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Participation in the Food Stamp Program: A Multivariate Analysis

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EXECUTIVE SUMMARY

The most recent estimates of participation in the Food Stamp Program (FSP) indicate that approximately 60 percent of FSP-eligible households participate in the program. Policymakers and program administrators have expressed concern about this less than universal participation, and are interested in the factors that are associated with nonparticipation and how program reforms affect the participation rate.

This report uses data from the Survey of Income and Program Participation (SIPP) to conduct an analysis of the determinants of FSP participation among eligible households. This analysis relies extensively on multivariate statistical techniques, which reveal how the participation rate varies with a given household characteristic, when the influence of other household characteristics is removed. In other words, a multivariate analysis indicates whether a given household characteristicper se has an effect on the probability of participation. This analysis is applied to the universe of households eligible for the FSP, and to four subgroups of this universe--households with an elderly member, households with a disabled member, female-headed households with children, and two-parent households with children.

Previous studies have used econometric analysis to examine the relationship between participation and household characteristics; however, most of these studies have relied on survey data collected prior to the elimination of the food stamp purchase requirement in 1979. This report uses SIPP data collected in 1985.

DEMOGRAPHIC CHARACTERISTICS AND FSP PARTICIPATION

The report examines the relationship between FSP participation and five demographic characteristics of eligible households: the age, education, race and ethnicity of the household head, the presence of children, and household size. The following are the major findings of this component of the analysis.

- The ***age*** of the household head seems to affect the probability of participation, but not in systematic manner. Participation is substantially higher than average when the household head is 30 to 39 years old, and substantially lower when he or she is older than age 70, while all remaining age groups participate at approximately the same rate.

    - Participation is significantly higher among households headed by a persons who is 60 to 69 years old than among households headed by a person older than 70.

- As found by previous research, participation tends to decline as the ***education of the household head*** increases; participation is highest among households in which the household head has less than 12 years of education.

- The net effect of the ***race of the household head*** on participation seems to be much smaller than indicated by previous research. A small difference between black and

white households is found in the overall population, with black households participating at a higher rate. However, among female-headed households with children and households with an elderly member, essentially no difference in participation exists according to the race of the household head.

  - Hispanic households participate at the same rate as white non-Hispanic households, with the exception of two-parent households with children, in which Hispanic households participate at a much lower rate.

- Another finding that diverges from the results of previous studies is that the presence of *children by itself* does not have a sizeable effect on the probability of participation.

- Participation increases with the *size* of the *household* up to household size three, after which it levels off. The fact of being a one-person household has a strong negative effect on the probability of participation, and this effect is found to be independent of whether the household contains an elderly person.

ECONOMIC CHARACTERISTICS AN-D FSP PARTICIPATION

The report examines the relationship between FSP participation and four economic characteristics of households: whether the household receives public assistance, whether it has assets, whether it has earnings, and the household's gross income (divided by the poverty threshold). The following are the major findings of this component of the analysis.

- The *receipt* of *public assistance* (AFDC and SSI) is the strongest predictor of FSP participation--FSP-eligible households that receive public assistance participate at dramatically higher rates than those that do not.

- Eligible households with *countable assets* participate in the FSP at rates that are significantly lower than those of households without countable assets.

- Unlike previous research, this study does *not* find that the *presence of earnings is* negatively associated with participation among FSP-eligible households. The only exception pertains to female-headed households with children, which participate at a lower rate when they have earnings.

- Households with less income, as measured by the *ratio of gross household income and the poverty threshold,* are substantially more likely to participate in the program. This finding implies that more needy households are more likely to be served by the FSP. The only exception to this negative relationship between income and participation pertains to households that report zero gross income. These households participate at a much lower rate than would be expected given their reported lack of resources. This odd result is likely due to the underreporting of income in SIPP.

THE BENEFIT AMOUNT AND FSP PARTICIPATION

This report devotes special attention to estimating the relationship between FSP participation and the food stamp benefit amount to which a household is entitled. In addition to providing descriptive information on this relationship, the analysis generates an estimate of the participation response that can be used to simulate the effects of program reforms--that is, to predict how FSP participation would change under a reform that altered the size and distribution of the benefit across households. The following are the major findings.

- The relationship between the FSP benefit amount and participation in the program is ***positive*** overall. However, the estimated ***net*** effect of a change in the benefit amount on participation is rather ***small.***

- An intuitive way to express the relationship between benefits and participation is the percentage point increase in participation associated with a $10 increase in benefits (the benefit amounts are expressed in 1985 dollars). The analysis suggests that this increase elicits a different response according to the current level of benefits: at $30, the participation response to a $10 increase is 1.5 percentage points; however, the response drops to 0.35 percentage points at $150 of current benefits.

I. INTRODUCTION

Although estimates of the rate of participation in the Food Stamp Program (FSP) vary across studies, the consensus among analysts is that substantially less than 100 percent of the households that are eligible to participate in the program actually do so. The most recent estimates have indicated that approximately 60 percent of FSP-eligible households participate in the program (Doyle and Beebout, 1988; Ross, 1988; and Doyle, 1990). Policymakers and program administrators have expressed concern about this less than universal participation, and are interested in the factors underlying nonparticipation and how program reforms might affect the participation rate.

Some researchers have used data from household surveys, such as the Panel Study on Income Dynamics (PSID), to investigate the reasons reported by FSP-eligibles for not participating (Blaylock and Smallwood, 1984, and U.S. General Accounting Office, 1988). Although extremely valuable, this type of research is based exclusively on subjective, perceptual data and thus cannot address the quantitative effects of the factors associated with nonparticipation, nor help predict the impact of FSP reforms on the participation rate.

Another strand of research on FSP participation has attempted to identify the demographic and economic characteristics associated with participation among FSP-eligible households. Applying multivariate analysis to household survey data, researchers have estimated the *net* effect of a given characteristic on the probability of participation--that is, the effect of a given characteristic independent of the effects of other characteristics. Estimates of these net effects can be useful for targeting outreach efforts toward specific demographic groups, for forecasting changes in participation associated with changes in the economy, and for simulating the changes in caseloads and expenditures stemming from changes in program regulations.

However, several methodological and survey data problems limit the reliability of the findings from this type of research: (1) income and program participation are typically underreported in

household surveys; (2) some surveys provide only a small part of the information necessary for simulating the food stamp eligibility determination process and the amount of benefits to which the eligible household is entitled, and (3) most surveys provide no information on the time and out-of-pocket costs that households incur to participate in the program.

Despite these limitations, studies of the factors associated with participation in the FSP have generated a consistent set of findings.[1] In particular, households headed by an employed person, an elderly person, or a relatively more educated person are less likely to participate in the FSP, while households that participate in other assistance programs and households that are female-headed or nonwhite are more likely to participate in the program.[2] However, most of these studies are based on data collected before the Food Stamp Act of 1977 was fully implemented. If participation behavior changed after the elimination of the purchase requirement--the major provision of the 1977 Act--the findings of the existing literature cannot be applied to the FSP in its present form.[3]

In this report, we use 1985 data from the Survey of Income and Program Participation (SIPP) to update previous multivariate analyses of the relationship between household characteristics and FSP participation. Although we cannot overcome most of the limitations imposed by survey data, we attempt to improve upon the existing research in four ways. First, we used a sophisticated computer simulation based on SIPP data (Doyle, 1990) to obtain our sample of FSP-eligible households and the amount of benefits to which they are entitled. Because SIPP provides sub-annual information on a household's income, assets, expenses, composition, and program participation, it is the best available data source for estimating FSP eligibility and potential benefits.

'Appendix A provides a synopsis of these findings.

[2]As discussed in Chapter V, less consensus has been reached about the relationship between the FSP benefit amount for which the household is eligible and the probability of its participation.

[3]Before the purchase requirement was eliminated, households were required to spend a portion of their income to obtain a given dollar value of food stamps. When this requirement was eliminated, the program became more accessible to eligible, low-income households, since they no longer needed to trade in cash in order to receive the food stamps.

Second, we devote special analytical attention to the relationship between participation and the amount of the FSP benefit. A knowledge of the response of the participation rate to changes in benefit levels is essential for forecasting the impact of reforms on program caseload and expenditures. We examine the methodological and practical problems involved in estimating this response.

Third, our analysis applies not only to all eligible households, but also to four subgroups of the eligible population: households with an elderly member, households with a disabled member, female-headed households with children, and two-parent households with children. Thus, we can examine whether the relationship between participation and household characteristics varies across demographic subgroups.

Finally, we present our estimation results in a way that facilitates their interpretation. Rather than presenting estimates of the coefficients of the participation equation, we use these estimates to calculate *predicted participation* rates for a household with average characteristics. Then we show the net effect on participation of a specific characteristic by computing the predicted participation rate at different levels of that characteristic, while we keep all the other characteristics fixed at their average values.

The remainder of this report is organized as follows. Chapter II contains a detailed discussion of the data and methodology used in the analysis. The findings of the analysis are presented in Chapters III through V. Chapter III examines the relationship between the demographic characteristics of households and their participation in the FSP, while Chapter IV extends the analysis to the economic characteristics of households. Findings on the relationship between the FSP benefit amount and participation in the program are presented in Chapter V. Chapter VI provides a summary of the findings and offers some concluding remarks.

II. DATA AND METHODOLOGY

This chapter discusses the methodological issues involved in our multivariate analysis of participation in the FSP.

An analysis of FSP participation consists of several steps. The first step is to define a sample of households that are representative of the population of households eligible to receive food stamps at a given point in time. This task is particularly challenging, since neither existing household surveys nor existing administrative data contain direct information on eligibility status. Second, once a sample of eligible households is constructed, the researcher must consider how participation is associated with the household's characteristics. This step entails specifying a "participation equation"--that is, postulating the link between the outcome (participation or nonparticipation) and the observed characteristics that may "explain" why certain eligible households will participate and others will not. The final step entails estimating the magnitude of these relationships from the data. These estimates allow the researcher to calculate the probability of participation for any particular type of household, depending upon its particular combination of characteristics.

In the first section in this chapter, we describe how we used data from the Survey of Income and Program Participation to obtain a sample of households simulated to be eligible for the FSP. Section B discusses how the participation equation can be specified, while Section C discusses how the underreporting of participation in households surveys can be addressed. Section D presents the types of variables included in the participation equation. Finally, Section E illustrates how we present the estimation results in this report.

A. SIMULATING FSP-ELIGIBILITY WITH SIPP DATA[1]

The Survey of Income and Program Participation (SIPP) is a nationally representative longitudinal survey of adults in the United States, providing detailed monthly information on income, labor force activity, and program participation. It is a multipanel longitudinal survey to which a new sample ("panel") is added each year. At the time this study was initiated, only data from the first two panels (1984 and 1985) were available. Each panel contains information on persons in a longitudinal sample who are followed for a period of over two and one-half years. The adults in the sample, age 15 or older, are interviewed every four months. In each round of interviewing (or 'wave"), a core questionnaire collects information on each of the four months preceding the interview date. In most waves, the monthly core questions are supplemented with questions on a variety of topical issues that vary from wave to wave. Because the interviewing process is staggered whereby one-fourth of all sampled households are interviewed in a month, the reference period covered in any given wave is not the same for all sample members.[2]

One feature of the SIPP design that is particularly relevant to this study is that the SIPP panels overlap for part of their duration. Thus, cross-sectional samples can be constructed with observations from more than one panel, thereby generating larger sample sizes. The data set used in our analysis combines data from the 1984 and 1985 panels of SIPP for the month of August 1985.[3]

'This section draws heavily on Doyle (1990). The reader familiar with SIPP and with the issues involved in eligibility simulation can skip to Section B.

[2]For further information on the design and scope of SIPP, see U.S. Department of Commerce (1987).

[3]More specifically, we derived our sample by combining observations from Wave 7 of the 1984 panel and Wave 3 of the 1985 panel. We merged each of the two waves with information collected in other selected waves of the respective panels. Although Wave 7 of the 1984 panel and Wave 3 of the 1985 panel were independent samples of the U.S. population, they were administered simultaneously. Furthermore, a straightforward adjustment to the sample weights allows estimates to be based on combined panels. We chose these two waves for the following reasons: (1) they contain topical information on assets; (2) together, they provide a relatively large sample size (27,660 households); and (3) they sampled the population in the month of August, making the reference period comparable to available administrative data, which is useful for purposes of quality control.

