The Effect of Supplemental Nutrition Assistance Program on Food Spending Among Low-Income Households

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Abstract

The main goal of this paper is to provide current information on the impacts of Supplemental Nutrition Assistant Program (SNAP) on food spending across two food subgroups: food at home (FAH) and food away from home (FAFH). Data was obtained from the BLS's Consumer Expenditure Survey and Detailed Monthly Consumer Price Indices from years 1998 to 2009. Censoring of expenditures and the endogeneity of the SNAP participation variable are accounted for with the use of specialized econometric procedures. We found that SNAP participation increases FAH by $25 and decreases expenditures on food away from home by $32. Since the average SNAP benefits received by participants in the program is $80, the marginal propensity to consume of food at home out of SNAP benefits is 0.31.

Keywords: Censored Demand, Control Function Approach for Endogeneity

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Introduction

The Supplemental Nutrition Assistance Program (SNAP), previously called the Food Stamp Program, is designed to help improve the health and well-being of low income households and individuals by providing them a means to meet their nutritional needs. The SNAP program has expanded dramatically during the recent economic downturn: the SNAP program budget went from $37.6 billion in 2008, to $68.3 billion in 2010; and the number of the program participants increased from 28.2 to 40.3 million (USDA, 2011). These figures demonstrate average annual increases of 15% in the number of participants and 28% in the program budget during the period, well above the corresponding average annual rates of increase of 3% and 7% for the previous three-year period (2005-2007).

The effectiveness of the SNAP program at increasing recipients' food expenditures is an issue of considerable policy interest and has received substantial attention in the economics literature. Most of the studies evaluating the effectiveness of SNAP on food expenditures have been conducted using an Engel curve approach where food expenditures are estimated as a function of income and socio-demographic characteristics of the individuals (e.g., Senauer and Young, 1986; Chavas and Yeung, 1982; Wilde, Troy and Rogers, 2009; Hoynes and Schanzenbach, 2009). However, the use of the Engel approach for the evaluation of the impact of the SNAP program suffers from at least two limitations. The first limitation has to do with the implicit assumption of these studies that prices are constant. Polinsky (1977) has pointed out that failure to specify cross-sectional price effects adequately could result in biased and misleading marginal effects of the variables included in Engel models.

The second limitation of the majority of studies using the Engel approach is related to the potential endogeneity of the SNAP benefits variable (Hoynes and Schanzenbach, 2009; Wilde, Troy and Rogers, 2009), which in most cases has been included as a separate argument in the Engel function (see Fox, Hamilton and Lin's (2004) literature review). The parameter corresponding to SNAP benefits is then used to estimate the marginal propensity to consume (MPC) food out of SNAP benefits as a measure of the program impact.[1] Since there is strong evidence that SNAP participants are self-selected into SNAP, not controlling for self-selection will result in biased MPC estimates.

Several studies have attempted to identify the causal effects of SNAP participation on some outcome measures using instrumental variables to control for selection. Gundersen and Oliveira (2001) examined the effect of SNAP on food insecurity using the 1991 and 1992 panels from the Survey of Income and Program Participation. The imputed answer of the respondent to a stigma-related question was used as an instrumental variable. Once selection was controlled for, SNAP participants were found to have the same probability of being food insecure as income-eligible nonparticipants (Gundersen and Oliveira, 2001). Meyerhoefer and Pylypchuk (2008) exploited variations in state-level SNAP outreach expenditures and recertification requirements to instrument SNAP participation decision. They found that SNAP participation by women resulted in a 5.9% increase in the likelihood of overweight and obesity. Kaushal (2007) used a 1996 federal law that banned immigrants from receiving SNAP benefits as a natural experiment to control for selection. No statistically significant effect of SNAP participation on the weight status of adult low-income immigrants was found (Kaushal, 2007). Yen et al. (2008) used variations in state Electronic Benefit Transfer adoption rate and SNAP recertification

[1] Previous literature on the subject calls these estimate MPC out of food stamps. In this proposal, we refer to them as MPC out of SNAP benefits to be consistent with the new name of the program.

periods as instruments and found that SNAP participation mitigates the severity of food insecurity. Finally, Mykerezi and Mills (2010) used state-level errors in benefit payments as instrument and found that SNAP lowers food insecurity by at least 18%. From the best of our knowledge, only the study by Hoynes and Schanzenbach (2009) has considered this issue in the context of food expenditures analysis.[2] To account for the potential endogeneity of the SNAP benefits variable, these authors use variation in the timing of food stamp introduction across areas in the U.S. However, a drawback of this study is the fact that the dataset used for their analyses covers the period between 1968 and 1978. Hence, their estimates need to be updated as economic conditions have changed dramatically over the past 40 years.

