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A Study of the Interdependent Food Stamp Program Participation and Food Demand Decisions

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ABSTRACT

This study addresses the effectiveness of the Food Stamp Program in increasing household welfare and increasing the demand for food. A theoretical model is developed to explain eligible households' program participation and their food expenditure decisions. This model advances beyond previous work in explicitly recognizing the interdependence of the program participation and food expenditure decisions. An important component of this interdependence is the connection between cash equivalence of stamps in the participation decision and in the demand for food. The theoretical framework generates restrictions on empirical specifications and indicates the essential characteristics of the empirical model. An econometric model of the program participation and food expenditure decisions is estimated.

The participation analysis indicated that stamps are virtually equivalent to cash in utility of market goods. An additional dollar in cash or in stamps affect the market goods component of utility similarly. In terms of nonmarket or stigma effects, however, stamps may confer less welfare gain than cash, depending on how the cash and stamp programs are administered. Stamps also have a much larger estimated effect on food expenditures than cash. While the program constrains consumption there is little "burden" from having to divert expenditures from all other goods to food. These results indicate that the Food Stamp Program, after the elimination of the purchase requirement, increases both household welfare and the demand for agricultural products. Except for nonmarket stigma effects, there is little indication of a tradeoff between improving household welfare and increasing agricultural demand.

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1. INTRODUCTION

The U.S. Food Stamp Program (FSP) is one of the largest domestic redistributive transfer programs ever effected. More than 22 million persons participated in the FSP in 1981, and a budget of $10 billion was established for fiscal year 1982. Because in kind transfer programs are inherently inefficient according to some widely used standards, the existence and size of the FSP raise interesting and unresolved theoretical issues and bring into question the adequacy of a standard economic model to represent and explain reality. The effects of the program on household welfare and household food demand are important empirical issues.

This study has two major parts. First, a theoretical model is developed to explain eligible households' program participation and their food expenditure decisions. This model advances beyond previous work in explicitly recognizing the interdependence of the program participation and food expenditure decisions. An important component of this interdependence for policy analysis is the connection between cash equivalence of stamps in the participation decision and in the demand for food. The theoretical framework generates restrictions on empirical specifications and indicates the essential characteristics of the empirical model.

Second, an econometric model of the program participation and food expenditure decisions is estimated. The extent to which food stamps are equivalent to cash is investigated as is the question of how this degree of cash equivalence affects FSP participation and food expenditures. Cash equivalence is related to the effectiveness of the program in increasing welfare and the demand for food.

This study of the behavior of FSP eligible households contributes to policy analysis in providing a method to evaluate the impact of the existing structure and proposed structural changes on the achievement of program objectives. The theoretical model is formulated to address the variety of policy questions that arise in evaluating in kind transfer programs. It is a start toward a refined and expanded theoretical model of recipient behavior in a public choice approach to policy analysis. The empirical findings contribute specifics to such an analysis of the FSP.

2. THE FOOD STAMP PROGRAM AND ECONOMIC ANALYSIS

A HISTORICAL PERSPECTIVE OF THE FOOD STAMP PROGRAM

Food assistance programs in the United States have taken two general forms—commodity distribution and food stamps. Under the former, the government purchases commodities and distributes them without charge, bypassing the market. Under the latter, the government subsidizes the stamps used by consumers to purchase food. Table 1 summarizes the development of federal food assistance programs. See also U.S. Congress, House (1976, 1977, 1979, 1980); Kotz (1971); American Enterprise Institute for Public Policy Research (1977); Claffey, Matsumoto, and Stucker (1981); U.S. Department of Agriculture, Food and Nutrition Service (1981); Allen and Longen (1981); Donnelly (1981). For a detailed history of the FSP see Ranney (1983).

Large food distribution systems were developed as an adjunct to agricultural programs designed to support farm income. To the extent that commodities received were food which the household could use, recipients' welfare was increased. But surplus commodities purchased and distributed did not necessarily mesh with the needs of households. Furthermore, retailers were not happy with the circumvention of the market under commodity distribution programs.

The first food stamp program, the Food Stamp Plan, was established in 1939. Eligibility was restricted to families on relief, Work Progress Administration workers, and others certified as needy by public assistance agencies. Some increase in consumer welfare should have occurred as a result of the shift from the commodity distribution program to the Food Stamp Plan because the consumer's choice set with respect to surplus commodities was expanded. Instead of receiving whatever foods were currently in surplus and locally available, the eligible consumer was able to choose from a list of surplus commodities and buy them with stamps.

The Food Stamp Plan became identified as an agricultural surplus removal program, and, as an agricultural program, was under the purview of the congressional agricultural committees for policy and appropriation purposes and was administered by the U.S. Department of Agriculture. State and local public welfare agencies were responsible for applicant contact, eligibility determination, and stamp disbursements. Strong concern with agriculture at the federal level and for increasing the general welfare of low

TABLE 1

Federal Food Assistance Programs, 1933 to 1985

Year	Program	Objectives	Notes on the program
1933	Federal Surplus Relief Corporation	Relieve commodity surpluses due in part to lack of consumer purchasing power stemming from high unemployment	Government purchased surpluses, distributed to unemployed
1935	Federal Surplus Commodities Corporation	Remove agricultural surpluses	Funded by 30 percent of annual customs receipts, government purchased surplus food and distributed it, via public assistance agencies, to eligible poor families, schools, and charities
1939	Food Stamp Plan	Aid for needy as certified by public assistance agencies	One bonus stamp redeemable for surplus food, given for every two stamps purchased for face value, purchase requirements increased with per capita incomes of eligible households
1946	National School Lunch Act	Remove agricultural surpluses and improve nutrition of school children	— — —
	Food for Peace	Remove agricultural surpluses and provide food aid overseas	— — —
1949	Additional authorization to purchase surplus commodities to distribute to the poor	Remove agricultural surpluses and provide aid to the poor	— — —
1961	Pilot food stamp projects	Improve food purchasing power and remove agricultural surpluses	Projects in eight test areas of the nation, coupons purchased by eligible participants at subsidized prices
1964	The Food Stamp Act	Raise the levels of nutrition among low-income households	Assets and income criteria required for eligibility. Required payments equal to average food expenditures for the specific income class
1971	Amendment to the Food Stamp Act	Established explicit nutritional goals	Eligibility tests made uniform across states, purchase requirements reduced to a level not to exceed 30 percent of income and in some cases to zero, benefits increased
1973	Amendment to the Food Stamp Act	— — —	Made county participation in FSP mandatory
1977	The Food and Agriculture Act	Encourage participation, target the program to those most in need, and control program costs	Purchase requirement eliminated, income eligibility level lowered, deductions limited, stricter asset tests applied, work requirements stipulated, and a cap placed on expenditures

1979, 1980	Amendments to the Food Stamp Act	Increase spending limits, combat fraud and abuse	— — —
1981	The Omnibus Reconciliation Act	Curb the growth of federal expenditures	Eligibility limits restricted, net income redefined, some benefits reduced, federally sponsored outreach activities eliminated
1981	The Food Stamp and Commodity Distribution Amendments	— — —	Allowed any political subdivision of any state to operate a workfare program, subject to approval by the Secretary of Agriculture
1982	The Omnibus Reconciliation Act	Curb the growth of federal expenditures	Benefit inflation adjustments reduced, eligibility standard and work requirements tightened, pilot projects with 20 hour per week work requirements authorized
1984	Continuing Resolution	Improve nutrition	Benefit levels slightly increased
1985	The Food Security Act	— — —	Eligibility requirements expanded, deductions increased, asset limits increased, state implementation of employment and training programs mandated.

income households at state and local levels set the stage for potential conflict.

One concern was insuring that food stamps would be used to increase recipients' expenditures on food beyond their previous (preprogram) expenditure level. Food stamp purchase requirements were set at the average expenditure for each per capita income class so that participating households had to commit at least an average amount to purchasing only food. Another problem was the nonparticipation of eligible households. Researchers found that many eligible households did not participate because they did not understand how the program worked and/or they were unable to meet the purchase requirements.

While World War II brought food rationing and surpluses evaporated, soon after the war farmers were once again faced with price-depressing overproduction. See Table 1 for several remedies used. Then in 1961 food stamp pilot projects, modeled after the original Food Stamp Plan with some modification, were tested in eight areas. Families were certified as eligible by state welfare agencies. The eligible families could pay an amount equivalent to the national average of food expenditures for households of their size and income class and receive food coupons of a higher monetary value. The purchase requirement insured that bonus coupons would be used "in addition to and not in substitution for regular food purchases" (U.S. Congress, House, 1977, p. 805). The decision not to issue special stamps for the purchase of surplus food marked an important policy shift from an emphasis on the removal of surpluses to an emphasis on increasing expenditures on food in general. In studies of the effectiveness of the program it was found that 90 percent of the participating families felt they were better off with food stamps than with surplus foods because they could purchase a wider variety of food. Nonparticipation of eligibles was identified as a major program weakness.

With the Food Stamp Act of 1964, nutritional and welfare objectives took priority over the food demand expansion effort. But the impact of the Food Stamp Program (FSP) on the welfare of families is not clear cut. Figure 1 illustrates alternative possibilities.[1] When no commodity distribution program is in operation, the budget constraint is ST. For the family's size and

1. Beginning with Southworth's (1945) analysis of the Food Stamp Plan, it has become conventional to separately aggregate food and nonfood to describe the effect of food subsidy programs on a representative household's decision making with a two-dimensional graph. Figure 1 and subsequent figures follow that convention.

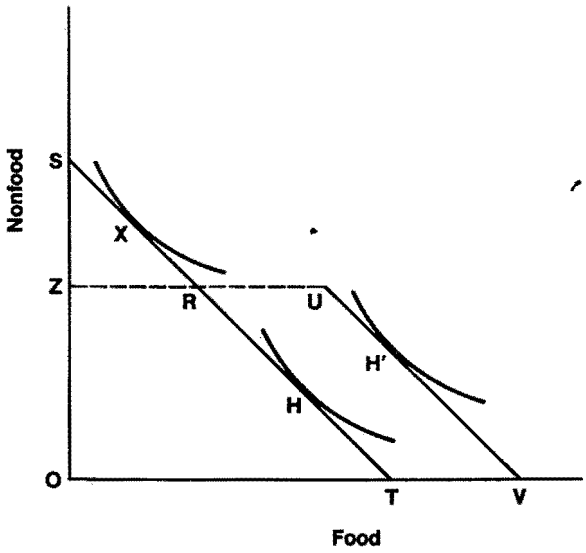

Figure 1. The Behavior of Eligible Households Under the Food Stamp Act of 1964

income level, the average expenditure on food, i.e., its purchase requirement, is SZ dollars. Its new budget constraint under the FSP will be SRUV, expanding the family's choice set by RUVT. If its original utility maximizing bundle of food and nonfood was represented by a point on the budget line on RT, H, for example, it would definitely be better off at H′ under FSP. If the family's initial maximizing bundle was on RS, however, it might be made better off by the program, but not necessarily.

The effect of the program will be to increase food expenditures of some but not all needy (eligible) households. Of the households with below average food expenditures, some may not participate because the purchase requirement is higher than the amount they are willing to allocate for food. Their preferences are such that the relevant portion of the budget constraint is above and to the left of R. If they do not participate, the program can have no effect on food expenditures. This result is perverse, because households with particularly low food expenditures are most likely to be nutritionally deficient. It is even more perverse if the household originally received surplus food. That is, with a commodity distribution program, the family received some food free, yet, with the FSP, it does not participate and receives no benefits.

Besides the problem of high purchase requirements prohibiting participation, a second major public policy problem was that of inequitable allotments. Because of increasing purchase requirements as per capita income increased for the same size family, total stamp allotment also increased as income rose (see Kotz, 1971, p. 247, and Appendix Table A.1). Critics argued that food needs of families of a given size are the same, so stamp allotments should vary inversely with income. Inequities also arose because eligibility standards varied from state to state.

Because of these and other criticisms, the FSP was modified by reducing purchase requirements and establishing total allotments such that participating families would be able to purchase "a more nutritionally adequate diet" (U.S. Congress, Congressional Budget Office, 1977, p. 5).

The 1971 amendment to the Food Stamp Act acted to increase participation, raise benefits, and set eligibility standards more according to need. Benefits were generally increased and benefit levels were to be adjusted annually. Uniform (nationwide) income and asset tests for eligibility, including some deductions from gross income for medical and other expenses, were established. The able-bodied were required to register for work. Households were granted permission to purchase one-fourth, one-half, three-fourths, or all of the total allotment, while monthly purchase requirements were reduced to a level not to exceed 30 percent of income and in some cases to zero.

Allowing families to purchase a fraction of their total allotments should have made some families better off. Figure 2 duplicates the all or nothing situation of Figure 1 with budget line SRUV. By allowing purchases of a fraction of the total allotments, the choice sets for eligible households were expanded. Those families who maximized utility somewhere between X and R previously (indifference curve I′), became better off under the new rules (curve I″), while those who had maximized on SX may have become better off.

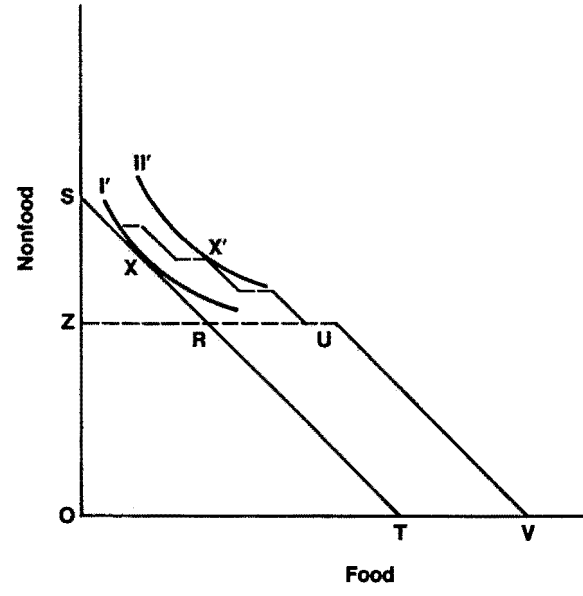

Figure 2. The Behavior of Eligible Households Under the 1971 Amendment to the Food Stamp Act of 1964

By the mid-1970s there was increasing pressure to change FSP. Provisions dealing with most concerns were contained in the Food and Agriculture Act of 1977. The first category of changes was effected to encourage participation of eligible households by eliminating the purchase requirement, simplifying application procedures, and increasing outreach efforts. The second category of changes involved targeting the program to those most in need; the third was an attempt to control program costs by placing caps on total annual expenditures.

The most profound structural change enacted in 1977 was elimination of the purchase requirement (EPR). Recall that under the old program, the purchase requirement was the amount the family had to pay to receive its full allotment of food stamps each month based on "ability to pay" determined according to family size and income. The full monthly allotment of stamps was set by the U.S. Department of Agriculture according to the cost of a nutritionally adequate diet (the Thrifty Food Plan) for particular family sizes. For example, it might be determined that a household should spend $120 per month for food (see Appendix Table A.2), yet could only afford $40, i.e., 30 percent of its adjusted income. In this case, the purchase requirement would be $40, but the household would receive $120 in food coupons—a federal subsidy or bonus of $80. In the 1971 amendment, families were given the choice of paying one-quarter, one-half, or three-quarters of the purchase requirement in exchange for the same fraction of their total allotment in a given month. In 1979, EPR meant that the household received only bonus stamps and paid nothing for them. The household just described would receive $80 in food coupons instead of $120. Graphically, this corresponds to a simple upward shift in the budget line without the discontinuous "ratchet effect" of the previous program (see Figure 3). Thus, if households maximized utility anywhere to the left of R under the previous program, then they would be better off after the change.

Opponents of EPR feared that there would be no way to ensure that households would still spend their total pre-EPR allotment ($120) on food. Without a food purchase requirement, households would actually have more cash to spend on anything they wished, not just on food, thus turning the FSP into a quasi-cash transfer program.

The net increase in participation due to EPR and tightened eligibility requirements had been seriously underestimated. The number of new participants was higher than expected, they entered the program faster than anticipated, and they were entitled to higher benefits than had been projected, The U.S. Department of Agriculture estimated that 30 percent of cost overruns were attributable to miscalculations regarding the impact of EPR, with unanticipated food price inflation accounting for another 56 percent.

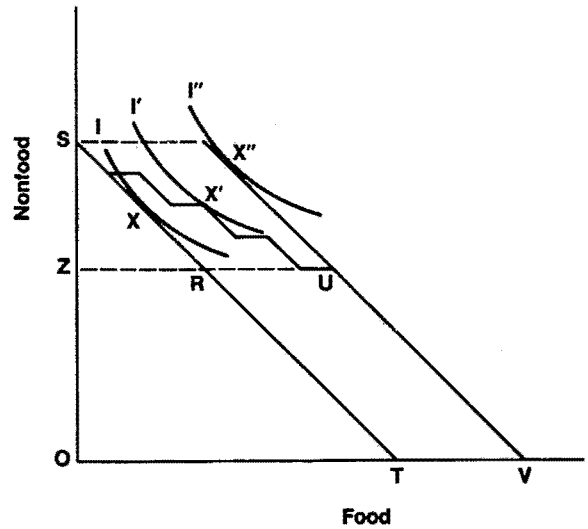

Figure 3. The Behavior of Eligible Households Under the Food Stamp Act of 1977

The Food Stamp Act was amended in 1979 and 1980 to extend spending limits and to enact provisions aimed at combating fraud and abuse, but concern about reducing or controlling the cost of the FSP continued to permeate congressional debate and lawmaking as well as public discussion. When spending caps had to be breached in 1979, 1980, and 1981, the FSP was opened up to heavy criticism and further change.

In 1981, Congress passed the Omnibus Reconciliation Act hoping to curb the growth in federal expenditures, but its passage did not complete congressional action concerning the FSP. Reauthorization legislation in the House and appropriations in the Senate were required. By mid-December 1981, the Food Stamp and Commodity Distribution Amendments were reported out of the Senate-House Conference Committee. The major program change of the 1981 amendments was to allow any political subdivision in any state to operate a workfare program, subject to approval by the Secretary of Agriculture. As proposed, every nonexempt household member would have to accept offered work to be valued at the higher of the state or federal minimum wage. Other than on a pilot basis, workfare programs had not been previously approved for food stamp or other assistance programs. In 1982, work requirements were tightened yet again, and pilot projects were authorized that would disqualify able-bodied individuals who did not work at least 20 hours per week or participate in a workfare program. Eligibility criteria were also tightened and inflation adjustments to benefit levels were slowed. Food stamp benefit levels were restored to 100

percent from 99 percent of the Thrifty Food Plan in 1984. Several marginal changes in the FSP were made in the 1985 Food Security Act, including slight increases in deductions and asset limits and mandated state implementation of employment and training programs for FSP participants. The FSP was protected from automatic budget cuts under the Gramm-Rudman-Hollings legislation, and a ruling by the Supreme Court, implies that funding for this program will follow normal legislative procedures.

Federal food assistance programs have evolved continuously from their inception during the Great Depression to the present. While the original dual objectives of the first commodity distribution and food stamp programs continue for the current FSP, their relative importance has changed. The original primary goal of farm relief was achieved by governmental purchases of price-depressing surplus commodities, while the secondary goal of providing food to the unemployed was accomplished by giving them those surplus commodities or encouraging the purchase of surplus food by issuing free coupons. The farm relief objective has been gradually superseded as major emphasis shifted to providing eligible low-income households with the opportunity to purchase a nutritionally adequate diet and increase their welfare.

This gradual shift from farm relief to household welfare is reflected in structural program changes over time. Benefits to recipients have become less restrictive compared to the initial tightly restricted distribution of surplus commodities. The original Food Stamp Plan continued to encourage the purchase of surplus commodities through the use of free coupons, but recipients were allowed to choose which and how much of the surplus commodities to purchase. Under the pilot food stamp projects of the early 1960s and the FSP of 1964 recipients' choices were further expanded and surplus removal was deemphasized by ceasing the issue of coupons for surplus commodities. EPR in the 1977 act placed even fewer restrictions on the consumption decisions of recipients. Instead of having to make a cash outlay or meet a purchase requirement in exchange for their total allotment of stamps, participating households received free bonus stamps (where bonus equals allotment minus the purchase requirement). Before EPR, only a small proportion of households had no purchase requirements. Participants, no longer required to spend the purchase requirement on food, were able to allocate their "freed up" cash as they wished. There was no guarantee that all households would spend at least as much on food as they would have under the pre-EPR program, so increased expenditures on food and agricultural products became less likely. The choice sets of participating households expanded, resulting in increased welfare for some households, while the potential for farm support may have decreased. Nevertheless, EPR did not reflect total elimination of farm support as a program objective. The large increase in participation due to EPR may have resulted in an increase in total food expenditures. Thus, changes in the form and amount of benefits have become less restrictive over time, suggesting a growing dominance of household welfare over farm support program objectives.

Federal administrative control over the FSP has expanded, and its form has become more centralized. The original Commodity Distribution Program allowed states to participate voluntarily. Each participating state established its own set of eligibility and benefit levels, while the federal government purchased and distributed surplus commodities to the states. When the original Food Stamp Plan was initiated, states could choose whether or not to operate a stamp plan or a commodity distribution program. The FSP of 1964 also provided for voluntary state participation and determination of eligibility, but benefit levels were set by the federal government. The 1971 and 1973 amendments required FSP participation by all states and established uniform (nationwide) eligibility criteria. Administrative control over food assistance programs shifted from states to the federal government, and voluntary FSP participation by states gave way to mandatory nationwide participation. The FSP became the first national welfare program with universal eligibility standards and benefit levels based on need and ability to pay, further establishing household welfare rather than farm support as its dominant objective.

In the 1970s, expenditures for the FSP increased dramatically, largely due to the increased participation resulting from expansion to nationwide coverage, program changes, and increases in food prices and unemployment. Concern over the high expenditures on FSP led to legislation aimed at cost cutting. Increases in benefits were delayed; eligibility criteria were tightened. Annual program expenditure caps were applied, although not observed. A block grant for an all-inclusive food assistance program was established for Puerto Rico to control the high cost of the FSP there. Other cost-cutting measures have been and are being considered.

Legislators may continue to advocate a succession of frequent small additional restrictions on FSP eligibility and reductions in real benefits, but more drastic methods for changing the program are being given serious consideration.