The sample that is used to estimate a food stamp participation equation must be restricted to households that are eligible for the Food Stamp Program. Since eligibility cannot be 'observed directly, it must be simulated on the basis of the household information provided in the survey. The procedure for simulating the eligibility for each household in the SIPP dataset is designed to replicate the actual FSP eligibility determination process as closely as possible. In other words, program eligibility and benefit criteria are applied to each household as if it had actually applied for food stamps. Details on the eligibility simulation and on the file development process are provided in Mathematica Policy Research (1990) and in Doyle (1990).

Although SIPP contains more information on the variables necessary for determining FSP eligibility and benefits than does any other available household survey, some limitations still remain. Despite the adjustments and enhancements made to the SIPP data, the simulation procedures cannot perfectly replicate the eligibility and benefit determination process mandated in the legislation. The specific discrepancies are as follows:

- ***Unit definition.*** Because SIPP does not measure the complete set of characteristics that the program uses to determine a food stamp unit--especially information on which dwelling-unit members customarily purchase and prepare food together--the simulated food stamp household may not be the same as the unit determined by the food stamp case worker. For this study, the program unit composition reported in SIPP by households receiving FSP benefits was used to simulate the food stamp unit. In other dwelling units that receive only cash assistance, the food stamp unit was equal to the cash assistance unit, plus any spouse or related children under age 18 in the dwelling. In all other dwelling units, the simulated food stamp unit was the same as the Census household--the group of individuals who live in the dwelling unit.

- Countable assets. We used the financial, nonfinancial, and vehicular assets reported in SIPP to estimate countable assets, according to program rules. However, SIPP does not explicitly measure all of the information necessary for this purpose, such as cash on hand.

- Gross income. The measure of gross income used in this study is close to, but not precisely the same as, gross income reported to the food stamp case worker. First, survey data on income and program participation, including the data collected in SIPP, tend to be underreported. Second, the definition of income measured in SIPP is not precisely the same as the definition of income used to determine food stamp eligibility. Third, as noted above, the household composition simulated with

SIPP data differs from the case worker's determination of the food stamp unit, thus leading to different aggregate income amounts for food stamp households.

- Net ***income.*** The measure of net income used to simulate eligibility in this study is not precisely the same as net income determined by the food stamp case worker: (1) we use approximated medical expenses for elderly and disabled individuals; (2) we use approximated shelter expenses for individuals in the 1985 panel; and (3) there is measurement error in the collection of shelter and child care expenses in SIPP. The SIPP definitions of shelter and dependent-care expenses also differ slightly from the FSP definitions.

- ***Disability status.*** We determined disability status on the basis of reported disability and reported income receipt, as specified under the program. Reporting and measurement errors in SIPP may somewhat distort the number of disabled individuals identified in this manner.

Table II.1 shows the possible bias due to each of these measurement and reporting errors.

TABLE II.1

FACTORS THAT AFFECT THE SIMULATION OF FOOD STAMP ELIGIBILITY BASED ON SIPP DATA, AND THE DIRECTION OF THE BIAS

Source of Error	Effect on Estimates of the Number of Eligibles
Unit Definition	Underestimate
Countable Assets	Overestimate
Gross Income:	
Underreporting	Overestimate
Definition	Underestimate
Net Income	unknown
Disability Status	Underestimate

SOURCE: Figure A-l in Doyle (1990).

The underreporting of gross income will bias estimates of the number of eligible households upward, since more households will appear to have met the income limits than actually did On the other hand, the omission of some types of expenses may bias the measurement of net income upward,

thus leading to underestimates of the number of eligible households. Moreover, the inability to perfectly replicate program regulations for calculating deductions from expenses may generate the reverse effect, or may reinforce the bias from omitting valid deductions. SIPP also omits selected assets, thus leading to overestimates of the size of the eligible population.

B. SPECIFYING THE PARTICIPATION EQUATION

We follow the existing literature on the determinants of participation in the FSP (Allin and Beebout, 1989) by specifying the econometric model of participation as a one-equation model, in which the dependent variable is the reported[4] participation status of the household (participant or nonparticipant), the explanatory variables are household characteristics (such as income, the presence of children, or the age of the household head), and the estimation sample consists of households simulated to be eligible for the FSP on the basis of current characteristics. The participation equation can be written as:

$$(1)\quad P = XB + e,$$

where P is reported participation, a discrete outcome, coded as one if the household participates, and zero otherwise; X is the vector of observed household characteristics; and B is the vector of parameters which represent the "net effect" of each variable on participation. XB denotes that each variable in the X vector is multiplied by the corresponding element in the B vector. Finally, e is the error term that represents all ***unobserved*** factors that affect participation.

Once equation (1) is estimated, the coefficients can be used to ***predict*** the probability of participation for any particular type of household--that is, for a household with a particular set of values for the variables contained in the vector X. This probability of participation can also be

[4] Issues associated with the underreporting of FSP participation are discussed later in this chapter.

interpreted as the ***predicted participation rate*** for that type of household. Each coefficient in the vector B can be interpreted as the ***net effect*** of a given characteristic on the participation rate.

One important complication arises in the estimation of equation (1). The fact that the dependent variable P is a discrete variable that assumes only two values makes the application of standard regression techniques (ordinary least squares, or OLS) very problematic (Amemyia, 1985). Among other things, if equation (1) is estimated with OLS, the predicted value of P for some households might he outside of the interval between zero and one, which is equivalent to saying that the associated predicted participation rate can be less than zero or greater than 100 percent. The standard approach to this problem is to use a nonlinear model, such as a probit or a logit model (Maddala, 1983). These models constrain the predicted probability of participation to be positive and less than one.

From a conceptual standpoint, probit and logit models are typically rationalized in terms of the so-called "latent variable" models. In this framework, observed participation or nonparticipation status is seen as the dichotomous realization of an underlying ***latent*** continuous variable, that in our case can be thought as the "propensity to participate" in the FSP. Let us represent this continuous variable as P*. The model then becomes:

(2) $P^* = XB + e$

(3) P = 1 (the household participates) if P* > 0

(4) P = 0 (the household does not participate) if P* c 0

Equation (2) implies that the latent propensity to participate depends both on observable and on unobservable household characteristics. If the latent variable were observed (i.e., if we knew the value of the propensity of each household to participate), then equation (2) could be estimated with standard regression techniques. However, all we observe is the discrete outcome, participation or

nonparticipation. This does not prevent us from estimating the effect of the observable characteristics X on the probability of participation, provided that we are willing to make an assumption about the probability distribution of the error term e.

One assumption used widely in the literature is that e has a standard normal distribution. This assumption generates the probit model.[5] The probability of participation for household i with characteristics X_i can be written as:

(5) Prob(participation) = Prob $(P^* > 0) = \text{Prob}\ (-e_i < X_iB) = \Phi(X_iB)$

and the probability of nonparticipation as:

(6) Prob(nonparticipation) = Prob $(P^* < 0) = \text{Prob}\ (-e_i > X_iB) = 1 - \Phi(X_iB)$

where $\Phi(\ )$ is the cumulative distribution function of the standard normal distribution. With this assumption of a normally distributed error term, the vector of marginal effects B can be estimated with econometric techniques referred to as maximum likelihood estimation.

C. THE PROBLEM OF THE UNDERREPORTING OF PARTICIPATION

An implicit assumption in the previous discussion is that the dependent variable of the participation equation is correctly observed for all eligible households. Unfortunately, there is solid evidence that household survey respondents *underreport* participation in the FSP (as well as in other welfare programs). Thus, some of the households that are simulated to be eligible and that actually are participating in the program are classified as not participating due to erroneous reporting.[6]

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[5]The choice of the probability distribution for the error term determines the particular estimation model. Normality leads to a probit model, while a logistic distribution yields a logit model. The estimation results typically do not differ substantially between the two models. We arbitrarily chose the probit model, but we verified that the logit model yields the same results.

[6]The opposite phenomenon takes place as well--that is, some households that report participating in the program are simulated to be ineligible according to the income and assets information they

(continued...)

However, whether such underreporting biases estimates of the determinants of participation must still be determined The existence of such bias crucially depends on whether underreporting is nonrandom--that is, correlated with the variables that determine participation.

Let us hypothesize that underreporting is negatively correlated with, say, the education of the household head, in the sense that more educated household heads are *more likely to report* participation, given that they participate. Let us also assume that education has a true negative effect on participation, in the sense that more educated household heads are *less likely to participate in* the program. In this case, the estimated effect of education on participation (measured by the coefficient on education in the participation equation) might actually be zero, because the true negative effect is offset by the positive effect of education on reporting. More generally, in the presence of nonrandom underreporting, the estimated coefficients in the participation equation would reflect both the true impact of the characteristic on the probability of participation ***and*** its effect on the probability of underreporting.

Unfortunately, the underreporting problem in the context of a study that relies on micro-level data--that is, data on the individual households--cannot be resolved easily. In the context of an aggregate approach for estimating participation rates, Doyle and Beebout (1988) and Doyle (1990) have confronted underreporting by using counts of participants derived from administrative data, rather than survey data, as the numerator of the participation rate.[7] This solution is clearly not

[6](...continued)
provide during the interview (*seemingly ineligible participants).* We exclude these households from the analysis in order to provide symmetry with households for which the same "error" is made in the eligibility simulation process (i.e., they are eligible but are simulated as ineligible), but that do not report participating. These households are necessarily excluded from the analysis, since the error cannot be detected in these cases. Thus, we avoid an asymmetry that could lead to biased estimates of the determinants of participation.

[7]In these studies, the denominator of the participation rate is taken to be the weighted count of eligible households based on SIPP data.

applicable here, since this study requires information on eligibility and participation for ***each*** individual household, and not aggregate counts.

Since no direct solution to the underreporting of participation seems to be available, ascertaining the relationship between underreporting and household characteristics would be useful. The ideal way to obtain a measure of this relationship would require a dataset in which both the participation status reported in the survey and the true participation status obtained from administrative data are available for each household. This information would support estimating a multivariate model of "participation reporting", in which the universe is defined as the households that are truly participating at a given point in time, and the dependent variable is whether those households report in the survey that they participate.

Unfortunately, datasets that contain this type of information are not available. A more indirect way to acquire a "sense" the relationship between underreporting and household characteristics is to compare the distribution of these characteristics among FSP participants in two different datasets, one affected by underreporting (such as SIPP) and one not affected by it (such as FSP program data). Following this approach, we have calculated the average values of the characteristics of households that report food stamp receipt in SIPP, and of FSP participants observed in the program's Integrated Quality Control System (IQCS) dataset. The results of this comparison are shown in Table II.2.

Let us use the age of the household head as an example of how the figures in Table II.2 could be interpreted. The fact that SIPP contains on average older FSP participants than IQCS does could be attributed to the fact that younger participants are more likely to underreport participation. However, other factors could affect the comparison of these characteristics between SIPP and IQCS, besides systematic underreporting in SIPP: small sample size, errors in the eligibility simulation, errors in measuring the characteristic itself in one or both data sources.

With this ***caveat in*** mind, the figures in Table II.2 could be interpreted as suggesting that households headed by a younger person or a black person, smaller households, households with less

income or more FSP benefits, and households that do not receive Public Assistance or do not report any earnings are *more* likely to underreport participation. However, most of the SIPP-IQCS differences in Table II.2 are rather small; the largest difference between SIPP and the IQCS is only 8.4 percent. While these small differences do not exclude the possibility that some of the estimates presented in the following chapters are biased due to underreporting, it suggests that this bias might not be large enough to affect the major findings of that analysis.

TABLE II.2

COMPARISON OF SELECTED CHARACTERISTICS OF FSP PARTICIPANTS IN THE SIPP AND IQCS DATA BASES

	SIPP Mean or Percentage	IQCS Mean or Percentage	Percentage Difference
Age of Reference Person	43.9	42.2	+ 4.0
Race of Reference Person (% Black)	35.6%	36.4%	- 2.2
Number of Persons	2.80	2.67	+ 4.8
Presence of Children	61.8%	59.2%	+ 4.4
Gross Income	$417	$397	+ 5.0
FSP Benefit Amount	$119	$116	+ 26
Receiving Public Assistance	69.7%	64.3%	+ 8.4
Reporting Earnings	21.1%	19.6%	+ 7.6

SOURCE: SIPP estimates are obtained from the August 1985 Food Stamp Eligibility File. IQCS estimates are obtained from the August 1985 analysis file of the Integrated Quality Control System.

NOTE: The food stamp unit is the unit of analysis for all estimates presented in the table.

D. THE EXPLANATORY VARIABLES IN THE PARTICIPATION EQUATION

This section addresses several issues associated with the explanatory variables that we chose for the participation equation. It also describes the demographic subgroups that we analyzed.