Given the limitations mentioned previously, this study proposes to analyze the effect of SNAP on consumer expenditures using a demand system approach. One of the reasons behind the paucity of studies evaluating the effectiveness of SNAP on household consumption using the demand system approach is the lack of price information in household expenditure surveys such as the Consumer Expenditure Survey (CEX) or the Current Population Survey-Food Security Supplement (CPS-FSS) (Slenick, 2005). Recent advances in the econometric literature have shown that, in some cases, it is possible to partially overcome this limitation with the construction of household specific price indices (Stone-Lewbel prices) derived from regional price indices (Hoderlein and Mihaleva, 2008). This procedure increases the cross-sectional variation of prices and improves identification of price effects.

Another advantage of the use of demand system approach is that it provides a theory-consistent framework for the study of the influence of a series of economic factors (including

[2] Wilde, Troy and Rogers (2009) also discuss this issue but they do not provide an estimate of the MPC. To deal with the potential endogeneity issue they estimate separate nonparametric Engel functions for participants and nonparticipants but use total income including cash income plus SNAP benefits as explanatory variables in their food expenditures models.

participation on the SNAP program and unemployment) on households' allocation of expenditures on food and nonfood items across different population groups, geographic locations, and seasons. Hence, the use of the demand system approach will shed light on factors influencing tradeoffs households make between food and non-food spending.

The main goal of this paper is to provide current information on the impacts of SNAP on food spending across two food subgroups: food at home (FAH) and food away from home (FAFH). Specific objectives of the study are: 1) to evaluate the effect of SNAP on households' expenditures on food, and 2) to analyze the influence of location, seasonality, economic conditions and demographic characteristics effects on households' allocation of expenditures on food.

Conceptual Models

The parametric demand model that will be used in this project is the Exact Affine Stone Index (EASI) demand system recently proposed by Lewbel and Pendakur (2009). Relative to the popular Almost Ideal Demand Systems, EASI allows for more flexible income expansion paths (Engel curves) and allows for unobserved preference heterogeneity (Lewbel and Pendakur, 2009). Since Lewbel and Pendakur (2009) found little empirical difference between the exact nonlinear and the approximate linear EASI estimates, we use the approximate linear version of the model. The modified linear EASI budget share demand model for good n can be written as:

$$w_n = \sum_{r=0}^{R} b_{rn}(lnx)^r + \sum_{m=1}^{M}(C_{mn}z_m + D_{mn}z_m lnx) + \sum_{k=1}^{N} A_{kn} lnp_k + \sum_{k=1}^{N} B_{kn} lnp_k lnx + \varepsilon_n \quad (1)$$

where *ln* before a variables refers to its natural log, lnx is a measure of real total expenditure ($lnx = lnY - \sum_{n=1}^{N} lnp_n w_n$), Y is the total (nominal) expenditure on all

commodities, w_n is the budgetary share allocated to the nth commodity (i.e. $w_n = p_n q_n / Y$), p_k is the price of commodity k, and R is the number of equations in the system. The regressors in this model include *M* different demographic characteristics z_m, *N* prices and interaction terms of the forms $lnp_k lnx$, and $z_m lnx$. This model is also a $(R-1)$ order polynomial in lnx which in turn is a nonlinear function of prices, shares, nominal expenditures and socio-demographic characteristics (see Lewbel and Pendakur, 2009, equation (8) for details).

Endogeneity of SNAP Participation and Expenditures

There is strong evidence that SNAP participants are self-selected into SNAP (e.g., Gundersen and Oliveira 2001; Hoynes and Schanzenbach, 2009) thus not controlling for self-selection will create the endogeneity issue, where the coefficient on SNAP is not causal. In the proposed study, we will use several state level SNAP rules as instrumental variables for causal inference.

In addition to the potential endogeneity of SNAP participation, we also consider the potential endogeneity of group expenditures. Instruments used to control for endogeneity of expenditures are income and income squared (see e.g., Blundell and Robin, 2000).