Various welfare reform, guaranteed income, or net income tax schemes have been proposed. Most, beginning with the Nixon administration's 1969 welfare reform proposal, the Family Assistance Plan,

include provisions to cash out the FSP and allow more universal coverage. "Cash out" means that, instead of receiving stamps, the participants receive benefits in cash. In general, welfare reform proposals consolidate the cashed-out FSP benefits with those from other cash transfer programs such as Aid to Families with Dependent Children (AFDC) or Supplemental Security Income. With a single cash benefit, the need for and cost of printing and dispensing stamps would be eliminated as would duplicate administrative operations.

But these welfare reform proposals would not necessarily make participating households better off. The Family Assistance Plan "would have made families worse off because the basic benefits plus state supplements combined with cashed-out food stamps would have been less than the current AFDC benefits plus the food stamp bonus in certain states" (Barth, Carcagno, and Palmer, 1974). Benefits from the Carter administration's 1977 proposed Program for Better Jobs and Income, another welfare reform proposal incorporating FSP cash out, would have exceeded the then-current benefits paid (AFDC plus food stamps) in only 12 states. While these proposals did not receive sufficient support for passage, some changes in FSP can be viewed as movements toward welfare reform. According to MacDonald (1977, p.10), congressional motivation for the 1973 and 1974 amendments to the Food Stamp Act, mandating nationwide coverage with uniform eligibility criteria and (increased) benefit levels.

> . . . could have been a desire to alleviate a generally recognized need for a guaranteed family income. In other words, extending benefits to all areas of the United States can be interpreted as a gradual welfare reform.

The Reagan administration's proposed "new federalism" contained provisions which could radically alter all federally supported food assistance programs, including FSP. States would take full responsibility for food stamp and welfare programs while all financial and administrative control over Medicare and Medicaid would be transferred to the federal government.

Thus, the FSP may be quite different within five or ten years. Cash out, block grants to states, gradual cut backs in eligibility criteria and real benefit levels, or combinations of the above are all possible. Given the consequences of the inaccuracy of previous estimates of the impact of program parameters, household characteristics, and economic conditions on participation, benefit levels, and costs, more accurate information and estimation methods are needed. If expenditure caps are to be strictly observed in the future, accurate projection of program costs will be crucial. If some form of "new federalism," such as nutritional assistance block grants is enacted, state legislators will need a paradigm for program design that will take into account the economic conditions and characteristics of households within their respective states. Determining the "best" program structure has been problematic from the earliest commodity distribution program to the present. The need remains to find a method to improve the well-being of those who still suffer from hunger even if only from time to time.

PREVIOUS RESEARCH ON FOOD STAMPS

This section contains a review of literature pertaining to the FSP and a discussion of several theoretical developments. First, we note various descriptive analyses of the FSP participation vs. nonparticipation decision. Second, we review empirical studies of how FSP participation affects the demand for food. Third, several more formal economic models are discussed—models that attempt to incorporate in kind transfers, such as food stamps, into the theoretical consumer model. It is these efforts, in particular, that we build upon in developing our theoretical model of the FSP eligible household's interdependent participation and food expenditure decisions in the following sections. Fourth, we set the FSP in the context of the emerging theory of redistributive transfers, which views a food stamp recipient's and a donor's, i.e., a taxpayer's, utility functions as interdependent. Finally, we consider the enlargement of the theoretical framework to the public choice (aggregate) level. While progress has been made in theory at the individual level, e.g., the theory of recipient and donor behavior and elementary models of redistributive transfers based on Pareto efficiency, much work remains on the collective decision process. Public choice theory offers a promising arena for this work.

The lengthy list of published economic literature regarding food stamp programs is chronologically headed by Gold, Hoffman, and Waugh's (1940) analysis of the Food Stamp Plan. Southworth's 1945 study of alternative methods for subsidizing food consumption is, according to Bryant, Bawden, and Saupe (1979, p. 105), the landmark piece of research on the subject. In it, Southworth raises the major issues of in kind welfare programs, and, in particular, food programs, and subjects them to analysis at both the household and market level. Southworth's theoretical framework for analyzing household consumption behavior in response to various forms of food consumption subsidies and his careful delineation of relevant policy issues continue to provide the basis for studies of the FSP.

Program Participation Studies

There are numerous descriptive empirical analyses of FSP participation and nonparticipation which can be conveniently divided into three categories. The first covers analyses of reasons for participating or not participating (Coder, 1974; Coe, 1977a, 1977b, and 1979; Crayton, 1975-76; Epperson et al., 1980; Lane, 1978; U.S. Department of Agriculture, Economics Research Service, 1967). Socioeconomic reasons frequently given for not participating include: problems with the purchase requirement, ignorance about the program, inconvenience, and stigma associated with applying for or using food stamps. Epperson et al. (1980) assert that eligible households choose the participation status that yields the highest possible utility level.

The second category includes analyses of the differences in participation rates by eligibles across states or from county to county (Bickel and MacDonald, 1975; Hines, 1975; Nelson, 1972; Sexauer, Blank, and Kinnucan, 1976; MacDonald, 1977 and 1978). Variables shown to be related to participation rates positively (+) or negatively (–) include percent of population with income below the poverty level (+), the unemployment rate (+), percent of population receiving welfare payments (+), percent of population in certain age categories (+ or –, depending on age group), labor force participation rate (–), and family size (+). MacDonald (1977) uses indifference curve analysis to develop the notion of monetary and psychic costs, in addition to the benefit of program participation.

The third, and most recent research area, includes studies of the effects on participation of the changes introduced by the Food Stamp Act of 1977, with emphasis on elimination of the purchase requirement (Merck, 1979; U.S. Department of Agriculture, Food and Nutrition Service, 1979).

Program Effects on Demand for Food

Much of the food demand/expenditure research has addressed the question of whether households of various sizes increased food purchases and/or changed types of food purchased as a result of participation in the program. The expenditure expansion effect of the FSP depends on the extent to which households substitute stamp purchases for cash purchases of food. Some researchers have approached this question by looking at the differences in food expenditures between participants, general nonparticipants, and, sometimes, eligible nonparticipants (Greenleigh Associates, Inc., 1979; Lane, 1978; Scearce, 1979; West, 1978). Others have looked at the effectiveness of bonus stamps in increasing expenditures on food by participating households (Madden and Yoder, 1972; Neenan and Davis, 1977; West and Price, 1976; and Reese, Feaster and Perkins, 1974). Boehm and Nelson (1978) estimated that the marginal propensities to spend bonus stamps on food by recipients ranged from .40 to .60, while Neenan and Davis (1977) found that for eligible nonparticipants the marginal propensity to spend income on food was .32. It is thought that with the elimination of the purchase requirement (EPR), the FSP may be less effective in increasing household food expenditures, but as yet there are no empirical estimates of the impact of EPR.

West (1978) investigated the manner in which participating, eligible nonparticipating, and all nonparticipating households allocate total food expenditures among food-group categories, including a food-away-from-home category. Percentages of expenditures allocated across the various food groups by participants and eligible nonparticipants were quite similar, but the latter group spends more than the former in the food-away-from-home category.

Theoretical Economic Models

Formal economic models of household behavior incorporating FSP participation have been developed by a number of researchers. Bryant (1971, 1972) developed a theoretical model of participant demand functions for in kind transfers and applied it to FSP data. Coe (1979a) chose an expenditure function approach to study the program participation decision, Salathe (1980) used income-consumption curves, while Clarkson (1975, 1976) and Mittlehammer and West (1975) utilized indifference curves to analyze the effects of the FSP on household behavior. Under certain assumptions, the indifference curve and income consumption curve approaches can be shown to yield identical results.[2] Mittlehammer and West considered the effect of the FSP on spending decisions of participating households, while Clarkson measured net recipient benefits to use as a predictor of participation.

Although Clarkson's, Mittlehammer and West's and Coe's studies were made before EPR, they will be described in some detail here because they provide a starting point for the theoretical framework to be developed.

Both Clarkson's and Mittlehammer and West's indifference-curve analyses use graphics as in Figure 4. The budget constraint for a family not participating in the FSP is ST. If the family participates, the budget constraint includes the notched segment from S to U and continues on to V. The notches indicate that

2. Huang, Fletcher, and Raunikar (1981) report that if rational households are assumed to optimally allocate their income to maximize utility with given budget constraints, the two approaches yield the same results.

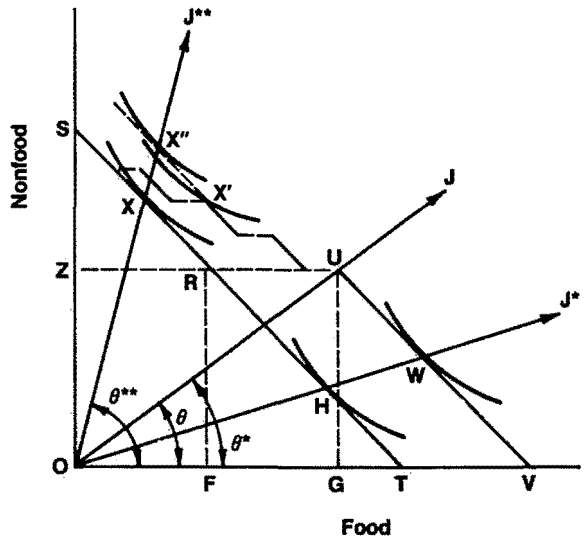

Figure 4. Indifference Curve Analysis of the Food Stamp Program (Mittlehammer and West, 1975)

households in the mid-1970s were allowed to purchase one-fourth, one-half, three-fourths, or all of the allotment while paying the same purchase requirement. If the family purchases its entire allotment with SZ dollars of income, the allotment is represented by OG with the corresponding bonus, FG.

Given its budget line, the rational household will purchase the number of stamps that will maximize its utility, allowing it to reach the highest possible indifference curve. Mittlehammer and West (1975) use vector OJ and the angle θ ($\tan\theta$ = UG/OG) to discriminate between two different sets of preferences and their implicit effect on food purchases. In case one, the income-consumption vector, OJ*, is such that $\tan\theta > \tan\theta^*$, meaning that the household spends more on food than its maximum food stamp allotment. At equilibrium, the marginal rate of substitution of food for other goods (MRS) equals the price ratio, so if this household were to receive a cash grant instead of food stamps, the equilibrium consumption bundle would be unchanged. Case two describes the situation where $\tan\theta^{**} > \tan\theta$: Purchases of food in the absence of the program are less than the total allotment of stamps. The in kind nature of the transfer requires that more of the budget be allocated to food than would be the case if a cash transfer were made (compare bundles X′ and X″). At equilibrium, the MRS does not equal the price ratio. In case three, the household's income-consumption vector is OJ; the effect of the program can go either way, depending on the shape of the indifference curves. Thus, very-low-income households may purchase more food due to the in kind aspect of the program, while higher-income households and those with strong preferences for food are probably not affected by its in kind nature.

Clarkson (1976) uses an equivalent variation measure of recipient net benefits to identify the welfare increase associated with FSP participation and to estimate the determinants of program participation. The equivalent variation is defined as the amount of cash that would be required to allow the household to achieve the same utility level as reached with food stamps. In Figure 5, the cash equivalent transfer (E) is the value of PR units of food, while the food stamp bonus (B) is the value of UR units of food. In this case B is greater than E. The value of bonus stamps equals the cash equivalent value (B = E) if the household's preferences are such that the new equilibrium occurs below U, say at H. Clarkson claims that his estimates of E provide a better predictor of the likelihood of participation than do measures of B.

Coe (1979) uses an expenditure function approach to explain the FSP participation decision. He posits two levels of utility: (1) the value of the indirect utility function if the household participates in the program and (2) the value if it does not participate, defined as:

$$u^A = g(Y, P_F) \tag{1}$$

for nonparticipation and

$$u^B = g(Y', (\frac{PP}{CA}) P_F) \tag{2}$$

for participation, where

Y = household income,

Y′ = Y minus the access cost of participation,

PF = the market price of a unit of food, defined to equal $1,

CA = the maximum coupon allotment, and

PP = the purchase price of the maximum coupon allotment of stamps to which the individual is entitled.

The fraction $\frac{PP}{CA}$ is the proportionately reduced price of the total allotment (CA); that is, $\frac{PP}{CA} P_F$ is the price of food for the FSP participant.

Coe inverts the indirect utility function to get the expenditure function, Y = E (u, p), or the minimum amount of income (Y) needed to reach a utility level (u) at given prices (p). For (1) and (2) the corresponding expenditure functions are:

$$Y = E(u^A, P_F) \text{ and} \tag{3}$$

$$Y' = E(u^B, \frac{PP}{CA} P_F). \tag{4}$$

For participation to be preferred ($u^B > u^A$), it must be true that:

$$Y' > E(u^A, \frac{PP}{CA} P_F), \tag{5}$$

because when (4) is substituted into (5):

$$E(u^B, \frac{PP}{CA} P_F) > E(u^A, \frac{PP}{CA} P_F). \tag{6}$$

Since, at given prices, utility is an increasing function of expenditures, (5) is a necessary condition for participation to be preferred.

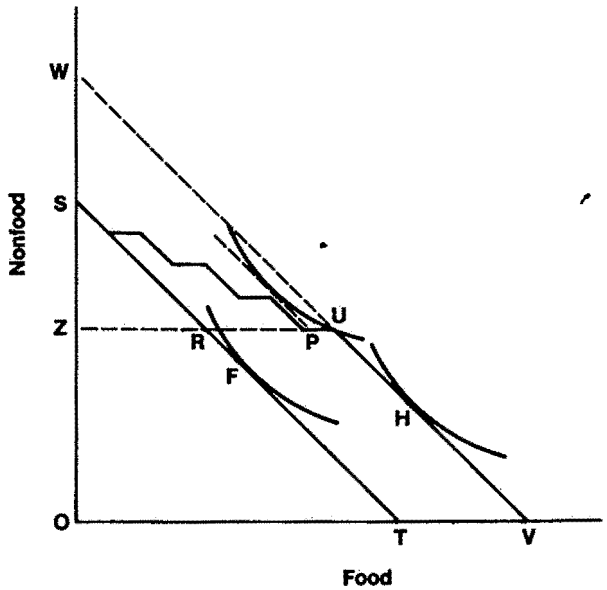

Figure 5. Indifference Curve Analysis of the Food Stamp Program (Clarkson, 1976)

By subtracting (5) from (3) Coe obtains:

$$Y - Y' > E(u^A, P_F) - E(u^A, \frac{PP}{CA} P_F) \qquad (7)$$

which says that access costs of program participation ($Y - Y'$) should be less than the benefits of the program (the right hand side of (7)). Thus, the benefits of program participation are measured as the difference between the two values of the expenditure function reflecting the benefit to the household of the reduced price of food associated with program participation. If inequality (7) holds, therefore, the household will participate in FSP since the benefits are greater than the associated access costs. Both Clarkson and Mittlehammer-West imply that beyond some point (U in Figure 5) the food stamp bonus can be treated as if it were a cash transfer.

Other researchers have also addressed the question of the cash equivalence of in kind transfers. Smeeding (1982) reports that empirical evidence indicates that most in kind transfer recipients would prefer cash transfers of equal value. Empirical studies of food stamp in kind transfers by Cooper and Katz (1978), Clarkson (1976), MacDonald (1977), Murray (1980), Plotnick and Smeeding (1979), and Smolensky et al. (1977) yield estimated cash equivalent values ranging from 93 to 96 percent of actual food stamp market values. These studies seem to imply that, on average, the equilibrium position of FSP households before the elimination of the purchase requirement (EPR) lies above and to the left of U in Figure 5. Smeeding (1975a,b) used pre-EPR data to simulate a FSP without a purchase requirement and estimated a cash equivalent value of 97 percent, lending support to the Clarkson and Mittlehammer-West hypothesis. The implication is that the cash-equivalent region extends all the way back to W in Figure 5, given EPR.

The purchase requirement had been considered a major reason for nonparticipation. If Figure 5 represents a true picture of the world, all eligible households would be expected to participate in FSP after EPR, but about 40 percent still do not. Figure 5 must, therefore, present an incomplete and somewhat inaccurate explanation of household participation and food demand decisions. Either budget constraints or preferences, or both, must be somehow misrepresented.

Both Clarkson and Coe indicate that the budget constraints may be incorrect because of lump-sum monetary costs associated with participation greater than or equal to the benefits the household would receive if it participated. This would cause a parallel downward shift of the constraint related to participation, positioning it lower than the nonparticipation constraint. Thus, an eligible nonparticipating household might be at F rather than H in Figure 5.

Preferences may also be misrepresented in the figure because we don't live in a two-good, food and nonfood, world. Rather, food purchased with food stamps may yield less satisfaction than food purchased with cash transfers or cash income due to "stigma" or the loss of prestige associated with program participation and loss of privacy associated with the visibility of stamp use. Expenditure decisions of eligible households may involve three basic goods—nonfood, food for cash, and food for stamps—and, therefore, cannot be accurately described in two dimensions. There may also be stigma associated with participation in cash transfer programs making a four-good world.

The possibility of stigma also brings into question the validity of using Figure 5 to analyze the cash equivalence of food stamps. Stigma is a nonmarket good that cannot be represented in Figure 5. Aside from stigma effects, stamps may not have full cash equivalence in some households. That is, holding all else constant, including prestige and privacy, a household's subjective evaluation of the stamp allotment may be less than its actual market value or food purchasing power, because stamps are restricted to food. This subjective evaluation may in turn, affect the program participation and food expenditure decisions.

Even though Figure 5 does not adequately describe the impact of the FSP on household decision making and welfare, it clearly illustrates that the participation decision determines which budget line (feasible set) is applicable. The participation decision identifies the region of relevant consumer preferences and thereby affects the food expenditure decision. That the program participation and food expenditure decisions are interdependent needs to be explicitly incorporated into the consumer behavior model. This we propose to

do, theoretically and then empirically. But first the FSP needs to be viewed from a broader perspective—from the emerging theory of redistributive transfers (interdependence of utility functions). Then, the possibilities of setting the FSP in a public choice theoretical framework are considered.

THEORY OF REDISTRIBUTIVE TRANSFERS

The FSP and the changes it has undergone have been catalysts for development of the theory of redistributive transfers. The behavior of FSP eligible households provides a natural testing ground for the relevant hypotheses derived from this theory.

The Traditional Model of Transfers

The theory of transfers was built on the notion of interdependent utilities, where donor and recipient preferences were realized to various degrees in a collective choice. The conventional economic model, because of its efficiency criterion, favors transfers in cash rather than in kind. The inefficiency of in kind transfers results from a restriction of the recipients' consumption choices. In kind transfers, such as food stamps, restrict recipient choices to specified commodity or service categories. Cash transfers are more efficient in that they embody no such restrictions. The usual recipient-oriented economic argument supporting unrestricted cash transfers is enunciated by Thurow (1974, p. 190):

> Governments may modify the market distribution of purchasing power, but then should stand aside and allow consumer sovereignty plus competitive markets to work. Any further intervention lowers consumer utility below what it otherwise could be.

Thurow's comment regarding the impact of further intervention or restrictions on consumer utility needs some qualification. Additional intervention, such as in kind rather than cash transfers, may lower the utility of some but not necessarily all recipients. The resulting utility level will be jointly determined by the recipient's preferences and by the type of intervention involved. This qualification to Thurow's statement can be illustrated graphically by comparing budget lines, feasible sets, and utility-maximization points for representative participants under different transfer schemes as in Figure 6. The FSP is taken as a case in point.

In the absence of transfers of any kind, the budget constraint for a representative low-income household would be ST. After the elimination of the purchase requirement, the FSP results in budget constraint SYUV. If the dollar value of the FSP subsidy (TV) was transferred in cash instead of stamps, the appropriate budget constraint would be WV. The recipient's choice

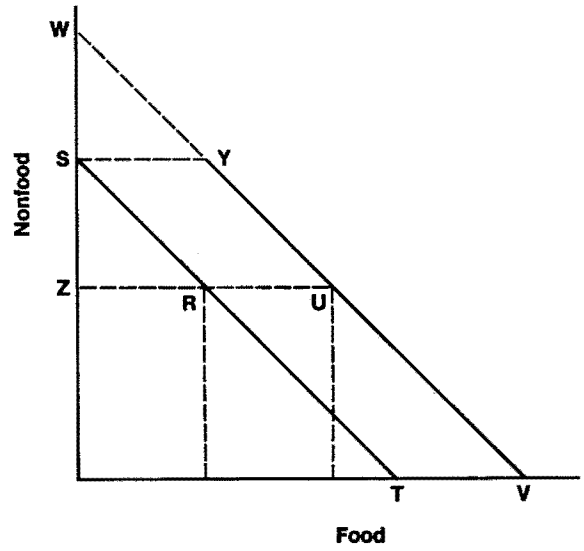

Figure 6. Budget Lines and Feasible Sets for Representative Participants Under Different Transfer Schemes

set is larger with a cash transfer than with food stamps. Households which maximize utility above and to the left of Y on the cash-transfer budget constraint could reach a higher utility level with transfers in cash than in stamps. For these households, Thurow's observation would be correct without amendment. Other households, however, may have preferences such that utility-maximization would occur somewhere between U and V with a cash transfer; their utility levels would be the same with either form of transfer.

The recipient-oriented approach, as qualified, supports cash transfers because the utility levels of all recipients would be as high or higher than with in kind transfers of equal dollar value. But if this economic framework is valid, we should observe few, if any, programs distributing in kind benefits. This is not the case. Food stamps, free or reduced-priced school lunches, Medicaid, and housing subsidies are four major in kind transfer programs. In 1980, one-sixth of U.S. households received one or more of these transfers (San Francisco Chronicle, July 7, 1982, p.12). The two large cash transfer programs, Aid to Families with Dependent Children (AFDC) and Supplemental Security Income do not dominate the current program mix. Expenditures for in kind transfer programs are usually substantially greater than total cash transfer program expenditures. In 1981, AFDC provided cash transfers to 11.1 million individuals at a cost of $12.8 billion, while 21.7 million received food stamps at a cost of $11.4 billion and 22 million received benefits from Medicaid at a cost of $30.5billion (U.S. News and World Report, February 8, 1982, p.19). Attempts to cash out or substitute cash for food stamps (pivotal aspects of most welfare reform or guaranteed income

proposals) have not succeeded. Because the alleged efficiency and superiority of cash transfers, derived from the conventional application of microeconomic theory, are not consistent with the existence of such substantial well-entrenched in kind transfer programs, the theory of redistributive transfers needs a new rationale.