The explanatory variables of the participation equation are essentially the demographic and economic characteristics of households. In measuring these characteristics, we adopted the Census definition of the household--the group of individuals who live in the dwelling unit. This definition deviates from the unit definition that we used in the eligibility and benefit simulation process, described in the first section of this chapter. In simulating eligibility, we used the information in SIPP to construct a unit that resembles the food stamp unit. However, replicating the food stamp unit in this way is not possible for households that currently do not participate in the FSP or do not receive cash assistance. For these households, the food stamp unit used in the eligibility simulation coincides with the Census household.

The choice to be made in the context of a multivariate analysis of FSP participation is whether one should use the characteristics of the simulated food stamp unit, with the limitations described above, or use in every case the characteristics of the Census household. We believe that the latter choice, although far from ideal, is less problematic. The main problem with using the characteristics of the simulated food stamp unit to analyze participation is the asymmetric treatment of participants and nonparticipants: the explanatory variables would be defined on the basis of a criterion that is correlated with the dependent variable (that is, participation status). Some characteristics might appear to affect participation only because they have been defined differently for participants and for nonparticipants. Therefore, we define all explanatory variables in the participation equation with reference to the Census household.

The first group of explanatory variables consists of the demographic characteristics of the household head (age, race and Hispanic origin, and level of education) and of the household itself (the number of persons and the presence of children). The relationship between these variables and

participation in the FSP is analyzed in Chapter III. The second group of explanatory variables consists of economic characteristics: total household income (expressed as a percentage of the poverty threshold), the presence of any earnings, asset ownership, and public assistance receipt. The relationship between these variables and FSP participation is discussed in Chapter IV. Finally, the relationship between participation and the amount of food stamp benefits for which the household is eligible is explored in Chapter V.

All of the explanatory variables enter into the participation equation as categorical variables, including variables that are continuous (e.g., age and income). Thus, we broke the continuous variables down into *discrete intervals. The* choice of transforming continuous variables into categorical ones has two motivations. First, this provides a convenient way to detect whether the sign and magnitude of the net effect of a characteristic on participation changes at different levels of the characteristic. For example, we find that participation is highest for the 30-39 age group and lowest for the *70* and older age group, while it is virtually the same for the other age groups. Specifying age solely as a continuous variable (even in nonlinear form) would not capture this irregular pattern. Second, the availability of estimated coefficients that correspond to different levels of an explanatory variable facilitates the task of computing predicted participation rates. For example, we show the effect of the age of the reference person on participation by computing the participation rate for each of the five age groups, holding all other variables constant at their sample means. Section E contains a more detailed discussion on how the results are presented in the report.

Our subgroup analysis encompasses four *demographic groups* within the food stamp population: (1) households that contain an elderly member, (2) households that contain a disabled member, (3) female-headed households with children, and (4) two-parent households with children. The four subgroups are not defined to be mutually exclusive. For example, a household can be counted not only as an elderly household but also as a female-headed household. Table II.3 shows the extent to which the four groups overlap.

It is interesting to note that households that contain a disabled member overlap with other subgroups to the greatest extent: approximately 50 percent of them are also classified in another subgroup. This implies that the results for this subgroup will often tend to be similar to those obtained for the overall F'SP-eligible population. Households that contain an elderly member overlap much less; only about 10 percent of them are classified elsewhere.

TABLE II.3

OVERLAP AMONG FOUR DEMOGRAPHIC SUBGROUPS
OF THE FSP-ELIGIBLE POPULATION
(unweighted counts)

	Households Counted as:			
	Containing an Elderly Member	Containing a Disabled Member	Female-Headed with Children	Two-Parent with Children
Also Counted as:				
Containing an Elderly Member	-	57 (17.2%)	53 (5.6%)	67 (10.0%)
Containing a Disabled Member	57 (4.2%)	-	64 (6.8)	53 (7.9)
Female-Headed Households with Children	53 (3.9)	64 (19.3)		0 (0.0)
Two-Parent Households with Children	67 (5.0)	53 (16.0)	0 (0.0)	-
Total	1,346	331	940	668

SOURCE: August 1985 Food Stamp Eligibility File.

NOTE: The numbers in parentheses are percentages of the column total.

Table B.1 in Appendix B presents the frequency distributions for all the explanatory variables used in the analysis, both for the overall FSP-eligible population and for the four demographic subgroups.

E. PRESENTING THE ESTIMATION RESULTS

We use two different formats to present the estimation results. We present the estimated coefficients of the participation equation (and their associated t-statistics) only in an appendix, because these coefficients are not the most intuitive way to illustrate the net relationships between participation and household characteristics. In the main body of the report, we use a more intuitive, illustrative approach by displaying the participation rate at the different levels of the characteristic under consideration, while fixing all the other characteristics at their sample means. In addition to these "predicted," or "regression-adjusted," participation rates, the tables in the main body of the report contain the corresponding "observed," or "unadjusted," participation rates--that is, the rates computed simply by dividing the number of (reported) participating households by the number of (simulated) eligible households.*

We use the estimated coefficients to compute the predicted participation rates in the following way. Let us consider a variable--for example, the education of the household head--that has three different values: in this case, less than high school, high school, and more than high school. Of the three values, two (say, the two highest values) enter into the participation equation as O-l dummy variables. Thus, we obtain two estimated coefficients for education: $ß_1$, the marginal impact on participation of having a high school education versus having less than high school, and $ß_2$, the marginal impact of having more than high school versus less than high school. In computing the predicted participation rates for the three levels of education, we must fix all the other characteristics at some common value in order to eliminate the effect of the other characteristics on the participation rates. Thus, we fix these characteristics at their sample means. Given this setup, the predicted, or regression-adjusted, participation rates for the three levels of education are computed as follows:

[8]These observed participation rates differ from the participation rates presented in Doyle (1990), where the count of participants (the numerator) is derived from administrative data, and only the count of eligibles (the denominator) is derived from SIPP.

$$
\begin{aligned}
& PR_{\text{less than high school}} && = 100*\Phi(\bar{X}\,B) \\
(7)\quad & PR_{\text{high school}} && = 100*\Phi(\bar{X}\,B + \beta_1) \\
& PR_{\text{more than high school}} && = 100*\Phi(\bar{X}\,B + \beta_2)
\end{aligned}
$$

where $\bar{X}$ is the vector of the sample means of all the explanatory variables with the exclusion the education dummies, B is a vector of coefficients, and the β_is are the coefficients on the education dummies. $\Phi(\,)$ represents the cumulative distribution function of the standard normal distribution, so that $\Phi(\bar{X}\,B)$ represents the probability of program participation by a household headed by a person ***without*** a high school diploma and whose other characteristics have values equal to their sample means.

The only drawback to presenting predicted participation rates rather than presenting the probit coefficients directly is that the standard errors cannot similarly be displayed, so that the difference between the rates predicted at different levels of a given explanatory variable cannot be tested directly for statistical significance. To remedy this lack of information, we also present the probit coefficients and their associated t-statistics (Appendix C). These coefficients are presented as the ***marginal effects*** on the probability of participation, rather than as "raw" probit coefficients (that is, the coefficients in the B vector in the participation equation).[9] Each of these marginal effects represents the percentage point difference in the participation rate relative to the excluded category of a given variable, while all the other explanatory variables are evaluated at their sample means.

One point should be noted about how we present the results in Appendix C, since our presentation deviates from how these results are traditionally reported. We present the marginal effects from several algebraically equivalent specifications of the probit equation. However, each

---

'Deriving marginal effects entails multiplying the "raw" probit coefficients by the standard normal density evaluated at the sample means. More formally, the coefficients presented in Appendix C are equal to $\phi(XB) * \beta_i * 100$, where $\phi(\,)$ is the density of the standard normal. The value of $\phi(XB)$ is also displayed, so that the raw coefficients β_i can be recovered. Details on how marginal impacts are derived from discrete-choice models are presented in Maddala (1983).

specification uses a different excluded category for each variable. This ***apparently confusing approach has an important motivation.*** It is intended to overcome a drawback to using variables in discrete rather than continuous form--the fact that the pattern of statistical significance of the coefficients of a discrete variable depends on the excluded category for that variable.

This point is better illustrated with an example. Returning to the three education categories referred to above, let us conjecture that the only statistically significant difference in participation is between the two extremes: less than high school and more than high school. If the participation equation is specified whereby the excluded category is the intermediate one (high school), the t-statistics will suggest that the difference in participation between each of these two extreme categories and the intermediate category is not significant. This result ***cannot*** be interpreted as evidence that education does not have any statistically significant impact on participation among the eligible population. In fact, if less than high school were the excluded category, the t-statistic on the more-than-high-school dummy would reveal a statistically significant difference.

The solution presented in Appendix C obviates the arbitrariness in choosing the excluded categories. This solution entails estimating a number of algebraically equivalent alternative specifications, all of which generate the same predicted participation rates. However, each specification generates a different pattern of statistical significance of the coefficients. When the analysis presented in the next three chapters requires a test of the difference between the participation rates computed at any two discrete levels of the same variable, we will refer to the results from the relevant specification presented in Appendix C.

III. FSP PARTICIPATION AND THE DEMOGRAPHIC CHARACTERISTICS OF HOUSEHOLDS

In this chapter, we examine how participation varies according to the demographic characteristics of FSP-eligible households. We present the analysis for all eligible households and separately for households with an elderly person, households with a disabled member, female-headed households with children, and two-parent households with children. Most of the tables in this chapter are arranged in groups of two: Table A presents participation rates among the entire FSP-eligible population, and Table B presents rates among the four subgroups.

The presentation follows the methodology outlined in Chapter II: we examine the relationship between participation and each household characteristic by comparing the "predicted" participation rates calculated at different levels, or categories, of that characteristic. For example, we analyze the relationship between FSP participation and the age of the household head by examining how much the predicted participation rate varies across age levels while all other characteristics are held constant at their average values. When appropriate, we also compare the pattern of the predicted rates with the corresponding pattern of the "observed" rates, which are the ratio of participants to eligibles within each level or category.

Before we begin the type of analysis described here, it is useful to compare the simple "average" participation rates among the four demographic subgroups and in the overall FSP-eligible population. The average predicted rate for a group is the rate computed for an "average household"--that is, one that has average values for *all* the characteristics for that group. Analogously, the average observed rate for a group is simply the the ratio of participants to eligibles in that group. The next section is devoted to a discussion of these average participation rates.

A. COMPARISON OF THE AVERAGE PARTICIPATION RATES

The predicted participation rate for an average FSP-eligiile household is 43.7 percent (Table III.1). The corresponding average observed participation rate is only slightly higher, 44.2 percent. At first glance, these rates seem quite low; however, it is important to keep in mind that the rates reported in this paper are based *entirely* on survey data, and are thus substantially lower than those based on administrative data for the numerator and survey data for the denominator, as was discussed in Chapter II. As reported by Doyle (1990), the household participation rate for all eligible households in August 1985 is 59.4 percent--l5 percentage points higher than the observed rate based solely on survey data.

TABLE III.1

AVERAGE PARTICIPATION RATES
AMONG ALL FSP-ELIGIBLE HOUSEHOLDS AND
AMONG SUBGROUPS OF THE FSP-ELIGIBLE POPULATION

	Participation Rates		Sample
	Predicted	Observed	Size
All FSP-Eligible Households	**43.7%**	**44.2%**	**3,559**
Households with an Elderly Person	30.2	32.2	1,346
Households with a Disabled Person	55.8	55.7	331
Female-Headed Households with Children	78.9	69.6	940
Two-Parent Households with Children	42.3	41.0	668

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

The predicted participation rates for an average household within the four demographic subgroups vary substantially around the rate for all FSP-eligible households. In particular, the

predicted participation rate among households that contain an elderly person is substantially lower (30 percent), while the rate among female-headed households with children is much higher (79 percent). This pattern is consistent with previous findings, including the participation rates presented in Doyle (1985), once we allow for the "downward shift" due to underreporting. Among households with a disabled member, the predicted rate is about 12 percentage points higher than the overall rate (56 versus 44 percent),' while the rate among two-parent households with children is very similar to the overall rate.