Elasticities and Marginal Propensity to Consume

Lewbel and Pendakur (2009; pages 12 and 44) provide formulas for the price and income semi-elasticities of the budget shares. It can be shown, that the conventional Hicksian, Marshallian and expenditure elasticities for good n can be calculated with the following formulas:

Hicksian price elasticities of good *n* with respect to price *k* (ε_{nk}^*):

$$\varepsilon_{nk}^* = \frac{1}{w_n}(A_{kn} + B_{kn} lnx) + w_k - \delta_{nk} \quad (2)$$

where δ is the Kronecker delta, which is equal to 1 when $n = k$, and equals zero otherwise.

Marshallian price elasticities of good *n* with respect to price *k* (ε_{nk}):

$$\varepsilon_{nk} = \varepsilon^{*}_{nk} - w_k \eta_n. \quad (3)$$

Expenditure elasticities of good *n* (η_n):

$$\eta_n = \frac{1}{w_n}\left(1 - \sum_{k=1}^{N} w_k \log p_k (\eta_k - 1)\right)\left(\sum_{r=1}^{R} r b_{rn} lnx^{r-1} + \sum_{m=1}^{M} D_{mn} z_m + \sum_{k=1}^{N} B_{kn} \log p_k\right) + 1 \quad (4)$$

where η_n is the expenditure elasticity of commodity group n with respect to nominal expenditures Y. The system of simultaneous equations in equation (4) can be solved for η_n.

Marginal effects of the demographic characteristics on shares can be calculated using the formula $\partial w_n / \partial z_m = C_{mn} + D_{mn} lnx$. The effect of a demographic characteristic on group expenditures is then ($Y\, \partial w_n / \partial z_m$). The SNAP dollar impact on household spending can be calculated dividing the estimated effect of SNAP participation on group expenditures by the amount of SNAP benefits received by the household.

Data

Data used in this study are obtained from the Bureau of Labor and Statistics (BLS)'s Consumer Expenditure Survey (CEX) Diary surveys and detailed Monthly Consumer Price Index (CPI) from 1998 to 2009, and the SNAP rules database (officially named the Food Stamp Program Rules Database) developed by the Urban Institute and the USDA Economic Research Service (ERS) (Finegold, Margrable, and Ratcliffe, 2007).

BLS Data

In the BLS's CEX Diary Survey households keep a two-week diary of all their food purchases made each day. Households daily expenditures on specific food product expenditures, identified in the original data set using Universal Classification Codes (UCC)**,** were added together to obtain bi-weekly expenditures on aggregate food sub-groups and groups (see Table

1). We excluded the following households from the diary sample: 1) households that report only one week of expenditure, 2) households with missing demographic variables and income, 3) households with income less than zero, and 4) households without a state identifier. The final sample contains 57,585 households from the 1998 to 2009 Diary Survey.

Besides household expenditures, the CEX collects information on all the demographics and family characteristics, and income. Household characteristics variables from the CEX survey used in this paper are age of household, household size, education of the household head, race of the household, region of residence, season, presence of children, SNAP participation and income (Table1). These variables were selected based on the results of previous studies and the objectives of this paper (Raper et al., 2002; Jensen and Yen, 1996; Stewart and Yen, 2004).

A dummy variable was created to identify poverty and non-poverty status households. Following Park et al. (1996) and Raper et al. (2002), this segmentation was done using the 1998-2009 poverty guidelines issued by the U.S. Department of Health & Human Services (HHS). An advantage of the EASI model is the fact that marginal effects and elasticities are a function of the socio-demographic characteristics, so there is no need to estimate separate consumer demand models (see equations above).

Another variable considered in the study are the general economic condition of the country. Two significant economy recession events are considered over the period of study. The first event occurs between year 2000 and 2001 and the second event happens from December 2007 to January 2010 (Kuma and Kaufman, 2011). Therefore, the dummy variable for the period of 2000-2001 and 2008-2009 are used to capture the economy recession.

SNAP variable and SNAP database

To ensure consistency in the definition of the SNAP participation variable we reviewed all the CEX survey questionnaires for the 1998-2009 period. Based on the review of the questionnaires, the SNPA participation was based on two questions that have been included in this survey during the study period. The first question used asked respondents "*Have any members of your CU received any Food Stamps (SNAP), in the past month?*" The second question used is '*In how many of the past 12 months were Food Stamps (SNAP) received?*".

Several state SNAP rules from the SNAP rules database were used as instrumental variables for SNAP participation (Table 3). The instrumental variables need to be correlated with participation but not provide additional information about the outcome variable that the participation status variable and other covariates do not already give.

