THE DETERMINANTS OF FOOD STAMP PROGRAM PARTICIPATION

J. E. Epperson, C. L. Huang, S. M. Fletcher, and W. K. Scearce

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 1975 (Beckel and MacDonald; Bennett et al. vs. Butz et al.).

Because of the importance of the Food Stamp Program (FSP), numerous studies have been conducted to gauge its intended effectiveness. Areas of study have included nutritional benefits of the program, impact on food expenditures, identification of ways to improve the rate of program participation, and identification of socioeconomic characteristics that may be important indicators of participation or nonparticipation in the program (for example, see Davis and Neenan; Lane; Neenan and Davis 1977, 1978; Salathe; Scearce et al.; Smith and Rowe; West; USDA, 1976, 1978).

The focus of our article is somewhat different in that we present a framework for effective program management based on the socioeconomic composition of households eligible to participate within the requirements of the program. The means of program management are seen to encompass the determinants of program participation. In addition the framework developed can be extended to other government and nonprofit programs which provide goods and services.

The benefit provided by the FSP is called bonus, that is, extra purchasing power through food stamps. Prior to 1979, depending on net income, coupons were purchased. Thus, bonus was equal to the difference between value of coupons received and purchase price. The number of stamps that could be purchased depended on the number of people in the household. Payment for coupons is no longer required, but the value of bonus for the old and new program is roughly equivalent (Faulkinberry; Stucker and Boehm).

SAMPLE

The data used to estimate the model are from a survey of households in the summer of 1974 conducted by Scearce et al. in Pittsylvania County, Virginia, and Lynchburg, Virginia. These two areas were chosen because they encompass both rural and urban populations. Random selection of households in each district was attempted. The total number of usable questionnaires obtained from the survey was 523: 228 in Pittsylvania County and 295 in Lynchburg. Each questionnaire representing a household was classified according to eligibility to participate in the Food Stamp Program. Two hundred thirty-nine households were classified as being eligible for the Food Stamp Program. Those classified as not eligible were not considered for further analysis.

For purposes of estimating the model, 199 observations (households) were used from those classified eligible to participate. Of the 199 used, 60 households actually participated in the Food Stamp Program and 139 did not.

DECISION MODEL AND STATISTICAL ESTIMATION

The analytical framework is McFadden's (1976) model for maximizing choice. A household eligible for participation in the FSP is assumed to choose the highest possible level of utility between two alternatives — participation or nonparticipation in the program. The indirect utility relation is expressed as

$$U(B) = V(Z + J, P_B, P_A) \quad (1)$$

where B is the quantity of food provided through food stamps measured in dollars, V is the indicator of choice, Z + J represents total income of the household, Z is nonlabor household income, J is labor household income, P_B is the price of B, and P_A is the price of the alternative to B. The dichotomous choice relation can be expressed as

$$D = f(Z+J, P_B, P_A, \underline{S}) \quad (2)$$

where D represents the decision to participate or not to participate in the FSP and $\underline{S}$ is a

J. E. Epperson, C. L. Huang, and S. M. Fletcher are Assistant Professors of agricultural economics, University of Georgia, Georgia Experiment Station. W. K. Scearce is Assistant Professor of agricultural economics, Oklahoma State University.

vector of socioeconomic characteristics added to allow household differences (Kinnucan and Sexauer; McFadden 1974, 1976; Prochaska and Schrimper). For statistical specification let x become the vector of arguments in f. A decision to participate in the FSP is assumed to be related to an index

$$I_t = \beta' x_t + e_t \tag{3}$$

for observation t, such that the probability of observing D is a monotonic, increasing function,

$$P_t(D|I_t) = P_t(I^* < I_t) = \int_{-\infty}^{I_t} \phi(\lambda)d\lambda \tag{4}$$

where β is a vector of unknown coefficients, e is an independently distributed error term with distribution N (0, σ^2), P_t is the probability that D will occur given I_t, I^* is some critical value of the random index which reflects household attributes and tastes, and $\phi(\lambda)$ is the probability density function (PDF) of a unit normal variate. To estimate β as presented we use the likelihood function as the normal equations are nonlinear.