With one exception, the *predicted* rate for an average household within each subgroup is very close to its *observed* counterpart, which merely says that the participation rate predicted for a household with "average" characteristics is similar to the average participation rate across all households in the group. However, a nonlinear model (such as probit) does not always generate average predicted rates that coincide with the observed ones. The participation rate of female-headed households is a case in point. Among this group, the predicted rate for an average household is significantly higher than the observed rate (79 percent, compared with 70 percent). The discrepancy between the predicted and observed rate tends to increase as the predicted rate moves away from 50 percent. A more formal explanation for this phenomenon is presented in Appendix D. However, it should be emphasized that this discrepancy does not affect the validity of the subsequent analysis. Our primary objective is to examine how predicted rates vary *across different levels* of a characteristic while all the other characteristics are held constant. In some instances, we compare the variation in predicted rates with the variation in the observed rates, in order to highlight how a multivariate analysis can lead to conclusions that differ from those based on a simpler

'This finding differs from the finding presented in Doyle (1990), in which the overall rate among households with a disabled person is nearly 13 percentage points *lower* than the rate among all households (46.7 percent, compared with 59.4 percent). This difference is due to the fact that the administrative data used in the numerator of Doyle's participation rates capture only those disabled persons who receive SSI. In contrast, SIPP captures disabled individuals who also receive Social Security or Veteran's benefits due to their disability.

descriptive analysis. The fact that the average predicted rates are "shifted away" from the observed rates does not hinder our ability to conduct either type of investigation.

We now examine how participation varies by the demographic characteristics of the household.

B. AGE OF THE REFERENCE PERSON

This and the next two sections examine differences in participation rates by the age, education, race, and ethnicity of the household reference person, respectively. The reference person in SIPP is defined as the first household member mentioned to the interviewer as the owner or renter of the dwelling unit. If no cash payments are made for rent, then the reference person is the first household member mentioned who is 18 years or older.

It is conceivable that the characteristics of the other household members may not be the same as those of the reference person, so that the reference person would not be "representative" of the demographic characteristics of the other members. However, when examining the relationship between FSP participation and person-level demographic characteristics (such as race or education), one is forced either to choose the characteristics of one household member or to construct some average measure for the household. We have chosen to follow the approach of examining the characteristics of the household reference person as defined in SIPP.

Table III.2A presents the predicted and observed participation rates disaggregated by the age of the reference person. The pattern of the predicted rates shows that the relationship between age and participation is not systematic, in the sense that it is not always increasing or always decreasing. Two age groups participate at rates that differ substantially from the overall rate. Households in which the reference person is 30 to 39 years old participate at a higher rate (53 percent), and households in which the reference person is 70 years or older participate at a much lower rate (31 percent). The participation rates of the other three age groups are much closer to the overall

average rate.[2] Moreover, the t-statistics reported in Table C.1 suggest that the differences in participation among these three groups are not statistically significant.

TABLE III.2A

PARTICIPATION RATES AMONG ALL FSP-ELIGIBLE HOUSEHOLDS, BY THE AGE OF THE REFERENCE PERSON

	Participation Rates		Sample
	Predicted	Observed	Size
All FSP-Eligible Households	43.7%	44.2%	3,559
Age of Reference Person:			
15 to 29 years	47.0	51.9	805
30 to 39 years	53.3	52.6	713
40 to 59 years	45.2	47.8	769
60 to 69 years	43.1	37.9	502
70 years or older	30.9	26.9	770

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTE: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

The age pattern of the predicted rates differs from the age pattern of the observed rates. The latter exhibit an almost steadily decreasing pattern across the age distribution, from 52 percent among the youngest group to 27 percent among older one. The largest difference between the pattern of predicted and observed rates occurs among households headed by a 60- to 69-year-old. For this group, the observed rate is 10 percentage points lower than the rate for households headed by a 40- to 59-year-old, while this difference almost disappears with the predicted rates, leaving only households headed by a person 70 years of age or older with a participation rate below 40 percent. This pattern represents an example in which a multivariate analysis of participation can unravel

[2]The break at age 60, instead of the more usual 65, was chosen because the FSP elderly provisions apply to persons age 60 and older.

phenomena that go unnoticed with a simple univariate analysis. The multivariate results suggest that some of the differences in participation implied by the observed rates are due to other factors that are *correlated* with age, rather than to age per se.

Table III.2B presents our analysis of the relationship between age of the reference person and participation for the four demographic subgroups. We discuss these results separately for each subgroup.

1. Households with an Elderly Member

In approximately 95 percent of households that ***contain an*** elderly member, one of the elderly persons in the household is also reported as the household reference person. Thus, very few households that contain an elderly person are headed by a person younger than 60 years of age. To analyze the pattern of participation by the age of the reference person among households that contain an elderly person, we collapsed the younger age categories into one category--the reference person is younger than age 60.

Table III.2B shows that the predicted and observed participation rates of households with an elderly member exhibit different patterns by the age of the reference person. Households in which the reference person is younger than age 60 have a substantially higher *observed* participation rate than those in which the reference person is 60 to 69 years or 70 years or older. When characteristics other than age are held constant in the predicted rates, the difference between the younger than 60 and 60 to 69 years of age categories is no longer statistically significant (Table C.2). By contrast, households whose reference person is 70 years or older participate at a statistically significant lower rate.[3]

[3]The predicted rates for the two elderly subgroups in Table III.2A and Table III.2B differ because the mean values of the characteristics other than age differ (education, race, household size, and income and assets.) The rates in Table III.2B are computed for an average *elderly* household, and those in Table III.2A for an average household.

TABLE III.2B

PARTICIPATION RATES AMONG SUBGROUPS OF THE FSP-ELIGIBLE POPULATION, BY THE AGE OF THE REFERENCE PERSON

	Participation Rates		Sample
	Predicted	Observed	Size
Households with an Elderly Person	30.2%	32.2%	1,346
Less than 60 years	31.1	47.2	74
60 to 69 years	35.6	37.9	502
70 years or older	26.8	26.9	770
Households with a Disabled Person	55.8	55.7	331
15 to 29 years	65.7	63.2	36
30 to 39 years	69.0	63.2	62
40 to 59 years	52.1	53.1	193
60 years or older	42.9	47.8	40
Female-Headed Households with Children	78.9	69.6	940
15 to 29 years	82.2	77.3	349
30 to 39 years	81.9	68.5	335
40 to 59 years	69.2	58.0	212
60 years or older	68.5	65.3	44
Two-Parent Households with Children	42.3	41.0	668
15 to 29 years	36.8	36.7	207
30 to 39 years	48.8	40.7	242
40 to 59 years	38.0	42.8	176
60 years or older	50.7	57.6	43

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

The major implication of these findings is that the elderly FSP-eligible population should not be seen as a homogeneous group as far as participation is concerned: the older group among the elderly population has a particularly low rate of participation.

2. Households with a Disabled Member

Due to the small number of households with a disabled member in which the reference person is older than 60 years of age, we collapsed the two highest age categories into one category, 60 years and older.[4] Both the observed and the predicted rates indicate that participation among households with a disabled member declines with the age of the reference person. Participation among the two youngest age groups is well above 60 percent, declines to about 50 percent for the 40- to 59-year-old group (which comprises the majority of households with a disabled member), and declines further to nearly 40 percent for the elderly. However, the difference between the latter two groups is not statistically significant.

3. Female-Headed Households with Children

The participation rates among female-headed households with children, disaggregated by the age of the reference person, exhibit an interesting pattern. The predicted rates clearly cluster around two levels: above 80 percent among households whose reference person is younger than age 40, and less than 70 percent for households whose reference person is older than age 40. The differences *within* the two broad groups are not statistically significant (Table C.4).

It appears that female-headed households with children exhibit different participation behavior when the reference person is younger than age 40 than when she is older than age 40. The situations of these two types of female-headed households may be very different: those in which the reference person is younger than age 40 are more likely to comprise mothers who live alone with very young children, while those in which the reference person is older may comprise three-generation families

[4] We made the same aggregation for female-headed and two-parent households with children.

(e.g., an unmarried mother who lives with her mother) or families in which an older mother has school-age children.

4. **Two-Parent Households with Children**

If one were to consider only the observed participation rates, one would conclude that participation among two-parent households with children ***increases*** steadily with the age of the reference person, ranging from 37 percent for households headed by a 15- to 29-year-old, to 58 percent for households headed by a person 60 years of age or older. The predicted rates offer a different picture, which is more in line with the results obtained for other demographic groups. As was true among all eligible households, the participation rate among two-parent households in which the reference person is 30 to 39 years old is significantly higher than for the two adjacent age groups. An unexpected result is the higher participation rate among households whose reference person is older than age 60. This result could be due to the fact that elderly couples who live with their grandchildren participate at higher rates than younger couples who live with their own children. However, due to the small sample size of this group, this rate does not differ statistically from the rate for any other age group (Table C.5).

C. EDUCATION OF THE REFERENCE PERSON

Consistent with the findings of previous research, the better educated the household reference person, the less likely the household is to participate in the FSP. Among all eligible households (Table III.3A), predicted and observed participation rates decline systematically with the education of the reference person.

The largest difference in predicted rates between adjacent education categories occurs between households in which the reference person has more than 12 years of education and those in which he or she has exactly 12 year of education (11 percentage points). A smaller, although still statistically significant, difference exists between the latter group and the group with less than 12 years

of education (5 percentage points). One interesting point to note is that the observed rates are very similar to the predicted rates, which implies that none of the other explanatory variables in the participation equation is highly correlated with the education of the reference person.

TABLE III.3A

PARTICIPATION RATES AMONG ALL FSP-ELIGIBLE HOUSEHOLDS, BY THE EDUCATION OF THE REFERENCE PERSON

	Participation Rates		Sample Size
	Predicted	Observed	
All FSP-Eligible Households	43.7%	44.2%	3,559
Education of the Reference Person:			
Less than 12 years	47.2	47.9	2,081
Exactly 12 years	424	43.6	1,018
More than 12 years	31.6	29.3	460

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTE: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

The patterns of predicted rates by the education of the reference person among households with an elderly or a disabled member (Table III.3B) are similar to the pattern among all households (participation declines monotonically with an increase in education), but the dispersion in the subgroup rates is much smaller, and the differences are never statistically significant. The range between the highest and lowest predicted rates is about 4 percentage points for households with an elderly member and 8 percentage points for households with a disabled member. It should be noted that the sample sizes for the more-than-high-school category are very small, making it difficult to detect any significant effect.

Among female-headed and two-parent households, the irregular pattern of participation by level of education might at first seem to contradict the decreasing pattern found for the other groups and for the overall population. However, the only statistically significant differences--between less than

TABLE III.3B

PARTICIPATION RATES AMONG SUBGROUPS OF THE FSP-ELIGIBLE POPULATION, BY THE EDUCATION OF THE REFERENCE PERSON

	Participation Rates		Sample
	Predicted	Observed	Size
Households with an Elderly Person	30.2%	32.2%	1,346
Less than 12 years	31.1	34.5	1,048
Exactly 12 years	26.9	25.5	209
More than 12 years	26.8	22.4	89
Households with a Disabled Person	55.8	55.7	331
Less than 12 years	58.1	60.1	210
Exactly 12 years	52.6	50.4	87
More than 12 years	49.7	43.7	34
Female-Headed Households with Children	78.9	69.6	940
Less than 12 years	82.4	76.4	484
Exactly 12 years	73.9	63.8	345
More than 12 years	77.7	59.3	111
Two-Parent Households with Children	42.3	41.0	668
Less than 12 years	41.9	44.8	327
Exactly 12 years	47.6	39.9	241
More than 12 years	31.4	31.1	100

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation, rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

12 years and exactly 12 years for female-headed households (Table C.4) and between exactly 12 years and more than 12 years for two-parent households (Table C.5)--are consistent with the overall decreasing pattern observed before.

D. THE RACE AND ETHNICITY OF THE REFERENCE PERSON

A comparison of the predicted participation patterns by the race and Hispanic origin of the household reference person (Table III.4A) yields some interesting results. Among all households, those whose reference person is black and non-Hispanic (hereafter referred to as black households) are more likely to participate than households whose reference person is white and non-Hispanic (hereafter referred to as white households) or Hispanic, while the latter two groups participate at nearly the same rate.

TABLE III.4A

PARTICIPATION RATES AMONG ALL FSP-ELIGIBLE HOUSEHOLDS, BY THE RACE AND ETHNICITY OF THE REFERENCE PERSON

	Participation Rates		Sample
	Predicted	Observed	Size
All FSP-Eligible Households	43.7%	44.2%	3,559
Race/Ethnicity of the Reference Person:			
White non-Hispanic	42.7	37.5	2,195
Black non-Hispanic	47.7	56.3	963
Hispanic	39.8	50.4	401

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTE: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

The latter finding is particularly relevant, in light of the observed rates, which indicate that Hispanic households participate at a rate that is 13 percentage points ***higher*** than among white

households.[5] Further, the gap in the predicted participation rates of black and white households is much smaller than the gap in the observed rates, falling from a 19 percentage point difference to a much lower, although still statistically significant, 5 percentage point difference. This pattern suggests that most of the difference in participation shown by the observed rates is due to factors that are *correlated* with race, rather than to race per se.