Incorporating Donor Preferences. The recipient-oriented theory of redistributive transfers is inconsistent with the popularity of in kind transfers because it is incomplete. Theory should account for the preferences of both donor taxpayers and recipients and for how those preferences are reconciled. The prevalence of in kind programs may thereby be justified. The formal method for jointly considering donor and recipient preferences uses interdependent utility functions.

There are two types of utility interdependencies. First, when individual A's satisfaction is affected by the utility level of individual B, B's utility becomes an argument in A's utility function. Because utility is positively related to income, individual B's income is sometimes included as an argument in A's utility function to represent this type of interdependency. If this form of utility interdependence exists, and redistribution is justified, the appropriate form of transfer would be cash. Second, the interdependence may be good-specific; that is, B's actual consumption of or expenditures on a particular good or service or category of goods or services would be arguments in A's utility function. With good-specific utility interdependence, in kind transfers may be justified.

Any individual's utility function can include the utility or consumption levels of many individuals. Thus, Hochman and Rogers (1969) suggest that part of the justification for income redistribution is the resulting increase in donor satisfaction. Using interdependent utility functions, they assert that income transfers are justified if the utilities of higher-income individuals are functions of and positively related to the incomes of lower-income persons (from purely charitable motives). When external benefits flow from the recipients' increased utility to the donor, their respective utility functions are interdependent and redistribution will yield gains to both. Assuming that voluntary redistribution through private charities is insufficient, a tax-transfer redistribution scheme operated by a collective institution such as the government can make everybody better off. Pareto optimality will be consistent with and, in fact, require income redistribution.

Hochman and Rogers' tax-transfer scheme does not correspond to any existing tax-transfer programs. In their model each person transfers income to every person lower in the income distribution. Thus, those taxpayers in the highest income bracket receive no transfers, those in the lowest pay no taxes, while those in between both pay taxes and receive transfers. Net income tax schemes resembling Hochman and Rogers' model have been proposed over the years, but not enacted. Current operating redistributive transfer programs, however, are means tested; that is, benefits are received only when household income for a given family size falls below a certain (quite low) level.

In Olsen's (1969) interdependent utility function model, the utility of an individual is a function of the consumption of private goods, collective consumption goods, and transfer activities, with transfer activities having the same general properties as other goods.[3] Utility could depend upon other individuals' consumption of specific goods (e.g., nutritious food) or services (e.g., medical care) rather than just additions to their general purchasing power (income). In this case in kind rather than cash transfers may be required for Pareto optimality.[4] But beyond some point, whether the transfer is in kind or in cash, additional transfers may not yield more satisfaction to the donor, i.e., the donor is satiated.

Olsen does not discuss what determines membership in either the donor or recipient group. Neither do Hochman and Rogers explain how gains from trade should be divided between recipients and donors. That is, the theory so far does not define the eligible set, which determines the number of potential participants and divides the gains from trade.

Browning (1974) notes that many in kind transfers or consumption subsidies for various goods and services (food, medical care, education, and housing) are in place, yet the arguments for a particular in kind subsidy, implicitly assume only one consumption externality. Rather, it would be appropriate to consider all goods with consumption externalities jointly, and compare the combination with a cash subsidy. Browning uses the interdependent utility function approach to appropriately analyze multiple

3. Because transfer activities are collective goods, total demand is derived by vertically summing individual demand schedules. Given the assumption of pricing by marginal evaluation or benefit taxation, only on efficient allocation of resources will exist. Individuals who prefer transfer activities will pay for those activities and the stronger their preferences, the more they will pay.

4. The cost of enforcing proper use and preventing black market sale of subsidy coupons such as food stamps or rent certificates used to effect in kind transfers may be high. Given the potentially high cost of administering in kind transfers, cash transfers may be preferred even in the presence of good specific interdependence, a point made by Tullock (1971) and conceded by Olsen (1971).

consumption externalities but he does not explain the prevalence of in kind transfer programs.

So far, the literature described indicates that redistribution with benefits in kind may be required to reach a Pareto efficient point on the contract curve. But ascertaining which point on that contract curve will be reached, how the gains from trade will be divided, and why an in kind program like the FSP is structured as it is, constitute a second stage of the evolving redistributive transfer theory.

Giertz and Sullivan (1977) use the utility interdependence redistribution model of Hochman and Rogers to examine the FSP as it was structured before the elimination of the purchase requirement. They hypothesize that subsidy voucher plans, like the FSP are structured as they are for the benefit of donors, that is, a good-specific utility interdependence is present.

In the two-person world of Giertz and Sullivan, the recipient's food consumption is an argument in the donor's utility function. The donor knows the recipient's preferences and sets the purchase requirement and stamp allotment to expropriate the recipient's potential welfare gain from the subsidy. The case where the donor captures all gains from trade is depicted in Figure 7. Point R represents the original equilibrium for the potential recipient in the absence of FSP. Suppose the potential recipient is indifferent between R and Y and that Y represents the particular food stamp allotment and purchase requirement chosen by the donor, given perfect information regarding the recipient's preferences. If the household chooses to participate ending up at Y, more food would be purchased which increases the donor's utility. In this case, the donor extracts all potential welfare gains from the recipient by setting the purchase requirements at SB and the allotment at OD.

Given the assumptions of interdependent utility functions, and perfect knowledge of the recipient's preferences by the donor, Giertz and Sullivan suggest that there may exist a range of Pareto optimal distributions where less than complete extraction of gains from trade by the donor is possible. Successful strategic behavior by the recipient could set the purchase requirement at SZ without changing the allotment. The recipient's new equilibriumwould be at U on a higher indifference curve, UR2. Compared to point R, at U more income is available for all other goods and food consumption is the same.

Giertz and Sullivan move from a two-person world into one in which the donor is viewed as a collective entity whose utility is affected by the food consumption of many individuals. Pareto optimality could occur

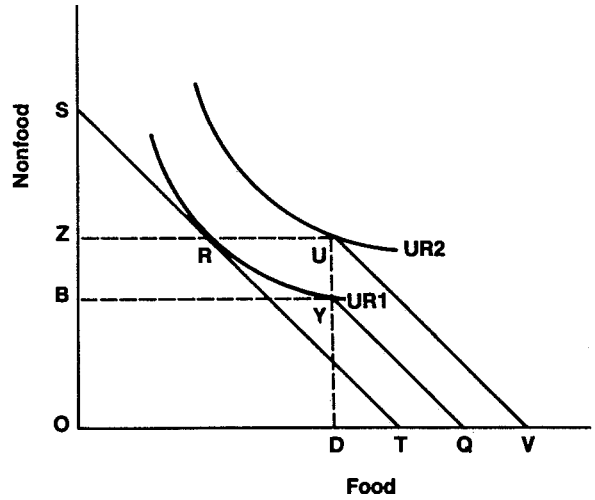

Figure 7. Gains from Trade from In-Kind Transfer Given Utility Interdependence

only if individual recipient preferences were known and perfect discrimination among the recipients was possible. They posit a scheme in which recipients in a particular class are treated the same with a donor utility function for each class of recipients, the arguments of which include the donor's consumption of all other goods, the allotment amount, and the number of class members participating in the program. Participation is a function of the purchase requirement and the allotment level.

Since Giertz and Sullivan's study, changes have been made in the structure of the FSP, the most profound of which was the elimination of the purchase requirement (EPR). Recall that opponents of EPR argued that it would allow too much flexibility to recipients in their food expenditure decisions,[5] the impact upon the nutritional status of recipients would be lessened, and the FSP would become largely an income transfer program.

Sullivan (1976) argued that EPR did not reflect donor preferences. Using the two-person model, he asserted that with EPR, the FSP could not possibly meet the Pareto criterion. Some recipients would purchase less food after EPR, decreasing the donor's utility.

While this conclusion remains valid in the many-recipient world, the failure to meet the Pareto criterion is then irrelevant. Sullivan did not carry over his analysis of EPR into this many-recipient framework. In particular, he neglected the donor's potential gain from increasing participation with EPR.

5. Under EPR, recipients are required to spend only the bonus value of stamps on food and not their entire monthly allotment.

Rather, after EPR, it would appear that welfare gains may accrue to both recipients and donors. Without a purchase requirement, no recipient is forced to remain on the same indifference curve. But EPR increased participation. Since the donor's utility in the Giertz and Sullivan model is a function of and positively related to the number of participants, donors' preferences may be accounted for even if the structure of the FSP includes no cash outlay by recipients. Thus, EPR could be consistent with the interdependent utility, donor maximization framework.

Browning (Spring 1981) rejects Giertz and Sullivan's basic hypothesis that the FSP operates largely for the benefit of donors with the policy parameters (program structure) set to maximize their preferences subject to the constraint that recipients not be made worse off. Among several other arguments, Browning presents convincing evidence of substantial gains to recipients from FSP.

While conceding that donor preferences affect the political decision to use in kind transfers, Browning concludes that the assumption of donor optimization is not adequate to explain the prevalence of in kind transfers, including the FSP.

Toward A Public Choice Framework

Giertz and Sullivan (1981) acknowledged and basically conceded Browning's points. Then, they present a useful diagrammatic illustration of donor coalitions and considered various historical structural changes in the FSP. They see EPR as arising from a coalition of recipients and donors with recipients' utilities (or incomes) as arguments in the (collective) donor's utility function. The coalition's goal was to reduce the food-specific nature of the program. With respect to EPR, they state (p. 116):

> Indeed, it is hard to see how something so peculiar could have evolved except as a result of a compromise coming out of a public choice process involving donors with both food-specific and utility (or income) interdependencies.

Public choice theory entails an atomistic notion of decision making (see Mueller, 1979; Ostrom, 1975). In addition to making decisions about market goods and services, individuals make decisions regarding the provision of public goods outside the marketplace based on their own preferences. How those individual preferences are reconciled in a collective choice is a central aspect of public choice theory. In contrast, a traditional public finance approach uses a social welfare function with some outside actor, perhaps a benevolent dictator, choosing a particular point on that function.

Browning (October 1981) uses public choice theory and offers a model of paternalistic in kind transfers. Like the Giertz-Sullivan model, good-specific externalities are present and interdependent utility functions are used, but Browning distinguishes between Pareto and paternalistic optima. While a Pareto optimum accounts for both recipient and donor preferences, the latter considers only donor preferences. Thus, because recipient preferences are disregarded, a paternalistic optimum can never be a Pareto optimum. Under Browning's paternalistic optimum, all recipients would consume the same amount of the subsidized good (assuming no enforcement costs), but the purchase price for coupons would vary directly with income adjusted for family size. The FSP, before EPR, fit the paternalistic criteria, but after EPR, was inconsistent with both Pareto and paternalistic optima. To incorporate the problem in a public choice framework Browning also turned to the use of coalitions, this time among voters. Simple majority voting determines the minimum allotment size and total cost in votes (p. 592):

> An equilibrium is established at a cost and quantity where a majority of voters opposes any increase or decrease in the minimum quantity of X (the allotment) and simultaneously a majority of voters opposes any increase in or reduction in total cost.

This political equilibrium sets the allotment at a level that maximizes the welfare of taxpayers given the total cost of the program and is a paternalistic optimum.

These first attempts of Giertz and Sullivan and of Browning to develop the collective choice aspects of in kind transfer programs are simplistic and extreme, but they point in a promising direction for further work.

State of the Theory

Programmatic concerns have influenced theoretical developments. The FSP has provided an important stimulus for theories of redistributive transfers, but EPR has produced difficulties for most of them. There has been progress toward an atomistic theory of redistribution based on Pareto efficiency, while much less has been accomplished on the collective decision process. Public choice theory applied specifically to collective decisions regarding redistributive transfers may prove useful when more adequately understood.

3. THEORY OF PARTICIPATION AND EXPENDITURES

THEORETICAL FRAMEWORK

Researchers have used microeconomic theory to reach policy-relevant conclusions about the Food Stamp Program (FSP) and to specify empirical models for explaining the impact of the FSP on household behavior. In this same spirit, a formal model of FSP participation and food expenditure decisions will be developed. By building on factors implicit in earlier models, this new theoretical framework may enhance our understanding of the behavior of FSP eligible households, generate restrictions relevant to the empirical specification, and yield accurate and useful information for better program design, budgeting, and implementation.

Economists usually begin with the neoclassical or marginalist paradigm, as described by, e.g., Silberberg (1978) to study household behavior. Individuals' preferences cannot ordinarily be directly observed, but their resource constraints and the choices they make are generally observable. The observable resource constraints and choices are, therefore, the basis for neoclassical analysis. Following Silberberg, the usual methodology is to: (1) postulate utility-maximizing behavior (unobservable), given fixed preferences and resource constraints; (2) develop a theoretical model of that postulate; (3) derive refutable hypotheses from predictions about how individuals' choices (observable) will change, at the margin, given exogenous changes in their resource constraints (observable); (4) design theoretically-consistent, realistic, test conditions, includiing an empirical specification that incorporates restrictions generated from the theoretical model; and (5) observe whether actual behavior under those test conditions is consistent with predicted behavior to confirm or refute the relevant hypotheses. The reliability and usefulness of such test results depend partly on how well the theoretical and empirical models describe the essential aspects of the postulated utility-maximization problem. In addition, it must be possible to exogenously change individuals' resource constraints. That is, resources are assumed to be parameters rather than choice variables.

This methodology must be modified somewhat to explain food consumption or expenditure decisions of households eligible for the FSP, because voluntary program participation implies some choice regarding their resource constraints and the associated consumption possibilities. The FSP increases the participating household's resources by the value of the food stamp allotment. Participation changes the location and shape of the feasible region in commodity space from which the household can choose its desired consumption bundle. The participation decision can be viewed as a choice between two different sets of resource constraints or consumption opportunities.

Since the participation decision defines the applicable resource constraints and those constraints interact with preferences to determine which particular consumption bundle is chosen, the quantity of food demanded by eligible households depends partly on the participation decision. Furthermore, *exogenous* changes in resources may generate *endogenous* resource changes. For example, we generally expect food expenditures to decrease if household income decreases. But a household experiencing a decrease in income may decide to participate in the FSP program and may thereby increase its food expenditures. Because the impact of an exogenous income change on food expenditures may depend on the participation decision, the expenditure and participation decisions are interdependent. The approach developed here explicitly recognizes this crucial interdependence for FSP eligible households.

THEORETICAL MODEL OF PARTICIPATION AND FOOD DEMAND

Utility maximization provides the framework for the interdependent participation and food expenditure decisions of FSP eligible households. In general, the utility-maximizing bundle of goods and services, including food, that the rational household chooses depends on its preferences, income, and relative prices. For FSP eligible households, utility maximization also depends on the program participation decision and its associated money and nonmoney entitlements and costs. To maximize utility, eligible households must first make the participation decision and then determine the level of food demand/expenditures as part of their resource allocation process. Rather than being strictly interdependent, the participation and expenditure decisions may be thought of as sequential.

Before they can participate, households must know about the program, apply and be certified as eligible, and then procure the stamps.[6] The application and certification process requires gathering the necessary

6. The household is certified as eligible if the members collectively pass an income test, an assets test, and fulfill a work requirement. Once certified, the household receives its allotment of food stamps redeemable for food in approved retail and wholesale food outlets. The amount of food (footnote continued on next page.)

income, asset, and work records; filling out forms; being interviewed by the eligibility worker; physically obtaining the stamps once certified, and traveling to and from the food stamp office. These activities which entail monetary costs can be considered the access costs of FSP participation.

There may also be nonmonetary costs. The extent to which the household feels a loss of prestige as a result of participation is one such psychic cost. Weisbrod (1970, pp. 2-3), describes stigma, the opposite of prestige, as:

> . . . the desire of the "poor" or "needy" to retain self-respect, dignity, and acceptance from the rest of society, and in particular the desire to not have other people know about their poverty, . . . (or) private life.

The stigma associated with FSP participation may have fixed and variable components. Fixed stigma costs may be incurred during the application and certification process. The applicant may feel stigmatized by being seen walking into the food stamp office, being identified by others as "poor," or having to divulge personal information to an eligibility worker. Variable stigma costs may occur as stamps are used in the store, since the FSP participant must separate items which can be purchased with stamps from those which cannot.

Access and stigma costs mean that eligible households could rationally choose nonparticipation, thereby foregoing an increase in resources in the form of food stamps. Thus, the participation decision is based on preferences, income, relative prices, the amount of food stamps involved, and costs associated with participation.

The representative eligible household is hypothesized to maximize a utility function,

$$u = U(G, F+S, R, X) \tag{1}$$

where G is a Hicksian composite of all other goods, F is food bought with cash, S is food bought with stamps, R is a composite representing the household's status and privacy, and X is a vector of household characteristics such as age and sex of household members, utility is maximized subject to:

$$P_F F + P_G G \leq Y', \tag{2}$$

$$P_F S \leq A, \tag{3}$$

$$R = R(S, X, d) \text{ and} \tag{4}$$

$$G > 0,\ F \geq 0,\ S \geq 0, \text{ and } F+S > 0 \tag{5}$$

Inequality (2) is the money income constraint with prices P_F and P_G where disposable income Y' is money income (Y) less the monetary access costs (C) of participation. Inequality (3) is the stamp allotment constraint with total allotment A. Equation (4) is the production of household status and privacy R. The partial derivative of this production function of household status and privacy (the opposite of stigma) with respect to S, $R_S \leq 0$, represents any marginal stigma associated with using stamps. That is, stigma may increase as more food is bought with stamps. The variable d in (4) is zero if the household does not participate in the FSP and one if it does. With respect to d, $R(S, X, d=1) \leq R(S, X, d=0)$. That is, the household may be stigmatized by participating in the FSP (a fixed cost), regardless of how much food it buys with stamps. The constraints in (5) indicate that some nonfood goods and services (G) and some food will be consumed whether food is purchased with stamps (S), with cash (F), or with both.

We first consider our representative eligible household as a FSP participant, then as a nonparticipant.[7] Substituting (4) into (1) with d = 1 for participation and using the other constraints yields the Lagrangian expression:

$$L = U[G, F+S, R, X] + \lambda_1 (Y' - P_F F - P_G G) + \lambda_2 (A - P_F S). \tag{6}$$

The first order necessary conditions for constrained maximization are:

$$\frac{\partial L}{\partial F} = \frac{\partial U}{\partial F} - \lambda_1 P_F \leq 0, \tag{7}$$

$$\frac{\partial L}{\partial G} = \frac{\partial L}{\partial G} - \lambda_1 P_G \leq 0, \tag{8}$$

$$\frac{\partial L}{\partial S} = \frac{\partial U}{\partial S} + \frac{\partial U}{\partial R}\frac{\partial R}{\partial S} - \lambda_2 P_F \leq 0, \tag{9}$$

$$F\frac{\partial L}{\partial F} = 0, \tag{10}$$

$$G\frac{\partial L}{\partial G} = 0, \tag{11}$$

$$S\frac{\partial L}{\partial S} = 0, \tag{12}$$

$$\frac{\partial L}{\partial \lambda_1} = Y' - P_F F - P_G G \geq 0 \tag{13}$$

$$\frac{\partial L}{\partial \lambda_2} = A - P_F S \geq 0, \tag{14}$$

$$\lambda_1 \frac{\partial L}{\partial \lambda_1} = 0, \tag{15}$$

(6. continued)
stamps received in a given month is determined in the following manner: The U.S. Department of Agriculture determines the cost of its Thrifty Food Plan for families of various sizes. Given each family's particular income and size, the "ability to pay" for food is calculated. The household receives food coupons in an amount equal to the difference between the cost of food required under the Thrifty Food Plan and the household's "ability to pay." The amount of food stamps received monthly is the federal subsidy, often referred to as bonus stamps.

7. The approach to the participation decision used here is essentially that of Lane, Kushman, and Ranney (1983) as refined in Ranney (1983).

$$\lambda_2 \frac{\partial L}{\partial \lambda_2} = 0, \text{ where} \tag{16}$$

$$G > 0, F \geq 0, S \geq 0, F+S > 0. \tag{17}$$

To interpret the first order conditions consider three cases: (1) $S = 0$, (2) $0 < S < A/P_F$, and (3) $S = A/P_F$. In the first, the household participates in the FSP in that eligibility certification and stamp procurement processes are undertaken, yet no food is purchased with stamps ($S = 0$). From (14) and (16), λ_2 equals zero. That is, a marginal increase in the stamp allotment (A) will not increase utility.[8] The λ_2 is also zero in case two when $0 < S < A/P_F$, but since $S > 0$, from (12):

$$\frac{\partial U}{\partial S} = -\frac{\partial U}{\partial R}\frac{\partial R}{\partial S}. \tag{18}$$

That is, when the stamp allotment constraint (14) is not binding, the participating household will purchase food with stamps until the marginal utility of stamp-purchased food equals the marginal disutility of the psychic burden associated with purchasing food with stamps. Therefore, even though we have assumed nonsatiety in all food purchased such that $F \geq 0$, $S \geq 0$, and $F+S > 0$, the household may not use all of its allotted stamps if the marginal utility of stamp-purchased food is fully offset by the marginal disutility of lost status and privacy (stigma). In case three, the allotment is exhausted, $S = A/P_F$, and λ_2 and F can be greater than or equal to zero. Regardless of whether F is positive or zero, when $\lambda_2 = 0$, allotment exhaustion occurs at the point described by (18) as in case two. When $\lambda_2 = 0$ and $S = A/P_F$, then from (12), the utility of a marginal increase in the allotment (λ_2) will equal the increase in utility due to increased stamp-purchased food after accounting for potential prestige and privacy losses associated with those increased purchases:

$$\frac{\partial U}{\partial S} + \frac{\partial U}{\partial R}\frac{\partial R}{\partial S} = \lambda_2 P_F. \tag{19}$$

Because

$$\frac{\partial U}{\partial S} > 0, \frac{\partial U}{\partial R} > 0, \text{ and}$$

$$\frac{\partial R}{\partial S} < 0, \frac{\partial U}{\partial S} > \frac{\partial U}{\partial R}\frac{\partial R}{\partial S}, \tag{20}$$

the quantity on the right hand side of (19) is a positive number. At equilibrium, therefore, nonsatiation in stamp food implies that the marginal utility from food purchased with stamps is greater than the marginal disutility or psychic burden associated with making these food purchases with stamps. If $F = 0$ when $S = A/P_F$ then from (15), $G = Y'/P_G$ with $\lambda_1 > 0$. If $F > 0$, for food stamp participants, from (7) and (8) and a binding income constraint (2):

$$\frac{\partial U/\partial F}{\partial U/\partial G} = \frac{P_F}{P_G}. \tag{21}$$

Equation (21) gives the usual case where the marginal rate of substitution between food and all other goods equals the price ratio.

