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Supplemental Nutrition Assistance Program and food insecurity among families with children☆

Jun Zhang [a], Steven T. Yen [b,*]

[a] Department of Agricultural and Resource Economics, University of Maryland, College Park, MD 20742, USA
[b] Department of Agricultural Economics, National Taiwan University, Taipei 10617, Taiwan, ROC

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Abstract

The roles of Supplemental Nutrition Assistance Program (SNAP) and parental resources in household food insecurity (FI) are investigated. For husband–wife families with children, SNAP participation reduces the probability of household FI among adults by 8.8%, but increases the probabilities of low food security by 6.1% and very low food security by 2.7%, both among children. The positive effects cast doubt on effectiveness of SNAP alone and call for additional policy measures to improve FI among children. SNAP participation can be promoted by policy instruments such as broad-based categorical eligibility and simplified reporting, and food security by promoting education and providing employment opportunities.

JEL classification: I12; I38; C31

Keywords: Food insecurity; Parental resources; Recursive ordered probability model; SNAP

1. Introduction

Household food security is an important public policy issue worldwide. Even in a developed country like the United States (U.S.), some low-income families still experience food insecurity (FI) due to lack of financial or other resources. In 2013, 14.3% of households in the U.S. were food insecure (a decrease from 14.9% in 2011) at least some time during the year, including 5.6% with

☆ This paper draws on Chapter 3 of Zhang's thesis at the University of Tennessee, where Yen was professor.

* Corresponding author. Tel.: +886 2 33662675; fax: +886 2 23628496.
E-mail addresses: zjun@umd.edu (J. Zhang), syen04@gmail.com (S.T. Yen).

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very low food security (VLFS) (Coleman-Jensen, Gregory, & Singh, 2014). Children and adults were food-insecure in 9.9% of households with children, essentially unchanged from 10.0% in 2011 and 2012 (Coleman-Jensen et al., 2014).

To enhance food security of low-income households, the U.S. Department of Agriculture (USDA) implements the Supplemental Nutrition Assistance Program (SNAP), formerly the Food Stamp Program (FSP), to provide food assistance via benefit payments to households meeting eligibility criteria. In 2013, SNAP provides benefits to 47.6 million people in the U.S. at a program expenditure of nearly $80 billion. Despite strong support from the government, the rate of households reporting FI had continued to rise until recently.

This mounting evidence of FI despite the government effort casts doubt on effectiveness of SNAP alone and calls for continuous investigation of the relationship between SNAP participation and FI. A better and up-to-date information on this relationship is important for deliberation of food assistance policies. Many studies have investigated the relation between SNAP participation and FI, with mixed findings. Some studies find SNAP participants more likely to be food insecure (Jensen, 2002; Ribar & Hamrick, 2003; Wilde & Nord, 2005), while others find no significant relation between SNAP participation and FI (Gundersen & Oliveira, 2001; Huffman & Jensen, 2008). More recent studies find that SNAP ameliorates FI to some extent (Bartfeld & Dunifon, 2006; Borjas, 2004; DePolt, Moffitt, & Ribar, 2009; Mykerezi & Mills, 2010; Nord & Golla, 2009; Yen, Andrews, Chen, & Eastwood, 2008).

Among studies reporting positive or statistically insignificant relation between SNAP and FI, Jensen (2002) estimates an ordered probability model of household FI and finds dependence between FSP participation and FI. Using a two-year panel sample from the Current Population Survey (CPS), Wilde and Nord (2005) find food security status deteriorated for households who entered FSP during 2001–2002. Gundersen and Oliveira (2001) estimate a simultaneous probit model using data from 1991 to 1992 Survey of Income and Program Participation (SIPP), and find FSP has no effect on food insufficiency. Huffman and Jensen (2008) estimate the effects of FSP and labor force participation on FI with a simultaneous equation model. FI is found to increase the probability FSP participation whereas the effect of FSP on FI is not significant.

Positive or insignificant effect of SNAP on household FI is generally believed to be caused by failure to accommodate household's self-selection into SNAP (Nord & Golla, 2009). Inconsistency among previous results calls for a more thorough investigation of the role of SNAP participation in FI. Recent analyses on the subject feature more careful attention to the selection issue of SNAP participation and find SNAP participation generally ameliorates FI (DePolt et al., 2009; Mykerezi & Mills, 2010; Ratcliffe & McKernan, 2010; Wilde, 2007; Yen et al., 2008).