Stone-Lewbel (SL) prices

The main drawback of using the CEX data is the lack of price or quantity information at the household level. To overcome this limitation, we construct household specific SL from detailed monthly CPI using a procedure suggested by Hoderlein and Mihaleva (2008). If the between-group utility function is weakly separable and the within group sub-utility functions are Cobb Douglas, then it can be shown that the SL price (v_{li}) index corresponding to the group i and household l is:

$$v_{li}(p_{li}, z_l) = \frac{1}{k_i} \prod_{j=1}^{n_i} \left(\frac{p_{ij}}{w_{lij}}\right)^{w_{lij}} \quad (5)$$

with a scaling factor k_i given by $k_i = \prod_{j=1}^{n_i} \bar{w}_{ij}^{-\bar{w}_{ij}}$, where n_i is the number of goods in group i, p_{ij} is the (regional) monthly price[3] of the jth good in group i, $w_{lij} = p_{lij}q_{lij}/y_{li}$ is household l within group budget share of the jth good in group i, $\bar{w}_{ij}$ is the budget share of good j in group i

[3] To produce consistent detailed monthly CPI series over time, we use 1998-2009 as the base period (i.e., average CPI values 1998-2009=100). Each CPI is deflated by using regional CPI for all items to construct regional monthly price. The monthly CPI series used in this project are not seasonally adjusted.

of the reference household[4] and z_l is a vector of observable demographic characteristics of household l. SL prices can then be used in place of original price data to estimate the between-group budget share. Notice that the construction of SL prices requires information on subgroups budget shares (Table 1).

Estimation Procedures

There are two issues that need to be considered for the estimation of EASI demand systems in equation (3): censoring of expenditures and the presence of discrete (SNAP participation) and continuous (total expenditures) endogenous variables.

Regarding censoring of the expenditures we consider two alternative approaches. The first approach involves the use of standard linear regression methods as suggested by Angrist (2001) and Deaton (1997) as a sensible approximation to an unknown model that generates the corner solutions (uncensored model). Implementation of this approach is carried out using Seemingly Unrelated Regression (SUR). The second procedure used for the estimation of the demand model is the two-step econometric method of Shonkwiler and Yen (1999).

Under the model assumptions, Shonkwiler and Yen's (1999) method provides consistent parameter estimates and is probably the most commonly used method to account for zero expenditures in demand model estimation (e.g., Alfonzo and Peterson, 2006; Carpio and Wohlgenant 2010; Yen and Lin 2006). The procedure works as follows. Consider the two equation system:

$$w_{ni}^{*} = f\left(lnx_i, ln\mathbf{p}_{\boldsymbol{i}}, \mathbf{z}_{\boldsymbol{i}}; \boldsymbol{\theta}_n\right) + \varepsilon_{ni},\ d_{ni}^{*} = \boldsymbol{\alpha}_n{}'\mathbf{x}_{\boldsymbol{i}} + v_{ni}\ , \tag{6}$$

$$\text{with } d_{ni}=\begin{cases}1 \text{ if } d_{ni}^{*} > 0\\ 0 \text{ if } d_{ni}^{*} \le 0\end{cases},\ w_{ni} = d_{ni} * w_{ni}^{*},\ n=1,2,$$

[4] The reference household is the household with average budget shares. .

where the subscript i denotes the ith household, The variable w_{ni}^{*} is the latent (unobserved) budget share and d_{ni}^{*} is the latent variable defining the discrete choice decision of a household whether to buy a commodity. The function $f(lnx_i, ln\mathbf{p_i}, \mathbf{z_i}; \boldsymbol{\theta}_n)$ is the EASI model as specified in equation (3), $\mathbf{z_i}$ represents the vector of socio-demographic characteristics, $ln\mathbf{p_i}$ the vector of log SL prices, lnx_i the log of real expenditures, and $\boldsymbol{\theta}_n$ is the vector of parameters. In the sample selection model, $\boldsymbol{\alpha}_n$ is a vector of parameters corresponding to the vector $\mathbf{x_i}$ of socio-demographic characteristics and v_{ni} is an error term. The vector of demographic variables in the sample selection equation $\mathbf{x_i}$ is the same as vector $\mathbf{z_i}$ used in the EASI demand model.

