisconsin-Madison.

Gundersen, C., and V. Oliveira. 2001. "The Food Stamp Program and Food Insufficiency." *American Journal of Agricultural Economics* 83(4):875–87.

Huffman, S.K., and H.H. Jensen. 2003. "Do Food Assistance Programs Improve Household Food Security? Recent Evidence from the United States." CARD Working Paper 03-WP 335, Iowa State University.

Jensen, H.H. 2002. "Food Insecurity and the Food Stamp Program." *American Journal of Agricultural Economics* 84(5):1215−28.

Kabbani, N.S., and P.E. Wilde. 2003. "Short Recertification Periods in the U.S. Food Stamp Program." *Journal of Human Resources* 38 (Suppl.):1112−38.

Kabbani, N.S., and M. Yazbeck. 2004. "The Role of Food Assistance Programs and Employment Circumstances in Helping Households with Children Avoid Hunger." Institute for Research on Poverty Discussion Paper No. 1280-04, University of Wisconsin-Madison.

Kabbani, N.S., and M.Y. Kmeid. 2005. "The Role of Food Assistance in Helping Food Insecure Households Escape Hunger." *Review of Agricultural Economics* 27(3):439−45.

Maddala, G.S. 1983. *Limited Dependent and Qualitative Variables in Econometrics*. New York, NY: Cambridge University Press.

Mallar, C.D. 1977. "The Estimation of Simultaneous Probability Models." *Econometrica* 45(7):1717−22.

Moffitt, R. 1983. "An Economic Model of Welfare Stigma." *American Economic Review* 73(5):1023−35.

Nord, M. 2001. "Food Stamp Participation and Food Security." *FoodReview* 24(1):13–19.

Nord, M. 2002. *A 30-day Food Security Scale for CPS Food Security Supplement Data*. Washington DC: U.S. Department of Agriculture, Economic Research Service, Electronic Publications from the Food Assistance & Nutrition Research Program, E-FAN-02-015.

Nord, M., M. Andrews, and S. Carlson. 2003. *Household Food Security in the United States, 2002*. Washington DC: U.S. Department of Agriculture, Economic Research Service, Food Assistance and Nutrition Research Report No. 35.

Rose, D., and V. Oliveira. 1997a. "Nutrient Intakes of Individuals from Food-Insufficient Households in the United States." *American Journal of Public Health* 87(12):1956−61.

Rose, D., and V. Oliveira. 1997b. *Validation of a Self-Reported Measure of Household Food Insufficiency with Nutrient Intake Data*. Washington DC: U.S. Department of Agriculture,

Economic Research Service Technical Bulletin No. 1863.

Rosenbaum, S. 1961. "Moments of a Truncated Bivariate Normal Distribution." *Journal of the Royal Statistical Society* (Series B) 23(2):405–8.

U.S. Department of Agriculture, Economic Research Service (USDA-ERS). 2005. *Food Security in the United States: Conditions and Trends, 2005*. Washington, DC. Page updated 25 October 2005. Available at: http://www.ers.usda.gov/briefing/foodsecurity/trends. Accessed 2 November 2005.

U.S. Department of Agriculture (USDA). 2004. *FY 2004 Budget Summary USDA, 2004*. Washington, DC. Available at: http://usda.gov/agency/obpa/Budget-Summary/2004/master2004.pdf. Accessed 23 August 2004.

Table 1. Summary Statistics

		FSP Non-Participants		FSP Participants	
Variable	Definition	Mean	SD	Mean	SD
FI	30-day adult-scale FI score, censored at 0	1.94	3.38	1.69	3.08
	Among the food insecure	7.36	1.84	6.88	1.68
	% food insecure	26.22		26.15	
Income	Household gross income, in $10,000	0.08	0.04	0.07	0.06
Shop frequency	Shopping frequency (times per week?)	0.22	0.09	0.26	0.10
Dep. children	Number of dependent children < 13 years old	0.82	1.20	1.25	1.33
EBT percentage	% of FSP benefits issued by EBT in residence state	0.14	0.32	0.11	0.30
Travel time	Time to store where most food shopping is done (hr.)	0.39	0.55	0.37	0.56
Immigrants	Population share of admitted immigrants per 1,000	3.06	2.52	3.14	2.55
Avoid telling people	Have avoided telling people about receiving food stamps	0.28		0.23	
Shop where unknown	Have gone out of their way to shop at a store where no one knows them	0.20		0.11	
Disrespect shopping	Have been treated disrespectfully when shopping with food stamps in a store	0.26		0.24	
Disrespect telling	Have been treated disrespectfully when they told people they received food stamps	0.21		0.12	
Never married	Respondent was never married	0.18		0.38	
Married	Married	0.44		0.18	
Sep./divorced	Separated or divorced	0.19		0.34	
Widowed	Widowed	0.19		0.10	
Female	Respondent is female	0.76		0.86	
One person HH	Only one person in the household	0.28		0.22	
Elderly	Member(s) > 60 years old present in household	0.39		0.22	