Using data from 1996 to 1997 National Food Stamp Program Survey, Yen et al. (2008) estimate a recursive system, a restricted form of the simultaneous equation system, and find FSP participation lowers FI score by 0.4 among food insecure households. Mykerezi and Mills (2010) estimate a similar model with the 1999 Panel Study of Income Dynamics (PSID); FSP participation is found to lower the severity of FI as in Yen et al. (2008) but in greater magnitudes. DePolt et al. (2009) use longitude data from low-income families with children living in Boston, Chicago, and San Antonio to evaluate the effect of FSP on food hardships. A quasi fixed-effects procedure is used to control for unobservable household characteristics and a strong negative association between FSP and food hardship is found. Ratcliffe and McKernan (2010) estimate a dummy endogenous variable model with 1996–2004 SIPP, using state policy variables as instruments for SNAP. Participation in SNAP is found to reduce the probability of FI by 31.2% and the probability of VLFS by 20.2%.

Most recent findings of negative association between SNAP and FI were based on the instrumental variable approach to address endogenous SNAP participation, and we identify four

shortcomings in these studies. First is use of old data (Mykerezi & Mills, 2010; Ratcliffe & McKernan, 2010; Yen et al., 2008). Second, except Ratcliffe and McKernan (2010), most studies address household FI in general and do not include VLFS among children, an issue of utmost policy importance (Nord, 2009). A third, most important, shortcoming which motivates this study, is the lack of enough attention to the different categories of household FI. Previous studies either concentrate on just two FI categories (food secure and food insecure) or use continuous FI scores without differentiating FI severity categories (e.g., Yen et al., 2008). The impact of SNAP participation FI categories may differ greatly rather than gradually and dividing FI into multiple categories will reduce statistical bias and better explore the effects of SNAP. Finally, this study addresses the roles of parental resources, besides SNAP, in household FI. Parental resources have been found to play a key role in child abuse and neglect in the economics literature (Paxson & Waldfogel, 1999), and these factors may well affect other aspects of children's welfare such as FI. No previous study has investigated the effects of parental resources on SNAP participation and FI among households with children. This study fills this empirical gap, by exploring the relationship between SNAP participation and FI, and how parental resources affect SNAP participation decision and FI, among households with children.

2. Conceptual framework

Our empirical specification is motivated by a utility maximization framework such that each SNAP eligible household derives utility from income (Y) and leisure (L):

$$U = U(Y, L) \tag{1}$$

This utility function is maximized subject to a time constraint

$$L + W = \bar{T} \tag{2}$$

where W is working hours and $\bar{T}$ is time available, both of household members. Household income is a function of working hours and SNAP participation

$$Y = Y(W, SNAP) \tag{3}$$

where $SNAP = 1$ if any household member participates in SNAP and =0 otherwise (e.g., Conte, Levy, Shahrokh, Staveley, & Thompson, 1998). There is disutility, $C = C(S)$, household participation in SNAP, which depends on a set of factors S, such as state SNAP policies which affect participation decision of the household. Then, SNAP participation decision can be expressed as

$$P_{SNAP} = U(Y_{SNAP=1}, L) - U(Y_{SNAP=0}, L) - C(S) \tag{4}$$

A household will participate in SNAP if $P_{SNAP} > 0$ but will not if $P_{SNAP} \leq 0$.

Assume food insecurity (FI) is a function of household income (Y) and economic and demographic variables (Z) such that FI index at category j is $FI_j = F(Y, Z)$. Then, maximizing the utility yields the reduced-form equation for household FI:

$$\begin{aligned} FI_j^* &= F(W, SNAP^P, Z) \quad \text{if} \quad P_{SNAP} > 0 \\ &= F(W, SNAP^{NP}, Z) \quad \text{if} \quad P_{SNAP} \leq 0 \end{aligned} \tag{5}$$

where $SNAP^P = 1$ and $SNAP^{NP} = 0$, and $FI_j = j$ if $\xi_{j-1} < FI_j^* \leq \xi_j$ where ξ_{j-1} and ξ_j are threshold parameters.