Popular candidates for arriving at P_t include probit, logit, and even OLS (McFadden [1976]; Deyak and Smith). Probit and logit are favorably considered in estimating dichotomous choice rather than OLS because such methods are designed to eliminate heteroscedasticity and restrict values of the dependent variable to range from 0 to 1 (Goldberger). Probit, which is represented by equation 4, seems to hold no practical advantage over logit. Both Amemiya and Finney indicate that approaches and results of the two methods are similar. Difference between the two approaches is in the type of probability density function used. As indicated in equation 4, the probit method utilizes a normal PDF whereas the logit method employs a logistic PDF.

VARIABLES

Because it was not feasible to estimate directly all of the arguments in x, proxies are used in part from the survey. Variables utilized in estimating equation 2 are given in Table 1. In relation to equation 2, PAR represents D, INC and WG relate to J, SS and NOR pertain to Z, DIS is a proxy for P_B, GSP and FE are proxies for P_A, and SH, FS, AG, R, and RA are encompassed by the $\underline{S}$ term.

Table 2 shows the hypothesized direction of effect between PAR and each of the observed variables. Each of the variables and effects are briefly discussed in turn.

TABLE 1. VARIABLES FROM A SURVEY IN VIRGINIA PERTAINING TO THE FOOD STAMP PROGRAM

Variable Name	Description	Classification	Mean: Participant	Mean: 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	0.00
PAR	Participation in FSP	1 if BON > 0, 0 otherwise	1.00	0.00
SH	Sex of the household head	1 if female, 0 if male	0.48	0.35
FS	Family size	Actual no. 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

TABLE 2. EXPECTED IMPACT OF REGRESSION VARIABLES ON PROBABILITY OF PARTICIPATING IN FSP

Observed Variable	Expected Effect on (PAR)
SH (female)	+
FS	+
AG	−
DIS	−
GSP	−
FE	+
INC	−
NOR (nonownership)	+
R (Black)	+
RA (rural)	−
WG	−
SS	−

Sex of the household head (SH) is expected to have a positive effect on probability of participation (PAR). This expectation should hold if women are disadvantaged in the labor market.

Family size (FS) as a variable is used to include the possible effects of the entire family rather than just the household head. It should have a positive effect on PAR because larger families require more food.

Age (AG) of the household head would be expected to have a negative effect on PAR because older people have fewer family members at home and thus can acquire less bonus. This effect is also suggested by the fact that AG and social security (SS) as a source of income

are expected to be positively correlated; thus AG will have a negative effect on PAR because of the expected relationship between SS and PAR.

The usual distance that the respondent travelled from home (DIS) is thought to involve costs in terms of time and money expended for excessive travel. Thus, DIS should have a negative impact on PAR.

Food obtained from gifts or self-production (GSP) is expected to have a negative influence on PAR because GSP can be considered a substitute for food potentially purchased with food stamps. In addition, time spent producing food may compete directly with time spent in the FSP administrative labyrinth.

The necessity or habit of buying more and/or better food is indicated by greater food expenditures which in turn cause a greater need for food stamps. If this reasoning is correct, food expenditures (FE) will have a positive effect on PAR.

Gross income (INC) is expected to have a negative effect on PAR. As income rises, all else constant, there is less need for food stamps. In addition, as the need for food stamps lessens, costs in the form of time and trouble of obtaining them may seem prohibitive.

If home ownership (NOR) is an indication of well-being, nonowners are likely to be less well off. If this expected relation holds, NOR should have a positive effect on PAR.

Race (R) is observed to be related to economic conditions of people. The mean income of black people is appreciably lower than the average income of all people in the United States. For this reason R is expected to have a positive effect on PAR.

Conditions corresponding to location (RA) would perhaps have an impact on participation. For instance, rural residents probably have more opportunity to produce some of their own food. If so, RA should have a negative effect on PAR.

Wage (WG) and social security (SS) represent sources of income. Both would have a negative effect on PAR because income from wage means the household head is employed, having less need for food stamps, and because older people who draw social security have fewer family members.

RESULTS

The results of estimating equation 2 are shown in Table 3. Results are given from both probit and logit estimation. Equations 1 and 3 in Table 3 include all variables from the survey hypothesized to explain FSP participation.

[1]Results of OLS were also very similar to those in Table 3.