The household's Marshallian demand function for food out of income given participation

$$F = F_P (P_F, P_G, Y', A, X) \tag{22}$$

can be obtained by simultaneously solving the above first order conditions for F.

Now suppose the *same* household does not participate in the program. Since no stamps are received ($A = 0$), the stamp allotment constraint (3) is irrelevant and no food is purchased ith stamps ($S = 0$). Participation related access costs and prestige losses are not incurred, so $C = 0$, $Y' = Y$, and $d = 0$. Thus, by adjusting (1), (2), (4), and (5) and deleting the stamp allotment constraint (3), the eligible nonparticipating household will maximize utility

$$U = U (G, F, R, X) \tag{23}$$

subject to the budget constraints,

$$P_F F + P_G G \leq Y, \tag{24}$$

$$R = R (S = 0, X, D = 0), \text{ and} \tag{25}$$

$$G > 0, F > 0. \tag{26}$$

The solution to this nonparticipating eligible household's constrained utility maximization problem will yield food and nonfood Marshallian demand functions for the eligible nonparticipating household. The same demand functions can also be derived from the indirect utility function

$$u = V_{NP} (P_F, P_G, Y, X) \tag{27}$$

which represents the maximum possible utility, given nonparticipation (NP). Marshallian demands can be obtained by applying Roy's identity. Consider, in particular, the demand function for food:

$$F = F_{NP} (P_F, P_G, Y, X) = -\frac{\frac{\partial V_{NP}}{\partial P_F}}{\frac{\partial V_{NP}}{\partial Y}} \tag{28}$$

where F indicates the quantity of food that the nonparticipating household is willing and able to purchase, given prices and income. In the case of nonparticipation, the indirect utility function and the associated demand functions will have the usual properties. Since these properties are used in specifying the empirical model below, they are given here.

The properties of the indirect utility function associated with nonparticipation are (Varian, 1978, p. 121):

8. A household not using stamps will generally be worse off by participating since $R (S, X, d = 1) \leq R (S, X, d = 0)$ and access costs are nonnegative. Hence, case 1 is irrelevant.

(1) V_{NP} (P_F, P_G, Y, X) is continuous for all P_F, P_G, $Y > 0$.

(2) V_{NP} (P_F, P_G, Y, X) is nonincreasing in (P_F, P_G). Similarly, V_{NP} (P_F, P_G, Y, X) is nondecreasing in Y.

(3) V_{NP} (P_F, P_G, Y, X) is quasi-convx in (P_F, P_G)

(4) V_{NP} (P_F, P_G, Y, X) is homogeneous of degree zero in (P_F, P_G, Y).

Letting x = the Marshallian and h = the Hicksian compensated demand functions for i = F, G; j = F, G, the properties of the demand functions are (Varian, p. 134):

(1) The compensated own price effect is non-positive,

$$\frac{\partial h_i (p, u)}{\partial p_i} \leq 0.$$

(2) The matrix with elements

$$\frac{\partial x_j (p, y)}{\partial p_i} + \frac{\partial x_j (p, y)}{\partial y} x_i$$

is a symmetric negative semidefinite matrix, and

(3) the Marshallian demand functions are homogeneous of degree zero in prices and income.

To investigate food expenditures of households eligible for the FSP, a sequential decision making process is hypothesized such that eligible households first compare the maximum utility achievable, given participation, to the maximum possible utility, given nonparticipation, to choose a participation status and then make their food expenditures based on that decision. Thus, the participation decision can be described as a comparison of the values of the participating and nonparticipating household's respective indirect utility functions. Each household chooses the participation status that yields the highest possible maximum utility. Then, the interdependency between the food expenditure and program participation decisions is formally represented by obtaining Marshallian demand functions from the appropriate indirect utility function. For the nonparticipating household, Roy's identity gave its Marshallian food demand in (28). For the participant, however, an analog to Roy's identity must be used. The derivation of participants' food demand functions and their properties follows.

Proposition: If $F_P(*)$ is the participating household's Marshallian demand function for food out of income, given participation, where (*) = (P_F, P_G, Y′, A, X), then

$$F_P(*) = \frac{-1}{\frac{\partial V_P}{\partial Y'}} \left[\frac{\partial V_P}{\partial P_F} + \frac{\partial V_P}{\partial A} S(*) \right] \tag{29}$$

provided that P_F, P_G, Y′, A > 0. $F_F(*)$ and S(*) are optimal values as functions of the parameters P_F, P_G, Y′, A and X.

Derivation: Recall the maximization problem for a participating household: Maximize (1) subject to (2), (3), (4), and (5). Express the optimal values of F, G, S, λ_1 and λ_2 as functions of the parameters. Assume $\lambda_1(*) > 0$. Substitute G(*), F(*), S(*), $\lambda_1(*)$, and $\lambda_2(*)$ into the Lagrangian (6) to obtain the indirect utility function V_P, where

$$V_P(*) = u\,[G(*), F(*) + S(*), R(*), X] + \lambda_1(*)\,[Y' - P_F F(*) - P_G G(*)] + \lambda_2(*)\,[A - P_F S(*)]. \tag{30}$$

Using the envelope theorem,

$$\frac{\partial V_P}{\partial P_F} = -\lambda_1(*)\, F_P(*) - \lambda_2(*)\, S(*), \tag{31}$$

$$\frac{\partial V_P}{\partial Y'} = \lambda_1(*), \text{ and} \tag{32}$$

$$\frac{\partial V_P}{\partial A} = \lambda_2(*). \tag{33}$$

Substituting (32) and (33) into (31) and rearranging terms yields

$$F_P(*) = \frac{-1}{\frac{\partial V_P}{\partial Y'}} \left[\frac{\partial V_P}{\partial P_F} + S(*) \frac{\partial V_P}{\partial A} \right].$$

Thus, the proposition is shown.

If the stamp allotment is not exhausted,

$$\frac{\partial V_P}{\partial A} = \lambda_2(*) = 0, \text{ and}$$

$$F_P(*) = \frac{\frac{-\partial V_P}{\partial P_F}}{\frac{\partial V_P}{\partial Y'}} \tag{35}$$

While (35) is of the same form as (28), the quantities of food demanded with cash by participating and nonparticipating households facing the same prices and with the same money income may be different. Intuitively, the quantities will differ because participation has a negative income effect through lump-sum costs (C), but permits some food to be acquired with stamps at zero money costs but with positive fixed and marginal stigma costs. Mathematically, the indirect utility function derivatives in (28) are evaluated at Y and d = 0, while those in (35) are evaluated at Y' and d = 1.

When the stamp allotment constraint is binding for all relevant values of the parameters, $S(*) \equiv A/P_F$, and the demand for food with cash becomes

$$F_P(*) = \frac{-1}{\frac{\partial V_P}{\partial Y'}} \left[\frac{\partial V_P}{\partial P_F} + \frac{A \partial V_P}{P_F \partial A} \right].^{9} \tag{36}$$

9. For details of the derivation, see Kushman (1984) and note a typographical error therein in which v should be substituted for x in the derivatives.

Regardless of the form of the food-with-cash demand function,

$$\frac{\partial V_P}{\partial P_G} = -\lambda_1(*)\, G_P(*). \tag{37}$$

Substituting (32) into (37) and rearranging yields the demand for all other goods:

$$G_P(*) = -\frac{\partial V_P}{P_G} / \frac{\partial V_P}{\partial Y'}. \tag{38}$$

Generally we cannot obtain an analogue to Roy's Identity for S(*) because when λ_2 = the second term on the right hand side of (31) vanishes.

The household compares the maximum utility possible given FSP participation, $V_P = V_P(P_F, P_G, Y', A, X, d = 1)$, to the maximum possible utility given nonparticipation, $V_{NP} = V_{NP}(P_F, P_G, A = 0, Y, X, d = 0)$, and chooses the option which will yield the higher maximum utility. The household's comparison can be represented by the relation Δ where

$$\Delta = V_P(P_F, P_G, Y', A, X, d = 0) - V_{NP}(P_F, P_G, A = 0, Y, X, d = 0). \tag{39}$$

The decision framework is:

If $\Delta > 0$, participate, (40)

$\Delta = 0$, be indifferent, (41)

$\Delta < 0$, do not participate. (42)

Recall that Coe (1979) uses expenditure functions rather than indirect utility functions to describe the FSP participation decision. While the expenditure function represents the same underlying preferences and behavioral assumptions as its dual, the indirect utility function, we use the latter because all of its arguments are observable while Coe's u^A and u^B are unobservable.

The properties of the indirect utility function given nonparticipation, (V_{NP} in Δ) are given above. Whether those properties carry over to the indirect utility function given participation, V_P is relevant because the properties of Δ depend on the properties of its components. Following standard techniques (see Varian, 1978, pp. 115-135, and Ranney, 1983, pp. 86-107), the following properties can be established for V_P:

1. $V_P(P_F, P_G, Y', A)$ is continuous at all P_F, P_F, Y, $A > 0$. The X and d = 1 in V_P have been suppressed for notational simplicity.

2. $V_P(P_F, P_G, Y, A)$ is (a) nonincreasing in (p_F, P_G), (b) nondecreasing in Y′, and (c) nondecreasing in A.

3. $V_P(P_F, P_G, Y', A)$ is homogeneous of degree zero in (P_F, P_G, Y′, A). That is, if prices, income net of the access costs, and the food stamp allotment are all multiplied by a positive number, the budget set and the utility-maximizing choices will not change.

In contrast to the case for nonparticipants, $V_P(P_F, P_G, Y', A)$ need not be quasi-convex in prices (Ranney, 1983, pp. 105-107).

The implications of the above propositions are: (1) For V_{NP} and V_P in Δ, theoretically consistent indirect utility functions should be continuous, nonincreasing in prices, and nondecreasing in income. (2) The second term of Δ, V_{NP}, is homogeneous of degree zero in prices and income and quasi-convex in prices. (3) The first term, V_P, is nondecreasing in the food stamp allotment, A, and homogeneous of degree zero in P_F, P_G, Y′ and A. (4) Quasi-convexity in prices need not hold for $V_P(P_F, P_G, Y', A)$ nor for Δ. (5) Δ should be homogeneous of degree zero in P_F, P_G, Y′, and A.

CASH EQUIVALENCE OF FOOD STAMPS

The theoretical framework just developed can be used to clarify various meanings of "cash equivalence" as applied to in kind transfers such as food stamps. Cash equivalence can refer to an equivalence of stamps to cash in utility or in the demand for food. Equivalence can be to cash from a transfer program or to that from some source other than a transfer program.

Equivalence in utility to nontransfer cash means that an allotment of food stamps yields the same utility as the same amount in nontransfer cash,

$$V_P(P_G, P_F, Y, A, X, d = 1) \equiv V_{NP}(P_G, P_F, Y + A, 0, X, d = 0) \tag{43}$$

If (43) holds, the derivatives of its left and right-hand sides are equal, and stamps must be equivalent to nontransfer cash in food demand. In fact, it follows that

$$F_{NP}(Y + A) \equiv F_P(Y, A) + A/P_F; \tag{44}$$

that is, the quantity of food demanded when not participating with income Y + A is identically equal to food bought with cash plus the food represented by the allotment when participating with income Y and allotment A. Identity (44) is the definition of equivalence to nontransfer cash in food demand. The stamps simply replace money that would have been spent on food if income had been larger by A.

If stamps are equivalent to nontransfer cash in food demand, they are also its equivalent in the demand for all other market goods, G. But substituting $F_P(Y, A)$ and $G_P(Y, A)$ into the utility function (1) will give the same utility as would substituting in $F_{NP}(Y + A)$ and $G_{NP}(Y + A)$, only if $R(S, X, d = 1) = R(S, X, d = 0)$, i.e., only if participation has no effect through nonmarket goods (no stigma).

Thus, equivalence to nontransfer cash in utility is sufficient for (43) and (44), but not necessary for equivalence to nontransfer cash in food demand. Further, nontransfer cash equivalence in demand is necessary but not sufficient for nontransfer cash equivalence in utility.

The situation becomes more complex when food stamps are compared to transfer cash (Ranney and Kushman, 1987). The transfer cash and a dummy variable for participation in the cash transfer program must be added to the arguments of (4). The essential results, however, are unchanged. Transfer cash equivalence in utility is sufficient but not necessary for transfer cash equivalence in demand. Transfer cash equivalence in demand and equivalence in nonmarket effects are sufficient but not necessary for transfer cash equivalence in utility.

These distinctions are useful in clarifying policy discussions of cash equivalence. Parties interested in the FSP's effect on agricultural demand or nutritional achievement well may use "cash equivalence" in the sense of nontransfer cash equivalence in demand. Parties focusing on the way the FSP is administered or on welfare effects for recipients are more likely to find nontransfer cash equivalence in utility relevant. For those concerned specifically with welfare effects, transfer cash equivalence in utility may be more realistic, but a specific cash transfer program would be needed for comparison.

SUMMARY

A theoretical model of household behavior, given FSP eligibility, based on constrained utility maximization has been developed. This theoretical framework clarifies the distinctions between equivalence in utility and in food demand of stamps, and equivalence of stamps to transfer or nontransfer cash. The derived restrictions on indirect utility functions and on food demand functions should be imposed on an empirical model. Wherever possible the empirical model should preserve the crucial interdependent nature of eligible households' program participation and food expenditure decisions, including tracing the related notions of cash equivalence in utility in the participation relation through to cash equivalence in food demand in the food expenditure relation.

4. HOUSEHOLD PARTICIPATION

ESTIMATION FRAMEWORK

Our empirical objective is to estimate equations explaining household decisions about whether to participate in the Food Stamp Program (FSP) and how much to spend on food. The estimation procedures should capture interdependence between the participation decision and the food expenditures decision. The equations should conform to the theoretical restrictions derived above.

The data were obtained in a survey of FSP eligible households in California, Indiana, Ohio, and Virginia. Interviews were conducted in 896 FSP eligible households between July 1979 and May 1980. The purchase requirement had been eliminated before the survey began, so the entire stamp allotment was "bonus stamps." The survey is described more fully in Appendix B.

Before the FSP participation and food expenditure relationships were estimated, the data were manipulated to create variables that conform as closely as possible to the theoretical model. Household income was corrected to incorporate the equivalent value of in kind household resources, specifically housing services and home-grown food. The resulting variable corresponds to income in the theoretical model as an all inclusive measure of household resources. Weights also were derived for the number of persons in the household and the relationships and age of persons in the household. These weights were used to put income and food expenditures on a per-equivalent person basis. This basis is consistent with the theoretical framework which contemplates only one type of household and one decision maker per household. The money variables used for the estimation were the result of these manipulations. The standardizations for assets and in kind resources and for number of persons and type of household are described in Appendix C.

In this section, the FSP participation and food expenditure decisions are developed in the context of the theoretical model of the previous section and an econometric problem called "sample partitioning." Estimates of a FSP participation equation also are presented. Estimating the participation equation is of interest on its own, and it is the first step in removing sample partitioning bias from estimates of food expenditure equations.

SAMPLE PARTITIONING— AN ECONOMETRIC PROBLEM

The sampling procedure selected households from the population of those eligible to participate in the FSP, but eligible households were not randomly assigned to the program participant or nonparticipant groups. Rather households partitioned themselves into subsamples of participants and nonparticipants, making the resulting subsamples potentially nonrandom. Some of the same unobservable factors that affect participation may affect food expenditures. An econometric problem results, known as sample-selection or

sample-partitioning bias.[10]

A primary objective of this study is to obtain reliable estimates of the parameters of food expenditure equations for both participants and nonparticipants in the FSP. Food expenditure relationships could simply be estimated for the participation and nonparticipation subsamples, but this would ignore the interdependency between the expenditure and participation decisions and the nonrandomness of the subsamples. We want to predict average food expenditures under various program structures. For example, how would expenditure behavior change if bonus stamp allotments were increased? Straightforward estimation, say, by ordinary least squares, on the subsample of participating households would indicate how participating households may respond to such a program change. But increasing bonus stamp allotments would likely encourage some nonparticipants to participate. Thus, the true effect on average expenditures of this program change would depend on the expenditure behavior of both continuing and new participants. In other words, the observed "average" relationship between the allotment and food expenditures will depend on who is included in the group being averaged. If sample-partitioning bias is present, the observed relationship between allotment and expenditures estimated from the participant subsample will not be representative of the real relationships for all eligible households, or of a random selection of eligible households (both participants and nonparticipants).

The expenditure behavior of households that would participate after a hypothetical program change is unobservable. If participants and nonparticipants behave, on average, in systematically different ways, estimates of the effects of changes in the FSP on food expenditures based on the nonrandom subsamples would be biased and inconsistent.

Heckman (1979), in the context of estimating labor supply equations, made two major contributions toward eliminating nonrandom selection bias. First, he views sample selection bias as parallel to the omitted variable problem. The omitted variable is a function of the probability that each observation self-selects into the subsample. Estimates based upon the subsample will be biased as long as the omitted variable is not included in the equation. Second, Heckman developed a method that provides consistent estimates of the omitted variable from probit analysis of the sample selection process, i.e., from an estimate of the probability of self-selecting into the subsample. Estimates of the omitted variable can then be included as an additional regressor in the equation using the self-selected subsample observations.

Following Heckman (1979), consider a two-equation model and a random sample of $i = 1, 2, \ldots, N$ observations,

$$Y_{1i} = X_{1i}\beta_1 + u_{1i} \text{ and} \tag{1a}$$

$$Y_{2i} = X_{2i}\beta_2 + u_{2i}, \tag{1b}$$

where the X_{ji} are vectors of exogenous regressors and the β_j are vectors of coefficients. The u_{ji} are the disturbances which are assumed to be bivariate normal, and

$$E(u_{ji}) = 0 \tag{2a}$$

for $j = 1, 2$,

$$E(u_{ji}u_{j'i}) = \sigma_{jj'} \tag{2b}$$

for $j = 1, 2$ and $j' = 1, 2$ and

$$E(u_{ji}u_{j'i'}) = 0 \tag{2c}$$

for i not equal to i'. The disturbances have zero means with no correlation across observations, but there is a correlation for a given observation between u_{1i} and u_{2i}.

Now, suppose we would like to estimate equation (1a), but observations on Y_1 are missing when Y_2 is less than or equal to zero. The population regression function would be

$$E(Y_{1i}|X_{1i}) = X_{1i}\beta_1 \text{ for } i = 1, 2, \ldots, N. \tag{3}$$

But the regression function for the selected sample, given the selection rule $Y_{2i} > 0$ is:

$$\begin{aligned} &E(Y_{1i}|X_{1i}, Y_{2i} > 0) \\ &= X_{1i}\beta_1 + E(u_{1i}|Y_{2i} > 0) \\ &= X_{1i}\beta_1 + E(u_{1i}|u_{2i} > -X_{2i}\beta_2) \end{aligned} \tag{4}$$

for $i = 1, 2, \ldots, N$. Thus, the selected sample regression function depends on both X_{1i} and X_{2i}. A sample selection bias arises from an omitted term, $E(U_{1i}|u_{2i} > -X_{2i}\beta_2)$.

Looking more closely at this omitted term, and assuming that $h(u_{1i}, u_{2i})$ is a bivariate normal density, it follows that,

$$E(u_{1i}|u_{2i} > -X_{2i}\beta_2) = \frac{\sigma_{12}}{(\sigma_{22})^{1/2}}\lambda_i, \tag{5}$$

where

$$\lambda_i = \frac{\phi(Z_i)}{1 - \Phi(Z_i)} = \frac{\phi(Z_i)}{\Phi(-Z_i)},$$

with ϕ and Φ the density and distribution functions, respectively, for the standard normal variable, and

$$Z_i = \frac{-X_{2i}\beta_2}{(\sigma_{22})^{1/2}}. \tag{6}$$

10. Sample selection bias can occur when estimation is based on a sample which is nonrandom either due to the manner in which the sample was selected or due to the fact that the units of observation, through their own behavior, self-select into a particular sample.

The λ_1 is the inverse of the Mills Ratio, which is often referred to as the hazard rate in reliability studies.

The regression function (4) for the selected sample can now be rewritten as

$$E(Y_{1i}|X_{1i}, Y_{2i} > 0) = X_{2i}\beta_2 + \frac{\sigma_{12}}{(\sigma_{22})^{1/2}} \lambda_i. \quad (7)$$

for a subset of the observation $i = 1, 2, \ldots, N_i$, with λ_i considered as the omitted variable. Inserting a consistent estimate of λ_i, say λ_i, into the selection sample regression will yield consistent estimates of both $\sigma_{12}/(\sigma_{22})^{1/2}$ and β_i.

Since u_{2i} is normally distributed, using (lb), the probit likelihood function for the set of N_1 observations where I_i equals one when $Y_{2i} > 0$ and $N - N_1$ observations where $I_i =$ when $Y_{2i} \leq 0$ is given by

$$L = \prod_{j=1}^{N_1} F(C_{2j}) \prod_{k=N_1+1}^{N} F(-C_{2k}), \quad (8)$$

where C_{2j} or $C_{2k} = -Z_i = X_{2i}\beta_i/(\sigma_{22})^{1/2}$. Given X_{2i} the probit analysis will yield a consistent estimate of $\beta_2/(\sigma_{22})^{1/2} = \beta^*$ from which consistent estimates of Z_i, hence, λ_i can be computed. The λ_i's are then added to the (la) specification yielding equation (7) which when estimated by ordinary least squares will yield consistent estimates of β_1 and $\sigma_{12}/(\sigma_{22})^{1/2}$. These estimates, however, will be inefficient due to the possible heteroskedasticity evident in equation (2c). A standard generalized least squares procedure can be used to obtain efficient estimates and appropriate standard errors.

If u_1 and u_2 are independent, however, then $\sigma_{12} = 0$ and the "omitted variable" drops out of the regression function for the selected sample. Similarly, if X_{2i} and X_{1i} are uncorrelated, no bias will be present. A test of the hypothesis that $\sigma_{12}/(\sigma_{22})^{1/2} = 0$ is a test for the absence of selection bias.