3. Econometric procedure

To address ordinal FI (y_1) with binary endogenous SNAP (y_2), we develop a recursive system comprising equations for corresponding latent variables y_1^* and y_2^*[1]:

$$y_1^* = \gamma y_2^* + x'\alpha_1 + u_1 \tag{6}$$

$$y_2^* = x'\beta_1 + w'\beta_2 + u_2 \tag{7}$$

where x and w are vectors of exogenous variables with conformable parameter vectors α_1, β_1, and β_2, γ is a scalar parameter, and the error terms (u_1, u_2) are distributed as bivariate standard normal with correlation ρ. The reduced forms consist of (7) and

$$y_1^* = x'(\alpha_1 + \gamma\beta_1) + w'(\gamma\beta_2) + u_1^* \tag{8}$$

where $u_1^* = u_1 + \gamma u_2$, and (u_1^*, u_2) are distributed as bivariate normal with variances $(\sigma^2,1) = (1 + 2\rho\gamma + \gamma^2,1)$, covariance $\sigma_{12} = \gamma + \rho$, and correlation $\tau = (\gamma + \rho)/(1 + 2\rho\gamma + \gamma^2)^{1/2}$.

Based on reduced forms (8) and (7), ordinal FI and binary SNAP participation are governed by

$$y_1 = k \quad \text{if} \quad \xi_{k-1} < y_1^* < \xi_k, \qquad k = 0, \ldots, K \tag{9}$$

$$\begin{aligned} y_2 &= 1 \quad \text{if} \quad y_2^* > 0 \\ &= 0 \quad \text{if} \quad y_2^* \le 0 \end{aligned} \tag{10}$$

where threshold parameters $\xi_0 = -\infty$, $\xi_1 = 0$, and $\xi_K = \infty$. Relative to two-step estimators for similar models (D'Antoni et al., 2013; Maddala, 1983, pp. 246–247), we develop a more efficient maximum-likelihood procedure. Denote the deterministic portions of (8) and (7) as $h'\delta_1$ and $h'\delta_2$ respectively, where $h = [x', w']'$, $\delta_1 = [(\alpha_1 + \gamma\beta_1)', \gamma\beta_2']'$, $\delta_2 = \left[\beta_1', \beta_2'\right]'$, and the cumulative distribution function (cdf) of the bivariate standard normal as Φ_2. The likelihood contribution for a sample observation is

$$\begin{aligned} Pr(y_1 = k, y_2 = j) = {} & \Phi_2\left(\frac{\xi_k - h'\delta_1}{\sigma}, (-1)^{j+1}h'\delta_2; (-1)^j\tau\right) \\ & - \Phi_2\left(\frac{\xi_{k-1} - h'\delta_1}{\sigma}, (-1)^{j+1}h'\delta_2; (-1)^j\tau\right), \quad j = 0, 1 \end{aligned} \tag{11}$$

Average marginal effects of continuous (discrete) exogenous variables can be calculated by differentiating (differencing) the joint probability in (11) and the associated marginal and conditional probabilities, such as $\Pr(y_1 = k)$, $\Pr(y_2 = 1)$, $\Pr(y_2 = 1|y_1 = k)$, and $\Pr(y_1 = k|y_2 = j)$ for $j = 0,1$. Then, the treatment effects of SNAP participation on FI category probabilities conditional on FI ($y_{1i} > 0$) are

$$TE_k = Pr(y_{1i} = k|y_{2i} = 1, y_{1i} > 0) - Pr(y_{1i} = k|y_{2i} = 0, y_{1i} > 0)$$

[1] Including y_1^* on the right-hand side of Eq. (7) would make the system fully simultaneous with two way causality. D'Antoni, Mishra, and Blayney (2013) use a simultaneous equation model with continuous-binary endogenous variables, estimated with a two-step procedure, in evaluating the effect of Milk Income Loss Contract program on milk production. The causality issue is addressed below.

$$= \frac{Pr(y_{1i} = k, y_{2i} = 1)}{Pr(y_{2i} = 1) - Pr(y_{1i} = 0, y_{2i} = 1)} - \frac{Pr(y_{1i} = k, y_{2i} = 0)}{Pr(y_{2i} = 0) - Pr(y_{1i} = 0, y_{2i} = 0)},$$

$$k = 1, 2, 3 \tag{12}$$

4. Data

Data come from 2010 to 2011 Current Population Survey-Food Security Supplement (CPS-FSS), collected in the December CPS. The sample is limited to SNAP eligible husband–wife families with children (HW-C), SNAP eligibility determined by the income criterion—annual income below 130% of federal poverty level. Sample statistics are presented in Table 1.