Children < 18	Child(ren) < 18 years old present in household	0.47	0.67
Single-headed	Single-headed household	0.09	0.39
Black	Race is Black	0.19	0.33
Asian	Race is Asian	0.02	0.01
Other race	Race is other non-White	0.18	0.20
White	Race is White (reference)	0.60	0.46
Hispanic	Of the Hispanic origin	0.14	0.16
Homeowner	Is a homeowner	0.47	0.17
Northeast	Resides in the Northeast (reference)	0.14	0.18
Midwest	Resides in the Midwest	0.25	0.22
South	Resides in the South	0.22	0.24
West	Resides in the West	0.39	0.36
Urban	Resides in an urban area	0.52	0.56
Rural	Resides in a rural area	0.19	0.15
Suburb	Resides in a suburban area (reference)	0.29	0.29
Dissatisfied-shop	Dissatisfied with shopping in the neighborhoods	0.22	0.29
Short recertification	Estimated certification period less than 6 months	0.24	0.15
Sample size		267	1912

Note: Total sample size is 2179. All sample statistics are weighted; see text for details. Among the food insecure, the FI score ranges from 4.92 to 10.85.

Table 2. Maximum Likelihood Estimates of FSP Participation and FI Equations

	FSP Participation		FI	
Variable	Estimate	S.E.	Estimate	S.E.
Latent variable				
FSP			–3.604***	1.335
Other explanatory variable				
Avoid telling people	0.183**	0.094		
Shop where unknown	–0.340***	0.113		
Disrespect shopping	–0.073	0.080		
Disrespect telling	–0.510***	0.094		
EBP percentage	–0.087	0.105		
Short recertification	–0.206**	0.094		
Immigrants	–0.019	0.017		
Travel time			0.545	0.501
Dissatisfied–shop			3.525***	0.587
Shopping frequency (÷ 10)	1.750***	0.332	3.584	3.863
Income	–1.958***	0.621	3.355	6.169
Elderly	0.033	0.088	–3.904***	0.819
Urban	–0.136*	0.082	–1.161	0.731
Rural	–0.019	0.097	–1.046	0.897
Dep. children	0.060*	0.035	0.249	0.312
Children < 18	0.229**	0.118	–0.572	1.100
Homeowner	–0.683***	0.075	–4.608***	1.144
Female	0.144*	0.082	–0.317	0.792
One-person HH	0.019	0.106	0.886	0.983
Married	–0.578***	0.097	–3.636***	1.182
Sep./divorced	–0.022	0.090	1.496**	0.722
Widowed	–0.390***	0.120	1.369	1.181
Single-headed	0.635***	0.105	0.966	1.232
Asian	–0.229	0.305	–4.388	2.732
Black	0.189**	0.084	0.471	0.793
Other race	–0.086	0.205	3.844**	1.664
Hispanic	0.127	0.219	–3.840**	1.789
Midwest	–0.227**	0.113	–1.393	0.967
South	–0.046	0.110	0.277	0.906
West	–0.092	0.119	–0.864	0.913
Constant	0.500***	0.193	–2.395	1.665
σ			9.500***	0.529
ρ			0.277**	0.136
Log likelihood	–3754.159			

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

Table 3. Marginal Effects of Exogenous Variables on Probabilities of FSP Participation and Food Insecurity