The first step of the Shonkwiler and Yen (1999) method involves the estimation of a probit model describing the sample selection. Estimates of $\boldsymbol{\alpha}_n$ from the probit are used to calculate $\Phi(\hat{\boldsymbol{\alpha}}_n'\mathbf{x_i})$ and $\phi(\hat{\boldsymbol{\alpha}}_n'\mathbf{x_i})$ which represent estimates of the cdf and pdf of v_{ni}, respectively In the second step, estimates of $\boldsymbol{\theta}_n$ are obtained by SUR using a modified version of the EASI demand model incorporating $\Phi(\hat{\boldsymbol{\alpha}}_n'\mathbf{x_i})$ and $\Phi(\hat{\boldsymbol{\alpha}}_n'\mathbf{x_i})$. The modified EASI demand model is:

$$w_{ni}^{*} = \Phi(\hat{\boldsymbol{\alpha}}_n'\mathbf{x_i})\, f(lnx_i, ln\mathbf{p_i}, \mathbf{z_i}; \boldsymbol{\theta}_n) + \delta_n\phi(\hat{\boldsymbol{\alpha}}_n'\mathbf{x_i}) + \xi_{ni},\ n=1,2. \quad (7)$$

In the case of the demand model estimated without considering the censoring issue (uncensored model), to avoid singularity of the variance-covariance matrix of residuals, only one demand equation was estimated and the parameters of the second equation were recovered using the adding up and symmetry restrictions. In the case of the censored demand models (equation (7)), both equations are estimated simultaneously and the adding-up and symmetry restrictions are imposed in the latent demand model. In this case, the singularity of the variance-covariance matrix of residuals is no longer an issue (Yen *et al*., 2002; Drichoutis *et al*., 2008). The MODEL procedure from SAS was used to estimate the parameters of the censored and uncensored demand models. Formulas for elasticities and marginal effects similar to those presented in

equations (2) to (4) were obtained from equation (7) in order to account for the censoring problem.

To account for the endogeneity of real log expenditures and the SNAP participation variable, we used the approach suggested by Blundell and Robin (2000) where equations (1) and (7) are augmented with two error terms ϑ_1 and ϑ_2 from reduced form models of real log expenditures and the SNAP dummy variable. Our reduced form of real log expenditures follows Blundell and Robin's (2000) specification and is defined as a function of log prices, demographic variables, interaction terms between socio-demographic characteristics and log income, linear and quadratic terms of log income, and the SNAP policy variables. The reduced form of the SNAP participation is defined as a function of the same variables used in the real log expenditures model. Both models were estimated using ordinary least square (OLS) procedures. Since SNAP participation is a dummy dependent variable, the estimated model is a linear probability model (Wooldridge, 2002).

To account for the use of two-step estimation procedures and the heteroskedasticity of the disturbances in the system of equations of the form in (1) and (7), we estimated standard errors for parameter, elasticities, and marginal effect estimates using the non-parametric bootstrapping procedure outlined in Wooldridge (2002: 379) using 400 replications.

Results and Discussion

Descriptive statistics

Descriptive statistics of aggregate food groups budget shares and household characteristics are presented in Table 2. Food at home constitutes the largest share of the total food budget at 63.96%, and food away from home the remaining 35.98%.

The summary statistics in Table 2 also indicate that the sample used in the analysis is representative of the US population. For example, the proportion of individuals with college education, the proportion of individuals of different races and the proportion of individuals living in different regions are very close to the values reported in various issues of the US Census Bureau Current Population Survey conducted during the same period.

About 19% of the households in the sample were classified as low income, however only 5% reported receiving SNAP benefits. Previous studies have found that the CEX survey underreports SNAP receipt which has the potential to bias the results. However, if the SNAP classification is not correlated with the instruments, estimates from instrumental variables models are unbiased (Wooldridge, 2002).

Regression Results

We present the results of three specifications two "naïve" specifications that ignore the endogeneity of log real expenditures and the SNAP participation variables. The first specification corresponds to a regression model that does not take into account the censoring and the second specification accounts for the censoring problem. The third specification is a complete specification that accounts for the endogeneity and censoring problems simultaneously. The estimated demand models presented and discussed in this section did not include interaction terms between prices and real expenditures ($lnp_k lnx$) and real expenditures and socio-demographic ($z_m lnx$). We discuss these additional specifications and others to explore the sensitivity of the findings.

Price and Expenditure Elasticities

All estimated own-price elasticies of demand are negative and consistent with economic theory. Own-price elasticities in the uncensored model are lower in absolute value relative to

those observed in the censored models. The Marshallian own-price elasticities of FAH are consistently higher than the Marshallian own-price elasticities of FAFH. The estimated Marshallian own-price elasticities of FAH are higher in absolute value than the three previous studies reported by Okrent and Alston (2010) (average -0.48, min -0.54, max -0.43). On the other hand, the Marshallian own-price elasticities of FAFH are generally lower than the eight previous studies also reported by these authors (average -1.02, min -1.50, max -0.69). However, most of the studies cited by Akrent and Alston (2010) use data corresponding to periods before 2001. The cross price elasticity of FAH with respect to the price of FAFH is consistently lower (in absolute value) than the cross price elasticity of FAFH with respect to the price of FAH.