4.1. Measuring FI and SNAP participation

The CPS-FSS contains 18 questions, 8 of which concern children's FI, during 12 months prior to the survey. From affirmative responses to the 18 questions and to the 8 children-specific items, household FI is classified into four categories (Nord, Coleman-Jensen, Andrews, & Carlson, 2010): food secure (FS, with <3 affirmative responses); and three categories among those with ≥3 affirmative responses: FI among adults only (FIA, <2 children-specific responses), low food security among children (LFSC, 2–4 children-specific responses), and very low food security among children (VLFSC, ≥5 children-specific responses). The above FI categories are coded as 0, 1, 2, and 3. The other endogenous variable, SNAP participation, is a binary indicator of whether anyone in the household received SNAP benefits in the past 12 months. Table 2 and Fig. 1 present the distribution and two-way frequencies of FI categories by SNAP participation status.

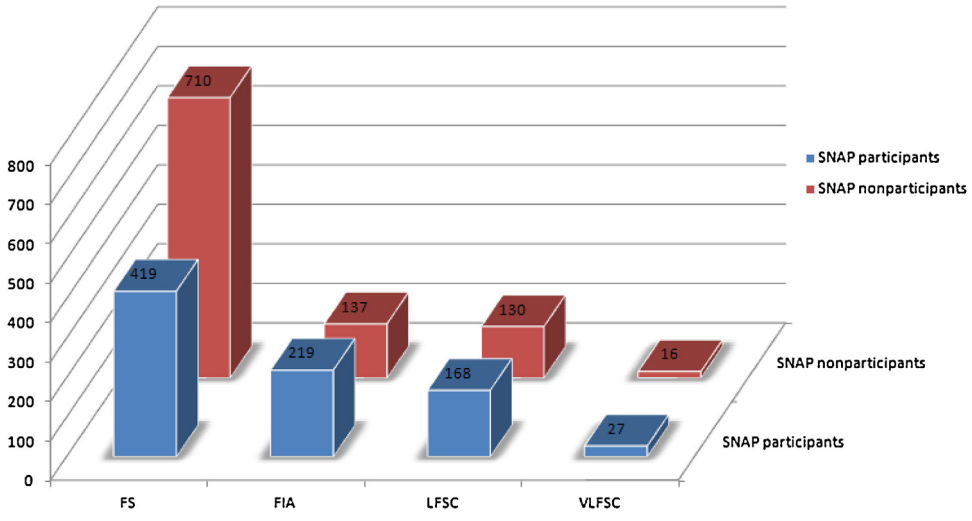

Fig. 1. Frequency distribution of SNAP participation and food insecurity categories.

Table 1
Definitions and sample statistics of variables (sample size = 1826).

Variable	Definitions	Mean	SD
Endogenous variables			
FI	Household food insecurity category (0–3)	0.59	0.84
SNAP	Any member in household received SNAP in past 12 months	0.46	0.50
State policy variables (continuous)			
Short: with earning	Proportion of SNAP units in state with 1–6 months recertification period, and with earnings	0.50	0.44
Short: without earning	Proportion of SNAP units in state with 1–6 months recertification period, and without earnings	0.40	0.33
State policy variables (binary, yes = 1, no = 0)			
Simplified reporting	For households with earnings, the state uses simplified reporting option for SNAP participants to report changes	0.85	
BBCE	State uses BBCE categorical eligibility for SNAP	0.63	
Household characteristics (continuous)			
Income	Household income in $10,000 per year	2.05	0.97
HH size	Number of persons living in household	4.89	1.57
Children	Number of children <18 years of age	2.48	1.28
Household and other characteristics (binary, yes = 1, no = 0)			
More money	Need to spend more money to buy enough food to meet needs than you do now	0.31	
Hispanic	Reference person is Hispanic	0.39	
White	Reference person is white	0.82	
Other race	Reference person is of other race	0.09	
Black	Reference person is black (reference)	0.09	
MSA	Reference person resides in Metropolitan Statistical Area	0.76	
South	Reference person resides in South	0.34	
Northeast	Reference person resides in Northwest	0.12	
Midwest	Reference person resides in Midwest	0.20	
West	Reference person resides in West (reference)	0.34	
Year 2011	Data collected in year 2011	0.56	
Parental resources (continuous)			
Age (H)	Age of husband	36.33	8.40
Age (W)	Age of wife	33.48	7.19
Work hours (H)	Husband's working hours per week	27.38	20.58
Work hours (W)	Wife's working hours per week	12.07	17.65
Parental resources (binary, yes = 1, no = 0)			
<High school	Reference person has <high school education	0.30	
Some college	Reference person attended college (no degree)	0.17	
College	Reference person has college education or higher	0.18	
High school	Reference person is high school graduate (reference)	0.36	
Employed (H)	Husband is employed	0.73	
Unemployed (H)	Husband is unemployed	0.15	
Not in labor force (H)	Husband is not in labor force (reference)	0.12	
Employed (W)	Wife is employed	0.39	
Unemployed (W)	Wife is unemployed	0.09	
Not in labor force (W)	Wife is not in labor force (reference)	0.52	

Table 2
Frequency distribution of SNAP participation and FI categories.