We observe a similarly declining gap in racial and ethnic differences in predicted participation rates among households with an elderly member and among female-headed households (Table III.4B). While differences are substantial among observed rates, the predicted rates vary only slightly. A net effect of race and ethnicity on participation does seem to exist for the other two subgroups. Race seems to be strongly associated with FSP participation among households with a disabled member, for which a substantial difference (over 15 percentage points) exists in the predicted participation rates of black and white households. Finally, among two-parent households with children, the distinctive findings are the near equality in the predicted participation rates of black and white households versus the substantially lower participation rate of households headed by an Hispanic person (14 percentage points lower than among white households).

To summarize, net differences in the predicted participation rates of *black and white* households seem to exist only among households that contain a disabled member, and a small but still significant difference between the two racial groups is found in the overall population. The participation rates of Hispanic households and white households tend to be similar, after the influence of all other factors is controlled for; the only exception is a much lower participation among Hispanic two-parent households.

[5] Doyle (1990) also found that Hispanic households participate at a higher rate than do white non-Hispanic households. It is important to remember that Doyle's participation rates are more akin to the observed rates presented in this paper than to the predicted rates.

TABLE III.4B

PARTICIPATION RATES AMONG SUBGROUPS OF THE FSP-ELIGIBLE POPULATION, BY THE RACE AND ETHNICITY OF THE REFERENCE PERSON

	Participation Rates		Sample
	Predicted	Observed	Size
Households with an Elderly Person	**30.2%**	**32.2%**	**1,346**
White non-Hispanic	28.8	27.0	913
Black non-Hispanic	33.9	45.3	338
Hispanic	30.6	38.2	95
Households with a Disabled Person	**55.8**	**55.7**	**331**
White non-Hispanic	50.1	49.7	194
Black non-Hispanic	65.6	66.2	104
Hispanic	57.4	57.7	33
Female-Headed Households with Children	**78.9**	**69.6**	**940**
White non-Hispanic	78.8	64.2	418
Black non-Hispanic	79.3	72.7	383
Hispanic	77.9	76.7	139
Two-Parent Households with Children	**42.3**	**41.0**	**668**
White non-Hispanic	44.7	41.7	434
Black non-Hispanic	45.0	44.9	113
Hispanic	31.7	34.3	121

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

E. THE PRESENCE OF CHILDREN AND HOUSEHOLD SIZE

We examine the variation in the participation rate by the presence of children only among the total eligible population (Table III.5A), and not among the four subgroups, because two of the groups--female-headed households and two-parent households--are defined on the basis of the presence of children, and the other two groups contain only a small number of households with children.

TABLE III.5A

PARTICIPATION RATES AMONG ALL FSP-ELIGIBLE HOUSEHOLDS, BY THE SIZE OF THE HOUSEHOLD AND THE PRESENCE OF CHILDREN

	Participation Rates		Sample
	Predicted	Observed	Size
All FSP-Eligible Households	43.7%	44.2%	3,559
Presence of Children Under 18:			
Not present	40.6	31.6	1,850
Present	47.1	57.6	1,709
Size of the Household:			
1 person	34.5	28.2	1,222
2 persons	45.4	45.6	747
3 persons	53.0	57.4	559
4 persons	48.4	55.3	464
5 or more persons	48.8	56.0	567

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTE: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

The presence *of children* younger than age 18, independent of other household characteristics (such as household size), does not have a substantial effect on the predicted participation rate. The observed rates show a very large difference (26 percentage points) between households with and without children; the predicted rates show only a small difference (6 percentage points) after the influence of other factors is controlled for. The large difference in the observed rates is only showing

the high correlation between the presence of children younger than age 18 and the receipt of public assistance.[6] The result shown in Table III.5A suggests that, between the presence of children and receipt of public assistance, it is the latter that has most of the effect on participation among FSP-eligibles.

We now analyze the effect of household size on participation. The overall pattern is that predicted participation rates increase with the size of the household. Among the overall eligible population (Table III.5A), we observe a 20 percentage point difference in the predicted participation rates of one-person and three-person households. The rates for larger households decline slightly relative to the ratio for three-person households, but the differences are not statistically significant (Table C. 1).

FSP participation also increases with household size among households with a disabled member, ranging from 46 percent for one-person households to over 69 percent for larger (four-person and larger) households (Table III.5B). Although the predicted participation rate is low among three-person households with a disabled member relative to two- and four-person households, these differences are not statistically significant (as shown in Table C.3). Among female-headed households with children,[7] participation increases monotonically with size, but a much smaller gap exists between the rates for small and large households. Two-parent households show a reverse pattern (that is, participation declines with household size), but none of the differences is statistically significant.

The preceding discussion shows that one-person households participate at lower rates than do larger households. We also know that the majority of households with an elderly member contain only one person,[8] while only 20 percent of all nonelderly eligible households are one-person house-

[6]According to SIPP, 77 percent of the FSP-eligible households that were receiving public assistance in August 1985 were receiving Aid to Families with Dependent Children (Doyle, 1990).

[7]By definition, there are no one-person female-headed households with children, and no two-parent households with fewer than three persons.

[8]The converse is also true: 66 percent of eligible persons who live alone are elderly.

TABLE III.5B

PARTICIPATION RATES AMONG SUBGROUPS OF THE FSP-ELIGIBLE POPULATION, BY THE SIZE OF THE HOUSEHOLD

	Participation Rates		Sample
	Predicted	Observed	Size
Households with an Elderly **Person**	**30.2%**	**32.2%**	1,346
1 person	**25.7**	**26.8**	812
2 persons	**31.6**	**32.5**	320
3 persons	**43.1**	**47.3**	94
4 persons	**48.5**	**61.6**	48
5 or more persons	**51.6**	**63.4**	72
Households with a Disabled Person	**55.8**	**55.7**	331
1 person	**46.2**	**46.3**	105
2 persons	**57.4**	**56.6**	94
3 persons	**49.0**	**56.1**	49
4 persons	**69.9**	**68.4**	35
5 or more persons	**69.1**	**68.8**	48
Female-Headed Households with Children	78.9	69.6	940
2 persons	71.6	63.9	**227**
3 persons	78.2	**67.5**	**293**
4 persons	82.2	**77.0**	**205**
5 or more persons	83.2	**72.3**	**215**
'Iwo-Parent Households with Children	42.3	41.0	668
3 persons	49.1	41.4	139
4 persons	40.6	35.1	213
5 or more persons	40.5	44.8	316

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

holds. This predominance of one-person households among the elderly raises several questions. Is the low participation rate among households with an elderly member due primarily to an unusually low tendency by persons who live alone to participate in the FSP? Alternatively, is the low participation rate among persons who live alone due primarily to a low tendency by the elderly to participate in the FSP? Which of the two effects prevails as an explanation for the very low participation rate among older persons who live alone? We conclude this section with a more in-depth discussion of the ***interaction of household size and elderly status in*** determining participation in the FSP.

In order to answer these questions, we estimated a variant of the participation equation on which the results presented in this chapter are based. We estimated a participation equation for the overall eligible population, including two dummy variables among the regressors--one indicating whether the household contains an elderly member, and another indicating whether the household contains one person or more than one person. We also included an interaction term (that is, the product of the two dummy variables). The other regressors were the same as those used thus far. The estimated coefficients of this equation allow us to compute separate predicted participation rates for (1) nonelderly, multi-person households; (2) elderly, multi-person households; (3) nonelderly, one-person households; and (4) elderly, one-person households. These rates are presented in Table III.6. Before we discuss these rates, it is important to mention that, while the two separate characteristics (the presence of an elderly person and the presence of just one person in the household) have large and statistically significant negative coefficients, the interaction term has a very small and insignificant positive coefficient, indicating that being a one-person household ***and*** being an elderly person does not reduce participation any further than the sum of the separate effects of these characteristics.

A comparison among the predicted rates in Table III.6 provides some insights into the relative importance of the "elderly effect" versus the "living alone effect" at explaining the lower probability of FSP participation. Table III.6 shows two complementary measures of the elderly effect--one for

multi-person households (the difference between lines (1) and (2), 13.6 percentage points) and one for one-person households (the difference between lines (3) and (4), 9.3 percentage points). The measures of the living-alone effect are derived similarly--one for nonelderly households (the difference between lines (1) and (3), 20.8 percentage points) and one for elderly households (the difference between lines (2) and (4), 16.5 percentage points). Overall, the living-alone effect is larger than the elderly effect, although the latter is also substantial.

These simple calculations suggest a resolution of the two questions. Something idiosyncratic about households headed by an elderly person seems to lead to their low FSP participation rate. Ponza and Wray (1990) found that elderly persons decide not to participate in the available USDA

TABLE III.6

PARTICIPATION RATES AMONG ALL FSP-ELIGIBLE HOUSEHOLDS, BY THE SIZE OF THE HOUSEHOLD AND THE PRESENCE OF AN ELDERLY MEMBER

	Participation Rates		Sample
	Predicted	Observed	Size
All FSP-Eligible Households	43.7%	44.2%	3,559
Presence of Elderly Member and Size of the Household:			
(1) Nonelderly, multiperson	55.2	55.6	1,877
(2) Elderly, multiperson	41.6	40.1	460
(3) Nonelderly, one-person	34.4	30.6	410
(4) Elderly, one-person	25.1	26.8	812

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTE: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

programs, including the FSP, for several reasons: they feel that they do not need the assistance or would rather rely on other sources; they dislike certain features of the programs (e.g., the application

process, the location of the program office, or the form of the program benefit); they believe that they are ineligible; or their decision is based on some combination of all these reasons. In particular, they found that many elderly persons do not participate in the FSP because they are entitled only to a small benefit amount.

Independent of the elderly effect, persons who live alone also seem to have an even lower propensity to participate in the FSP. These persons might be more likely to rely on other households for their food consumption and meal preparation, so that the in-kind benefits provided by the FSP would be relatively less valuable to them. The attempt in SIPP to include "money received from relatives and friends" among the sources of income might not be sufficient to capture the complexity of the inter-household transfer of resources, most of which might be in-kind (such as health insurance coverage, the provision of clothing and transportation, and food sharing). Therefore, on average, one-person households might have more resources available to them than is revealed by their income and assets, which could partially explain their very low rate of FSP participation.'

An alternative explanation, which can easily be extended to small households, is associated with the importance of the costs of participation. More specifically, both monetary and nonmonetary costs are involved in applying for benefits and in obtaining the coupons every month. At the same time, the size of the benefit increases with the size of the household, everything else held constant." Small households are thus more likely to feel that the size of the benefit is insufficient to compensate for the costs of participation. Whether the latter is a "size effect" or a "benefit effect" is an important question, and one difficult to answer, since the size of the benefit depends strictly on the size of the household.[11] Chapter V discusses this issue more extensively.

'Over 25 percent of all PSP-eligible nonelderly, nondisabled individuals who live alone reported zero income in August 1985.

[10]More precisely, the size of the benefit increases with the size of the food stamp unit, but the distinction is immaterial for this discussion.

[11]More precisely, it is the guarantee amount (i.e., the benefit for a household with zero net income) that depends strictly on the size of the food stamp unit.

IV. FSP PARTICIPATION AND THE ECONOMIC CHARACTERISTICS OF HOUSEHOLDS

This chapter examines differences in participation in the FSP by the economic characteristics of households. In particular, we examine differences in household participation rates by (1) the ratio of the household's income to the OMB poverty threshold, (2) whether the household receives public assistance, (3) whether the household has earnings, and (4) whether the household has positive assets.

As in Chapter III, this analysis applies to all FSP-eligible households (Table A in each set of tables) and then to the four demographic subgroups of the eligible population: households with an elderly or a disabled member, female-headed, and two-parent households with children (Table B in each set).

A. HOUSEHOLD INCOME AS A PERCENTAGE OF THE POVERTY THRESHOLD

Before we discuss the relationship between participation and household gross income, it is useful to recall that we are using as explanatory variables the characteristics of the Census household--that is, the group of individuals who live in the dwelling unit. In Chapter II we decided to use the characteristics of the Census household on the grounds that the food stamp unit as defined by program regulations is not known for those who do not report FSP participation because SIPP asks about the composition of the food stamp unit only for those households that report participation. Using a "double standard" (the characteristics of the food stamp unit for participants and the characteristics of the Census household for nonparticipants) might bias the estimates of the effects of the explanatory variables on participation. Some characteristics might appear to affect participation only because they have been defined differently for participants and for nonparticipants.

