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Ben Senauer and Nathan Young

For food stamp recipients whose normal food purchases exceed their coupon allotment, the traditional economic model predicts that the impact of food stamps on food spending will be the same as for an equal cash transfer. The Tobit analysis in this study indicates that, for these recipients, food stamps have a substantially greater impact on at-home food expenditures than an equal amount of cash income. These results reject the traditional model. Several possible explanations of this behavior are discussed.

Key words: food expenditures, food stamps, Tobit analysis.

The effectiveness of the Food Stamp Program (FSP) at expanding recipients' food expenditures is an issue of significant policy interest and has received considerable research attention. A model first presented in a 1945 article by Herman Southworth, and refined and modified by others since then, has become universally accepted as the conceptual basis for explaining the relation between food stamps and food spending (Huang, Fletcher, and Raunikar; Mittelhammer and West; Neenan and Davis; Olsen; and Phillips and Price). The Southworth model distinguishes between two types of households receiving food stamps. For participating households whose food expenditures exceed their coupon allotment, the program is inframarginal and functions as an unrestricted transfer. For those recipients the marginal effect of food stamps on food purchases should be no different than for an equivalent cash income subsidy. The other category of participants includes those households for which the program is extramarginal and acts as a restricted transfer. For these households the coupon allotment exceeds their pre-participation level of food spending; and, while participating in the program, they spend no additional cash beyond their food stamp allotment on food.

The primary purpose of this study was specifically to implement a test of the Southworth model. The empirical analysis utilized data from the University of Michigan's Panel Study of Income Dynamics (PSID). By using data for 1978 and 1979, the impact of food stamps on food spending prior to and following the elimination of the purchase requirement (EPR) could be assessed. The empirical results demonstrate that the Southworth model is incomplete. Several possible factors are suggested to explain the observed difference between the impact of cash income and food stamps on household food expenditures, even for inframarginal recipients.

The Traditional Model and Previous Research

The traditional Southworth model may be summarized as:

$$\begin{aligned}&\text{Maximize } U = U(F,X)\\&\text{subject to: } P_xX + P_fF = M + FSBON\\&\text{and } P_xX \leq M\\&\text{which together imply: } P_fF \geq FSBON + FSPAY\end{aligned}$$

where the utility function contains F (food used at home) and X (food away from home and nonfood), and P_x and P_f are the respective prices with M (money income), $FSBON$ (food

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stamp bonus value), and *FSPAY* (food stamp payment) in the budget constraints. The final constraint simply indicates that all food stamps received are used to purchase food. After elimination of the purchase requirement, *FSPAY* is zero and *FSBON* equals *FS* (food stamp allotment); otherwise *FS* equals *FSBON* plus *FSPAY*. One common hypothesis generated by this model is that for inframarginal households with $P_fF > FS$, then $MPC_M = MPC_{FSBON}$; the marginal propensities to consume for food at home from cash income (M) and the food stamp bonus (*FSBON*) should be equal, if at-home food spending exceeds the allotment.

However, in regressions that are nonlinear in variables, this hypothesis could be difficult to test since the marginal impact of a factor is not constant but depends on the level at which it is evaluated. An alternative, testable hypothesis used in this analysis is that for inframarginal households the proportion of total household income received in the form of bonus food stamps should have no impact on food spending. If *PROP* is defined as *FSBON*/(M + *FSBON*), then based on the Southworth model the expected impact of *PROP* on at-home food expenditures (P_fF) is zero, if $P_fF > FS$.

Table 1 summarizes the results of the previous major empirical studies on the impact of food stamps on food expenditures. The data bases, specific methodological approaches, and statistical techniques differed among these studies. Nevertheless, each of these studies provides a separate estimate of the marginal propensity to consume (MPC) for food used at home from money income and the food stamp bonus.[1] In every study an additional dollar of bonus food stamps has a substantially greater impact on food used at home than a dollar increment in money income. The marginal propensity related to the food stamp bonus is at least twice as large as that for cash income in every case.

