Food Stamp Program Participation Behavior—An Econometric Explanation[1]

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ABSTRACT

The effect of selected socioeconomic factors on household participation in the Food Stamp Program was estimated. The demand relation for food stamp bonus is conceptually derived via conventional utility theory. The sample encompasses eligible participants and nonparticipants. Thus, bonus, which quantifies extent of participation as the dependent variable, is zero for nonparticipants. For this reason the Tobit model is used in estimating the demand relation in lieu of ordinary least squares. Fair's computational procedure, which is reportedly faster than Newton's, was used.

Impact of family size and level of income on extent of bonus use, was significant. Other economic factors which have a similar impact are home ownership and type of income such as wage and social security. Age and sex of the household head were also important variables. Applications of the statistical relation include participation prediction, elasticities, and probability changes associated with isolated exogenous variable changes.

The estimation procedure for the model framework yields encouraging results. Thus, a more general application of the framework may be of interest in evaluating participation in other types of programs.

INTRODUCTION

The Food Stamp Act of 1964 (with subsequent amendments) charges the U.S. Department of Agriculture with extending the benefits of the program to all households willing and eligible to participate. This duty was reinforced by a federal court ruling in 1974 (2). It has been estimated that only about 50% of those eligible to participate in the program were actually doing so (1, 6).

Given that a household is legally eligible to participate in the program, the extent of participation is likely to depend on a number of factors other than mere eligibility. The purpose of this study is to observe the usefulness of economic theory in estimating the effects of certain selected factors on actual participation of the household in the Food Stamp Program.

PROCEDURE

THE MODEL

Participation in the Food Stamp Program can be analyzed within a framework suggested by conventional demand theory. Since food stamps

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are redeemable for food at a value greater than their purchase price, the demand for food stamps is derived from the utility of more and better food consumption.

In brief the problem of maximizing utility derived from participating in the Food Stamp Program for a household can be formulated as follows:

$$\text{Max } U = a_1 + a_2 (BON + C) + a_3 (BON + C)^2 \qquad /1/$$
$$\text{s.t. } C = f(FS, INC)$$
$$BON \geq OC$$

where BON is the bonus value of food stamps or the difference between the face value of the stamps and associated cost, C is the cost of stamps, FS is family size, INC is household income level, and OC is the opportunity cost incurred by the household for participating in the program.

In order to insure that equation 1 can be a maximum, the first and second order conditions must be satisfied. The simultaneous equations conceptually used for this purpose can also be used to ascertain the demand function for food stamp bonus (BON) through total differentiation and solution for the derivative of BON with respect to each exogenous variable while holding all other exogenous variables constant. The resulting demand function is:

$$BON = g(FS, INC, OC). \qquad /2/$$

Consequently, demand for food stamp bonus is found to be related to the size of the household, household income, and other costs involved in the participation of the Food Stamp Program.

For the purpose of obtaining parameter estimates of the above demand equation for food stamp bonus, the stochastic disturbance, *e*, must be added and the basic assumptions concerning the disturbance term must be made. Other socioeconomic variables were also added to the statistical equation to account for variation in characteristics of households. Thus, the statistical demand equation specified for empirical analysis becomes:

$$BON = h(FS, INC, OC, SE, e) \qquad /3/$$

where SE represents other socioeconomic variables to be included in the statistical demand relation and e is an error term associated with the statistical model.

DATA

The data used to estimate the model are from a survey conducted in the summer of 1974 of households in Pittsylvania County, Virginia and Lynchburg, Virginia (5).

Table 1 gives variables extracted from the survey data which were judged potentially useful in estimating the statistical model. In relation to equation 3, DIS and GSP are seen as variables representing OC while SH, AG, FE, NOR, R, RA, WG and SS are encompassed by the SE term. The discussion regarding the effects of the exogenous hypothesized variables is deleted in the interest of space.

STATISTICAL ESTIMATION

Interest in the statistical model pertains to the effect of the exogenous variables on extent of food stamp bonus utilization (BON). Therefore,

TABLE 1.—*Variables constructed from a survey in Virginia regarding the Food Stamp Program*

Variable name	Description	Classification	Mean	
			Participant	Non-participant
BON	Bonus value from using food stamps or the difference in face value of stamps and cost of stamps (dollars)	Exact amount reported	69.48	0
SH	Sex of the household head	1 if female, 0 if male	0.48	0.35
FS	Family size	Actual number of persons reported	4.00	3.42
AG	Age of respondent	Actual age reported	50.52	57.76
DIS	Distance in miles that respondent usually travels from home	1 = 0–5, 2 = 6–10, 3 = 11–15, 4 = 16–20, 5 = 21–25	1.63	1.78
GSP	Gifts of food and self-produced food	1 if GSP > 0, 0 otherwise	0.55	0.63
FE	Food expenditures previous week (dollars)	Exact amount reported	30.92	29.35
INC	Gross annual family income (dollars)	1.0 = less than 1,000 1.5 = 1,000–1,499 2.0 = 1,500–1,999 3.0 = 2,000–2,999 4.0 = 3,000–3,999 5.0 = 4,000–4,999 6.0 = 5,000–5,999 10.0 = 6,000–9,999 11.0 = 10,000 and over	3.08	4.03
NOR	Ownership of residence	1 if no, 0 if yes	0.73	0.54
R	Race	1 if Negro, 0 otherwise	0.61	0.66
RA	Location of residence	1 if rural, 0 otherwise	0.48	0.49
WG	Source of income	1 if wages, 0 otherwise	0.35	0.46
SS	Source of income	1 if social security, 0 otherwise	0.45	0.55