SNAP participation	Household food insecurity (FI)				Total
	FS	FIA	LFSC	VLFSC	
Participants	419	219	168	27	833
Nonparticipants	710	137	130	16	993
Total	1129	356	298	43	1826
Ratio of participants	37%	62%	56%	63%	46%

4.2. State policy variables for identification

For maximum-likelihood estimation of the current model, identification criteria are met without exclusion restrictions owing to distributional assumption of the error terms. To avoid over-burdening the nonlinear functional forms for identification, however, exclusion restrictions are imposed. Four state SNAP policy variables, from one year before FSS data collection, are included in the SNAP equation.[2] They are proportion of SNAP units with earnings (Short: with earning) and proportion without earnings (Short: without earning), both with a short (1–6 month) recertification period. The third variable is an indicator of Simplified reporting for households with earnings, which may encourage SNAP participation. The fourth variable, also binary, indicates broad-based categorical eligibility (BBCE) for SNAP. BBCE eliminates the asset tests for most households, simplifying the process and reducing eligibility determination errors (Mabli & Ferrerosa, 2010).

4.3. Parental resources and other household characteristics

Beside SNAP, we address the role of parental resources in SNAP participation and FI. Parental resources play a key role in child abuse and neglect (Paxson & Waldfogel, 1999), and we hypothesize these variables can affect SNAP participation and children's welfare such as FI. Husband and wife's ages, working hours, employment statuses, and household head's education belong to this category.

Other explanatory variables are household annual income, household size, number of children, financial status for food, race, and locations of residence (Table 1).[3]

5. Results

5.1. Maximum-likelihood estimates

Table 3 presents the maximum-likelihood estimates. To ensure that the model is useful in guiding policies, we first test two hypotheses regarding causality: (i) Does SNAP participation affect FP? (ii) Conditional on that causality, does FI affect SNAP participation? The coefficient of latent SNAP in the FI equation is negative (−0.464) and significant at the 5% level of significance, suggesting that participation in SNAP decreases FI. As to the reverse causality, hypothesis (ii), we

[2] State SNAP policy variables from June 2009 and 2010 are used along with December 2010 and 2011 FSS data.

[3] Household income in the CPS data is coded as categorical using a scale which ranges from 1 to 16. The household income used in this study is the mean amount corresponding to each category. Since the HW-C samples are restricted to SNAP eligible households, mean income for the top income category is not an issue.

Table 3
Maximum-likelihood estimates of endogenous probability model.

Variable	SNAP participation	Food insecurity
SNAP		−0.464 (0.206)**
State policy variables		
Short: with earning	0.032 (0.271)	
Short: without earning	−0.190 (0.366)	
Simplified reporting	0.218 (0.105)**	
BBCE	0.157 (0.066)**	
Household characteristics		
Income	−0.264 (0.036)***	−0.202 (0.052)***
HH size	0.130 (0.035)***	0.075 (0.038)**
Children	0.058 (0.040)	0.048 (0.036)
More money	0.293 (0.070)***	0.915 (0.111)***
Hispanic	−0.298 (0.079)***	−0.145 (0.093)
White	−0.007 (0.126)	−0.032 (0.115)
Other race	0.109 (0.159)	0.118 (0.142)
MSA	−0.248 (0.080)***	−0.150 (0.087)*
South	0.124 (0.089)	0.099 (0.080)
Northeast	0.102 (0.121)	0.092 (0.116)
Midwest	0.067 (0.101)	−0.059 (0.100)
Year 2011	0.068 (0.067)	0.138 (0.059)**
Parental resources		
Age/10 (H)	−0.139 (0.063)**	−0.034 (0.064)
Age/10 (W)	−0.207 (0.075)***	−0.067 (0.082)
Work hours/10 (H)	−0.115 (0.026)***	−0.098 (0.029)***
Work hours/10 (W)	−0.105 (0.037)***	−0.084 (0.035)**
<High school	−0.075 (0.085)	0.037 (0.082)
Some college	−0.114 (0.096)	−0.104 (0.093)
College	−0.290 (0.094)***	−0.320 (0.092)***
Employed (H)	0.147 (0.141)	0.134 (0.134)
Unemployed (H)	0.461 (0.128)***	0.277 (0.140)**
Employed (W)	0.099 (0.131)	0.199 (0.116)*
Unemployed (W)	0.262 (0.117)**	0.213 (0.110)*
Constant	1.016 (0.264)***	−0.049 (0.431)
ξ_2		0.529 (0.107)***
ξ_3		1.484 (0.292)***
ρ		0.656 (0.169)***
Log likelihood	−2702.982	
Sample size		1826