A shortcoming of these studies, though, is that they have not distinguished between infra- and extramarginal food stamp recipients and have thus averaged together two possibly quite different types of behavior. Furthermore, the traditional Southworth model has not been rejected on the basis of these results because a sufficient number of households were assumed to be in the extramarginal, restricted recipient category to explain the higher MPC from food stamps (Chavas, p. 226). However, given the various reforms of the FSP over the last twenty years which have continually reduced the number of extramarginal recipients, this rationalization has become increasingly dubious. This paper conclusively demonstrates that this explanation does not adequately account for the higher MPC from food stamps than cash.

[1] Some of these studies relate to household food expenditures and others to the value of actual food consumed. The term MPC is applied to both cases.

The Data and Statistical Model

The PSID surveys covered approximately 5,000 families, who were interviewed in the spring of each year, oversampling the lower income portion of the population (Institute for Social Research). The sample used in our econometric analysis was limited to include only households currently receiving food stamps for two reasons. First, the questions eliciting food expenditure information in the PSID surveys were different for food stamp recipient and nonrecipient households. Second, the impact of possible functional form misspecification can be partially offset if local approximation properties are improved by making the sample more homogenous. The samples used contained 573 households for 1978 and 574 for 1979. Separate regressions were run for each year: 1978, which was prior to EPR, and 1979, which was after EPR. The purchase requirement was eliminated on a nationwide basis in January 1979. In 1978, 164 households spent no additional cash on food beyond their food stamp allotment. In 1979, 82 families were in this category. Therefore, the program was an inframarginal, unrestricted transfer for 71.4% of the recipients in 1978 and for 85.7% in 1979. The larger number of inframarginal recipients in 1979 reflected the impact of EPR.

The design of the empirical analysis was adjusted for the fact that the food expenditure and income data were not collected for a concurrent period of time in the PSID. In the PSID interview, the food expenditure question related to the previous month, whereas the income questions related to the preceding calendar year. For example, the income data collected in the spring 1979 PSID survey are for 1978, and the 1980 survey contains 1979 calendar year income data. To overcome this

Table 1. The Marginal Propensities to Consume for Food at Home from Money Income and Food Stamp Bonus from Various Studies

MPC	Studies[a]									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Money income	.14	.05	.03	.03	.05	.13	.06	.06	.10	.08
Bonus	.35	.86	.56	.31	.30	.37	.45	.17	.23	.30

[a] Sources: Study (1) Hyman and Shapiro, p. 267 (figures given are for urban, low-income households); (2) Benus, Kmenta, and Shapiro, p. 137; (3) West, p. 49 (Model 1); (4) West, Price, and Price, p. 137 (evaluated at the mean, MPC for income derived from the elasticity; (5) West and Price, pp. 728–29; (6) Chavas and Young, p. 136 (estimates are for metropolitan households with non-black, non-college-educated heads; (7) Neenan and Davis, p. 95 (for food stamp participants, evaluated at group sample means); (8) Johnson, Burt, and Morgan, pp. 62–63 [equation (3)]; (9) Smallwood and Blaylock, p. 20; (10) Allen and Gadson, p. 42.

problem, the regression analysis included as explanatory variables both the current calendar year's income and that for the previous year. This approach also had the beneficial effect of reducing the bias introduced by transitory income. To explain household food expenditures in the spring 1979 month, for example, both the income data for calendar year 1979 and 1978 were included. Some thought was given to combining current and lagged income in some arbitrary weighted average. However, it seemed preferable to include both terms and to allow the data to dictate the proper weighting. For the same reason as for income, current and lagged variables for the proportion of total household income received in the form of bonus food stamps (*PROP*) were introduced.