BON is the dependent variable in the estimating equation. Ordinary Least Squares seems inappropriate as an estimating technique in this case because 139 of 199 observations contain zero values for BON. As a result, if OLS is used, the estimated relation will likely be flat, underestimating at the high end of the relation (4).

An alternative procedure developed to handle zero values of the dependent variable is the Tobit model (7). Previously, Tobit estimates were computed with Newton's method; however, a new and faster computational procedure has been developed by Fair (3). The computer program developed for this analysis is based on Fair's computational approach.

The symbolic representation of the estimating model used in this analysis is:

$$\begin{aligned} BON_i &= \beta' E_i + e_i \text{ if RHS} > 0, \\ &= 0 \qquad \text{if RHS} \leq 0 \qquad (i = 1,2, \ldots, N) \end{aligned} \qquad /4/$$

where β is a Kx1 vector of unknown coefficients, E_i is a Kx1 vector of independent variables for observation i, e_i is an independently distributed error term with distribution $N(0,\sigma^2)$, and where RHS refers to the right hand side of the equation.

RESULTS

The results of estimating equation 4 are shown in table 2. Variables contained in equations 1 and 3 are the same except that equation 3 excludes the age variable.

Equation 1 includes all the variables constructed from the survey data for purposes of estimating the theoretical model. Variables with extremely low t statistics in equation 1 were eliminated in equation 2. In equation 2 age, family income, and wage are negative while family size is positive. An increase in family size can give rise to a greater use of food stamp bonus yielding greater utility from the purchase of food. An increase in age is interpreted as involving a reduced family utility for the purpose of food since age of the household head is associated with fewer family members. Family income and wage appear to be good proxies for opportunity costs. The time and trouble associated with participation in the Food Stamp Program must be weighed against the need for food in relation to the availability of funds to purchase food. The variables pertaining to the sex of the household head and social security income in equation 2 have the correct signs according to expectations. However, the t statistics are not high enough to be conclusive.

All but two of the variables in equation 1 that were omitted from equation 2 had correct signs. Only the race and rural area variables had incorrect signs. It may be that race is not a good proxy for wage nor rural area as a proxy for in-kind income encompassing gifts of food and self-

produced food. Equation 3 contains all variables except age. As a result, the social security and nonownership variables increased significantly in importance as explanatory variables. Equation 4 encompasses the variables in equation 3 with the more significant t statistics. The family size variable shows increased significance without the age variable. Also, the nonownership and social security variables have become prominent as explanatory variables. All three variables which increased in significance as explanatory variables in the absence of age were income related.

TABLE 2.—*Coefficient estimates and* t-*statistics*[1] *for each estimating equation*

	Equation			
	1	2	3	4
Intercept	44.012	68.316	−20.361	−38.296
	(.92)	(1.79)	(−.57)	(1.30)
SH	28.820	29.642	28.607	29.570
	(1.83)	(1.88)	(1.78)	(1.85)
FS	11.243	11.194	13.586	14.281
	(2.72)	(3.03)	(3.34)	(4.01)
AG	−1.072	−1.428		
	(−1.92)	(−2.60)		
DIS	−7.451		−8.132	
	(−.93)		(−.98)	
GSP	−3.597		−7.160	
	(−.21)		(−.41)	
FE	.447		.518	
	(.86)		(.99)	
INC	−10.138	−10.039	−9.899	−8.920
	(−2.35)	(−2.40)	(−2.47)	(−2.11)
NOR	25.277		35.183	37.227
	(1.48)		(2.07)	(2.21)
R	−20.547		−21.026	
	(−1.24)		(−1.25)	
RA	10.242		12.409	
	(.51)		(.60)	
WG	−64.901	−71.932	−64.877	−69.021
	(−3.07)	(−3.33)	(−3.03)	(−3.19)
SS	−41.360	−36.569	−62.799	−61.421
	(−1.83)	(−1.62)	(−3.07)	(−3.00)

[1] Values in parentheses are *t*-statistics.