Note: Asymptotic standard errors in parentheses.
* Indicates statistical significance at the 10% level.
** Indicates statistical significance at the 5% level.
*** Indicates statistical significance at the 1% level.

carry out a Lagrange multiplier test based on estimates of the recursive model, and find latent FI insignificant in the SNAP participation equation (LM = 0.91, df = 1, p-value = 0.34). Thus, there is no evidence that FI affects SNAP participation, supporting use of the recursive system (versus a simultaneous equation model) for policy analysis with the current sample. While our result echoes findings from previous studies regarding causality (Mykerezi & Mills, 2010; Yen et al., 2008), it is worth noting that a lagged response to FI may have resulted in the absence of causality in a single cross section. This causality issue is of important policy relevance and is worthy of further investigation with pooled cross section or panel data.

Table 4
Average treatment effects of SNAP on probabilities of food insecurity (conditional on FI > 0).

Food insecure category	ATE
Food insecurity among adults (FIA, FI = 1)	−0.088 (0.014)***
Low food security among children (LFSC, FI = 2)	0.061 (0.010)***
Very low food security among children (VLFSC, FI = 3)	0.027 (0.005)***

Note: Asymptotic standard errors in parentheses.
*** Indicates statistical significance at the 1% level.

The error correlation (ρ) estimate is positive (0.656) and significant at the 1% level. This significant error correlation provides an additional empirical support for the recursive system and suggests that unobserved characteristics, such as food prices, food accessibility, and unavailable policy variables (Lin, Ver Ploeg, Kasteridis, & Yen, 2014), affect SNAP and FI in the same direction. Importantly, the two state policy variables, BBCE and Simplified reporting, are positive and significant at the 5% level, rejecting the hypothesis of weak instruments and, more importantly, justifying their uses as policy tools in promoting SNAP participation and, hence, reducing FI. The effects of other important variables are quantified further in terms of treatment effects and marginal effects.

5.2. Treatment effects of SNAP participation on FI

How effective is SNAP in combating FI? The ATEs, calculated separately for adults and children, provide the answer (Table 4). For a randomly selected HW-C household, participation in SNAP reduces probability of FIA by 8.8 percentage points (henceforth, %); thus, SNAP is effective in ameliorating FI among adult households. SNAP participation however increases probabilities of LFSC by 6.1% and VLFSC by 2.7%. These results for households with children call for additional effort by the federal government and other non-profit organizations to reach out to these segments of the population, rethink the federal food assistance programs, and supplement SNAP with other programs.

5.3. Marginal effects of policy and parental resource variables

Marginal effects are calculated to further quantify the roles of policy and parental resources in SNAP participation and FI. First are marginal effects of these variables on the probability of SNAP participation (Table 5). Among the state policy variables, BBCE contributes to participation in SNAP by 5.26%. The effects of Simplified reporting are even more pronounced, by 7.26%. These results establish BBCE categorical eligibility and Simplified reporting as two important policy tools in promoting SNAP participation and, in view of the program's effect on FI, in ameliorating FI among adult households.

Among the parental resource variables, a 10 year increase in husband's (wife's) age decreases the probability of SNAP participation by 4.66% (6.92%), likely due to greater financial stability among older households. Husband and wife's working hours, which increase financial resources and decreases reliance on SNAP, are also negatively associated with SNAP participation, with a 10-h increase in husband (wife)'s working hours per week decreasing the probability of SNAP participation by 3.85% (3.50%). Compared with high school educated households, college education decreases the probability of SNAP participation by 9.58%.

Table 5
Average marginal effects of explanatory variables on probability of SNAP participation.