Application of the Heckman model usually occurs when observations are missing on Y_{1i} unless $Y_{2i} > 0$. In a labor supply context, for example, the market wage, Y_{1i}, is not observed unless the individual is actually a labor force participant, i.e., unless hours of work are positive, $Y_{2i} > 0$. In the current study expenditures on food (Y_{1i}) are observed whether or not the household participates in the FSP, but the impact of program benefits and costs on food expenditures is not observed unless the household participates in the program ($Y_{2i} > 0$). Thus, although there are no actual missing observations, a similar approach can be used to correct for "the sample partitioning problem." The extension of the Heckman model to the sample partitioning case has been outlined concisely by Greene (1979).

Probit analysis of the participation decision based on the entire sample using (8) is the first step. The λ_i's for participants (P) and nonparticipants (NP) are then computed as follows:

$$\lambda_i^P = \phi(Z_i)/(1 - \Phi(Z_i)) \quad (9)$$

for all of those observations for which $Y_{2i} > 0$ and the binary dependent variable $I_i = 1$, and

$$\lambda_i^{NP} = \phi(Z_i)/\Phi(Z_i) \quad (10)$$

for all of those observations for which $Y_{2i} \leq 0$ and $I_i = 0$, where $Z_i = -X_{2i}\beta_2/(\sigma_{22})^{1/2}$. $I_i = 1$ if the household participates in the FSP, zero if it does not participate. In the two food expenditure equations to be estimated, one for participants and one for nonparticipants, the appropriate λ_i's are included as regressors to account for the possibility of sample selection or partitioning bias. Thus, a three-equation system results which includes a participation equation, an expenditure equation for participants, and an expenditure equation for nonparticipants. These three equations coincide with those developed in the theoretical section, (39), (22), and (28), respectively. Assuming that stamps are all spent, a total food expenditure equation for participants can be obtained by adding stamps to cash expenditures.

While the Heckman technique corrects for possible sample selection bias, there is one drawback. Ordinary least squares estimation of participants' and nonparticipants' food expenditures requires estimation of the probability of participation using probit analysis to calculate the sample selection bias correction factor (λ_i). Computational practicality requires specifications that are linear in the parameters. But the theoretical analog to probit estimation of the participation decision, the difference between two indirect utility functions, may not be linear in parameters. The estimation instrument can, therefore, be regarded only as an approximation to the theoretical specification.

The participation and food expenditure equations estimated below are potentially subject to simultaneity problems. In the participation equation, for instance, household income, labor supply, and participation in other welfare programs are used to explain participation in the FSP. Yet, household labor supply, income, and participation in programs like Aid to Families with Dependent Children (AFDC) may be decided jointly with FSP participation. Neither the degree of a simultaneous-equations problem nor the properties of the estimators are known a priori under these circumstances, and sufficient data to use alternative estimates (e.g., instrumental variables) were not available. The estimates reported below are the best available, but they should be regarded in light of this potential simultaneity problem. The claims made for the sample-partitioning estimator, likewise, are conditional on the absence of significant simultaneity problems.

SPECIFICATION OF THE PARTICIPATION EQUATION

The participation decision, specified as a difference in equation (39) Section 3, can also be represented by the ratio of the values of each household's participating and nonparticipating indirect utility function, V_P and V_{NP} respectively, such that

$$\Delta = \frac{V_P (P_G, P_F, Y', A, X, d = 1)}{V_{NP} (P_G, P_F, A = 0, Y, X, d = 0)} \quad (11a)$$

or, assuming indirect utility is always positive, a logarithmic transformation may be used:

$$\ln \Delta = \ln V_P (P_G, P_F, Y', A, X, d = 1) - \ln V_{NP} (P_G, P_F, A = 0, Y, X, d = 0) \quad (11b)$$

where P_G and P_F are prices of all other goods (G) and food (F), respectively; Y and Y′ are total household resources and total resources less monetary access costs of the FSP, respectively; A is the food stamp allotment; and X is a vector of household characteristics. Characteristics in X may affect utility directly or indirectly through their effect on R, the composite good representing household prestige and privacy. Variable d in (11) also affects utility indirectly through its impact on R. Recall that R was defined in equation (4) of Section 3 as

$$R = R (S, X, d), \quad (12)$$

where S is stamp-purchased food.

Marginal stigma effects of stamp use are assumed negligible, i.e., $\partial R/\partial S = 0$. The stigma from using stamps is not likely to increase much as the number of stamps increases.[11]

The assumption of no marginal stigma effect of stamp use, together with nonsatiety and an interior solution, such that $G > 0$ and $F + S > 0$, implies that households will spend their entire allotment of stamps for food. Hence, household stamp allotments are assumed to be exhausted.[12] Resale of stamps and purchases of nonfood goods or services with stamps are assumed negligible. It also is assumed that there are no lump-sum monetary access costs associated with program participation, an assumption which implies the equality of Y and Y′ in (11).

Even disregarding their stigma effects, stamps may still not be fully cash equivalent for some households. That is, holding all else constant, including prestige and privacy, a household's subjective evaluation of the stamp allotment may be less than its actual food purchasing power because stamps are constrained to be used for food. This subjective discount may affect the program participation decision. Variables hypothesized to affect the degree to which household allotments are cash equivalent will therefore be included in estimating the probability of deciding to participate. Eligible households' cash equivalent stamp allotment can be calculated from the estimated parameters of a probit participation equation (Hanemann, 1984; Kushman, 1987).

Let V be the indirect utility function for a representative member of a household eligible for the FSP with

$$V = K [(Y/P) + (A/P) \Phi]^{\beta} Te^{u}. \quad (13)$$

In (13), let

$K = e^{\Sigma b_j c_j}$,

where the c_j are household characteristics that affect indirect utility directly and b_j are the associated parameters;

Y = income;

A = face value of the food stamp allotment;

P = an all items price index;

Φ = the extent to which the food stamp allotment is cash equivalent, $0 \leq \Phi \leq 1$;

$T = e^{\Sigma b_r c_r}$, if the househouse participates, where the c_r household characteristics are assumed to affect indirect utility through prestige and privacy, and b_r are the associated parameters; = 1 if the household does not participate;

β = a parameter;

and

u = an error term.

Income is standardized for in kind household resources excluding food stamps, and income and the stamp allotment are standardized for number of persons and type of household. Define the error term as

$$u = \delta u_p + (1 - \delta) u_{NP} \quad (14a)$$

where

δ = 1 if the household participates and 0 otherwise; (14b)

$E(u) = E(u_P) = 0$ if $\delta = 1$ and $E(u_{NP}) =$ if $\delta = 0$; and (14c)

11. Stigma may increase, however, with the number of shopping trips where stamps are used. But this sort of increase can be avoided by using stamps infrequently to "stock up."

12. Empirical evidence suggests that a large proportion of eligible households supplement stamp food purchases with cash purchases, so they must have exhaused their allotments. Senauer (1982) reports that over two-thirds of participants spend more than their allotment on food.

$$\mathrm{Var}(u) = \mathrm{Var}(u_P) = \sigma_P^2 \text{ if } \delta = 1 \text{ and} \tag{14d}$$
$$\mathrm{Var}(u_{NP}) = \sigma_{NP}^2 \text{ if } \delta = 0.$$

If the household participates in the Food Stamp Program, then (13) becomes

$$V_P = e^{\Sigma b_j c_j} [(Y/P) + (A/P)\,\Phi]^{\beta} e^{\Sigma b_r c_r} e^{u_P}. \tag{15}$$

Equation (15) is the appropriate representation for V_P in (11a), the participation equation. If the household does not participate, A = 0, T = 1, u = u_{NP}, and (13) becomes

$$V_{NP} = e^{\Sigma b_j c_j} [Y/P]^{\beta} e^{u_{NP}}. \tag{16}$$

Equation (16), then, represents V_{NP} in (11a). Transform (15) and (16) logarithmically to obtain

$$\ln V_P = \Sigma b_j c_j + \beta \ln [(Y/P) + (A/P)\,\Phi] + \Sigma b_r c_r + u_P \tag{17}$$

and

$$\ln V_{NP} = \Sigma b_j c_j + \beta \ln [Y/P] + u_{NP}, \tag{18}$$

respectively. By subtracting (18) from (17), we obtain

$$\ln \Delta = \beta \ln [(Y/P) + (A/P)\,\Phi] - \beta \ln (Y/P) + \Sigma b_r c_r + u^* \tag{19}$$

where

$$u^* = u_P - u_{NP}. \tag{20a}$$

Equation (19) is our empirical counterpart for (11b) the participation equation in logarithms. In (19) u^* is defined such that from (14c)

$$E(u^*) = E(u_P) - E(u_{NP}) = 0 \tag{20b}$$

and from (14d)

$$\mathrm{var}(u^*) = \sigma_P^2 + \sigma_{NP}^2 + 2\mathrm{cov}(u_P, u_{NP}) \tag{20c}$$

Definitions of Δ, Φ, and $\Sigma b_r c_r$ remain for the final specification of (19).

The extent to which the allotment is cash equivalent (Φ) is defined as a logistic function,

$$\Phi = \frac{1}{1 + e^{-\phi' x}} \tag{21}$$

where ϕ_i's are parameters associated with x_i variables assumed to affect the degree of cash equivalency. Function (21) is bound by zero and one. (See Pindyck and Rubinfeld, 1976, p. 247.) If $\phi' x$ approaches negative infinity, Φ approaches zero and $[(Y/P) + (A/P)\,\Phi]$ in (19) approaches $[Y/P]$; stamps would be valueless and contribute nothing to total resources—they would be perfectly noncash equivalent. At the other extreme, as $\phi' x$ approaches positive infinity, Φ approaches 1 and stamps approach perfect cash equivalence.

Define $\phi' x$ in (21) as

$$\phi' x = \phi_1 (Y + A) + \phi_2 (P_F/P_F) + \phi_3 \left(\frac{A}{Y + A}\right) \tag{22}$$

The ϕ_1 are parameters associated with x_1, total nominal resources, x_2, the price of food (P_F) relative to the price all other goods (P_G) and x_3, the share of total resources represented by the face value of the allotment and therefore constrained to food purchases. Substitute (21) into (19) to obtain

$$\ln \Delta = \beta \ln \left[\frac{Y}{P} + \frac{A}{P}\left(\frac{1}{1 + e^{-\phi' x}}\right)\right] - \beta \ln \left(\frac{Y}{P}\right) + \Sigma b_r c_r + u^*. \tag{23}$$

Although the logarithm of the bracketed term in (23) cannot be further broken down, a Maclaurin series expansion can be used as an approximation:

$$f(\phi) \approx f(0) + \phi_1 \frac{\partial f}{\partial \phi_1} + \phi_2 \frac{\partial f}{\partial \phi_2} + \phi_3 \frac{\partial f}{\partial \phi_3} \tag{24}$$

where

$$f(\phi) = \ln \left[\frac{Y}{P} + \frac{A}{P}\left(\frac{1}{1 + e^{-\phi' x}}\right)\right]. \tag{25}$$

Using (24) and (25) the specific series is

$$\ln \left[\frac{Y}{P} + \frac{A}{P}\left(\frac{1}{1 + e^{-\phi' x}}\right)\right] \approx \ln \left[\frac{Y}{P} + \frac{A}{2P}\right] + \phi_1 Z (Y + A) + \phi_2 Z (P_F/P_G) + \phi_3 Z \left(\frac{A}{Y + A}\right) \tag{26}$$

where the common term in the derivatives is

$$Z = \left(\frac{A}{2P}\right) \left(\frac{1}{Y + (A/2P)}\right). \tag{27}$$

Substituting (26) into (23) and rearranging yields

$$\ln \Delta = \beta (CE_0) + \beta\phi_1 (CE_1) + \beta\phi_2 (CE_2) + \beta\phi_3 (CE_3) + \Sigma b_r c_r + u^* \tag{28}$$

where the cash equivalence (CE) measures are

$$(CE_0) = \ln \left[\frac{Y}{P} + \frac{A}{2P}\right] - \ln \left(\frac{Y}{P}\right),$$

$$(CE_1) = Z \left(\frac{Y}{P} + \frac{A}{2P}\right),$$

$$(CE_2) = Z (P_F/P_G), \text{ and}$$

$$(CE_3) = Z \left(\frac{A}{Y + A}\right).$$

What may we hypothesize regarding the signs of β, $\beta\phi_1$, $\beta\phi_2$, and $\beta\phi_3$? Since the first factor of each, β, is the exponent of total resources for the indirect utility function, β should be greater than zero. The signs of $\beta\phi_1$, $\beta\phi_2$, and $\beta\phi_3$, therefore, will depend on ϕ_1, ϕ_2, and ϕ_3. Consider the derivative of Φ with respect to an x_i,

$$\frac{\partial \Phi}{\partial x_i} = \frac{\phi_i e^{-\phi' x}}{(1 + e^{-\phi' x})^2}. \tag{29}$$

Since

$$\frac{\phi_i e^{-\phi' x}}{(1 + e^{-\phi' x})^2} > 0,$$

(29) must have the sign of ϕ_i. Recall that x_1, x_2, and x_3, defined in (22), determine the extent to which stamps are cash equivalent. Stamps will be closer to cash equivalence the less burdensome the household finds restricting part of its resources to food purchases. This "burden," all other things constant, may be (1) greater, the higher the household's nominal resource level (Y + A), because households with higher resource levels, if unrestricted, would spend a smaller proportion of income on food, i.e., $\phi_1 > 0$; (2) less, the higher the relative price of food, since more of the budget would be spent on food anyway, i.e., $\phi_2 > 0$; and (3) greater, the larger the share of income constrained to food purchases; i.e., $\phi_3 > 0$.

In the indirect utility function for FSP eligible households (13), there are two functions of household characteristics, T and K. The characteristics to be included in K (i.e., the c_j are those that affect utility directly, whether or not the household participates in the program. In contrast with K, T is defined as a function of household characteristics (c_r) that determine household prestige and privacy levels and so affect utility only when the household participates. Consequently, when V_P (15) and V_{NP} (16) are transformed logarithmically and differenced as in (19), $\ln K = \Sigma b_j c_j$ drops out of the participation equation while $\ln T = \Sigma b_j c_j$ does not.

We do not know *a priori* which household characteristics belong in K and which in T. That is, we do not know which household characteristics should be excluded from the participation equation because they affect utility in the same way regardless of participation status and do not influence the participation decision. Neither do we know which characteristics should be included because of their effect on prestige and privacy associated with program participation. Some characteristics could affect utility both directly and indirectly.

Some household characteristics are intuitively "better candidates" for the prestige and privacy effect of FSP participation. These characteristics are designated, therefore, as belonging in T and are defined below. Those assumed to affect indirect utility directly, belonging in K, are also listed below. A second version of the participation equation included a full set of explanatory variables because of our uncertainty about the exact specification. Many of these variables have been included in other studies of participation.

Household Characteristics Assigned to K

c_0 = constant.

c_1 = sex of household head (HSEX):
= 1 if male, and
= 0 if female.

c_2 = education of household head (ED1):
= years of education if years ≤ 12, and
= 0 otherwise.

c_3 = education of household head (ED2):
= 1 if years of education > 12, and
= 0 otherwise.

c_4 = ethnicity (ETH1):
= 1 if Black, and
= 0 otherwise.

c_5 = ethnicity (ETH2):[13]
= 1 if "other," and
= 0 otherwise.

Household Characteristics Assigned to T

c_6 = participation in other food programs (FA):
= 1 if any member of the household participates in school lunch or breakfast programs, Meals for the Elderly, the Expanded Food and Nutrition Education Program, or the Women and Infant Care Program, and
= 0 otherwise.

c_7 = neighborhood effects (HOOD):
= 1 if friends, neighbors, or relatives of any household member receive food stamps, and
= 0 otherwise,

c_8 = homeownership (OWN):
= 1 if the residence is owned by the household, and
= 0 otherwise.

c_9 = number of hours worked last week by the principal earner (EHRS).[14]

c_{10} = participation in public assistance programs (PA):
= 1 if any member of the household receives public assistance in the form of Aid to Families with Dependent Children or General Assistance, and
= 0 otherwise,

c_{11} = age of household head (HAGE).

c_{12} = 1 if the household is located in the metropolitan county in Virginia, and
= 0 otherwise (VM)

13. The omitted category is white.

14. The principal earner is defined to be the household member who earned the most income over the previous two-month period.

c_{13} = 1 if the household is located in the nonmetropolitan county in Virginia, and
= 0 otherwise (VNM)

c_{14} = 1 if the household is located in the metropolitan county of Ohio, and
= 0 otherwise (OM)

c_{15} = 1 if the household is located in the nonmetropolitan county of Ohio, and
= 0 otherwise (ONM)

c_{16} = 1 if the household is located in the metropolitan county of Indiana, and
= 0 otherwise (IM)

c_{17} = 1 if the household is located in the nonmetropolitan county of Indiana, and
= 0 otherwise (INM)

c_{18} = 1 if the household is located in the metropolitan county of California, and
= 0 otherwise (CAM)[15]

If participation in other food and public assistance programs indicates that household prestige or privacy considerations are not important for a particular household, FA and PA may be positively related to FSP participation. If a household's neighbors, friends, or relatives participate in the FSP, experienced prestige or privacy loss may be reduced, meaning that HOOD may also be positively related to the participation decision. Well-established homeowners may feel more stigmatized by program participation, so OWN may be negatively related to participation. Households with strong labor force attachments may also experience relatively greater prestige losses from participation, making EHRS negative. The regional variables represent possible differences in program administration or other unspecified characteristics that may affect households' prestige or privacy levels.

Of these variables, EHRS, PA, and income (including the equivalent value of in kind resources) are potentially subject to simultaneity problems. The requirement that FSP eligible persons register for and accept reasonable work opportunities reduces the potential simultaneity with work hours and money income.

The dependent variable of (28) remains to be specified. While we do not observe $\ln \Delta$, we do observe participation status which can be represented by a binary variable, PART. If $\ln \Delta \geq 0$, then the household participates and PART = 1. If $\ln \Delta \leq 0$, the household does not participate and PART = 0. The means and standard deviations for all variables used to estimate the participation equation (28) are presented in Table 2.[16]

Because the dependent variable for participation is dichotomous, probit analysis is used to estimate the probability that a household participates in the FSP. The estimation procedure also produces the sample-partitioning bias correction factors, λ_P and λ_{NP}, to be used in estimating the food expenditure equations for participants and nonparticipants, respectively.

PARTICIPATION RESULTS

The participation equations estimate the probability that households participate in the FSP as a function of total real resources and various household characteristics. Total real resources include the value of total cash and in kind income and the cash equivalent value of the food stamp allotment. The first set of household characteristics consists of those assumed to affect utility directly, regardless of participation status; the second set of household characteristics is assumed to affect utility indirectly through the effect on participation-related prestige and privacy levels. While there is no theoretical rationale for including the former set in the participation equation, these characteristics are included because of the possibility that they directly affect utility. However, the *a priori* classification of household characteristics into K and T remains tentative.

Estimates for the probit participation equation are presented in Table 3. The first column reports the estimates from using all household characteristics, including those that we did not consider good candidates for the equation, but which had been used in other studies. The second and third columns give estimates resulting from excluding certain variables we thought did not "belong" in the equation. These versions also exclude two variables indicated as statistically insignificant in the first round: CE_1, one of the cash-equivalency coefficients for stamps and the food assistance program variable (FA). A striking aspect in the comparison of the first version with the others is that those household characteristics regarded as poor candidates for inclusion on an *a priori* basis performed poorly in estimation, validating their exclusion.

15. The omitted category is the nonmetropolitan California county.

16. Note that the participation rate, where participants are defined as those who actually received stamps in the interview month, is only about 47 percent. This rate is lower than that generally found for participation, partly because of definitional differences in "participation." When the entire year is counted, the sample participation rate increases to 57 percent. That is, the participation rate will tend to be greater the longer the time period considered.

TABLE 2

MEANS AND STANDARD DEVIATIONS OF VARIABLES USED FOR ESTIMATING THE PARTICIPATION EQUATION[a]

Variable	Mean	Standard Deviation
PART	.46657	.49926
Cash Equivalence Measures		
CE_0	.12455	.23454
CE_1	14.07800	12.29700
CE_2	.05379	.05984
CE_3	.07505	.04015
Household Characteristics Assigned to K		
HSEX	.41185	.49254
ED1	9.73560	2.59670
ED2	.15653	.36364
ETH1	.33131	.47104
ETH2	.04103	.19852
Household Characteristics Assigned to T		
FA	.22948	.42082
HOOD	.62006	.48574
OWN	.32219	.46767
EHRS	13.83300	19.65700
PA	.32219	.46767
HAGE	43.74200	19.24300
County Classification		
VM	.11702	.32169
VNM	.15653	.36364
OM	.09423	.29236
ONM	.08511	.27925
IM	.13526	.34226
INM	.13222	.33899
CAM	.15653	.36354

[a]Sample Size = 658.

TABLE 3

PARTICIPATION ESTIMATION RESULTS: PROBIT COEFFICIENTS AND STANDARD ERRORS--PRELIMINARY FORM, FINAL FORM, AND THE FORM FOR OBTAINING THE SAMPLE PARTITIONING BIAS CORRECTION FACTORS

Variable[a]	Coefficient (Standard Error)		
	Preliminary Form[b]	Final Form[c]	Form for S-P Bias Correction Factors[d]
Constant			
	- 0.8332[e] (.4512)	- 1.035[f] (.1743)	- 0.9837[f] (.1843)
Cash Equivalence Measures			
CE_0	1.6521[f] (.4623)	1.8064[f] (.4529)	1.7794[f] (.4539)
CE_1	0.0038 (.0077)	--	--
CE_2	12.3170[f] (3.4173)	13.7780[f] (2.8901)	13.5970[f] (2.9313)
CE_3	-24.1780[f] (5.6171)	-26.1530[f] (5.3921)	-25.8140[f] (5.4534)
Household Characteristics Assigned to K			
HSEX	0.0749 (.1248)	--	--
ED1	0.2490 (.1736)	--	--
ED2	- 0.0226 (.0269)	--	--
ETH1	0.0383 (.1816)	--	--
ETH2	0.3634 (.3038)	--	--
Household Characteristics Assigned to T			
FA	0.0741 (.1378)	--	--
HOOD	0.3886[f] (.1244)	0.4539[f] (.1189)	0.3883[f] (.1203)
OWN	- 0.2644[e] (.1455)	- 0.3399[f] (.1398)	- 0.3271[f] (.1419)
EHRS	- 0.0182[f] (.0036)	- 0.0172[f] (.0030)	- 0.0167[f] (.0034)
PA	0.5878[f] (.1595)	0.6266[f] (.1444)	0.6333[f] (.1457)
HAGE	- 0.0041 (.0046)	--	--
County Classification			
VM	0.3843 (.2914)	0.1972[e] (.2186)	0.2175 (.2267)
VNM	0.5324[e] (.2721)	0.3833[e] (.2203)	0.4213[e] (.2303)
OM	0.4887[e] (.2603)	0.3255[g] (.2253)	0.3279 (.2330)

Table 3 (continued)

Variable[a]	Coefficient (Standard Error)		
	Preliminary Form[b]	Final Form[c]	Form for S-P Bias Correction Factors[d]
ONM	0.6935[f] (.2746)	0.4970[g] (.2469)	0.4743[e] (.2529)
IM	0.7192[f] (.2882)	0.5395[f] (.2231)	0.5391[f] (.2269)
INM	0.2288 (.2455)	0.0953 (.2145)	0.0474 (.2229)
CAM	0.3722[e] (.2248)	0.2379 (.2011)	0.2494 (.2100)

[a]Variables are defined in text.