	Probability of FSP Participation			Probability of Food Insecure		
Variable	Cond. on Food Insecure	Cond. on Food Secure	Unconditional	Cond. on FSP Participation	Cond. on FSP Non-participation	Unconditional
			Continuous Exogenous Variables			
Income	–0.673***	–0.620***	–0.657***	0.323*	0.343*	0.367**
	(0.223)	(0.203)	(0.111)	(0.177)	(0.197)	(0.183)
Dep. children	0.022*	0.019*	0.020*	0.002	0.003	–0.001
	(0.013)	(0.012)	(0.012)	(0.010)	(0.011)	(0.010)
EBT percentage	–0.030	–0.028	–0.029	0.009	0.010	0.011
	(0.037)	(0.034)	(0.035)	(0.012)	(0.012)	(0.014)
Immigrants	–0.007	–0.006	–0.006	0.002	0.002	0.002
	(0.006)	(0.005)	(0.006)	(0.002)	(0.002)	(0.002)
Shop frequency	0.622***	0.566***	0.587***	–0.064	–0.056	–0.096
	(0.120)	(0.108)	(0.111)	(0.091)	(0.102)	(0.094)
Travel time	0.002	0.001	0.000	0.009	0.021	0.019
	(0.002)	(0.001)	(0.000)	(0.007)	(0.019)	(0.018)
			Discrete Exogenous Variables			
Avoid telling people	0.062**	0.057**	0.059**	–0.019**	–0.020**	–0.023**
	(0.032)	(0.028)	(0.030)	(0.010)	(0.011)	(0.011)
Shop where unknown	–0.124***	–0.116***	–0.121***	0.037**	0.038**	0.044***
	(0.043)	(0.041)	(0.042)	(0.016)	(0.017)	(0.017)
Disrespect shopping	–0.026	–0.024	–0.025	0.008	0.008	0.009
	(0.028)	(0.026)	(0.027)	(0.010)	(0.010)	(0.011)
Disrespect telling	–0.188***	–0.178***	–0.185***	0.056**	0.058**	0.068***
	(0.036)	(0.035)	(0.036)	(0.025)	(0.027)	(0.026)

Elderly	–0.001	–0.004	–0.011	–0.127***	–0.144***	–0.132***
	(0.032)	(0.029)	(0.029)	(0.022)	(0.026)	(0.023)
Urban	–0.051*	–0.046*	–0.046*	–0.025	–0.029	–0.024
	(0.029)	(0.027)	(0.027)	(0.022)	(0.024)	(0.023)
Rural	–0.010	–0.008	–0.006	–0.033*	–0.037	–0.040
	(0.035)	(0.032)	(0.033)	(0.027)	(0.031)	(0.028)
Children < 18	0.079*	0.073*	0.078**	–0.044	–0.047	–0.050
	(0.043)	(0.039)	(0.040)	(0.035)	(0.039)	(0.036)
Homeowner	–0.264***	–0.244***	–0.244***	–0.082***	–0.096***	–0.073***
	(0.029)	(0.027)	(0.028)	(0.021)	(0.025)	(0.022)
Female	0.050*	0.047*	0.049*	–0.027	–0.028	–0.030
	(0.031)	(0.028)	(0.029)	(0.026)	(0.028)	(0.027)
One person HH	0.010	0.008	0.006	0.029	0.032	0.029
	(0.038)	(0.034)	(0.035)	(0.033)	(0.036)	(0.034)
Married	–0.222***	–0.205***	–0.207***	–0.061**	–0.072**	–0.053*
	(0.037)	(0.035)	(0.036)	(0.027)	(0.031)	(0.028)
Sep./divorced	–0.003	–0.004	–0.007	0.055**	0.060**	0.057**
	(0.032)	(0.029)	(0.030)	(0.024)	(0.026)	(0.024)
Widowed	–0.139***	–0.131***	–0.140***	0.194**	0.100***	0.104***
	(0.047)	(0.045)	(0.046)	(0.039)	(0.042)	(0.040)
Single-headed	0.208***	0.186***	0.194***	–0.035	–0.032***	–0.046*
	(0.031)	(0.027)	(0.028)	(0.026)	(0.030)	(0.027)
Asian	–0.099	–0.086	–0.081	–0.108*	–0.125*	–0.109*
	(0.119)	(0.112)	(0.113)	(0.062)	(0.074)	(0.066)
Black	0.066**	0.060**	0.062**	–0.004	–0.003	–0.007
	(0.029)	(0.026)	(0.027)	(0.023)	(0.026)	(0.024)

Other race	–0.019	–0.020	–0.029	0.152***	0.165***	0.158***
	(0.075)	(0.069)	(0.071)	(0.060)	(0.064)	(0.061)
Hispanic	0.031	0.033	0.041	–0.128***	–0.145***	–0.134***
	(0.077)	(0.068)	(0.069)	(0.043)	(0.050)	(0.044)
Midwest	–0.086**	–0.078**	–0.079**	–0.023	–0.028	–0.020
	(0.043)	(0.039)	(0.040)	(0.029)	(0.032)	(0.030)
South	–0.015	–0.014	–0.016	0.015	0.016	0.016
	(0.040)	(0.036)	(0.037)	(0.029)	(0.032)	(0.030)
West	–0.035	–0.031	–0.031	–0.020	–0.023	–0.019
	(0.043)	(0.039)	(0.040)	(0.028)	(0.032)	(0.029)
Short recertification	–0.074**	–0.068**	–0.071**	0.022*	0.023*	0.027**
	(0.035)	(0.032)	(0.034)	(0.012)	(0.013)	(0.013)
Dissatisfied-shop	0.011**	0.007***	0.000	0.127***	0.140***	0.131***
	(0.005)	(0.003)	(0.000)	(0.022)	(0.024)	(0.022)

Note: Asymptotic standard errors in parentheses. Asterisks indicate levels of significance: *** = 1%, ** = 5%, * = 10%.