TABLE 3. COEFFICIENT ESTIMATES AND t-STATISTICS[a] FOR EACH ESTIMATING EQUATION

	Probit		Logit	
	Equation			
	1	2	3	4
INTERCEPT	0.7554	-0.2757	1.3328	-0.4407
SH	0.3221 (1.53)	0.3374 (1.66)	0.5291 (1.48)	0.5763 (1.67)
FS	0.1208 (2.03)	0.1318 (2.68)	0.2161 (2.12)	0.2303 (2.75)
AG	-0.0118 (-1.53)		-0.0196 (-1.51)	
DIS	-0.0935 (-0.89)		-0.1708 (-0.92)	
GSP	-0.0934 (-0.40)		-0.1710 (-0.44)	
FE	0.0021 (0.29)		0.00028 (0.22)	
INC	-0.1753 (-2.87)	-0.1528 (-2.71)	-0.3174 (-2.76)	-0.2789 (-2.64)
NOR	0.2615 (1.15)	0.3871 (1.84)	0.4387 (1.13)	0.6435 (1.78)
R	-0.2528 (1.15)		-0.4309 (-1.15)	
RA	0.0466 (0.17)		0.0822 (0.18)	
WG	-0.5975 (-2.08)	-0.6156 (-2.19)	-0.9866 (-2.00)	-1.0067 (-2.13)
SS	-0.4012 (-1.29)	-0.6129 (-2.29)	-0.6585 (-1.23)	-1.0042 (-2.23)
-2 x Log Likelihood Ratio	35.571	30.341	36.000	30.820

a Values in parentheses are t-statistics.

Equations 2 and 4 represent the net result of variable elimination on the basis of correlation between independent variables, low t values, and incorrect sign. As shown in Table 3, both probit and logit models give the same signs.[1]

Predicting Participation

Both models, probit and logit, allow measurement of the threshold of decision making given some specified criterion. In this case the decision of interest is whether or not to participate in the FSP. Table 4 summarizes the results of this analysis derived from equations 2 and 4 of Table 3.

Predicted values of PAR are compared with actual values (0,1) to measure predictive performance given a criterion array. This comparison is accomplished by using both models. In

TABLE 4. PREDICTING PARTICIPATION IN THE FOOD STAMP PROGRAM

Classification Criterion[a]	Percentage of Households Classified Correctly	
	Probit	Logit
50-50	73	73
60-40	67	67
70-30	50	53
80-20	26	29
90-10	9	11

[a]Using the 70-30 criterion as an example, the probit method correctly classified 50 percent of all eligible households in the sample where the predicted probability of participation was 0.70 or greater for participating households and 0.30 or less for nonparticipating households.

Table 4, a criterion of 60-40 means that if the predicted value of PAR is greater than or equal to 0.60 and the actual value of PAR is 1, the household is correctly classified as a FSP participant. If the predicted value is less than or equal to 0.40 and the actual value is 0, the household is correctly classified as a nonparticipant. If the predicted and actual values do not conform as described, the household cannot be correctly classified. As shown in Table 4, the logit method appears to classify more accurately than the probit method as the classification criterion becomes more restrictive.

Participation Responsiveness

The impact of independent variables on the probability of participation in the FSP can be determined by focusing on one independent variable at a time, allowing it to change while all other independent variables are held constant. The change in the probability of participation associated with the change of a particular independent variable is given in Table 5.

TABLE 5. CHANGE IN PROBABILITY OF PARTICIPATION IN THE FOOD STAMP PROGRAM FOR ELIGIBLE HOUSEHOLDS[a]

Variable	∂PAR/∂X	
	Probit	Logit
SH	0.11	0.11
FS	0.05	0.05
INC	-0.04	-0.04
NOR	0.12	0.12
WG	-0.20	-0.19
SS	-0.20	-0.20

[a]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.

Again, the analysis allows a comparison of results from probit and logit via equations 2 and 4 of Table 3. For 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 probability of the household's participation in the FSP increases by 0.11.

FS was evaluated on the basis of a change of family size from 4 to 5 members. The effect of change in income level on probability of participation was evaluated for a shift of household income from class $3,000-3,999 to class $4,000-4,999. As shown in Table 5, the greatest change in probability due to change in any of the independent variables is associated with the change of household head from a nonwage earner to a wage earner and from a nonrecipient to a recipient of social security. Thus, change in income source greatly affects the probability of participation.

SUMMARY AND CONCLUSIONS

We develop a framework for estimating the likelihood of participation in the FSP and change in the probability of participation associated with isolated change in the socioeconomic determinants of FSP participation. The desirability of probit and logit models for this task is suggested through examination of capabilities and limitations in conjunction with those of OLS. Analysis is accomplished by using probit and logit for purposes of comparison.