[b]Sample size = 858.

[c]Sample size = 691.

[d]Sample size = 656.

[e]Significant at 10 percent in two-tail t test.

[f]Significant at 1 percent in two-tail t test.

[g]Significant at 5 percent in two-tail t test.

The number of observations differs in each version. In the first, if an observation was incomplete for any of the 22 variables, it was rejected, thus reducing the sample size to 658. In the second, fewer observations had to be rejected simply because there were fewer variables for which information was required. In the third version, planned for use in the sample-partitioning bias correction, observations were also rejected if information was missing for any of the variables used in the subsequent food expenditure equation estimations.

The "economic incentive" variables (CE_0, CE_1, CE_2, and CE_3) reflect both the attraction of the allotment as an increase in purchasing power and the noncash-equivalency that results from constraining the transfer to be spent on food. The method of their inclusion based on the indirect utility function was novel, and it is gratifying that all but CE_1 are highly significant and carry the anticipated signs.

Using the participation equation results, the extent to which the stamp allotment is cash equivalent, the coefficient Φ, may be computed. For 835 cases in the sample, the mean was about 0.96. This indicates that stamps are, on average, 96 percent cash equivalent. This mean is very close to that obtained by Smeeding (1982, 1975b). Although the extent of cash equivalency is, of course, not uniform among eligible households, the distribution is tight. Only 3percent of the estimated values for Φ are less than 0.60, another 4 percent are between 0.61 and 0.89. More than 92percent are 0.90 or greater, and 84percent are 0.99 or greater. Thus, for the vast majority of eligible households, stamps are estimated to be nearly equivalent to cash.

Since the extent to which the stamp allotment is cash equivalent varies with allotment size, we also calculated a weighted average of the estimated cash-equivalent coefficients, using as weights the stamp allotment for each household, i.e., $\Sigma\Phi A/\Sigma A$ where Φ is the estimated cash equivalency coefficient and A is the stamp allotment for each household. The average was about 0.91; that is, the total of all cash grants would have to be at least 91 percent as large as the value of total food stamp allotments to confer on households the same increase in welfare.

Finally, those household characteristics felt to be especially related to the effect of prestige and privacy on participation in the FSP—participation in public assistance, homeownership, having friends or relatives who participate, and labor force attachment—carry the anticipated signs and the coefficients are highly significant. Their importance as indicators of sensitivity to the social consequences of participation is thereby validated.

5. FOOD EXPENDITURES

ESTIMATION FRAMEWORK

Recall from the theoretical development in Section 3 that for nonparticipating households the Marshallian demand function for food was obtained using Roy's Identity:

$$F = F_{NP}(P_F, P_G, Y, X, d=0) = -\frac{\partial V_{NP}}{\partial P_F} / \frac{\partial V_{NP}}{\partial Y}. \quad (1)$$

Similarly, an analog to Roy's identity yielded the food demand function for FSP participants:

$$F = F_P(P_F, P_G, Y', A, X, d=1)$$

$$= -\frac{1}{\partial V_P/\partial Y'}\left[\frac{\partial V_P}{\partial P_F} + \frac{\partial V_P}{\partial A} A/P_F\right]. \quad (2)$$

Because of the assumption that the food stamp allotment will be exhausted, $S = A/P_F$ in (2). Food expenditure functions can be obtained by multiplying both sides of each demand function by the price of food.

The structure of the empirical model should match the theoretical model as closely as possible. That is, (1) and (2) should be applied to the empirical indirect utility functions ((15) and (16) of Section 4) to obtain theoretically-consistent specifications of food expenditure equations for FSP nonparticipants and participants, respectively. Unfortunately, an exact correspondence between empirical and theoretical models is rarely possible.

The theoretically consistent food demand function for participants is nonlinear and quite complex and would be difficult to estimate econometrically. Because the partitioning bias correction procedure requires food expenditure equations that are linear in parameters, we specify tractable functional forms and impose theoretically-derived restrictions.

Thus, theoretical and pragmatic considerations together contribute to the specification of the food expenditure equations, From the general theoretical formulation in Section 3, we know that the demand for food by nonparticipants (1) is a function of prices, income and household characteristics. Participants' food demand (2) is a function of these same variables plus the food stamp allotment. (Recall that access costs are assumed to be zero, so $Y' = Y$). We also know that the demand functions should be specified with relative prices and real income, including the real value of food stamp allotments, that the demand function for nonparticipants should be homogeneous of degree zero in income and prices, and that the participants' demand function is homogeneous of degree zero in prices, income and the allotment.

SPECIFICATION OF FOOD EXPENDITURE FUNCTIONS

As a starting point for specifying both expenditure relationships, define the food demand equation for nonparticipants as

$$F_{NP} = \beta_{11}\frac{Y}{P_F} + \beta_{12}\frac{P_G}{P_F}, \quad (3)$$

where

F_{NP} = quantity of food demanded by a nonparticipant,

$\frac{Y}{P_F}$ = income relative ot the price of food,

$\frac{P_G}{P_F}$ = price of all other goods (P_G) relative to the price of food (P_F), and

β_{1i} = parameters, where i = 1, 2.

This specification is theoretically consistent in that real income and relative prices are included as explanatory variables, and F_{NP} is homogeneous of degree zero in income and prices.

For participants' food demand, arguments for real food stamp allotments per index person are added to (3). Define F_P such that

$$F_P = \beta_{21}\frac{Y}{P_F} + \beta_{22}\frac{A\Phi}{P_F} + \beta_{23}\frac{A(1-\Phi)}{P_F} + \beta_{24}\frac{P_G}{P_F} \quad (4)$$

where

F_P = quantity of food demanded by a participant,

$\frac{A\Phi}{P_F}$ = portion of food stamp allotment that has been estimated as cash equivalent,

$\frac{A(1-\Phi)}{P_F}$ = portion of food stamp allotment that has been estimated to be not equivalent to cash, and

β_{2i} = parameters, where i = 1, . . ., 4.

Again, the income, allotment, and food demand variables have been standardized for in kind resources, number of persons, and type of household, as appropriate. The variables Y/P_F and P_F/P_G are as defined in (3). Theoretical consistency is maintained because the two allotment variables are defined in real terms, and the function is homogeneous of degree zero in Y, A, P_F, and P_G.

Multiplying both sides of (3) and (4) by P_F, gives

$$P_F F_{NP} = \beta_{11}Y + \beta_{12}P_G \text{ and} \quad (5)$$

$$P_F F_P = \beta_{21} Y + \beta_{22} A\Phi + \beta_{23} A(1 - \Phi) + \beta_{24} P_G, \quad (6)$$

the food expenditure equations for nonparticipants and participants, respectively.

The first three terms of (6), which together represent total household resources for participating households, have been separately specified to reveal any differences in their effects on food expenditures. Heuristically, the extent to which food stamps increase the demand for food depends on (1) the effect of stamps through an expansion of general purchasing power and (2) the extent to which stamps constrain part of total household resources to be spent on food. The coefficient β_{21} associated with Y will reflect the relationship between general purchasing power and food expenditures. Generally, a one-dollar increase in Y will increase food expenditures less than a one-dollar increase in food stamps. A sufficient condition for this would be that $\beta_1 < \beta_2$ and $\beta_1 < \beta_3$ where $\beta_1, \beta_2, \beta_3 > 0$. An increase in the stamp allotment will increase food expenditures but less so when stamps are more nearly cash equivalent. Hence,

$$\frac{\partial P_F F}{\partial A} = (\beta_2 - \beta_3)\Phi + \beta_3 > 0 \text{ and} \quad (7)$$

$$\frac{\partial^2 P_F F}{\partial A \partial \Phi} = \beta_2 - \beta_3 < 0 \text{ and} \quad (8)$$

together with the differentiation between cash and stamps require that $\beta_3 > \beta_2 > \beta_1, > 0$. These signs and differences are adopted as hypotheses to be tested with the estimated food expenditure functions.

In addition, both food expenditure specifications include certain household characteristics as explanatory variables. Recall that two sets of household characteristics were specified for the participation equation. One set (the c_j) has been posited as affecting the indirect utility function regardless of participation status; the other set (the c_r) has been hypothesized to affect indirect utility through association with participation-related prestige and privacy levels. Because we could not be sure of categories for household characteristics we included all characteristics in the specification of the participation equation, and two versions of each fooexpenditure equation were estimated: one with only the c_j the other with both the c_r and c_j. The omission of the c_r characteristics in the expenditure equations tests the assumption that household prestige and privacy levels affect only the participation decision.[17]

Since many households consume home-produced food, its value should be combined with food expenditures to obtain a dependent variable that represents the value of total food consumption. Let total monthly household food expenditures (EX) be the sum of food purchases in grocery stores and specialty shops. Define the value of total food consumed as

$$EXG = \frac{EX}{(1 - GRO)} \quad (9)$$

where GRO is the proportion of food consumed that is home-grown.[18] This definition, EXG, implicitly gives market value to home-grown food.

One last qualification involves the price of all other goods (P_G) present in the food expenditure equations. Because our sample was gathered over a relatively short time span (about 10 months), the available price indexes exhibit little variation. Hence, the estimated equations will not include as an explanatory variable. The term involving P_G is subsumed into the constant term of the equation.

Two specifications of the food expenditure equation for FSP participants are:

$$EXG_P = b_{10} + \beta_{11} Y + \beta_{12} A\Phi + \beta_{13} A(1 - \Phi) + \Sigma b_{1j} c_j + \Sigma b_{1r} c_r + u_1 \quad (10)$$

and

$$EXG_P = b_{20} + \beta_{21} Y + \beta_{22} A\Phi + \beta_{23} A(1 - \Phi) + \Sigma b_{2j} c_j + u_2; \quad (11)$$

for nonparticipants the specifications are:

$$EXG_{NP} = b_{30} + \beta_{31} Y + \Sigma b_{3j} c_j + \Sigma b_{3r} c_r + u_3 \quad (12)$$

and

$$EXG_{NP} = b_{40} + \beta_{41} Y + \Sigma b_{4j} c_j + u_4 \quad (13)$$

where u_1, u_2, u_3, and u_4 are error terms. Descriptive statistics for the variables used are in Tables 4 and 5.

Due to sample partitioning, ordinary least squares (OLS) estimates may be biased. Both the sample partitioning corrective estimation procedure (S-P) and OLS were used to estimate each equation. The presence of sample-partitioning bias may be tested by the statistical significance of the participation-derived instruments in the expenditure function estimates. The economic significance of any bias may be determined by comparing the estimates m OLS and the sample-partitioning technique. Some explanatory variables in the expenditure equations also may present simultaneity problems. These variables include Y, CE, NCE, EHRS, PA, and OWN.

17. The one exception is HAGE, age of household head. Because HAGE, though categorized in c_r, may well have both indirect and direct effects, we include HAGE among the c_j.

18. EXG also is standardized for number of persons and type of household.

TABLE 4

MEANS AND STANDARD DEVIATIONS OF VARIABLES IN EXPENDITURE EQUATIONS OF FOOD STAMP PROGRAM PARTICIPANTS[a]

Variable	Mean	Standard Deviation
EXG	115.9700	85.3590
Y	311.2400	288.6500
CE[b]	59.5280	41.1440
NCE[c]	36.6540	19.5550
HSEX	.3258	.4694
ED1	9.6839	2.5422
ED2	.1484	.3561
ETH1	.3968	.2461
ETH2	.0645	.4900
HOOD	.7387	.4405
OWN	.2161	.4123
EHRS	9.2935	17.1870
PA	.4903	.5007
HAGE	40.7420	17.6820
VM	.1161	.3209
VNM	.1323	.3393
OM	.1226	.3285
ONM	.0936	.2917
IM	.2005	.4054
INM	.0710	.2572
CAM	.1581	.3654

[a]Sample size i 310. See footnote a, Table 3.
[b]CE, cash equi alence = AΦ.
[c]NCE, not cas' equivalent = A(1-Φ).

TABLE 5

MEANS AND STANDARD DEVIATIONS OF VARIABLES IN FOOD EXPENDITURE EQUATIONS OF FOOT STAMP PROGRAM NONPARTICIPATIONS[a]

Variable	Mean	Standard Deviation
EXG	109.9300	73.3570
Y	421.7000	346.1100
HSEX	.5000	.5007
ED1	9.7919	2.6512
ED2	.1532	.3607
ETH1	.2775	.4484
ETH2	.0289	.1678
HOOD	.5231	.5002
OWN	.4220	.4956
EHRS	18.1470	20.8100
PA	.1879	.3912
HAGE	46.5000	20.1040
VM	.1185	.3237
VNM	.1619	.3689
OM	.0723	.2593
ONM	.0780	.2686
IM	.0809	.2731
INM	.1879	.3912
CAM	.1676	.3741

[a]Sample Size is 346. See footnote a, Table 3.

FOOD EXPENDITURE ESTIMATION RESULTS

Tables 6 and 7 report the estimates for the food expenditure equations. There is evidence of sample partitioning bias in the second expenditure equation for nonparticipants from the small standard error associated with the coefficient of λ_{NP}. In the analysis of results, therefore, the S-P estimates will be used for this equation. The OLS estimates will be used for the other three equations where no bias is apparent.

A general issue is whether certain household characteristic variables (the c_r affect only the participation decision through stigma effects or whether they also affect utility and food expenditures directly. The first and second columns of each table report the results when all household characteristics are included. Generally, those variables expected, *a priori,* to affect the stigma related to participation but not food expenditures are statistically insignificant. The occasionally significant regional dummy variables may reflect price variations across regions. While there is some evidence that the public assistance variable (PA) is positively associated with expenditures, in general, results of estimation with the c_r validate our *a priori* categorization and confirm that the stigma-related variables should be excluded from the food expenditure equations.

For participating households, the hypothesized differences in the coefficients of the income (Y), cash-equivalent stamps ($A\Phi$), and noncash-equivalent stamps ($A(1-\Phi)$), i.e., that $\beta_3 > \beta_2$, $\beta_3 > \beta_1$, and $\beta_2 > \beta_1$, were examined using t-tests of coefficient differences. All three null hypotheses were rejected at the 1 percent level, giving strong support for the theoretical implications. These results show that stamps are six times more effective in increasing expenditures on food than cash grants. The coefficient for noncash-equivalent stamps is about one, indicating that an additional dollar added to the most constrained component of stamps means one dollar more spent on food. That is, the effect of this marginal dollar in stamps on food expenditures is not mitigated by partially replacing money that would have been spent on food.

Income, food stamp allotment, and food price expenditure elasticities for program participants were calculated in two ways.[19] Holding Φ fixed, the respective elasticities associated with EXG are 0.2789, 0.3367, and –0.3843. But since Y, A, and P_F are arguments of Φ, the extent of cash equivalency will vary as these arguments vary. Allowing Φ to vary with variation in the rele vant arguments, the respective expenditure elasticitiesfor EXG are 0.2780, 0.3348, and –0.3847. For nonparticipants, income and food price expenditure elasticities for EXG, using the S-P estimates, are 0.4331 and –0.5669, respectively.

6. SUMMARY AND POLICY IMPLICATIONS

The objective of this research was to develop and implement, using post-EPR household survey data, a theoretically consistent and econometrically sound model of the interdependent FSP participation and food demand decisions. First, a formal and complete theoretical model of program participation and food expenditures was developed using the standard economic paradigm of household utility maximization.

This theoretical framework provided the basis for clarifying the various definitions of cash equivalence. Cash equivalence of stamps in utility or recipient welfare is a theoretically and empirically distinct concept from cash equivalence in a recipient's demand for food. A further distinction can be made between food stamp equivalence to transfer cash and to nontransfer cash.

The participation decision was modeled as choosing the course of action that yielded the highest utility, represented by the difference between two indirect utility functions. It was shown that the demand for food purchased with cash can be obtained for FSP eligible, nonparticipating households using Roy's identity. For participating households, under the assumption that all stamps are used, an analog to Roy's identity was used to derive a food demand function. The demand for cash-purchased food when participating is shown to depend on the extent to which stamps are equivalent in their marginal effect on utility to an increase in cash income.

Models were specified according to theoretical implications for a probit equation explaining the decision to participate in the FSP, and for regressions for food

19. Ignoring P_G and household characteristics for clarity, the formula for the price elasticity is obtained by applying the chain rule to equation (6) and (4) which yields

$$\eta_{P_F F_P, P_F} = 1 - \frac{1}{P_F F_P}(\beta_{22} A\Phi + \beta_{23} A(1-\Phi)).$$

TABLE 6

PARTICIPANTS' FOOD EXPENDITURES ESTIMATION RESULTS WITH ORDINARY LEAST SQUARES (OLS) AND SAMPLE PARTITIONING BIAS CORRECTION (S-P) ESTIMATIONS[a]

Variable[b]	Coefficient (Standard Error)			
	(1) S-P	(1) OLS	(2) S-P	(2) OLS
CONSTANT	-42.5340 (48.4720)	- 5.0304 (34.5940)	36.0920 (30.6470)	27.9100 (30.1320)
Y	0.0787[c] (.1778)	0.0901[c] (.1516)	0.1069[c] (.0156)	0.1016[c] (.0151)
AΦ	.7055[c] (.1497)	0.6194[c] (.1305)	0.5203[c] (.1322)	0.5838[c] (.1205)
A(1-Φ)	1.1726[c] (.2600)	1.1519[c] (.2614)	1.1195[c] (.0258)	1.1659[c] (.2564)
HSEX	8.0494 (9.4633)	8.2922 (9.8849)	4.6891 (9.4549)	1.6653 (9.2094)
ED1	15.4340 (12.7450)	15.3750 (13.2040)	23.1520[c] (12.4100)	22.1530[c] (12.5970)
ED2	2.7484 (1.6913)	2.8794 (1.9700)	2.9283 (1.9069)	2.7226 (1.9335)
ETH1	7.2717 (11.9130)	7.3188 (12.3640)	1.2294 (6.8841)	1.7229 (9.0099)
ETH2	-45.6020[d] (18.0050)	-46.6650[d] (18.6290)	-16.2980 (16.9990)	-13.8840 (17.1450)
HOOD	18.3090 (12.2110)	10.2970 (9.6916)	--	--
OWN	-15.4730 13.2610	- 7.4407 (10.9650)	--	--
EHRS	- 0.3994 (.4204)	- 0.0377 (.2589)	--	--
PA	34.6960[e] (15.8940)	21.5760[e] (10.0520)	--	--
HAGE	0.2557 (.3544)	0.2772 (.3693)	- 0.3287 (.3066)	- 0.3638 (.3102)
VM	-29.9540 (22.0370)	-34.5070 (21.9060)	--	--
VNM	- 2.1739 (23.0220)	-10.1460 (22.0260)	--	--
OM	-16.9820 (20.4690	-22.5370 (19.8860)	--	--
ONM	-30.5540 (22.7930)	-40.8700[e] (20.7490)	--	--
IM	- 3.3286 (21.9590)	-12.3030 (20.4710)	--	--
INM	-11.9550 (21.8780)	-11.6460 (22.2870)	--	--
CAM	33.1650[f] (17.6740)	28.0960 (17.1330)	--	--
	37.8500 (34.9600)	--	-15.0970 (13.8910)	--

[a]Sample size = 310.

[b]Variables are defined in text.

[c]Significant at one-tenth of 1 percent in two-tail test.

[d]Significant at 1 percent in two-tail test.

[e]Significant at 5 percent in two-tail test.

[f]Significant at 10 percent in two-tail test.

TABLE 7

NONPARTICIPANTS' FOOD EXPENDITURES ESTIMATION RESULTS WITH ORDINARY LEAST SQUARES (OLS) AND SAMPLE PARTITIONING BIAS CORRECTION (S-P) ESTIMATIONS[a]

Variable[b]	Coefficient (Standard Error)			
	(1) S-P	(1) OLS	(2) S-P	(2) OLS
CONSTANT	68.1470[c] (27.6789)	90.8750[d] (23.575)	86.5900[d] (23.4150)	111.1200[d] (20.5560)
Y	0.0974[d] (.0106)	0.0911[d] (.0098)	0.1002[d] (.0104)	0.0924[d] (.0098)
HSEX	4.8640[d] (6.7131)	3.5238 (6.8661)	5.8354[d] (6.8456)	1.3664 (6.6198)
ED1	- 7.9917 (10.1420)	- 8.4539 (10.437)	- 7.4437 (9.4625)	- 9.8267 (9.5249)
ED2	1.1437 (1.3719)	0.9077 (1.4082)	0.7942 (1.3996)	0.5934 (1.4212)
ETH1	- 7.2330 (10.487)	- 5.0548 (10.781)	- 5.8119 (7.4309)	- 2.5977 (7.3443)
ETH2	36.9430[f] (19.1100)	39.3560[e] (10.934)	64.4730[d] (19.0520)	72.5590[d] (21.2200)
HOOD	-10.6810 (8.3695)	- 4.0091 (6.9602)	--	--
OWN	6.4397 (8.4206)	1.0825 (7.4674)	--	--
EHRS	0.2138 (.2500)	0.0024 (.1868)	--	--
PA	3.0500 (12.9110)	16.4460[f] (8.9441)	--	--
HAGE	- 0.9143 (.2303)	- 1.0073[d] (.2285)	0.8834 (.1913)	- 1.0008[d] (.1848)
VM	10.0340 (16.9380)	12.8870 (16.995)	--	--
VNM	13.3770 (15.3420)	21.3270 (14.316)	--	--
OM	20.4340 (16.5970)	27.4550[f] (15.958)	--	--
ONM	-21.8570 (16.9010)	-10.8820 (15.088)	--	--
IM	16.1730 (18.0800)	25.9850 (16.896)	--	--
INM	5.4565 (13.5590)	8.0143 (13.417)	--	--
CAM	42.1320[c] (12.7180)	45.6490[c] (12.451)	--	--
λ_{NP}	-30.0180 (20.7070)	--	-20.9690[e] (10.1480)	--

[a]Sample size = 346.