All estimated expenditure elasticities of demand are positive and less than one for FAH and positive and greater than one for FAFH. These results are in general consistent with previous studies (Nayga and Capps, 1992; Park et al., 1996).

Marginal Effects

The estimated "marginal effects" measure the effect on the conditional mean of total expenditures on FAH and FAFH of a change in the socio-demographic variables. Hence, it is important to mention that mean bi-weekly expenditures in FAH and FAFH are $141.74 and $79.73, respectively.

For those parameters that are statistically significant, the direction of the effects (i.e., the sign of the parameters) is generally consistent across specifications. Except for age, family size, and the time trend which are continuous variables, all the other regressors in the demand models are dummy variables.

Regarding the continuous variables our results indicate that each additional year of age increases households' expenditures on FAH and reduces expenditures on FAFH. The result of

the time trend suggests that, after controlling for other factors, expenditures on FAH have increased and expenditures on FAFH have decreased during the period of analysis. The effect of family size is not consistent across models. In the uncensored model each additional member in the family increases expenditures on FAH and decreased expenditures on FAFH. The opposite is true for the censored demand models.

The marginal effects of the dummy variables are the effects in relation to households with characteristics of the dummy variables not included in the model: households whose household head is not college educated, residing in the West, of race other than white or black, without children and not receiving SNAP benefit. The baseline household is also non-poor and non-Hispanic and participated in the survey during a non-recessionary period. Relative to this type of household, the effects of dummy demographic variables are as follows (we focus the discussion on the results from the censored model that controls for endogeneity of expenditures and SNAP participation):

(a) Households with a household head with college education spend less on FAH and more on FAFH.

(b) Relative to other races, white households spend more on FAFH and spend less on FAH.

(c) Expenditures on FAFH are higher in spring and fall than during the winter.

(d) Households with children spend more on FAH.

(e) When the economy is in recession, households spend less on FAFH (Kuma and Kaufman, 2011).

(f) Relative to households living in the West, households living in the Northeast spend more on FAH and less on FAFH.

(g) Relative to non-Hispanic households, Hispanic households spend more on FAH but less on FAFH.

(h) Poor households spend more on FAH and less on FAFH than non-poor households.

Finally, with regard to the effect of SNAP participation which is the main focus of this study, we found that household receiving SNAP benefits spend $25 more on FAH and $32 less on FAFH relative to households that do not receive SNAP benefits. The magnitude (in absolute value) of the effects is higher than those found using an uncensored model or a censored demand model without controlling for endogeneity which highlights the need for taking into account this problem. It is also important to mention that among all the specifications shown in Table 4, the SNAP variable is consistently among the explanatory variables with the highest effect on expenditures.

Summary and Conclusions

The main goal of this paper is to provide current information on the impacts of SNAP on food spending expenditures across two food subgroups: food at home and food away from home. The empirical analysis is conducted using the Exact Affine Stone Index (EASI) demand system recently proposed by Lewbel and Pendakur (2009). Data for the study was obtained from the BLS's CEX survey and monthly CPIs from years 1998 to 2009. Censoring of expenditures and the endogeneity of the SNAP participation variable are accounted for with the use of specialized econometric procedures. Several state level SNAP rules are used as instrumental variables for causal inference of SNAP participation.

The use of a theoretically consistent demand model as the framework for the empirical analysis allowed us to estimate marginal effects and elasticities of demand for FAH and FAFH.

The majority of previous studies analyzing the demand for these goods had been conducted using data previous to 2001.

With respect to the effect of the SNAP variable, we found that SNAP participation increases FAH by $25 and decreases expenditures on food away from home by $32. Since the average SNAP benefits received by participants in the program is $80, the marginal propensity to consume (MPC) of food at home out of SNAP benefits is 0.31. The results of this study contributes to the literature providing new estimates of the impact of SNAP since most of the studies evaluating the program use data previous to 2001 (Fox, Hamilton and Lin, 2004).