The full empirical model specified for inframarginal households was

$$\text{(1a)}\quad \text{Ln}FEH_i = a + b_1\text{Ln}Y_i + b_2(\text{Ln}Y_i)^2 + b_3\text{Ln}YL_i + b_4(\text{Ln}YL_i)^2 + c_1PROP_i + c_2PROPL_i + d\text{Ln}AGEH_i + e\text{Ln}AE_i + fSEXH_i + gRACE_i + u_i,$$

and the model for extramarginal households was

$$\text{(1b)}\quad \text{Ln}FEH_i = \text{Ln}FS_i$$

where $\text{Ln}FEH_i$ is the log of the annual value of the ith household's food expenditures for use at home, including food purchased with food stamps; $\text{Ln}Y_i$, the log of total household income, including the value of bonus food stamps, in the same year as the food expenditure data; $\text{Ln}YL_i$, the log of total household income, including the value of bonus food stamps received, in the year preceding the food expenditure data; $PROP_i$, the proportion of total income received as bonus food stamps in the same year as the food expenditure data; $PROPL_i$, the proportion of total income received as bonus food stamps in the year preceding the food expenditure data; $\text{Ln}AGEH_i$, the log of the age of the household head in years; $\text{Ln}AE_i$, the log of an adult equivalent scale, which accounts for family size and composition; $SEXH_i$, the sex of the household head, 0 if male and 1 if female; $RACE_i$, race of the household head, 0 if white and 1 if nonwhite; $\text{Ln}FS_i$, the log of the food stamp allotment received; and u_i is the error term.

The logarithmic functional form utilized displayed a more homogenous error structure than a linear form. Since the simple double-log formulation imposes a constant income elasticity, the income squared terms were included. Inclusion of four income terms in equation (1a) undoubtedly introduced some multicollinearity. However, as the point of the statistical analysis was a specific hypothesis test, a conservative approach was to accept some loss in efficiency and in the power of the test, in order to avoid invalidating the test due to omitting relevant variables. The dependent variable was specified on a household basis, as was done by Basiotis, Brown, Johnson, and Morgan and Chen and Johnson, rather than on a per capita or per adult equivalent basis.[2] The

[2] Our basic specification is also mathematically equivalent to the per adult equivalent model used by several previous researchers. In that model household food expenditure and income are divided by the number of adult equivalent persons and adult equivalent units are also included as a separate variable (Hyman and Shapiro, and West and Price). Our basic model in exponential form is

$$FEH = a(Y)^b(AE)^d.$$

If both sides of this equation are divided by AE, one obtains

$$FEH/AE = a(Y)^b(AE)^{d-1}.$$

Then, if the terms on the right-hand side are rearranged by multiplying by (AE^b/AE^b):

$$FEH/AE = a(Y/AE)^b(AE)^{b+d-1}.$$

Only the interpretation of the coefficients for adult equivalent units is different between the above model and the specification which we estimate.

sociodemographic variables included as explanatory factors are typical of those utilized in previous cross-sectional analyses of household food expenditures (Huang, Fletcher, and Raunikar, pp. 23–24). An adult equivalent scale for total food derived from that reported by Price was used.

Previous empirical investigations of the food expenditure-food stamp relationship have not addressed the censored sample problem, which occurs when the dependent variable in an empirical model is restricted by some limiting value (Judge, Griffiths, Hill, and Lee, pp. 583–622). In the past, it has been argued that food stamps did not set a lower limit on at-home food expenditures since households could choose partial participation, purchasing only a portion of their coupons, and could also reallocate coupons between months (Mittelhammer and West). However, with EPR, there is no longer a reason for partial participation. In addition, a statistical problem akin to that created by a limited dependent variable will occur whenever a significant proportion of households have food expenditures exactly equal in value to their food stamp allotment, even if some others spend less than their allowable allotment.

Beyond these arguments, the structure of the PSID questionnaire made addressing the censored sample problem a necessity in our analysis. In the PSID, FSP participant households were only asked the amount of cash they spent on food, above and beyond the food stamp coupons received that month, which were presumed to be spent on food (Institute for Social Research, pp. 39–40). Therefore, their monthly at-home food expenditures (FEH) were prohibited from being less than their food stamp allotment (FS). The restriction $FEH \geq FS$ was imposed on the data.