[b]Variables are defined in text.

[c]Significant at 1 percent in two-tail t test.

[d]Significant at one-tenth of 1 percent in two-tail t test.

[e]Significant at 5 percent in two-tail t test.

[f]Significant at 10 percent in two-tail t test.

expenditures for participants and for nonparticipants. These models were estimated using data from a four-state post-EPR survey of FSP eligible households. The specification of the model is innovative in that results of each stage were used in subsequent stages. The Heckman/Greene approach was used to test for the presence of sample-partitioning bias in ordinary least-squares food expenditure equation estimates.

The participation probit equation demonstrated the role of stamp allotments as an attraction, increasing purchasing power and thereby determining participation. Stamps are less than perfectly cash equivalent, however, because they must be spent on food. The proportion of the face value of stamps that would have to be given in cash to confer the same increase in welfare in terms of command over market goods and services was calculated at 0.96; that is, stamps are nearly cash equivalent. In fact, for 84 percent of the sample the proportion is 99 percent or more of the face value of stamps. Thus, from the recipient's point of view the FSP is very efficient as a welfare program, given the basic type of program administration. Weighting the cash equivalent coefficient estimate by the stamp allotment for each household reveals that aggregate household income would have to be increased by 91 percent of the aggregate value of the food stamp allotment to increase the market goods component of utility to the level attained with stamps. This average is very near the value obtained by Smeeding (1982, 1975b) using a simpler estimation technique. Hence, our results tend to validate his highly practical approach, suggesting that it may be useful for policy analysis.

The participation probit equation also demonstrated the nonmarket (stigma) effects of privacy and prestige that arise from participation in the gram. The importance of certain household characteristics as indicators of sensitivity to the social consequences of participation—use of public assistance programs, homeownership, having friends or relatives who participate, and labor force attachment—was validated. This social sensitivity causing differences in participation suggests some possible restructuring of the manner in which certification and stamp redemption are handled. For instance, mailing stamps instead of having participants pick them up would reduce the visibility of participation. The results for the "stigma" variables point out that while stamps may be nearly cash equivalent in command over market goods and services, they will be more or less cash equivalent in nonmarket terms, depending on how the FSP and the alternative cash program are run.

Food expenditure equations incorporating the extent to which the allotment is cash equivalent were derived from the participation results. Money and stamp resources were separated into cash income, cash equivalent stamps, and noncash equivalent stamps. The expenditure coefficients of these three resources were of the expected relative magnitudes. Results show that stamps are more effective at increasing expenditures on food than cash grants by a factor of about six to one. Income, stamp, and price elasticities were of magnitudes generally found by other investigators.

The expenditure equation results show that stamps are not equivalent in demand to nontransfer cash; hence, they cannot be equivalent in welfare as determined by market goods and services although they apparently come close. (The cash equivalent coefficient in the participation equation of slightly less than one, supports this finding.) Neither are stamps equivalent to transfer cash in nonmarket, i.e., prestige and privacy, components of utility.

This combination of (1) a substantial difference between the effects of stamps and cash on food expenditures and (2) the near cash equivalence of stamps in the market component of indirect utility, suggests that eligible households can substitute between food and other market goods rather easily in utility. The broad programmatic definition of food, including high convenience processed foods and snack foods, may contribute to this ease of substitution. Also, eligible households are at income levels where additional expenditures on any necessities are considered important.

From a broader theoretical perspective, this study of household behavior given FSP eligibility, needs to be placed in a public choice framework. The behavior of eligible households is an essential component of public choice. Household behavior may determine, in part, how the set of persons eligible for the prograam is defined and how the gains from trade are divided between recipients and donors. The most important positive, if not normative, contribution of the household analysis in this study will be in the further development of economic thought at the public choice level. A full understanding of cash and in kind redistributive transfers will require continuing public choice research.

From a broader policy perspective, the results of this study indicate that the FSP, even after the elimination of the purchase requirement, continues to meet the dual objectives historically associated with federal food assistance policy: increasing household welfare and stimulating demand for agricultural products. Our analysis of participation indicated that stamps are nearly equivalent to cash in utility. That is, an additional dollar in cash or in stamps will affect utility similarly. Yet we also learned that stamps have a much larger effect on food expenditures than cash does. Despite the fact that there is a real constraint on consumption associated with the program, there is little "burden" from having to divert expenditures from

all other goods to food. This combination of results suggests that there is little trade off between using stamps to expand agricultural demand and using them to enhance recipients' perceived welfare when compared with alternative cash transfer programs with similar stigma effects. If stamps were replaced by an equal-valued cash transfer, household welfare may not be markedly affected, but food expenditures would be substantially less. Thus, the FSP is apparently a more efficient mechanism for both enhancing the welfare of the poor and increasing demand for the agricultural sector than a system of cash grants would be. While consideration of administrative costs and stigma effects might alter this conclusion, the analysis presented here suggests little reason to change from stamps to a system of cash grants.

APPENDICES

APPENDIX A: INFORMATION ABOUT FOOD STAMP PROGRAM REGULATIONS

Appendix Table A.1

Monthly Purchase Charge, Bonus Stamps, and Total Stamp Allotment[a]

Monthly net income 4-person household (in 1969 dollars)	Purchase Requirement	Bonus Stamps	Total Stamps Allotment
00 to 19.99	2	58	60
20 to 29.99	6	54	60
30 to 39.99	10	52	62
40 to 49.99	14	48	62
50 to 59.99	20	44	64
60 to 69.99	26	40	66
70 to 79.99	32	38	70
80 to 89.99	36	36	72
90 to 99.99	40	36	76
100 to 109.99	44	34	78
110 to 119.99	48	34	82
120 to 139.99	52	32	84
140 to 159.99	56	28	86
160 to 179.99	60	26	88
180 to 199.99	64	24	90
200 to 219.99	68	24	92
220 to 239.99	72	24	96
240 to 269.99	76	24	100
270 to 299.99	80	24	104
300 to 329.99	84	24	108
330 to 359.99	88	24	112
360 to 389.99	92	24	116
390 to 419.99	96	24	120
420 to 449.99	100	24	124

[a]Used in all states except Alabama, Arkansas, Kentucky, Louisiana, Georgia, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia.

Source: Kotz, 1971, p. 247.

Appendix Table A.2

Representative Maximum Allowable Monthly Net Income Eligibility Standards, Monthly Coupon Allotments, and Purchase Price Requirements for a Family of Four, 48 states and the District of Columbia

Date	July 1975		July 1977		July 1979	July 1981
Maximum Net Income	$540		$567		$596	$705
Monthly Stamp Allotment	$162		$170		a	a
	PURCHASE REQUIREMENTS (PR) AND BONUS STAMPS (B)					
Monthly Net Income[b]	PR	B	PR	B	B	B
$ 0	$ 0	$162	$ 0	$170	$204	$233
30	4	158	4	166	213	224
50	10	152	10	160	189	218
100	25	137	25	145	174	203
150	41	121	41	129	159	188
200	53	109	53	117	144	173
250	71	91	71	99	129	158
300	83	79	83	87	114	143
350	95	67	95	75	99	128
400	113	49	113	57	84	113
450	131	31	131	39	69	98
500	138	24	140	30	54	83
540	138	24	146	24	42	71
567	---	---	146	24	34	63
596	---	---	---	---	25	54
705	---	---	---	---	---	22

[a]With the implementation of the 1977 Act, the purchase requirement was eliminated and each household received the value of bonus stamps to which it was entitled.

[b]Definition of net income and the value of the monthly allotment of food stamps under the Food Stamp Act of 1977:

Sources: U.S. Department of Agriculture, Food and Nutrition Service, May 7, 1975; May 3, 1977; May 11, 1979; May 22, 1981.

Net Income (NI)

Net Income = a – b – c – d, where

a = monthly income
= INC.

b = standard deduction
= $70 if the household was interviewed in any month from July through December, 1979.
= $75 if the household was interviewed in any month from January through May, 1980.

c = earned income deduction
= (monthly earned income) x (.20).

d = shelter/dependent care deduction
= (1) + (2) if this sum is $\leq$ $85
= $85 if (1) + (2) $\geq$ $85

(1) = monthly shelter expense in excess of 50% of monthly income
= (shelter expense) – (INC/2) if this number is $>$ 0
= 0 if this number is $<$ 0.

(2) = monthy expense for dependent care.

Value of Food Stamp Allotment (A)

Food stamp benefits for all households are defined as follows. Define:

(1) Mon = month of interview which can take on the values 6 through 12 or 1 through 5.

(2) HS = household size.

(1) SI2 through SI12 = a set of dummy variables for household size

SI(i) = 1 if HS = i
where i = 2, 3, . . ., 12.

(4) Net Income = NI as defined above.

For example, if the household has four members, then SI2, SI3, SI5 through SI12 are set equal to zero and SI4 is set equal to one.

If $6 \leq$ Mon $\leq$ 12, then

$$A = 61 - 0.3(NI) + 51(SI2) + 100(SI3) + 143(SI4) + 181(SI5) + 230(SI6) + 260(SI7) + 306(SI8) + 352(SI9) + 398(SI10) + 444(SI11) + 490(SI12)$$

If $1 \leq$ Mon $\leq$ 5, then

$$A = 83 - 0.3(NI) + 32(SI2) + 82(SI3) + 126(SI4) + 165(SI5) + 215(SI6) + 246(SI7) + 292(SI8) + 339(SI9) + 386(SI10) + 433(SI11) + 480(SI12)$$

This treatment of month of interview follows the semiannual pattern of food stamp allotment adjustments. To constrain (A) to the maximum allowable allotment size, as required under the program structure, the following limits are placed upon (A):

A = 10 if HS = 1, and $6 \leq$ Mon ≤ 12,
and $170 \leq$ NI ≤ 306, or

if HS = 1 and $1 \leq$ Mon ≤ 5,
and $246 \leq$ NI ≤ 306, or

if HS = 2 and $6 \leq$ Mon ≤ 12,
and $340 \leq$ NI ≤ 403.

A = 0 if HS = 1 and NI > 306, or
if HS = 2 and NI > 403, or
if HS = 3 and NI > 500, or
if HS = 4 and NI > 596, or
if HS = 5 and NI > 693, or
if HS = 6 and NI > 790, or
if HS = 7 and NI > 886, or
if HS = 8 and NI > 983, or
if HS = 9 and NI > 1080, or
if HS = 10 and NI > 1177, or
if HS = 11 and NI > 1274, or
if HS = 12 and NI > 1371.

APPENDIX B: THE SURVEY

Survey Sites

This study uses survey data from four states. Researchers in California, Indiana, Ohio, and Virginia collaborated in collecting the data. Interviews were conducted with 896 FSP eligible households between July 1979 and May 1980. Participants were no longer paying cash for stamps by mid-1979, so their entire allotment was "bonus stamps."

In each state, one metropolitan county and one nonmetropolitan area (either a county or a group of two or more counties) were randomy selected. to reduce the costs of finding eligible households, only census tracts or census county enumeration districts (ED's) whose 1970 percentage of households-in-poverty was at or below the median county's percentage, were listed. From these two lists for each state—one list of blocks (in tracts) for the selected metropolitan county and one for county ED's for the nonmetropolitan area—systematic random samples were drawn. Within the chosen blocks or ED's, an attempt was made to screen all households for eligibility and then to interview all eligible households. The screening questionnaire was adapted from the survey instrument for the National Food Consumption study of 1977-78, which contained a section to determine FSP eligibility based on income, family size, assets and allowable deductions.[20]

Of the interviewed households, 513 indicated they participated in the FSP during the month they were interviewed. Of the 885 households responding to the question on residence, 306 resided in counties classified by the Bureau of the Census as metropolitan; 579, in nonmetropolitan counties. Information about household composition, employment status of household members, household resources, food and other expenditures, budgeting problems, attitudes toward the FSP, program participation status, reasons for participating or not participating, and other socioeconomic characteristics was gathered from each household.

The Sampling Process

One metropolitan county and a nonmetropolitan area for each of the four states were randomly drawn. On the nonmetropolitan list, counties were sometimes combined so that at least 400 eligible households would be available for selection. (Allowing for a 50 percent response rate and for the fact that only some census enumeration districts (ED's) of the county would be surveyed meant that at least 400 households were necessary to insure completing 100 interviews there.) Then, metropolitan census tracts and census county enumeration districts (ED's) with a concentration of FSP eligible household sufficient to obtain 100 interviews in each had to be identified. Because FSP eligibility is closely related to the official definition of poverty, the percentage of the population in poverty is an indicator of the percentage eligible for the FSP. Consequently, only ED's whose (1970) proportion in poverty was at least as great as that for the median county in each state were selected.

The number of households to be contacted within each ED was computed using the followng formula:

$$\text{Number of households to be contacted in each selected ED} = \frac{\text{Minimum number of interviews}}{\text{(Response rate) (Median percentage in poverty for the state) (100)}}$$

where the minimum number of interviews was 100 and the assumed response rate was 50 percent. From the list of poverty-tract ED's in a county, the number of households to be surveyed in that county was determined by:

$$\text{Number of ED's to be surveyed in a county} = \frac{\text{Number of households to be contacted}}{\text{Mean number of households per poverty-tract ED in the county}}$$

The sample interval (X) was found by:

$$X = \frac{\text{Number of poverty-tract ED's in a county}}{\text{Number of ED's to be selected from that county}}$$

From the list of poverty-tract ED's in a county, the first was chosen from a random number table, then every

20. The U.S. Department of Agriculture survey instrument carries the Office of Management and Budget No. 40-576023.

X^{th} ED was designated for household interviewing. Every household in the designated ED was contacted.

Interview Contacts

Interviewers, familiar with survey techniques and with the interview areas, were paid and trained. They were supervised by researchers and graduate assistants from the respective state educational institutions. Procedures described in Caddell, Krug, and Sohr (1974) were amended for the project.

All occupied housing units in each selected ED were contacted. The interviewer presented a letter of introduction from the investigators explaining the survey. Respondents' cooperation was implied by their agreeing to be screened for eligibility. If no one was home, interviewers left letters of introduction, noting the time of their intended return. A minimum of four call-backs were made.

Screening

Screening procedures allowed the interviewer to speak with any responsible adult in the unit. Each food-sharing group residing in the housing unit was screened separately for eligibility.

A screening form was used to determine eligibility of households for the FSP. Its design was adapted from the U.S. Department of Agriculture's 1977-78 Nationwide Food Consumption Study, Supplemental Survey of Low-Income Households (see Rizek, 1978). However, criteria used in screening were the uniform national standards of eligibility specified in the *Food and Agriculture Act of 1977* with amounts for eligible income and deductions being those in effect as of July 1, 1979. Ownership of property other than the personal residence was not included among the screening criteria. Eligibility of nonparticipating households was determined on the basis of income and expenses for the previous month, a method representing a refinement over previous studies of FSP nonparticipants (see Coe, 1977; Scearce, Paxton, and Jensen, 1975; Feaster and Perkins, 1973; Greenleigh Associates, Inc., 1970).

Eligibility Standards

In 1978, participation in the FSP was limited to those households whose net income after certain deductions was below nonfarm income poverty guidelines of the federal government and whose financial assets did not exceed $1,750 or $3,000 for a two or more person household with at least one person 60 or over (U.S. Congress 1977, pp. 692-4). The income deductions were (1) $70 or $75, depending on the interview month, (2) 20 percent of earned income, and (3) dependent care and shelter costs limited to about 50 percent of income. Physically and mentally fit members of households applying for food stamps had to register and accept suitable employment if offered, unless they were responsible for the care of dependent(s) or unless they were students attending school more than half-time (U.S. Congress, 1977, pp. 965-966). Once eligibility was determined, the person primarily responsible for making decisions about the purchase and preparation of food was interviewed with the main questionnaire.

APPENDIX C: PRELIMINARY ESTIMATION AND DATA MANIPULATIONS

Estimation of An Equivalent Variation Measure of Household Assets

The estimation of an equivalent variation measure of household assets is a prerequisite for empirical analysis of eligible households' program participation and food expenditure decisions. Equivalent variation estimates yield cash-equivalent values for household assets, plus an index of family size and life cycle stage. Household income variables and the estimated household asset values are combined into a single variable representing the value of total household resources. The equivalent variation for assets is used, along with the index of household size and life cycle stage, to transform the household data into total resources, food expenditures, and total food consumed per representative household member.[21]

Derivation of the Equivalent Variation for Household Assets

Total household resources that determine the household's choice set include earned and unearned income and the value of the household's in kind resources. Here, for convenience, we frequently refer to in kind resources as "assets." Because income data are usually more easily obtained and more accurate than asset data, income is frequently used as a proxy for total household resources. Still, household consumption choices depend on total resources available. To avoid the potential information loss from using income as a proxy, a method of estimating the value of household in kind resources from commonly available data is needed.

One way to convert in kind resources to equivalent

21. For a general development of the method of estimating equivalent values for in kind resources and the indexes of famize size and life cycle stage see Kushman and Ranney (1986).

income is to develop an equivalent variation measure of in kind resources. We seek an equivalent variation measure (E^{HA}) of the value of household assets (HA) to add to cash income (y°) when estimating the determinants of FSP participation and food expenditures.

Following Varian's development of the equivalent variation for a price change, we define E^{HA} as the equivalent variation for a change from one set of assets held, HA° to another, HA^1. To derive E^{HA} set the two indirect utility functions before and after the asset change equal:

$$v(p, HA^\circ, y^1) = v(p, HA^1, y^\circ) \quad (1)$$

where income with the asset change is y° and without the asset change it is y^1, and

$$y^1 = y^\circ - E^{HA}, \text{ or} \quad (2)$$

$$E^{HA} = y^\circ - y^1. \quad (3)$$

The corresponding expenditure functions are obtained first by taking the inverse function for the right hand side of (1)

$$y^\circ = e(p, HA^1, u^1), \quad (4)$$

where

$$u^1 = v(p, HA^1, u^1), \quad (5)$$

and then the left hand side:

$$y^1 = e(p, HA^\circ, u^1), \quad (6)$$

Together (2), (4) and (6) imply

$$y^\circ = e(p, HA^\circ, u^1) + E^{HA}. \quad (7)$$

By setting (7) equal to (4),

$$E^{HA} = e(p, HA^1, u^1) - e(p, HA^\circ, u^1) = y^\circ - y^1. \quad (8)$$

In general, if $HA^1 > HA^\circ$, the number E^{HA} will be negative and vice versa. Thus, the equivalent variation of a change in an individual's assets is the difference between the amount of money (y°) needed to achieve utility level u^1 with assets HA^1 and the amount of money (y^1) needed to achieve utility level u^1 with assets HA^1 and the amount of money the individual needs to achieve utility level u^1 with assests HA°.

To compare a person with and without assets, i.e., $HA^\circ = 0$ and $HA^1 > 0$; we need an estimate of y^1 the amount of cash income needed without assets to achieve the same level of satisfaction (u^1) reached with assets. Since $y^1 = y^\circ - E^{HA}$, given u^1 and y°, y^1 could be estimated directly or calculated from an estimate of E^{HA}.

These indirect utility functions and equivalent variation measures are defined for individuals, not households; yet our data are for households. Further, the impact of a given amount of household resources on household satisfaction levels will likely depend on family size and life-cycle stage. These effects should be included when estimating the equivalent variation measure for household assets.

Let y° be redefined as the value of total household cash income per "index person," such that

$$y^\circ = \frac{Y^\circ}{N}, \quad (9)$$

where Y° is total household cash income and the index (N) is some function of family size (n) and life-cycle stage (LC), or

$$N = f(n, LC). \quad (10)$$

Substituting (10) into (9) and the resulting expression into (5) yields

$$u^1 = v(p, HA^1, \frac{Y^\circ}{f(n, LC)}). \quad (11)$$

Given the specification of v, f, and HA^1 in (11) and u^1, p, HA^1, y°, n, and LC, the resulting indifference surface equation can be estimated. For each household, we can calculate

$$\hat{N} = f(n, LC), \quad (11a)$$

$$\hat{y}^\circ = \frac{Y^\circ}{N}, \text{ and} \quad (11b)$$

$$\hat{u}^1 = \hat{v}(p, HA^1, y^\circ) \quad (11c)$$

where $\hat{N}$, f, $\hat{y}^\circ$, $\hat{u}^1$, and $\hat{v}$ are estimates of the functions or quantities based on the chosen specifications. By setting HA^1 equal to zero and replacing $\hat{y}^\circ$ with $\hat{y}^1 = \hat{y}^\circ - E^{HA}$ in (11c) we obtain

$$\hat{u}^1 = \hat{v}(p, HA^\circ, y^1). \quad (12)$$

Estimates of $\hat{E}^{HA} = \hat{y}^\circ - \hat{y}^1$ can be derived by equating (12) with (11c) as in (1) and applying the operations indicated in (4) through (8).

Calculation of Theoretically Consistent Variables

A direct approach to estimating an indifference surface u^1 in (11) would require observing a cardinal utility function. A somewhat weaker assumption, however, that utility is measured in an interpersonally comparable manner but ordinally relative to a threshold, can be used to estimate an indifference surface. While indirect utility is not observable, household satisfaction with its command over resources can be ordered, possibly by sorting responses to a survey question about such a satisfaction level.

In developing a method to estimate life cycle effects and equivalent variations we rely on the work of Van Pragg (1968) and others who have used reported satisfaction with income to estimate poverty income thresholds. As reported by Buyze (1982), Van Praag introduced a welfare function of income where individuals' verbally qualified welfare levels (e.g., "good," "sufficient," and "bad," etc.) were assigned equal intervals on a zero-one scale. Thus, income was represented by u(y), a cardinal utility function defined over a zero-one range, where y is after-tax income.