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Table 1: Detail of Expenditure and Price Series of Food Commodity Groups and Sub-Groups

Food Commodity Groups	Universal Classification Codes (UCC)	CPI Item code
Food at home		
Cereal and bakery products	010110<=UCC<=020820; 180612	SAF111
Meats and eggs	030110<=UCC<=080110	SAF112
Dairy and related products	090110; 090210; 100210 <=UCC<=100510	SEFJ
Fruits and vegetables	110110<=UCC<=120410; 130121; 130310; 130320; 140110<=UCC<=140340	SAF113
Nonalcoholic beverages	130110; 130122; 130211; 130212; 140410; 140420; 170110<=UCC<=170530; 200112	SAF114
Fats and oils	100110; 160110<=UCC<=160320	SEFS
Sugar and other sweets	150110<=UCC<=150310	SEFR
Miscellaneous foods	180110<=UCC<=180520; 180620<=UCC<=180710	SEFT
Food away from home		
Full service meals and snacks	190112; 190212; 190312; 190322; 190912; 190922	SEFV01
Limited service meals and snacks	190111; 190211; 190311; 190321; 190911; 190921	SEFV02
Other food away from home	190114; 190214; 190314; 190324; 190914; 190924; 190113; 190213; 190313; 190323; 190913; 190923; 190115; 190116; 190215; 190216; 190315; 190316; 190325; 190326; 190915; 190916; 190925; 190926	SEFV03, SEFV04, SEFV05

Notes: The price index for a food composed of more than one CPI is simply the sum of each component CPI weighted by its expenditure share

Table 2: Descriptive Statistics of Expenditure Shares and Household Characteristics (Number of Observations=57,585)

Variable	Definition	Mean	Std. Dev.	Min	Max
Total Expenditures on Food	Two-week expenditures on FAH and FAFH	221.47	148.05	0	1064.76
Expenditure Shares					
Food at home	Budget share of FAH	0.6396	0.2635	0	1
Food away from home	Budget share of FAFH	0.3598	0.2631	0	1
Continuous Variables					
Age of household	Age of household	48.790	17.118	18	94
Family Size	Number of household numbers	2.559	1.475	1	14
Time trend		6.652	3.277	1	12
Dummy Variables (yes = 1, no = 0)					
Education of the household head					
College-educated	Household head has at least college education	0.301	0.458	0	1
Non college-educated	Household head has less than college education	0.699	0.458	0	1
Race of the household head					
White	Household head is white	0.832	0.374	0	1
Black	Household head is black	0.110	0.313	0	1
Other race	Household head is other race	0.058	0.233	0	1
Season					
Spring	Household completed the survey in the spring	0.266	0.442	0	1
Summer	Household completed the survey in the summer	0.249	0.432	0	1
Fall	Household completed the survey in the fall	0.243	0.429	0	1
Winter	Household completed the survey in the winter	0.242	0.428	0	1
Presence of children	Whether the household have children under 18	0.360	0.480	0	1
SNAP Participation	Whether the household receives SNAP benefits	0.049	0.215	0	1
Economic conditions	Whether the survey is conducted in period of recession	0.317	0.465	0	1
Region of residence					
Northeast	Household lives in the Northeast	0.206	0.405	0	1
Midwest	Household lives in the Midwest	0.231	0.422	0	1
South	Household lives in the South	0.315	0.464	0	1
West	Household lives in the West	0.248	0.432	0	1
Hispanic	Whether household head is Hispanic	0.113	0.316	0	1
Income group	Whether household is low income	0.194	0.396	0	1

Table 3: Instrumental Variables to Control for Endogeneity of SNAP Participation

Policy variable	Description	Expected effect on participation	Previous literature	Source
Immigration eligibility	Whether noncitizen immigrants are eligible for	+	Kaushal (2007)	ERS updated SNAP rules database
Short recertification period	Percent of SNAP units that have to be recertified at high frequencies (e.g. 1-3 months)	–	Kabbani and Wilde (2003); Meyerhoefer and Pylypchuk (2008)	Same as above
Categorical eligibility	Whether the state removed the asset test	+		Same as above
Simplified reporting	Whether the state simplifies reporting of changes in earnings by SNAP units	+		Same as above