From this standpoint, the explanatory variables that are a major concern are those constructed from "summing over" all household members, such as income or household size, while variables that represent the characteristics of the reference person are not a concern because the reference person

is not likely to change according to different definitions of the household unit. For example, let us hypothesize that household members with earnings are less likely than individuals with no earnings to be reported to the food stamp office as part of the food stamp unit--that is, as part of the group of individuals customarily purchasing and preparing food together. The survey would capture the exclusion of such members from the food stamp unit only among participating households. Thus, households with larger earnings would be overrepresented among nonparticipating households, and the estimated relationship between participation and earnings (and possibly income) would be distorted toward a negative value.

To avoid this potential distortion, we used the characteristics of the Census household as explanatory variables for both participants and nonparticipants. However, the definition of the income variable somewhat complicates the analysis. The income variable used as an explanatory variable in the participation equation no longer coincides with the gross income used for determining FSP eligibility (Chapter II, Section A). For example, while only elderly and disabled households are exempt from the gross income screen (130 percent of the OMB poverty threshold), our sample contains a substantial number of nonelderly and nondisabled households who are simulated to be eligible but whose household income exceeds 130 percent of the OMB poverty threshold. More generally, the distribution of household income among FSP participants in our sample no longer coincides with the distribution of gross income among participants observed in administrative data. This discrepancy between household income and gross income used in the eligibility determination led us to adopt a different breakdown of the income/poverty variable than typically used in FSP participation studies (for example, by Doyle, 1990). In particular, we do not show a separate "above 130 percent of poverty" category.

With these caveats in mind, we now examine the estimated relationship between participation and household income. In Tables IV.1A, we see that this relationship has an overall negative pattern, which is in accordance with expectations: households that have greater need (a lower income to

poverty ratio) are more likely to be served by the FSP than less needy households, The only exception to this negative pattern pertains to households that report no income at all; among these households, the participation rate is lower than among households that have income between 1 and 50 percent of the poverty threshold. Before discussing households that have positive income, we explore this odd result for zero-income households in more detail.

TABLE IV.1A

PARTICIPATION RATES AMONG ALL FSP-ELIGIBLE HOUSEHOLDS, BY HOUSEHOLD INCOME RELATIVE TO THE POVERTY THRESHOLD

	Participation Rates		Sample
	Predicted	Observed	Size
All FSP-Eligible Households	43.7%	44.2%	3,559
Household Income as a Percent of the Poverty Threshold:			
Zero	41.7	24.9	160
1 to 50 percent	58.6	68.0	650
51 to 75 percent	55.7	59.8	654
76 to 100 percent	44.2	41.1	910
101 percent or more	30.2	26.4	1,185

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTE: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

1. Zero-Income Households

A priori, one would expect that households that do not receive income would participate in the FSP at relatively high rates, since they apparently have no other resources. However, previous research based on survey data has found that estimated participation rates among households that report no income are surprisingly low. For example, using data from the 1979 Income Survey Development Program (ISDP), Czajka (1981) found that the observed participation rate among

households with zero gross monthly income was almost 38 percentage points lower than the rate among households whose income was 1 to 50 percent of the poverty threshold (5 percent, compared with *43* percent).'

Our findings on zero-income households are somewhat less dramatic. First, we find that a lower proportion of all eligible households report zero income: only 4.5 percent of the eligible population report zero income, compared with about 10 percent of the sample of eligible households examined by Czajka. The frequency of zero reported income varies considerably by demographic subgroup. It is very low among households with an elderly member, and (by definition) none of the households with a disabled member has zero income.' Zero income is also rarely reported by female-headed households (2.1 percent), while the proportion of zero-income two-parent households is close to the overall average (4.6 percent). This finding implies that the bulk of zero-income households comprise households that are excluded from the four demographic subgroups examined here. In fact, ***almost half*** of all zero-income households constitute individuals who live alone, are younger than age 60, and are not disabled, while these individuals represent less than 10 percent of all FSP-eligible households.

Both the predicted and observed participation rates among zero-income households in SIPP are ***below*** those for households at higher income levels. However, while Czajka found that only 4.6 percent of zero-income households participate in the FSP, we obtain a 25 percent observed rate and a 42 percent predicted rate (Table IV.1A). The large difference between observed and predicted rates reinforces the notion that the characteristics of zero-income households tend to differ from those of the rest of the FSP-eligible population: in the predicted participation rate, the multivariate adjustment has removed the effect of nonincome variables; in the observed rates, this effect remains. Although higher than their observed rate, the predicted rate of zero-income households' is still 17

'These figures are weighted averages of the participation rates calculated for the three months of the ISDP examined by Czajka.

'Disabled persons are defined as those individuals who collect SSI, Social Security, or Veteran's benefits due to their disability.

percentage points below that of households in the next higher income category, 1 to 50 percent of the poverty threshold. As indicated in Table C.l, the latter difference is statistically significant.

Although less dramatic than in Czajka's study, this pattern of participation among zero-income households in SIPP is still at variance with our expectations. It seems counterintuitive that households in (apparently) dire need would be less likely to seek FSP benefits than less needy households. A plausible explanation for the low participation of zero-income households is the *underreporting of income.* Let us hypothesize that the number of households that truly do not have income of any type is very small. At the same time, the number of households whose income is high enough to make them ineligible for the FSP is very large. If even a very small *proportion* of these ineligible households erroneously report no income and are thus misclassified as eligible, the absolute number of these households would easily be large enough to outweigh the number of households that truly do not have income, thereby creating the perverse pattern of low participation that we observe for the entire group of seemingly zero-income households.

2. Households with Positive Incomes

In general, and in line with expectations, participation in the FSP *declines as* household income increases relative to the poverty threshold The predicted participation rate is almost 60 percent among households in the lowest income bracket (1 to 50 percent of poverty), and only 30 percent among households whose income is above the poverty line. As shown in Table C.1, the differences in the predicted participation rate between any two contiguous income brackets are statistically significant, with the exception of the difference between the 1 to 50 percent and 51 to 75 percent of poverty categories, which is small and not significant.

The participation pattern by household income of all FSP-eligible households observed in Table IV.1A does not exactly replicate the participation pattern of the four demographic subgroups in Table IV.1B. For all subgroups except female-headed households, the predicted participation at 1 to 50 percent of poverty is marginally *lower* than the rate at 51 to 75 percent of poverty. However, these

TABLE IV.1B

PARTICIPATION RATES AMONG SUBGROUPS OF THE FSP-ELIGIBLE POPULATION, BY HOUSEHOLD INCOME RELATIVE TO THE POVERTY THRESHOLD

	Participation Rates		Sample
	Predicted	Observed	Size
Households with an Elderly Person	30.2%	32.2%	1,346
Zero	20.8	14.8	7
1 to 50 percent	29.8	31.4	79
51 to 7.5 percent	40.9	40.9	192
76 to 100 percent	38.0	38.9	489
101 percent or more	21.6	24.1	579
Households with a Disabled Person	55.8	55.7	331
1 to 50 percent	61.9	66.8	16
51 to 75 percent	67.1	71.7	87
76 to 100 percent	57.9	59.1	87
101 percent or more	46.8	41.9	141
Female-Headed Households with Children	78.9	69.6	940
Zero	58.0	29.6	20
1 to 50 percent	86.8	87.4	320
51 to 75 percent	84.0	80.1	244
76 to 100 percent	70.3	59.6	157
101 percent or more	64.4	36.7	199
Two-Parent Households with Children	42.3	41.0	668
Zero	47.0	28.6	31
1 to 50 percent	58.9	57.2	134
51 to 75 percent	60.2	60.5	107
76 to 100 percent	35.6	33.6	160
101 percent or more	29.3	29.9	236

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

differences are not statistically significant (Table C.2 through C.5). For all demographic groups except elderly households, the largest drop in participation takes place between 51 to 75 percent and 76 to 100 percent of the poverty threshold.

B. THE RECEIPT OF PUBLIC ASSISTANCE

Not surprisingly, the receipt of public assistance (PA) is a strong predictor of a household's participation in the FSP, as shown in Tables IV.2A.[3] (In this report, public assistance refers to SSI, AFDC, general assistance, foster child care payments, and other welfare.) Households that receive

TABLE IV.2A

PARTICIPATION BATES AMONG ALL FSP-ELIGIBLE HOUSEHOLDS, BY THE RECEIPT OF PUBLIC ASSISTANCE AND THE PRESENCE OF EARNINGS AND ASSETS

	Participation Rates		Sample
	Predicted	Observed	Size
All FSP-Eligible Households	43.7%	44.2%	3,559
Do not receive public assistance	25.5	22.0	2,094
Receive public assistance	71.0	76.9	1,465
Do not have earnings	46.9	48.7	2,300
Have earnings	37.9	35.6	1,259
Do not have countable assets	50.0	57.2	1,996
Have countable assets	35.9	27.1	1,563

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTE: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

[3] Previous research has consistently found a strong positive relationship between participation in the FSP and participation in public assistance programs, as shown in Table Al.

public assistance are between two and three times more likely to participate in the FSP than are households that do not. Among all eligible households, the ***difference in*** the predicted participation rates between households that do not receive public assistance and those that do is a dramatic 45 percentage points, from a 26 percent rate to a 71 percent rate. The difference is even larger among two-parent households, from 28 percent to ***83*** percent (Table IV.2B).

It is noteworthy that the differentials in the predicted rates of PA recipients and PA nonrecipients are only marginally smaller than in the observed rates. For example, among all households, the observed rates are 77 and 22 percent, respectively, while the predicted rates are 71 and 26 percent. In other words, the wide differential in the observed rates is not due to the fact that other observable factors are correlated with the receipt of public assistance: FSP-eligible households seem to have a true propensity to apply for food stamps according to whether they receive or do not receive public assistance, even when their income and other characteristics differ.

This large difference in FSP participation by PA receipt and PA non-receipt is subject to several interpretations. The difference could, at least in part, reflect a true *effect*; for example, households that enroll in the AFDC program might be sent automatically to the FSP caseworker by the AFDC caseworkers, while similar households that do not apply for AFDC have less chance to come in contact with the FSP caseworker. On the other hand, the apparent PA effect on food stamp participation could be due to the fact that the decision to apply for food stamps is part of a more general decision to apply for the available 'welfare package." In this case, AFDC and FSP participation are the joint outcomes of some underlying decision process that cannot be observed, and which might involve decisions about living arrangements or labor force participation.

C. THE **RECEIPT OF EARNINGS**

For the most part, previous research has found that households that receive earnings, or those in which the head of household is employed, are significantly less likely to participate in the FSP than are households that do not receive earnings, even when total income is held constant. We find some

TABLE IV.2B

PARTICIPATION RATES AMONG SUBGROUPS OF THE FSP-ELIGIBLE POPULATION, BY THE RECEIPT OF PUBLIC ASSISTANCE AND THE PRESENCE OF EARNINGS AND ASSETS

	Participation Rates		Sample
	Predicted	Observed	Size
Households with an Elderly Person	**30.2%**	**32.2%**	1,346
Do Not Receive Public Assistance	**18.9**	16.7	814
Receive Public Assistance	51.4	57.9	532
Do Not Have Earnings	**30.2**	**30.8**	1,147
Have Earnings	**30.0**	**41.5**	199
Do Not Have Countable Assets	**37.2**	**43.7**	**669**
Have Countable Assets	**23.9**	**20.9**	**677**
Households with a Disabled Person	**55.8**	**55.7**	331
Do Not Receive Public Assistance	33.4	32.0	76
Receive Public Assistance	62.5	63.1	255
Do Not Have Earnings	**59.2**	**58.5**	**262**
Have Earnings	43.0	**43.4**	**69**
Do Not Have Countable Assets	58.1	61.8	**203**
Have Countable Assets	52.1	46.2	**128**
Female-Headed Households with Children	**78.9**	**69.6**	**940**
Do Not Receive Public Assistance	45.7	30.4	341
Receive Public Assistance	90.7	92.4	599
Do Not Have Earnings	**84.4**	86.1	**566**
Have Earnings	**68.6**	43.5	**374**
Do Not Have Countable Assets	81.1	77.0	**708**
Have Countable Assets	71.3	46.5	**232**

TABLE IV.2B (continued)

	Participation Rates		Sample
	Predicted	Observed	Size
Two-Parent Households with Children	42.3	41.0	668
Do Not Receive Public Assistance	275	26.9	495
Receive Public Assistance	83.2	84.7	173
Do Not Have Earnings	38.0	520	226
Have Earnings	44.5	35.3	442
Do Not Have Countable Assets	51.1	56.6	284
Have Countable Assets	36.0	29.7	384

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

support for this finding, but not for all demographic groups, and the effect of earnings is small, particularly when compared with the effect of public assistance. Among the overall eligible population (Table IV.2A), the difference by receipt of earnings is statistically significant but not very large, about 9 percentage points. About one-third of all PSP-eligible households in SIPP report earnings.