Table 4. Marginal Effects of Exogenous Variables on Levels of Food Insecurity

Variable	Conditional on FSP = 0, FI > 0	Conditional on FSP = 1, FI > 0	Conditional on FI > 0	Unconditional
		Continuous Exogenous Variables		
Shopping frequency (÷ 10)	–0.396	–0.432	–0.670	–0.706
	(0.708)	(0.636)	(0.652)	(0.688)
Income	2.398*	2.240*	2.561**	2.701**
	(1.369)	(1.236)	(1.272)	(1.342)
Dep. children	0.020	0.016	0.008	0.009
	(0.074)	(0.067)	(0.069)	(0.072)
EBT percentage	0.067	0.064	0.077	0.081
	(0.085)	(0.079)	(0.095)	(0.100)
Immigrants	0.014	0.014	0.017	0.017
	(0.016)	(0.013)	(0.015)	(0.015)
Travel time	0.144	0.130	0.134	0.141
	(0.133)	(0.120)	(0.123)	(0.130)
		Binary Exogenous Variables		
Elderly	–1.004***	–0.905***	–0.937***	–0.929***
	(0.183)	(0.163)	(0.168)	(0.157)
Urban	–0.203	–0.177	–0.165	–0.174
	(0.170)	(0.153)	(0.158)	(0.167)
Rural	–0.257	–0.231	–0.235	–0.243
	(0.214)	(0.192)	(0.199)	(0.200)
Children < 18	–0.331	–0.307	–0.347	–0.370
	(0.273)	(0.246)	(0.254)	(0.273)
Homeowner	–0.665***	–0.581***	–0.512***	–0.521***
	(0.174)	(0.151)	(0.155)	(0.152)
Female	–0.198	–0.184	–0.209	–0.225
	(0.199)	(0.179)	(0.185)	(0.203)
One-person HH	0.223	0.200	0.204	0.218
	(0.254)	(0.228)	(0.235)	(0.256)
Married	–0.501**	–0.434**	–0.373*	–0.383**
	(0.218)	(0.193)	(0.199)	(0.200)
Sep./divorced	0.423**	0.381**	0.396**	0.427**
	(0.183)	(0.165)	(0.170)	(0.188)
Widowed	0.709**	0.650**	0.731***	0.825**
	(0.303)	(0.274)	(0.285)	(0.340)

Single-headed	–0.227	–0.238	–0.320*	–0.331*
	(0.208)	(0.186)	(0.188)	(0.191)
Asian	–0.878*	–0.786	–0.785	–0.726*
	(0.539)	(0.485)	(0.505)	(0.395)
Black	–0.020	–0.027	–0.051	–0.054
	(0.178)	(0.159)	(0.165)	(0.172)
Other race	1.184***	1.068***	1.114***	1.278**
	(0.481)	(0.432)	(0.446)	(0.548)
Hispanic	–1.018***	–0.921***	–0.963***	–0.912***
	(0.361)	(0.325)	(0.334)	(0.279)
Midwest	–0.192	–0.164	–0.140	–0.146
	(0.224)	(0.201)	(0.209)	(0.215)
South	0.110	0.101	0.110	0.117
	(0.224)	(0.202)	(0.208)	(0.224)
West	–0.157	–0.137	–0.130	–0.136
	(0.220)	(0.198)	(0.206)	(0.215)
Avoid telling people	–0.139*	–0.134*	–0.160**	–0.167**
	(0.074)	(0.070)	(0.079)	(0.081)
Shop where unknown	0.270**	0.254**	0.310***	0.337***
	(0.120)	(0.110)	(0.118)	(0.132)
Disrespect shopping	0.056	0.054	0.065	0.069
	(0.071)	(0.067)	(0.078)	(0.083)
Disrespect telling	0.411**	0.383**	0.472***	0.520***
	(0.191)	(0.175)	(0.180)	(0.206)
Short recertification	0.161*	0.153*	0.185**	0.199**
	(0.089)	(0.082)	(0.093)	(0.101)
Dissatisfied–shop.	0.991***	0.891***	0.918***	1.025***
	(0.176)	(0.155)	(0.160)	(0.188)

Note: Asymptotic standard errors in parentheses. Asterisks indicate levels of significance: *** = 1%, ** = 5%, * = 10%.