Table 4: Price and Expenditure Elasticities

	Hicksian price elasticities		Marshallian price elasticities		Expenditure Elasticties
	FAH	FAFH	FAH	FAFH	
Uncensored Demand Model					
FAH	-0.0266** (0.0077)	0.0260** (0.0077)	-0.6090** (0.0079)	-0.3016** (0.0079)	0.9106** (0.0030)
FAFH	0.0462** (0.0137)	-0.0468** (0.0137)	-0.6951** (0.0142)	-0.4638** (0.0141)	1.1590** (0.0054)
Censored Demand Model					
FAH	-0.1465** (0.0094)	0.1459** (0.0095)	-0.7703** (0.0100)	-0.2049** (0.0097)	0.9752** (0.0045)
FAFH	0.2984** (0.0153)	-0.2990** (0.0152)	-0.3665** (0.0159)	-0.6730** (0.0154)	1.0395** (0.0072)
Censored Demand Model Controlling for Endogeneity of Expenditures and SNAP Participation					
FAH	-0.1404** (0.0084)	0.1398** (0.0085)	-0.7685** (0.0129)	-0.2135** (0.0098)	0.9821** (0.0144)
FAFH	0.2886** (0.0137)	-0.2892** (0.0136)	-0.3693** (0.0206)	-0.6593** (0.0154)	1.0286** (0.0230)

** Statistically significant at the 0.05 level.
* Statistically significant at the 0.10 level.

Table 5: Marginal Effects of Socio-Demographic Characteristics

	Age	Family size	Time trend	At least college education	Race		Seasonal			Presence of children	SNAP	Recession	Region			Hispanic	Low Income
					White	Black	Spring	Summer	Fall				Northeast	Midwest	South		
Noncensored Demand Model without the interaction term																	
FAH	0.604**	5.196**	0.031	-3.215**	-5.009**	-0.861	-2.882**	-2.707**	-1.479**	6.618**	17.798**	0.378	1.132*	-0.827	-1.714**	4.852**	8.394**
	(0.018)	(0.241)	(0.072)	(0.523)	(1.045)	(1.340)	(0.607)	(0.629)	(0.676)	(0.748)	(1.091)	(0.510)	(0.698)	(0.631)	(0.635)	(0.748)	(0.656)
FAFH	-0.604**	-5.196**	-0.031	3.215**	5.009**	0.861	2.882**	2.707**	1.479**	-6.618**	-17.798**	-0.378	-1.132*	0.827	1.714**	-4.852**	-8.394**
	(0.018)	(0.241)	(0.072)	(0.523)	(1.045)	(1.340)	(0.607)	(0.629)	(0.676)	(0.748)	(1.091)	(0.510)	(0.698)	(0.631)	(0.635)	(0.748)	(0.656)
Censored Demand Model without the interaction term																	
FAH	0.126**	-2.158**	0.560**	-8.831**	-6.473**	0.715	-1.130	-1.340	0.268	3.016**	0.947	-0.413	5.268**	0.414	1.124	4.061**	17.090**
	(0.048)	(0.435)	(0.105)	(0.631)	(1.104)	(1.934)	(1.007)	(1.009)	(0.956)	(1.165)	(2.232)	(0.777)	(1.036)	(0.932)	(0.932)	(1.256)	(1.075)
FAFH	-0.511**	3.017**	-0.646**	16.540**	9.624**	-4.002	2.046	2.025	0.536	0.085	-10.237**	-1.493	-7.970**	-0.946	-3.014**	-10.419**	-28.929**
	(0.047)	(0.467)	(0.132)	(0.955)	(1.924)	(2.433)	(1.301)	(1.290)	(1.262)	(1.452)	(2.307)	(0.939)	(1.351)	(1.271)	(1.175)	(1.490)	(1.234)
Censored Demand Model Controlling for Endogeneity of Expenditures and SNAP Participation																	
FAH	0.176**	-2.315**	0.382**	-8.359**	-5.469**	-0.321	-1.128	-1.472	0.257	2.718**	25.199**	-0.297	4.270**	0.058	0.521	3.068**	13.151**
	(0.044)	(0.557)	(0.105)	(0.702)	(1.266)	(1.820)	(0.869)	(0.952)	(0.893)	(1.165)	(3.655)	(0.739)	(0.974)	(0.862)	(0.820)	(1.236)	(1.322)
FAFH	-0.553**	3.167**	-0.486**	16.069**	8.703**	-3.045	2.034*	2.135*	0.536	0.341	-31.921**	-1.582*	-7.063**	-0.625	-2.463**	-9.481**	-25.323**
	(0.044)	(0.567)	(0.129)	(0.990)	(1.858)	(2.326)	(1.085)	(1.187)	(1.142)	(1.375)	(3.672)	(0.908)	(1.249)	(1.159)	(1.095)	(1.417)	(1.510)

** Statistically significant at the 0.05 level.
* Statistically significant at the 0.10 level.