The use of ordinary least squares (OLS) under these circumstances produces biased and inconsistent estimators (Judge, Griffiths, Hill, and Lee, p. 615). Simply deleting the limit observations creates what Judge, Griffiths, Hill, and Lee refer to as a truncated sample, and OLS again does not yield unbiased and consistent estimators (pp. 583–86). For this reason, Tobit analysis, a normal distribution maximum likelihood procedure, which has been widely used to estimate limited dependent variable models, was employed (Huang, Fletcher, and Raunikar; McDonald and Moffitt, and Tobin).

To apply Tobit analysis, equations (1a) and (1b) were respecified as

$$\text{(2a)}\quad \text{Ln}FEH_i = \beta X_i + e_i, \text{ if } \beta X_i + e_i > \text{Ln}FS_i$$

$$\text{(2b)}\quad \text{Ln}FEH_i = \text{Ln}FS_i, \text{ if } \beta X_i + e_i \leq \text{Ln}FS_i$$

where X_i is the matrix of explanatory variables for the ith household specified in equation (1a), β is the vector of unknown parameters, $\text{Ln}FEH_i$ and $\text{Ln}FS_i$ are as previously defined, and e_i is the truncated normal error term (Tobin). Tobit analysis will be used to determine the effect of the explanatory variables on at-home food spending, conditional upon food expenditures being greater than the food stamp allotment.

Food stamp proportion ($PROP$) was specified as an exogenous variable in the empirical model. Chen and Johnson demonstrate that the food stamp participation decision can be treated as occurring prior to the food expenditure decision, in a triangular recursive system with a diagonal covariance matrix. Moreover, in the Southworth model participation is considered exogenous. Ranney's work indicates that limiting the sample to only food stamp recipients should not introduce sample selection bias.

Empirical Results

In table 2 the first column provides the Tobit regression results for 1978 and the second for 1979. OLS regressions were also run over the samples containing all food stamp recipients, using the specification given in equation (1a). The R^2 was .64 for 1978 and .55 for 1979. The marginal propensities to consume on at-home food from money income and food stamps were derived from the Tobit results. Given our specification, the long-run impact of a change in cash income or food stamps is equal to the sum of the MPC's from the current and lagged variables.[3] The estimated long-run MPC with respect to money income is .050 for 1978 and .073 for 1979. The MPC with respect to food stamps is .327 and .264 for the two years. These results are in general agreement with those from previous studies given in table 1.

[3] Since the relationships are nonlinear, rather than just determine the MPC's at some arbitrary level of the variables, the marginal propensities were directly computed for each household in the sample and then the median of these values is reported. The formulas used to calculate the MPC's are available from the authors.

Table 2. Tobit Regression Results for Food Expenditures for Use at Home

Independent Variables	1978	1979
CONSTANT	.424	−2.765
	(.15)[a]	(.93)
Ln*Y*	−.136	1.850
	(1.04)	(2.90)
$(\text{Ln}Y)^2$	.011	−.096
	(1.26)	(2.73)
Ln*YL*	1.436	−.078
	(2.27)	(.32)
$(\text{Ln}YL)^2$	−.072	.015
	(1.98)	(1.00)
PROP	.077	.350
	(.38)	(1.66)
PROPL	.678	.274
	(3.58)	(1.30)
Ln*AGEH*	−.195	.014
	(3.54)	(.25)
Ln*AE*	.807	.707
	(10.66)	(8.44)
SEXH	−.050	−.043
	(1.11)	(.97)
RACE	−.056	−.017
	(1.20)	(.34)
Chi-square statistic	16.92	6.64
Significance level	.01	.05

[a] The asymptotic *t*-ratios are given in parentheses. The proportion of observations at the limit is .714 for 1978 and .857 for 1979; the estimated variance of the error in the Tobit equations is .420 for 1978 and .455 for 1979.

Interestingly, in 1979 the current income variables as well as the current proportion (*PROP*) are significant, and the lagged variables are not. In 1978 the pattern is reversed. This reversal of pattern for these variables can perhaps be explained by the impact of the substantial changes in FSP rules that coincided with eliminating the purchase requirement. In the 1979 regressions the current income and proportion variables reflect the impact of the 1979 rule changes, which included EPR, whereas the lagged variables do not. There was also a considerable turnover in the population of food stamp recipients at that time, as some recipient households with higher income levels lost their eligibility. A test for structural difference between the 1978 and 1979 regressions suggests the 1979 rule changes caused a shift in structure and that multicollinearity is unlikely to be a complete explanation for the observed differences.