Among female-headed households **with** children (Table IV.2B) the effect of earnings is relatively large (and statistically significant); the predicted participation rates among female-headed households with and without earnings are 69 and 84 percent, respectively. It is important to remember that this differential in predicted participation does not merely reflect the differential between those that receive and do not receive public assistance, because PA receipt is included in the participation equation.

Among households with a disabled person, the participation differential by the presence of earnings is large (16 percentage points), but, due to the small proportion of households that report any earnings, the difference is not statistically significant (Table C.3). Among households with an elderly member, the presence of earnings has no impact on participation, and the proportion that report earnings is very small. Among two-parent households with children the pattern of participation by presence of earnings seems to be reversed. The predicted participation rate of two-parent households is ***higher (44*** percent), rather than lower, than the rate for those without earnings (38 percent). However, this difference is not statistically significant (Table C.5). Surprisingly, the observed rates exhibit the opposite, and more usual, pattern--35 percent and 52 percent for households with and without earnings, respectively.

D. THE PRESENCE OF ASSETS

Among all eligible households and among three of the subgroups (households with an elderly member, female-headed households, and two-parent households with children), households with

positive assets participate at significantly lower rates than do households without assets.[4] In most cases, this predicted differential is about 15 percentage points. The only apparent exception to this pattern pertains to households with a disabled member, for which the differential is smaller (6 percentage points) and not statistically significant.

[4]In this report, we consider only assets that are countable under the FSP.

V. THE RELATIONSHIP BETWEEN FSP PARTICIPATION AND THE FOOD STAMP BENEFIT AMOUNT

This chapter investigates the relationship between the size of the food stamp benefit and the probability of FSP participation. From a public policy perspective, this relationship is more important than the relationship between participation and the demographic and economic characteristics of households. Policymakers have only a limited ability to affect the demographic and economic characteristics of households, particularly in the short run, but are able to change the level of food stamp benefits by adjusting the parameters of the program, such as the maximum allotment, the benefit reduction rate, and shelter, medical, and child care deductions.'

In fact, most of the FSP reform proposals considered periodically by Congress imply changes in the amount of benefits for at least some eligible households. Thus, forecasting the impact of program reforms on participation requires an understanding of how participation varies across households that qualify for different levels of benefits, and, in particular, how a change in the benefit amount for a given household affects that household's probability of participation. In recognition of the importance of the benefit-participation relationship, and in light of the methodological problems involved in estimating such a behavioral relationship, we devote a separate chapter and a more in-depth analysis to this topic.

The remainder of this chapter is organized as follows. Section A evaluates the estimates of the benefit-participation relationship found in previous studies and discusses the methodological problems associated with these estimates. Section B contains our estimates of the benefit-participation relationship based on the 1985 SIPP data.

'Congress and program administrators also have partial control over aspects of the program that might affect the costs of participation, such as work-registration requirements for able-bodied adult recipients, the geographical distribution of food stamp offices, the amount of documentation required for verifying income and expenses, and the type of benefit issuance. However, typical household surveys, such as SIPP and CPS, do not contain any information on the costs that households incur when they participate in the FSP.

A. PREVIOUS ESTIMATES OF THE BENEFIT-PARTICIPATION RELATIONSHIP

The empirical evidence on the relationship between the benefit amount and FSP participation is mixed. On an a priori basis, one would expect that the data would show a positive relationship between participation and potential benefit amounts. In other words, one would expect that a household entitled to a large food stamp benefit would be more *likely* to participate in the FSP than would a household entitled to a smaller benefit, *everything else held constant. The* primary reason for this expectation lies in the existence of costs of participation--that is, the monetary and nomnonetary costs that participants incur in applying for benefits and obtaining the coupons each month. Most of these costs are fixed--that is, they do not vary with the amount of the benefit. Thus, it seems plausible that as the amount of the benefit rises without a contemporaneous change in the costs of participation, the probability of participation increases. However, existing studies have yielded divergent findings about both the sign and the magnitude of this effect.

Some studies, such as Smallwood and Blaylock (1985), Johnson et al. (1982), and Devaney and Fraker (1987), have found a positive *sign* for the effect of potential benefits on participation. All three of these studies used a linear specification for the benefit variable (explained later in this section), and were based on the 1977-78 Nationwide Food Consumption Survey, Low-Income sample (NFCS-LI). Despite these similarities, the *magnitude* of the estimated benefit effect varied substantially across the three studies (and even within each study), depending on how the participation equation was specified and how the benefit variable was constructed for nonparticipating households.

Johnson et al. used two methods to construct the potential benefit amount. The first method entailed using rather crude proxies for the benefit amount--namely household's maximum allotment and the size of the household. The second method entailed *imputing* the potential benefit for nonparticipating households using the self-reported benefit amount and other characteristics of

participating households.[2] The estimates of the benefit effect varied widely across the different specifications, in part because not all the measures of potential benefits were expressed in the same units. But even if one restricts the comparison to the estimates obtained with the imputation procedures, the differences are still substantial, as shown in the first two columns of Table V.l. The effect estimated with one imputation procedure is more than twice that estimated with the other procedure.

TABLE V.l

ESTIMATES OF THE EFFECT OF THE BENEFIT AMOUNT ON THE PROBABILITY OF FSP PARTICIPATION

Data Set/Year	NFCS 1977-78				PSID 1979	
Author(s)	Johnson et al. (1982)		Smallwood & Blaylock (1985)	Devaney & Fraker (1987)	Coe (1983)	
Method	Benefits imputed by OLS	Tobit			No. of children excluded	included
Percentage point difference in the probability of participation related to a $10 difference in the *monthly* benefit amount	2.3	4.8	1.5	1.7	0.6	-0.10

NOTE: The estimates presented by the authors were transformed to increase comparability. However, the comparability is far from perfect, due to differences in sample definitions, model specifications, and reference years. These studies are based on the Nationwide Food Consumption Survey, Low-Income sample (NFCS-LI) and on the Panel Study of Income Dynamics (PSID).

Although the primary objective of the studies by Devaney and Fraker and Smallwood and Blaylock was not to analyze FSP participation, each study included a participation equation in its model of food expenditures to control for differences between FSP participants and nonparticipants in factors that could affect expenditures on food. The two studies obtained very similar estimates of

[2]Two alternative statistical techniques were used to perform the imputation: one technique was ordinary least squares (OLS) regression corrected for selection bias using the Heckman correction procedure; the second method was a Tobit estimation procedure.

the benefit effect on participation, but they are much smaller than those obtained by Johnson et al. (Table V.1).[3]

None of these studies included household size or the number of children among the explanatory variables in the participation equation.[4] Coe (1983) found that the estimates of the benefit effect were very sensitive to the inclusion of the number of children. When this variable was excluded from the equation, the estimated effect was positive and significant (although three times smaller than that estimated by Devaney and Fraker). When the number of children was included, the effect became negative and significant, indicating that the positive effect obtained in the first specification should be interpreted as an effect of household size and composition, rather than as a net benefit effect (Table V.1).

All of the studies discussed thus far in this chapter used a ***linear*** specification for the benefit variable. A linear specification does not allow the benefit-participation relationship to change in magnitude (nonlinearity) or in sign (nonmonotonicity) over different ranges of the benefit variable. The study by Czajka (1981), based on 1979 Income Survey Development Program (ISDP) data, relaxed the linearity assumption by treating the benefit amount as a discrete variable of benefit ranges and including in the participation equation a dummy variable for each discrete interval. Czajka found that the benefit-participation relationship was positive overall but nonmonotonic--that is, it increased over certain ranges of benefits but decreased over others.

These contradictory findings in the literature are symptomatic of the methodological problems involved in analyzing the benefit-participation relationship. Based on the literature review, as well as on our own experience, we have identified the following three broad methodological issues:

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[3]Devaney and Fraker used a Tobit regression to impute the benefit amount for nonparticipants. Smallwood and Blaylock did not report the method they used to derive the benefit amount for nonparticipants.

[4]Johnson et al. included household size *only* as a ***proxy*** for the benefit amount, and not simultaneously with it.

1. ***The benefit amount cannot be observed for nonparticipants. The*** benefit amount must be imputed or simulated on the basis of the household's demographic and economic characteristics as reported in the survey. Thus, the simulated or imputed benefit variable is sensitive to a wide range of reporting errors and missing information. For example, households that underreport income during the interview are simulated to be eligible for a benefit amount larger than the amount for which they are actually eligible.

2. ***The benefit amount does not vary independently from household characteristics.*** Differences in the FSP benefit amount across households at a given point in time depend exclusively on differences in the characteristics of these households, notably differences in income, household size, and allowable deductions. If *all* the household characteristics were to enter the ***participation equation*** in exactly the same form as they enter the ***benefit determination formula,*** they would be perfectly collinear with the benefit amount, and the benefit effect on participation could not be identified. In order to identify this effect with cross-sectional data, one must impose: (a) ***exclusion restrictions***, which means that some of the determinants of the benefit amount (e.g. the shelter deduction) are assumed ***a priori*** not to affect the participation decision, so that they are excluded from the participation equation; or (b) ***functional form assumptions,*** which is to say that the determinants of the benefit amount enter the participation equation in a different form than they enter the benefit determination formula. In the next section we discuss in more detail which restrictions and functional form assumptions we imposed in order to identify the benefit effect on participation.

3. ***The complexity of the participation decision may go beyond our modelling ability and the availability of data. The*** decision process undertaken by households in choosing whether to participate in the program is likely based on factors and circumstances that are not adequately reflected in survey data nor captured by a simple one-equation econometric model. The omission of some of these circumstances might distort the estimates of the benefit-participation relationship. One example is a lack of knowledge about program eligibility rules by nonparticipating households. Households eligible for small benefit amounts may be less likely to be aware of their eligibility, but a simple model attributes their lower participation rate to the smaller benefit amounts, rather than to their lack of knowledge.

B. SIPP-BASED ESTIMATES OF THE BENEFIT-PARTICIPATION RELATIONSHIP

Our approach to the analysis of the benefit-participation relationship is more elaborate than that found in the literature, and is designed to address some of the methodological concerns discussed in the previous section. Moreover, our approach is more complex than that followed in Chapters III and IV to analyze the relationship between participation and the other household characteristics. Therefore, a brief overview of the methodology is in order.

To remedy the fact that the benefit amount for nonparticipants cannot be observed, we ***simulated*** the benefit amount on the basis of the current characteristics of food stamp households in SIPP. Measurement error and the lack of some information in SIPP (for example, on medical expenses) make this simulation imperfect. However, we believe that this solution represents a substantial advance over regression-based imputation methods or the use of crude proxies, such as household size. It is important to note that we simulated the benefit amount for *all* households, regardless of whether they were in fact receiving and reporting a benefit amount. Using reported benefits for participants but simulated benefits for nonparticipants would create a "double standard" that could bias the estimates of the benefit effect.[5]

We imposed several assumptions on the participation equation that help identifying the benefit effect. Most of these are ***ad hoc*** assumptions--that is, they are not suggested by any formal behavioral model of program participation.

- Our participation equation *excludes* the ***amounts*** of the allowable deductions. However, the ***presence*** of some deductions is captured by the explanatory variables included in the equation: (a) the receipt of earnings variable captures the earnings deduction; (b) the presence of elderly captures the possibility that a medical deduction is claimed; and (c) the presence of children captures the possibility that the dependent care deduction is claimed. However, none of these explanatory variables enters the participation equation in exactly the same form as they enter the benefit determination formula. For example, the ***amount*** of earnings determines the earnings deduction, while we control only for the receipt of earnings. Our participation equation totally excludes the excess shelter deduction, since it is not captured by any of the explanatory variables.

- Household size enters the benefit determination formula through the maximum allotment, which increases gradually with household size, in order to reflect economies in food consumption that can be realized by larger households. Our participation equation ***includes*** household size as a categorical variable--that is, as a series of dummy variables for each household size, which allows also for a nonlinear pattern. Thus, in this case, we do ***not*** impose any restriction that helps identify the benefits effect. In other words, the benefit effect that we estimate is a true effect, ***net*** of any household-size effect.

'Table II.2 (page 15) shows that the average simulated benefit for participants is 2.6 percent higher than the average benefit observed in the FSP administrative data for the same period.