PREDICTING PARTICIPATION

The Tobit model selected for use in this study has incorporated the threshold concept in the decision-making process and can be used to predict rate of participation. This is illustrated by using equation 4 of table 2 to obtain the threshold level of decision for eligible households. The means and standard deviations of the expected food stamp bonus (BON) for participants and nonparticipants are calculated. For partici-

pants, the mean and standard deviation of the expected bonus were 32.24 and 27.18, respectively. For nonparticipants, they were 15.47 and 13.14. Overlap of the two tails of the distribution of standard deviation from the means included values from 5.06 to 28.61, suggesting a value of expected bonus within this range for most of the respondents. These values are then used to predict the rate of participation. Thus, if a particular household's expected food stamp bonus exceeded 28.61, it is very likely that the household will choose to participate in the Food Stamp Program. On the other hand, if the expected bonus value is less than 5.06, the household likely will be a nonparticipant. For households with expected bonus values which fall in between the two threshold values, behavior is indecisive. For the participating households, almost 89 percent were correctly predicted by this model. However, only about 48 percent of the nonparticipants were correctly predicted by the estimated equation.

TABLE 3.—*Elasticities and change in probability of participation in the Food Stamp Program for eligible households*[1]

Variable	Elasticity of expected bonus value[1]	Change in the probability of participation[1]
SH	0.35	0.17
FS	1.11	0.06
INC	−0.74	−0.04
NOR	0.34	0.15
WG	−0.51	−0.31
SS	−0.46	−0.28

[1] For the dummy variables SH, NOR, WG, and SS, a one unit change was used; for FS, a change from family of 4 to family of 5 was used; for INC, a change from income level of 4 to income level of 5 was used to compute the elasticity and probability.

PARTICIPATION ELASTICITIES

The impact of exogenous variables on the dependent variable (BON) can be determined by focusing on one exogenous variable at a time, allowing it to change while holding all other exogenous variables constant. For example, allowing family size (FS) to increase would cause BON to increase above the true value of the household's expected bonus value. Such effects of changes in the explanatory variables on the movement and magnitude of the expected bonus value, however, cannot be interpreted directly from the coefficients of the estimated Tobit model.

The expected value of bonus is used in computing elasticities with respect to a certain exogenous variable, all others constant. Since the magnitude of these elasticities is determined not only by the initial level at which they are evaluated but also by the probable change as per the cumulative density function (4), the nonlinear estimating technique allows validity only for estimates of small deviation from the initial level of

evaluation. Table 3 presents elasticities computed as described above for changes of a particular exogenous variable, given that all other exogenous variables are held constant at the mean.

The change in the probability associated with the change of a particular exogenous variable is also given in table 3. For the dummy variables SH, NOR, WG, and SS, a one unit change was used. Thus, if the sex of the household head is allowed to change from male to female, the household's expected food stamp bonus will increase by 35 percent, and it increases the probability of the household's participation in the Food Stamp Program by 0.17.

The results from this analysis suggest that household expected bonus value is most responsive to changes in family size and household income level. The change in the probability of participation in table 3 should be interpreted as the change in probability of participating in the Food Stamp Program, given the initial probability of household participation in the program. As shown in table 3, the greatest change in probability due to change in any of the independent variables is associated with the change of household head from a non-wage earner to a wage earner. Thus, the change in the income source greatly affects the probability of participation. Although expected bonus values are more responsive to changes in FS and INC, the associated changes in probability are rather small.

CONCLUSION

This paper is primarily concerned with the development of a theoretical model which may be useful in explaining the extent of use of food stamp bonus among those who are eligible to participate in the program. However, the model has much wider application as it is amenable to other programs where an evaluation of program participation is desirable. In a practical sense estimation of any adaptation of the theoretical model can be done relatively efficiently in terms of computer speed via Fair's computational procedure.

The main impetus for this paper was to see to what extent economic theory could be used to explain a phenomenon which has been the subject of attention from diverse disciplines. It should be pointed out that the data used for testing the theoretical model encompassed a rather small sample. However, results of the estimating procedure are encouraging; thus, further testing of the model with other data might be of interest.

RESUMEN

El efecto de factores socio-económicos seleccionados en la participación de la familia en el Programa de Cupones para Alimentos se estimó. La demanda por el bono de los cupones se deriva conceptual-

mente por medio de la teoría de utilidad. La muestra incluye participantes y no participantes elegibles. Así, pues, el bono, que cuantifica la amplitud de la participación como la variable dependiente, es cero para los no participantes. Por esta razón el modelo de Tobit se usó para estimar la relación de la demanda en vez del método corriente de mínimos cuadrados. El procedimiento de computación de Fair se usó en vez del de Newton por ser más rápido.

El tamaño de la familia y el nivel de ingresos afecta significativamente la amplitud de uso del bono. Otros factores económicos que también la afectan en forma similar son la posesión de la vivienda y tipo de ingreso, tales como salarios y pagos de seguridad social. La edad y el sexo del jefe de familia también fueron variables importantes. La aplicación de la relación estadística incluye la predicción de la participación, elasticidades y cambios en la probabilidad asociados con cambios variables, aislados y exógenos.

El procedimiento de estimación para el modelo arroja resultados alentadores, por lo cual, una aplicación más general del esquema podría ser de interés para evaluar la participación en otros tipos de programas.

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