Our statistical test of the Southworth model is based on its central implication, that for inframarginal recipients cash and food stamps are equivalent in their effect on at-home food expenditures. For our specification, the Southworth model provides the null hypothesis that the proportion of income received as bonus food stamps should have no impact on food expenditures for nonlimit households. Specifically, the variables *PROP* and *PROPL* are not expected to affect Ln*FEH*. In addition to the regressions reported in table 2, restricted regressions which omitted *PROP* and *PROPL* were also estimated. A likelihood ratio test was then utilized to test the joint significance of the current and lagged proportion variables. Under the null hypothesis which conforms to the Southworth model, twice the difference in value of the two log likelihoods calculated will be distributed as a chi-square variable with two degrees of freedom. The chi-square statistics, plus the level of statistical significance, are given at the bottom of table 2. The traditional Southworth model is rejected in both years at least at a 5% significance level.

Possible Explanations

Several possibilities exist which could explain the greater impact of food stamps than cash on food spending, even when the transfer is unrestricted. The first is that food stamps may generate a sense of gratitude or responsibility among recipients. Recipients could feel that since society intends for food stamps to be used to expand their food consumption, they should in fact use their allotment for that purpose. Second, intrahousehold differences in tastes may exist. Food stamps could give a household member(s) with a greater preference for food or nutrition more control over the household budget, since they must be legally allocated to food. A preliminary indirect test of this model, based upon interacting *SEXH* with *PROP* and *PROPL*, failed to reveal a significant intrahousehold preference difference effect.[4] However, further work must be done to conclusively demonstrate this result.

A third possible explanation is provided by the permanent income hypothesis. Food stamps could be viewed as a more permanent source of income than that earned through employment, given the high unemployment rate and temporary nature of employment experi-

[4] A more extensive discussion of this test may be obtained from the authors.

enced by many low-income households. Fourth, the dynamics of the household budgetary process may be altered by the receipt of food stamps. When a household receives a monthly food stamp allotment, larger and/or more expensive food purchases are typically made early in the month. As the food purchased with food stamps runs out later in the month, the family may begin to eat less well, but also will spend cash to buy additional food (West, Price, and Price).

Conclusions

The empirical evidence rejects the traditional model, which predicts that for inframarginal recipients the impact of food stamps is solely through the income effect. The results indicate that food stamps have a significantly greater impact on food purchases than an equal amount of cash income, even when they are an unrestricted transfer. These findings have important implications for both current policy and future research concerning the Food Stamp Program.

A recent issue of significant policy debate was the effect of elimination of the food stamp purchase requirement (EPR) on the program's impact on expanding food demand. Predictions were made that after EPR the program's impact on food spending would be severely reduced and would be only slightly greater than a cash transfer (Salathe, p. 92). Based on the traditional theory, the reasoning was that EPR would shift a substantial number of recipient households from an extramarginal, restricted transfer situation to an inframarginal, unrestricted one. The results for 1979, following EPR, confirm that food stamps still have a substantially greater impact on food spending than an equivalent amount of cash income.

A current policy issue involves the effect cashing-out the present program, replacing food stamps with a cash transfer, would have on household food expenditures and aggregate food demand. The traditional model, given the large proportion of inframarginal recipients after EPR, suggests a relatively small impact. However, because inframarginal households treat stamps differently than cash, the decline in food expenditures with a cash-out could be substantial. The results of this study suggest that if a policy objective is to increase recipient household food expenditures, then the Food Stamp Program should not be cashed out.

Finally, rejection of the traditional model poses significant new research questions. Possible explanations of the observed behavior of food stamp recipients need to be refined and empirically tested. This investigation will likely require a close examination of the actual process households utilize to determine budget allocations.

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