Goedhart, Kapteyn, and Van Praag (1977) extend Van Pragg's approach to measure poverty and variations in the poverty line with family size. From the responses to a question about minimum income (Y_{min}), i,e, "the income at which respondents could still make ends meet," they estimated:

$$\ln (Y_{min}) = \beta_0 + \beta_1 \ln (fs) + \beta_2 \ln (Y) + \varepsilon$$

where fs is family size, Y is actual income and ε is a random error term. The authors define the poverty line for each family size as that income level where, for the typical respondent, $Y = Y_{min}$.

Kapsalis (1981) replaced the dependent variable used by Goedhart, Kapteyn, and Van Praag with Y_{adq}, obtained by asking people how adequate they consider their income to be. Responses were scaled from 1.0 for adequate income, through 0.5 for barely adequate income, to 0.0 for inadequate income. Kapsalis defined the poverty line as that level of Y, actual income, that makes Y_{adq} 0.5. This modification has two advantages: Existing surveys in which respondents evaluated the adequacy of their respective family incomes can be used; and evaluating income adequacy may be easier than specifying a particular minimum income level, so responses to income adequacy questions may yield more reliable information.

In our survey, households were asked, "To what extent do you think your income is enough for you to live on?" The following responses were possible:

(a) Can afford almost everything and still save money,
(b) Can afford almost everything desired except some things,
(c) Can afford necessities and some extras, but not all wants,
(d) Can meet necessities only, and,
(e) Income is not at all adequate.

By defining

Z = 1 if the response is (a), (b), or (c) and

Z = 0 if the response is (d) or (e),

Z can be used as a binary measure of a household's indirect utility function. Even though we cannot observe v(y), we do observe

$$\text{prob}\,(Z = 1) = \text{prob}\,(v \geq v^*), \tag{13}$$

where v* is some threshold level of utility associated with meeting necessities. We can, therefore, use probit (or logit) analysis to estimate

$$\text{prob}\,(Z = 1) = \text{prob}\,[v\,(p, HA, Y^\circ / f\,(N, LC)) \geq v^*], \tag{14}$$

thereby obtaining estimates, up to a positive scale factor, of the parameters of v and f, the indirect utility and life cycle function, respectively. Since even cardinal utility functions are arbitrary up to a positive affine transformation, the scale factor is irrelevant.

Estimation of the income satisfaction model (14) allows us to recover equivalent variation values for assets and in kind resources and adjustment factors for standardizing life cycle stage and family size. These results can be used to calculate theoretically consistent variables for resources per index person, $\hat{y}^1$, the value of the food stamp allotment per index person, $\hat{a}$, and the value of total food consumed per index person. By so doing, we construct a "unit household member" that more closely corresponds to our theoretical, homogeneous consumer unit.

Specification of the Equivalent Variation Equation

Total resources, food stamp allotment, and food expenditures per index person can be obtained by (1) estimating the indifference surface $u^1 = v\,(p, HA, y)$ and (2) calculating $\hat{y}^1 = \hat{y}^\circ - \hat{E}^{HA}$ and $\hat{N} = f\,(n, LC)$. Each household's estimated y^1 represents total household resources per index person. Then, calculated N's are used to obtain expenditures and food stamp allotment per unit household member. First, estimate: $u^1 = v\,(p, HA, Y)$.

Let the household's indirect utility function be

$$v\,(y) = Ky\beta e^u \tag{15a}$$

which in logarithms is

$$\ln v = \ln K + \beta \ln y + u, \tag{15b}$$

where y is the real value of total household resources adjusted for household size and life cycle status, K is some function of household characteristics, and u is an error term. This form accords well with marginal utility measurements of some psychophysicists, who have concluded that a power function with an exponent of 0.43 and constant K appropriately describes the relationship between utility and money. But, as noted by Breault (1981), other variables probably affect the value of the power exponent, so β in (15b) is estimated together with the effects on utility of several household characteristics.

Let the real value of total household resources be

$$y = y^\circ e^{\Sigma g_k f_k} e^{\varepsilon}, \tag{16a}$$

which, by logarithmic transformation, is

$$\ln y = \ln y^\circ + \Sigma g_k f_k + \varepsilon, \tag{16b}$$

where y° is total cash income adjusted for price level, family size, and life-cycle status, g_k's are parameters associated with the f_k's which are binary or continuous measures of household asset holdings, and ε is a random error term. Substituting (l6b) into (l5b) yields

$$\ln v = \ln k + \beta\,[\ln y^\circ + \Sigma g_k f_k] + u^*. \tag{17a}$$

$$\ln k + \beta\,[\ln y] + u^*, \tag{17b}$$

where

$$u^* = \beta\varepsilon + u. \tag{18}$$

If v were observed, given and u^1 and y^o, y and E^{HA} could be estimated directly from (17a), for example by ordinary least squares.

While ln v cannot be observed, we do observe whether or not the households in the sample felt that their money income was sufficient for more than just necessities. From this information we create the dichotomous dependent variable Z defined above indicating whether the household can afford extras. Combining (17a) with (14) and rearranging yields the underlying probability specification for probit analysis,

$$\text{prob}\,(Z = 1) = \text{prob}\,[u^* \geq \ln v^* - \delta - \beta\,(\ln y^o + \Sigma g_k f_k)], \qquad (19)$$

where $\delta = \ln k$ = constant, for now. Equation (19) gives the probability that, given the systematic component, the household judges its income to be at least sufficient to meet necessities where u* follows a cumulative normal distribution. Second, derive $\hat{y} = \hat{y}^o - \hat{E}_{HA}$ and $\hat{N}$ from estimation of (19).

In general, measurement of the equivalent variation requires that the utility level be held constant at u^1. While we cannot directly hold $\ln v = \ln u^1$ constant, we can hold constant the prob (Z = 1), i.e., the probability that the household will state it can afford at least something more than necessities. From the probit estimate of (19), we can calculate the index $\ln \hat{v}$ and then hold $\hat{v}$ and, hence, the prob (Z = 1), constant. We obtain:

$$\ln \hat{v}\,(p, HA^1, y^o) = \delta^* + \beta^* \ln y^o + \Sigma\,(\beta g_k)^*\, f_k \qquad (20a)$$

Note that probit estimates are accurate up to scale factor σ. That is, the estimated coefficients, δ^*, β^*, and each $(\beta g_k)^*$ are estimates of and, δ/σ, β/σ, and $(\beta g_k)/\sigma$, respectively. For all k $(\beta g_k)^*/\beta^* = (\beta g_k)/\sigma \,/\, \beta/\sigma = (\beta g_k)/\beta = g_k$. Equation (20a), therefore becomes

$$\ln \hat{v}\,(p, HA^1, y^o) = \delta^* + \beta^*(\ln \hat{y}^o + \Sigma g_k f_k) \qquad (20b)$$

To get $\ln v\,(p, HA^o, y^1)$, we set all f_k in (20b) equal to zero to reflect no assets (HA^o) and substitute $\ln y^1 = \ln (y^o - e^{HA})$ from (2) for $\ln y^o$ and obtain

$$\ln \hat{v}\,(p, HA^o, y^1) = \delta^* + \beta^* \ln (\hat{y}^o - E^{HA}). \qquad (21)$$

Since the utility levels have been held constant in a probabilistic sense, we can set (21) equal to (20b)

$$\ln \hat{v}\,(p, HA^o, y) = \ln \hat{v}\,(p, HA^1, y^o) \text{ or} \qquad (22a)$$

$$\ln (\hat{y}^o - E^{HA}) = \ln \hat{y}^o + \Sigma g_k f_k \qquad (22b)$$

Taking the antilogs of (22b), gives

$$\hat{y}^o - E^{HA} = \hat{y}^o e^{\Sigma \hat{g}_k f_k} \qquad (22c)$$

Rearranging (22c), we have

$$\hat{E}^{HA} = \hat{y}^o - \hat{y}^o e^{\Sigma g_k f_k} = \hat{y}^o - \hat{y}^1 \text{ or} \qquad (23a)$$

$$\hat{E}^{HA} = \hat{y}^o\,(1 - e^{\Sigma \hat{g}_k f_k}). \qquad (23b)$$

Equation (23b) gives the desired equivalent variation estimate.

A measure of real household resources per index person that includes the equivalent variation values of household assets can be derived from (23b),

$$\hat{y}^1 = \hat{y}^o - \hat{E}^{HA} = \hat{y}^o - \hat{y}^o(1 - e^{\Sigma g_k f_k}) \text{ or} \qquad (24a)$$

$$\hat{y}^1 = \hat{y}^o - \hat{E}^{HA} = \hat{y}^o(e^{\Sigma g_k f_k}) \qquad (24b)$$

This $\hat{y}^1$ corrects for asset holdings.

Because household preferences and perceived income adequacy may depend on household size and life cycle stage as well as other household characteristics we expand (17a) and, hence, (19). Recall that y^o, introduced in (16a) is defined as total real cash income adjusted for household size and life-cycle stage. That is, y^o is real cash income per index person. Define

$$y^o = \frac{Y^o}{NP} \text{ and} \qquad (25)$$

$$N = \frac{n}{e^{\Sigma a_i d_i}} \text{ and} \qquad (26)$$

where Y^o = total monthly cash income, P = price level, n = the number of persons in the household, $d_i = 1$ if the household is in life-cycle stage i, and the a_i's are parameters associated with life-cycle stages. Thus, the index (N) adjusts cash income for life-cycle stage and size of the household. For other household characteristics, let $\delta = \ln K$ and define

$$K = e^{b_0} + \Sigma b_j c_j \text{ or} \qquad (27a)$$

$$\ln K = b_0 + \Sigma b_j c_j \qquad (27b)$$

where b_0 is some constant and the b_j's are parameters associated with c_j household characteristics, excluding household size and life-cycle stage.

Substitute (26) into (25) and apply a logarithmic transformation to obtain

$$\ln y^o = \ln Y^o - \ln P - \ln n + \Sigma a_i d_i \qquad (28)$$

Substitution of (28) and (27b) into (17a), gives

$$\ln v = b_0 + \Sigma b_j c_j + \beta\,[\ln Y^o - \ln P - \ln n + \Sigma a_i d_i + \Sigma g_k f_k] + u^*. \qquad (29)$$

Rearranging (29) yields the equation underlying the final probit to be estimated

$$\ln v = b_0 + b_j c_j + \beta\,[\ln Y^o - \ln P - \ln N] + \Sigma(\beta a_i) d_i + \Sigma(\beta g_k) f_k + u^*. \qquad (30)$$

Given the $\hat{a}_i$ derived from the probit estimates of (30), an estimated index of household size and life-cycle status (N) can be calculated for each household using (26). These estimated index values are used to convert household income, food stamp allotments, and food expenditures into per unit household member values for subsequent estimation procedures. The $\hat{N}$'s are also used to calculate the value of cash income per index person, for each household from

(25). The incomes are used, in turn to obtain the estimated equivalent variation values for household assets and the measure of total household resources per index person from (24b).

Estimation of Resources, Family Size, and Life Cycle Effects

Life cycle status dummy variables (d_i) are described in Appendix Table C.1. Appendix D outlines the derivations of price indices used. The household characteristics variables are the c_0-c_5 variables assumed to affect indirect utility directly as defined in Section 4. The household assets variables used in the equivalent variation estimation are defined below. Descriptive statistics for all variables in equation (30) are presented in Appendix Table C.2.

Household Assets

f_1 = homeownership (OWN):
= 1 if the residence is owned, and
= 0 otherwise.

f_2 = housing tenure (HT):
= age of household head, 18 if age $\geq$ 18, and
= 0 otherwise.

f_3 = proportion of all food consumed that is grown at home (GRO):
= 1.0 if all food consumed is grown at home,
= .75 if most but not all food consumed is grown at home,
= .50 if half of all food consumed is grown at home,
= .17 if very little of all food consumed is grown at home, and
= 0.0 if none of the food consumed is grown at home.

f_4 = gifts of food or furniture (GIFTS):
= 1 if the household received gifts of food or furniture and
= 0 otherwise.

Variables f_1 and f_2 represent home equity values where (f_2) age of household head, is a proxy for housing tenure. Since home loans are repaid over many years, age of household head and home equity values should be positively related. While home ownership undoubtedly produces an in kind flow of housing services, it often represents a mortgage obligation that restricts the flexibility with which income might be used and reduces its effective value. Thus, the net relationship of home ownership to the household's ability to obtain at least its necessities, is ambiguous.

The proportion of all food consumed that is grown at home (f_3) is expected to be positively related to the probability of being able to procure necessities. On average, less than 10 percent of food consumed is grown at home (Appendix Table C.2). Gifts of food or furniture (f_4) may also positively affect the ability to afford extras. The mean of variable Z indicates that 32 percent of the sample households report they are able to obtain more than necessities (Appendix Table C.2). Monthly real income from all sources (excluding food stamps) per household index person (REAL) should positively affect the perceived ability to afford necessities. About one-fourth of the sampled households fall in life-cycle state eight (d_8) that is, they have no children present, and the household head is older than 60.

Equivalent Variation Results

The estimates of equivalent variations for household assets are derived from probit estimation of the probability that the household will report being able to afford more than necessities. The probability of a favorable report is a function of real cash income per household member, asset holdings, life- cycle stage, and other household characteristics. Two versions of this equation were estimated: The first or preliminary version includes all variables in Appendix Table C.2; the final version omits most of the asset and life-cycle variables whose coefficieent estimates were not statistically significant in the first version. Results are presented in Appendix Table C.3.

In the first version, only three life-cycle coefficients are significantly different from zero: (d_3) the household head is married and the average age of children is between five and 12, (d_5) the household head is unmarried and the average age of children is less than or equal to five, and (d_6) the household head is unmarried and the average age of children is between five and 12. It may be that the presence of children is a more salient factor in the household's perceived ability to afford "extras," than the age of the adults or marital status. Only one asset coefficient, that for the proportion of food consumed that is grown at home (GRO), is statistically significant.

In the final form, life-cycle stages d_2 and d_3 and d_5 and d_6 were combined to represent more general life-cycle stages, i.e., in stage $d_2 + d_3$, the household head is married with children less than 12 years old; in stage $d_5 + d_6$, the household head is unmarried with children under 12.

The asset variable OWN was retained in the final form due to strong *a priori* expectations that home-ownership will affect the likelihood of being able to afford more than necessities. The coefficient estimates for OWN also provide a test for the U.S. Department of Agriculture's policy of not counting housing assets when determining eligibility. If home ownership costs strain the budgets of eligible households, the coefficient for homeownership would be zero or even negative. We had hypothesized a positive coefficient to reflect the positive value flowing from homeownership. It

turns out that the coefficient is negative in both estimates and marginally significant in the final form, tending to validate USDA's policy of not counting housing assets. Given the ambivalence in interpretation of this variable, the coefficient associated with OWN is treated as insignificant rather than significantly negative in the analysis to follow.

Both life-cycle stage coefficients are positive and highly significant in the final form. Real cash income per household member (REAL) is related positively to the probability of a favorable report.

The coefficients of ED2 and ETH1 are also positive and significant in the final form. That is, those households with heads who are Black (ETH1) or who have more than a secondary education (ED2) are more likely to be able to afford more than necessities, all other things constant. One may speculate that these results may reflect differing perceptions of the necessity threshold by race, and differing efficiencies in converting money to utility by educational levels.

Based upon the final form probit estimates, the index of household size and life-cycle status ($\hat{N}$) and total real household resources per index person (y) were calculated for each household in the sample. The calculated $\hat{N}$'s were used to generate a's, the real food stamp allotment per index person, and food expenditures per index person for each sample observation. The calculated a's and y's were then used to generate independent variables for use in estimating the participation and food expenditure equations.

Appendix Table C.1

Definitions of Dummy Variables ($d_1, \ldots, d_8$) for Household Life Cycle Stages

For each household, $d_i=1$ if the household exhibits the characteristics listed below and $d_j=0$ for all $j \neq i$. For the omitted category $(d_1, \ldots, d_8)=0$.

Variable	Household Characteristics Associated with d_i		
d_i	Marital Status of Household Head	Average Age of children (AAK)	Age of Household Head (HA)
Omitted Category	Not Married	No Children	HA $\leq$ 60
d_1	Married	No Children	HA $\leq$ 60
d_2	Married	AAK $\leq$ 5	Any Age
d_3	Married	5 < AAK < 12	Any Age
d_4	Married	AAK $\geq$ 12	Any Age
d_5	Not Married	AAK $\leq$ 5	Any Age
d_6	Not Married	5 < AAK < 12	Any Age
d_7	Not Married	AAK $\geq$ 12	Any Age
d_8	Married or Unmarried	No children	HA > 60

Appendix Table C.2

Means and Standard Deviations of Variables Used for Equivalent Variation Estimation[a]

Variable	Mean	Standard Deviation
Z	.32815	.46984
HSEX(c_1)	.43969	.49667
ED1(c_2)	9.68610	2.65210
ED2(c_3)	.15435	.36151
ETH1(c_4)	.30869	.46225
ETH2(c_5)	.04929	.21661
REAL[b]	4.91950	.69367
d_1	.05058	.21929
d_2	.10765	.31014
d_3	.11284	.31660
d_4	.06096	.23941
d_5	.09468	.29297
d_6	.12970	.33619
d_7	.06485	.24642
d_8	.24384	.69367
OWN(f_1)	.35538	.47894
HT(f_2)	12.34900	20.23800
GRO(f_3)	.08926	.14139
GIFTS(f_4)	.14527	.35260

[a]Sample size is 771. The sample includes all households with valid responses to all relevant questions as long as they do not receive SSI benefits in California.

[b]REAL = ln Y° - ln P - ln n.

Appendix Table C.3

Equivalent Variation Estimation Results: Probit Coefficients and Standard Errors, Preliminary and Final Forms[a]

Variable[b]	Coefficient (Standard Error)	
	Preliminary	Final
CONSTANT	-3.2761[c] (.4945)	-3.1432[2] (.4522)
HSEX	0.0498 (.1286)	0.1157 (.1173)
ED1	0.1337 (.1609)	0.1360 (.1552)
ED2	0.0482[d] (.0209)	0.0565[c] (.0203)
ETH1	0.1815 (.1127)	0.1985[e] (.1119)
ETH2	0.2035 (.2601)	0.2364 (.2574)
REAL	0.4027[c] (.0855)	0.3546[c] (0.0179)
d_1	0.2736 (.2824)	---
d_2	0.3556 (.2267)	---
d_3	0.5036[c] (.2310)	---
d_4	0.1925 (.2634)	---
d_5	0.3700[e] (.2255)	---
d_6	0.4131[d] (.2144)	---
d_7	0.0952 (.2367)	---
d_8	-0.1430 (.1685)	--
d_2+d_3[f]	--	0.3805[c] (.1462)
d_5+d_6[g]	--	0.3740[c] (.1491)
OWN	-0.0281 (.1109)	-0.2552[d] (.1075)
HT	-0.0039 (.0047)	--
GRO	0.9361[c] (.9361)	0.9065[c] (.3614)
GIFTS	-0.0326 (.1392)	--

[a]Sample size = 771.

[b]Variables are defined in the text, this Appendix.

[c]Significant at 1 percent in one-tail t test.

[d]Significant at 5 percent in two-tail t test.

[e]Significant at 10 percent in two-tail t test.

[f]d_2+d_3 = 1 if d_2 or d_3 = 1, = 0 otherwise.

[g]d_5+d_6 = 1 if d_5 or d_6 = 1, = 0 otherwise.

APPENDIX D: ADJUSTING FAMILY BUDGETS FOR INFLATION USING THE CPI AND CONSTRUCTION OF A REGIONAL NONFOOD CPI

Regional Inflation Adjustment

To estimate how spending patterns of FSP eligible households differ among the four national regions surveyed, tables describing a lower income budget for a four-person family from 1972 and 1978 were assembled from U.S. Department of Labor, Bureau of Labor Statistics (1980) and U.S. Bureau of Census (1978) publications. Because these budgets are published annually and the interview information was current up to the month just before the survey, the budgets had to be corrected to a monthly basis for changes in the cost of living. The budgets were adjusted using the consumer price index (CPI) for urban wage earners and clerical workers in each area surveyed. The appropriate CPI index by region/population that best fit the sample was found based on the populations of the standard metropolitan statistical area (SMSA) or nonmetropolitan counties surveyed.

Because the CPI figures were only available bimonthly, interpolations were made by estimating the shape of the CPI functions over time. The CPI and logarithm of the CPI of the western region, population class D, and the Cincinnati SMSA were graphed against time. Both showed nearly linear trends. The CPI for the western region, Class D population's food at home, decreased sharply between August and October 1979 in contrast to the generally rising trend. A detailed CPI report indicated a drop in fresh fruit prices. U.S. Department of Agriculture's March 1980 Fruit Situation showed a steep decline in fruit prices received by producers over this period. Thus, the data suggest that there was a real switch from the trend rather than just sampling error. Also, regional differences were evident in the data. The linear interpolation between months brought out and used the information in such variations. The CPI figures, tabulated bimonthly between April 1978 and February 1980 and linearly interpolated for the alternate months, included all food, food at home, food away from home, commodities less food, nondurables less food, and all items.

A regional price index for all items except food does not exist. Using the national CPI for nonfood and the national CPI's for all items and for food, we predicted the values of a regional nonfood price index as follows.

Let

$$CPIALL_N = w_1 CPINONFOOD_N + w_2 CPIFOOD_N \qquad (1)$$

where the subscript N indicates national indices and the w_i are weights. Rearranging (1) we obtain

$$CPINONFOOD_N = \left(\frac{1}{w_1}\right) CPIALL_N$$

$$CPINONFOOD_N = \left(\frac{w_2}{w_1}\right) CPIFOOD_N. \qquad (2)$$

Then, the regional (R) nonfood index was estimated using Ordinary Least Squares:

$$CPINONFOOD_R = b_1 CPIALL_N + b_2 CPIFOOD_N + u. \qquad (3)$$

The coefficient estimates were:

$b_1 = 1.21638$

$b_2 = -0.220285.$

Finally, for each household, we calculated a nonfood CPI given that household's regional CPI's:

$$CPINONFOOD_R = 1.21638(CPIALL_R) - 0.220295(CPIFOOD_R).$$

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