SNAP policy variable		Parental resource variables	
Short: with earning	1.06 (9.07)	Age/10 (H)	−4.66 (2.10)**
Short: without earning	−6.36 (12.25)	Age/10 (W)	−6.92 (2.49)***
BBCE	5.26 (2.18)**	Work hours/10 (H)	−3.85 (0.86)***
Simplified reporting	7.26 (3.45)**	Work hours/10 (W)	−3.50 (1.23)***
		<High school	−2.51 (2.82)
		Some college	−3.80 (3.16)
		College	−9.58 (3.04)***
		Employed (H)	4.82 (4.52)
		Unemployed (H)	15.84 (4.41)***
		Employed (W)	3.29 (4.33)
		Unemployed (W)	8.89 (3.97)**

Note: All effects on probabilities are multiplied by 100. Asymptotic standard errors in parentheses.
** Indicates statistical significance at the 5% level.
*** Indicates statistical significance at the 1% level.

Employment status is another factor. Households with an unemployed husband (wife) are 15.84% (8.89%) more likely to participate in SNAP, compared to households without a husband or wife in the labor force. These results of education and employment suggest effort to promote college education and generate employment opportunities in the public and private sectors can ease the federal government's financial burden of SNAP.

Table 6 presents the marginal effects on the joint probabilities of SNAP participation and FI categories.[4] Parental resources play key roles in household FI for both SNAP non-participants and participants. Husband and wife's ages have opposite effects on the "joint probabilities" of FI (and SNAP) between SNAP non-participants and participants. A 10-year increase in husband's (wife's) age increases the joint probabilities of FIA, LFSC, and VLFSC by 1.21%, 1.07%, and 0.16% (1.65%, 1.41%, and 0.21%) among non-participants; it decreases the probabilities of FS and FIA by 3.51% and 0.81% (4.87% and 1.28%) among participants. Effects of working hours also differ notably between non-participants and participants. A 10-h increase in husband's (wife's) working hours per week increases the joint probabilities of FS by 3.34% (2.93%) among non-participants, while decreasing the joint probabilities of FIA, LFSC and VLFSC by 0.97%, 1.14% and 0.28% (0.86%, 0.98% and 0.23%). Compared to SNAP non-participating households without a husband in the labor force, husband's unemployment is associated with a 11.11%, 2.67%, and 1.84% lower joint probabilities of FS, FIA, and LFSC. The effects are opposite among the SNAP participants—at 8.40%, 3.48%, and 3.31% higher.

Wife's unemployment decreases the joint probability of FS by 7.31% among SNAP non-participants; it increases the probabilities of FIA and LFSC by 2.22% and 2.63% among participants. Effects of education are notable among SNAP participants—a college educated household has 2.71%, 3.47%, and 0.88% lower joint probabilities of being FIA, LFSC and VLFSC. The above results suggest policies promoting education and employment opportunities in the public and private sectors can work toward alleviating household FI.

[4] Each joint probability in this section refers to the probability an FI category *and* SNAP participation (or non-participation), and not among the FI categories.

Table 6
Average marginal effects of explanatory variables on joint probability of SNAP and FI.