Variables that appear important in explaining FSP participation include sex of the household head, family size, household income, ownership/nonownership of home, and source of income. Through an application of the models, 73 percent of sample households are correctly classified on the basis of the least restrictive classification criterion. The greatest likelihood of change in program participation is shown to be associated with a change in source of income.

The framework we develop can be applied by many other government or nonprofit organizations that monitor changing demands of the citizenry on the basis of socioeconomic characteristics of the clientele population.

REFERENCES

Amemiya, T. "Qualitative Response Models." *Ann. Econ. Soc. Meas.* 4(1975):363-72.

Beckel, G. and M. MacDonald. "Participation Rates in the Food Stamp Program: Estimated Levels, by State," Dis. Pap. 253-75. Madison, Wisconsin: Institute for Research on Poverty, 1975.

Bennett, J. et al. vs. Butz, E. L. et al. United States District Court, D. Minnesota, Fourth Division, *Federal Supplement,* Vol. 386, West Publishing Company, 1974.

Davis, C. G. and P. H. Neenan. "Impact of Food Stamp and Nutrition Education Programs on Food Group Expenditure and Nutrient Intake of Low Income Households." *S. J. Agr. Econ.* 11(1979):121-9.

Deyak, Timothy A. and V. Kerry Smith. "Congestion and Participation in Outdoor Recreation: A Household Production Function Approach." Paper presented at Winter Meetings of Econometric Society, Dallas, Texas, Dec. 1975.

Faulkinberry, Patricia. "Federal Food Dollars Go South." Federal Reserve Bank of Atlanta, *Econ. Rev.* 62(1977):135-41.

Finney, D. J. *Probit Analysis.* Cambridge: Cambridge University Press, 1973.

Goldberger, A. S. *Econometric Theory.* New York: John Wiley & Sons, Inc. 1964.

Kinnucan, Henry and Benjamin Sexauer. "The Demand for Home-Produced Food by Rural Families." *Amer. J. Agr. Econ.* 60(1978):338-44.

Lane, S. "Food Distribution and Food Stamp Program Effects on Food Consumption and Nutritional 'Achievement' of Low Income Persons in Kern County, California." *Amer. J. Agr. Econ.* 60(1978):108-16.

McFadden, D. "Conditional Logit Analysis of Qualitative Choice Behavior," in *Frontiers in Econometrics,* P. Zarembka, ed. New York: Academic Press, 1974, p. 105-42.

_____. "Quantal Choice Analysis: A Survey." *Ann. Econ. Soc. Meas.* 5(1976):363-90.

Neenan, P. H. and C. G. Davis. "Impact of the Food Stamp Program on Low Income Household Food Consumption in Rural Florida." *S. J. Agr. Econ.* 9(1977):89-98.

_____ and _____. *Impact of the Food Stamp and Expanded Food and Nutrition Education Programs on Food Expenditure and Nutrient Intake of Low Income Rural Florida Households.* Fla. Agr. Exp. Sta. Bull. 805, 1978.

Prochaska, Fred J. and R. A. Schrimper. "Opportunity Cost of Time and Other Socioeconomic Effects on Away-From-Home Food Consumption." *Amer. J. Agr. Econ.* 55(1973):595-603.

Salathe, Larry E. "The Impact of the Food Stamp Program on Household Food Purchases." *Amer. J. Agr. Econ.* 61(1979):1143.

Scearce, W. Keith, J. Marshall Paxton, and Robert B. Jensen. *Food Stamps: A Study in Two Virginia Localities.* Virginia Polytechnic Institute and State University, Department of Agricultural Economics, 1975.

Smith, L. W. and G. Rowe. *Food Stamp Participation of Hired Farm Worker Families.* AER-403. Washington, D.C.: USDA ESCS, 1978.

Stucker, Thomas A. and William T. Boehm. *A Guide to Understanding the 1977 Food and Agricultural Legislation.* Agr. Econ. Rep. 411, USDA, ESCS, Sept. 1978.

West, Donald A. "Food Expenditures and the Food Stamp Program: Some Recent Evidence From the Consumer Expenditure Survey." *Amer. J. Agr. Econ.* 61(1979):1143.

U.S. Department of Agriculture. *Characteristics of Food Stamp Households.* Food and Nutrition Service Rep. FNS-168, Sept. 1976.

_____. *The Food Stamp Program: A Review of Selected Economic Studies.* USDA ESCS 34, Sept. 1978.