Variable	FS	FIA	LFSC	VLFSC
Probability of SNAP non-participation and				
State SNAP policy variables				
Short: with earning	−0.33 (2.87)	−0.34 (2.95)	−0.33 (2.81)	−0.05 (0.46)
Short: without earning	2.01 (4.15)	2.07 (3.97)	1.97 (3.79)	0.32 (0.62)
BBCE	−1.59 (1.46)	−1.72 (0.65)***	−1.67 (0.67)**	−0.28 (0.13)**
Simplified reporting	−1.94 (2.04)	−2.44 (1.10)**	−2.45 (1.20)**	−0.42 (0.24)*
Parental resource variables				
Age/10 (H)	2.22 (1.67)	1.21 (0.52)**	1.07 (0.52)**	0.16 (0.09)*
Age/10 (W)	3.65 (2.05)*	1.65 (0.63)***	1.41 (0.64)**	0.21 (0.12)*
Work hours/10 (H)	3.34 (0.73)***	0.39 (0.24)	0.13 (0.25)	−0.01 (0.04)
Work hours/10 (W)	2.93 (0.97)***	0.40 (0.33)	0.17 (0.33)	0.00 (0.06)
<High school	−0.07 (2.29)	1.16 (0.73)	1.21 (0.76)	0.21 (0.14)
Some college	3.49 (2.76)	0.30 (0.82)	0.04 (0.84)	−0.02 (0.15)
College	10.22 (2.70)***	0.13 (0.88)	−0.60 (0.85)	−0.17 (0.14)
Employed (H)	−4.43 (3.91)	−0.38 (1.27)	−0.04 (1.31)	0.03 (0.23)
Unemployed (H)	−11.11 (3.40)***	−2.67 (1.01)***	−1.84 (0.95)*	−0.22 (0.17)
Employed (W)	−5.32 (3.43)	0.66 (1.13)	1.12 (1.18)	0.25 (0.22)
Unemployed (W)	−7.31 (3.05)**	−1.07 (0.98)	−0.49 (1.00)	−0.01 (0.18)
Probability of SNAP participation				
State SNAP policy variables				
Short: with earning	0.96 (8.21)	0.15 (1.30)	−0.01 (0.13)	−0.04 (0.37)
Short: without earning	−5.76 (11.04)	−0.91 (1.79)	0.05 (0.67)	0.26 (0.54)
BBCE	4.71 (1.70)***	0.78 (0.45)*	−0.01 (0.54)	−0.21 (0.19)
Simplified	6.30 (2.61)**	1.17 (0.71)*	0.08 (0.75)	−0.29 (0.28)
Parental resource variables				
Age/10 (H)	−3.51 (1.45)**	−0.81 (0.48)*	−0.37 (0.63)	0.04 (0.20)
Age/10 (W)	−4.87 (1.73)***	−1.28 (0.58)**	−0.75 (0.78)	−0.02 (0.25)
Work hours/10 (H)	−1.46 (0.65)**	−0.97 (0.21)***	−1.14 (0.30)***	−0.28 (0.10)***
Work hours/10 (W)	−1.44 (0.90)	−0.86 (0.28)***	−0.98 (0.38)**	−0.23 (0.13)*
<High school	−3.01 (1.92)	−0.22 (0.66)	0.45 (0.89)	0.27 (0.29)
Some college	−1.34 (2.18)	−0.98 (0.75)	−1.19 (1.01)	−0.30 (0.31)
College	−2.52 (2.24)	−2.71 (0.71)***	−3.47 (0.89)***	−0.88 (0.27)***
Employed (H)	1.67 (3.34)	1.24 (1.05)	1.52 (1.49)	0.39 (0.49)
Unemployed (H)	8.40 (3.32)**	3.48 (1.09)***	3.31 (1.60)**	0.65 (0.53)
Employed (W)	−1.19 (3.10)	1.28 (0.98)	2.39 (1.40)*	0.81 (0.51)
Unemployed (W)	3.38 (2.97)	2.22 (0.94)**	2.63 (1.42)*	0.66 (0.49)

Note: All effects on probabilities are multiplied by 100. Asymptotic standard errors in parentheses.
* Indicates statistical significance at the 10% level.
** Indicates statistical significance at the 5% level.
*** Indicates statistical significance at the 1% level.

6. Concluding remarks

This paper investigates the roles of parental resources and other socio-demographic variable in SNAP participation and FI, and the effects of SNAP participation on FI, among HW-C households. Our primary finding is that the role of SNAP is mixed. Among food insecure households, participation in SNAP ameliorates FI among adults (FIA) but increases probabilities of low food

security (LFSC) and very low food security (VLFSC) among children. Our result is consistent with previous findings that SNAP participation ameliorates FI among FIA households (Mykerezi & Mills, 2010; Yen et al., 2008). Contradictory results of SNAP participation are found among LFSC and VLFSC households. This positive association between SNAP participation and being LFSC or VLFSC, while small in magnitudes, is reasonable when taking into account the possibility that households with *severe* FI are more likely to participate in SNAP—a causal relationship found absent in the current single cross section.

This study is the first to evaluate the implication of SNAP participation and FI across parental resource variables and FI categories among HW-C households. Findings are important for the public sector—by informing deliberation by policy makers concerned about household food security issues. By calculating marginal effects of explanatory variables for SNAP non-participants and participants, we find that parental resource and socio-demographic variables affect SNAP non-participants and participants differently. For SNAP nonparticipants, husband's (wife's) age and working hours are all positively correlated with each FI categories, but for SNAP participants, these parental variables are negatively correlated with each FI category. Our findings suggest that state SNAP policy tools such as BBCE and Simplified reporting can encourage SNAP participation, thus lowering the probability of FIA and improving food security among adult households. For households with children, additional effort is called for to deliberate other policy measures such as other federal programs and informal food assistance programs, to improve food security among these households. Finally, our results on parental resources suggest food security can be achieved by promoting education and providing employment opportunities in the public and private sectors.

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