- Income enters the benefit determination formula as income net of allowable deductions, while our participation equation controls for gross income divided by the poverty threshold and expressed as a categorical variable.

- Finally, all explanatory variables in the participation equation are defined for the Census households, while the benefit amount is computed for the (simulated) food stamp unit. For about 13 percent of the observations, the Census household and the simulated food stamp unit do not coincide. These cases reduce the overall correlation between the simulated benefit amount and the variables that enter into the benefit determination formula.

The last issue pertains to the specification of the benefit variable itself. We estimate two different versions of the participation equation.[6] In the first model, the benefit variable is specified in *discrete intervals,* in the same manner that we treated the other continuous variables--age, education, income, and household size--in the previous two chapters. This specification allows us to compute and compare observed and predicted participation rates for each discrete benefit interval. In the second model, we treat the benefit amount as a *continuous* variable, which is necessary in order to simulate the effect of program reforms on participation. In a simulation context, one must be able to simulate the effect of *any* change in the benefit amount, including a change that may be too small to move a given household from one benefit interval to the next.

1. FSP Participation and the Benefit Amount: The Discrete Case

The results for all FSP-eligible households are shown in Table V.2A. The predicted participation rates by level of benefits show an overall *increasing* pattern. Predicted participation rates range from 35 percent for households entitled to $10 worth of food stamps per month to 52 percent among households entitled to more than $220 per month. This relationship is not a strong one: a twentyfold difference in the level of benefits is associated with only a 17 percentage point difference in the probability of participation. If this difference is interpreted as a behavioral response, these results

[6] The other explanatory variables are the same as those used in the specification that formed the basis for the analysis in Chapter III and IV.

imply that only a very small fraction of FSP-eligible households would respond to a change in benefits by altering their participation decisions.

TABLE V.2A

PARTICIPATION BATES AMONG ALL FSP-ELIGIBLE HOUSEHOLDS, BY THE FSP BENEFIT AMOUNT

	Participation Rates		Sample
	Predicted	Observed	Size
All FSP-Eligible Households	**43.7%**	**44.2%**	**3,559**
FSP Benefit Amount:			
$10 or less	**34.8**	**25.3**	**695**
$11 to $50	**41.4**	**33.2**	**680**
$51 to **$80**	**47.4**	**38.3**	**799**
$81 to **$150**	**44.2**	**55.1**	**704**
$150 to $220	**51.0**	**70.2**	**396**
$220 or more	52.3	66.9	285

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTE: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

The only exception to the overall increasing pattern of the benefit-participation relationship is the **3** percentage point decrease in the predicted rates between two intermediate intervals of the benefit distribution ($51 to $80 and $81 to $150). However, as shown in Table C.6, the difference between the corresponding probit coefficients is not statistically significant. Despite this lack of significance, this decrease looks peculiar when compared with the 17 percentage-point increase between the same benefit levels in the observed participation rates (Table V.2A). A possible explanation for the sharp increase in the observed rate is that the two benefit intervals imply different household sizes. In 1985, one-person households could not qualify for more than $80 worth of food stamps. In fact, households in the $81 to $150 interval are entirely multiperson households, while

those in the $51 to $80 interval are predominantly one-person households (58 percent). Since one-person households have a markedly lower tendency to participate in the program, their dominant presence reduces the observed participation rate in the $51 to $80 interval. Such "shift" in terms of household composition between the two intervals does not affect the predicted participation rates, because the latter are computed for the average household size.

We now extend the analysis of the benefit-participation relationship to the four demographic subgroups (Table V.2B). The predicted participation rates by the level of benefits for ***households with an elderly member*** present a "convex" pattern, first increasing from 26 to 35 percent for benefits up to $80, and then decreasing to 30 percent for a benefit level above $80. However, the difference among the corresponding probit coefficients for the three higher intervals is not statistically significant, while the coeffkient for the benefit interval of $10 or less is significantly lower than the coefficients for higher levels of benefits (Table C.6). This basically flat profile for the predicted participation rates stands in sharp contrast with the increasing pattern of the observed participation rates, which range from 24 to 44 percent. The different pattern in the predicted and observed rates of elderly households suggests that most of the variation in the observed rates is due to a household-size effect, not to a true benefit effect. As discussed before, the highest observed participation rate (44 percent) occurs among households that qualify for more than $80 worth of benefits, all of which are multiperson households.

Another demographic group whose participation does not seem to be affected by the level of benefits are ***female-headed households with children. The*** pattern of the predicted rates is flat, with virtually no difference between the lowest and highest levels of benefits. By contrast, the observed rates exhibit a sharp increase, from 43 percent for households entitled to $50 or less in benefits to 84 percent for those entitled to more than $220. The difference between the two patterns suggests

TABLE V.2B

PARTICIPATION RATES AMONG SUBGROUPS OF THE FSP-ELIGIBLE POPULATION, BY THE FSP BENEFIT AMOUNT

	Participation Rates		Sample
	Predicted	Observed	Size
Households with an Elderly Person	30.2%	32.2%	1,346
$10 or less	26.1	23.6	531
$11 to $50	32.2	35.7	352
$51 to $80	35.4	35.1	314
$81 or more	29.7	44.2	149
Households with a Disabled Person	55.8	55.7	331
$10 or less	38.3	38.2	113
$11 to $50	56.2	56.0	69
$51 to $80	59.3	58.2	61
$81 to $150	70.5	72.2	55
$150 or more	81.5	82.8	33
Female-Headed Households with Children	78.9	69.6	940
$50 or less	77.1	43.2	134
$51 to $80	79.3	47.6	117
$81 to $150	80.4	73.9	327
$150 to $220	78.8	80.7	237
$220 or more	78.1	84.1	125
Two-Parent Households with Children	42.3	41.0	668
$50 or less	25.6	23.4	115
$51 to $80	39.8	33.7	93
$81 to $150	40.1	36.6	182
$150 to $220	53.7	56.8	129
$220 or more	50.0	50.8	149

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The predicted participation rates are computed from the probit coefficients presented in Appendix C. The observed participation rates are computed as the weighted number of households reporting FSP participation divided by the weighted number of households simulated to be eligible.

that some of the characteristics of female-headed households are strongly correlated both with the probability of participation and with the level of benefits to which they are entitled. When the effect of these other characteristics on participation is eliminated by holding them constant at their sample means, the *net* benefit effect becomes almost nonexistent.

Among ***households with a disabled member*** participation appears to be strongly influenced by the level of benefits to which they are entitled. Both their predicted rates and their observed rates exhibit a sharply increasing pattern, ranging from about 38 percent for households entitled to the $10 minimum to above 80 percent for those entitled to $150 or more. Although the differences among the various intervals are not always statistically significant, this sharply increasing pattern suggests that benefit amounts have a greater effect on the participation of households with a disabled member than on the participation of elderly households. A possible explanation for this pattern might be that disabled individuals face particularly high costs of participation.

Two-parent households with children also exhibit increasing participation rates, though not as sharp as among households with a disabled member. Both their predicted and their observed rates range from about 25 percent for households entitled to the $10 minimum benefit to about 50 percent for those entitled to $220 or more.

In conclusion, the results for the demographic subgroups imply that the participation rates of households that contain a disabled member and those headed by two adults are affected by the level of benefits, while the participation rates of female-headed households and households that contain an elderly person are not. These results are not completely surprising, given what we know about the FSP participation of these subgroups. The overall participation rates of female-headed households and elderly households are very high and very low, respectively, which tend to make them more insensitive to variations in benefit amounts than are households with a disabled member and those headed by two adults.

2. FSP Participation and the Benefit Amount: the Continuous Case

The breakdown of the benefit amount into discrete intervals is useful when conducting a descriptive analysis, as was reported in Section B.l. However, when simulating the impact of benefit changes, one must be able to simulate the effect of any change in the benefit amount, including changes that may not be large enough to move a given household from one discrete benefit interval to another. To support such simulations, one must estimate the behavioral response to a benefit change by treating the benefit amount as a ***continuous*** variable.

Adopting a continuous rather than a discrete benefit variable is not the only specification issue relevant to benefit simulations. Another is how to allow for possible *nonlinearities* in the benefit-participation relationship--that is, how to allow the response to a given dollar ***change*** in benefits to vary according to the pre-reform level of benefits. We considered three alternative specifications for the functional form of the relationship between participation and a continuous benefit variable--linear, piecewise linear, and logarithmic. The ***linear*** specification assumes that a given dollar change in benefits has the same effect on participation at any initial level of benefits. In other words, a $10 change in benefits has the same effect whether the household is currently entitled to a benefit of $20 or a benefit of $200. Since all but one of the studies reviewed in Section A relied on a linear specification, we include it as a basis of comparison.

The *piecewise* ***linear*** specification allows the magnitude and even the sign of the participation response to a change in the benefit amount to vary over different ranges of the benefit amount, while constraining the benefit-participation relationship to be linear within each range. This specification represents a fairly flexible way to specify the relationship. The main disadvantage of a piecewise linear specification is that the points ("kinks") that delimit the different ranges must be chosen arbitrarily.

The ***logarithmic*** specification has several advantages over the other two: (1) it allows for a nonlinear benefit-participation relationship, in the sense that a given dollar change in benefits has

a **progressively *smaller*** effect on participation at higher levels of benefits; (2) it forces the estimated relationship to be monotonic--that is, either always increasing or always decreasing, but never a mixture of the two; and (3) it produces only one coefficient for the benefit variable, which facilitates using the model estimates to simulate the participation response to a change in benefits.

In the remainder of this chapter, we do not present the "raw" coefficients of the benefit variable, because these coefficients are not comparable across the three specifications. Rather, we convert them into more readily interpretable measures of the benefit-participation relationship, measures that can be compared across the different specifications. We present these measures in Table V.3 and the mathematical formulas used to compute them in Appendix E, together with the "raw" probit coefficients.

In Table V.3, we first show the ***predicted participation rates,*** computed at different levels of benefits for a household with average characteristics. The purpose of presenting these rates is to give a sense of the overall pattern of the benefit-participation relationship implied by the three specifications. The predicted participation rates are also plotted in Figure V.l. The second measure we show in Table V.3 is the ***change in the probability ofparticipation*** associated with a $10 change in benefits, again computed at different levels of benefits for an average household. Finally, we present two measures computed not for an average household, but across ***all households. They*** are the ***change in the*** *average* ***participation rate*** associated with a $10 increase in benefits for all households, and with an 8.6 percent increase also given for all households. In 1985, these increases in benefits would have had a roughly equivalent budgetary impact (the average benefit paid out to FSP recipients in 1985 was $116, so that a generalized 8.6 increase is equivalent in the aggregate to a $10 increase for every recipient). These two measures are similar to those typically obtained in a microsimulation environment, in which the effect of a benefit change is simulated for each eligible household in the sample, rather than for a "representative" household.

TABLE V.3

THE BENEFIT-PARTICIPATION RELATIONSHIP ESTIMATED WITH ALTERNATIVE SPECIFICATIONS OF THE BENEFIT VARIABLE

Predicted Participation Rates
Computed at Different Levels of Benefits for an Average Household

Level of Benefits	Linear Specification	Piecewise Linear Specification	Logarithmic Specification
$10	40.0	35.5	34.7
$30	41.0	40.6	40.6
$80	43.4	47.8	45.9
$150	46.8	47.4	49.5
$220	50.2	49.5	51.6
$300	54.2	52.0	53.3

Change in the Participation Rate Associated with a $10 Increase in Benefits
Computed at Different Levels of Benefits for an Average Household
(percentage point change)

Level of Benefits	Linear Specification	Piecewise Linear Specification	Logarithmic Specification
$10	.476	254	5.16
$30	.479	1.40	1.81
$80	.485	-.055	.693
$150	.490	.312	.372
$220	.492	.312	.253
$300	.489	.312	.185

Change in the Participation Rate, Computed Across All Households
(percentage point change)

Type of Benefit Change	Linear Specification	Piecewise Linear Specification	Logarithmic Specification
$10 increase	.328	.843	.903
8.6% increase	.260	.300	.306

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The mathematical formulas used to derive the estimates shown in this table are presented in Appendix E, together with the probit coefficients.

a. The Effects for an Average Eligible Household

According to the linear specification, participation increases with the benefit amount, but the effect is very small. This pattern is evident in Figure V.l, in which the linear specification of the benefit-participation relationship is shown as a straight line with a very flat slope. Equivalently, the middle panel in Table V.3 shows that a $10 increase in benefits is associated with approximately half of a percentage point increase in the probability of participation for an average household, regardless of whether this household currently receives, say, $10 or $200 worth of benefits.'

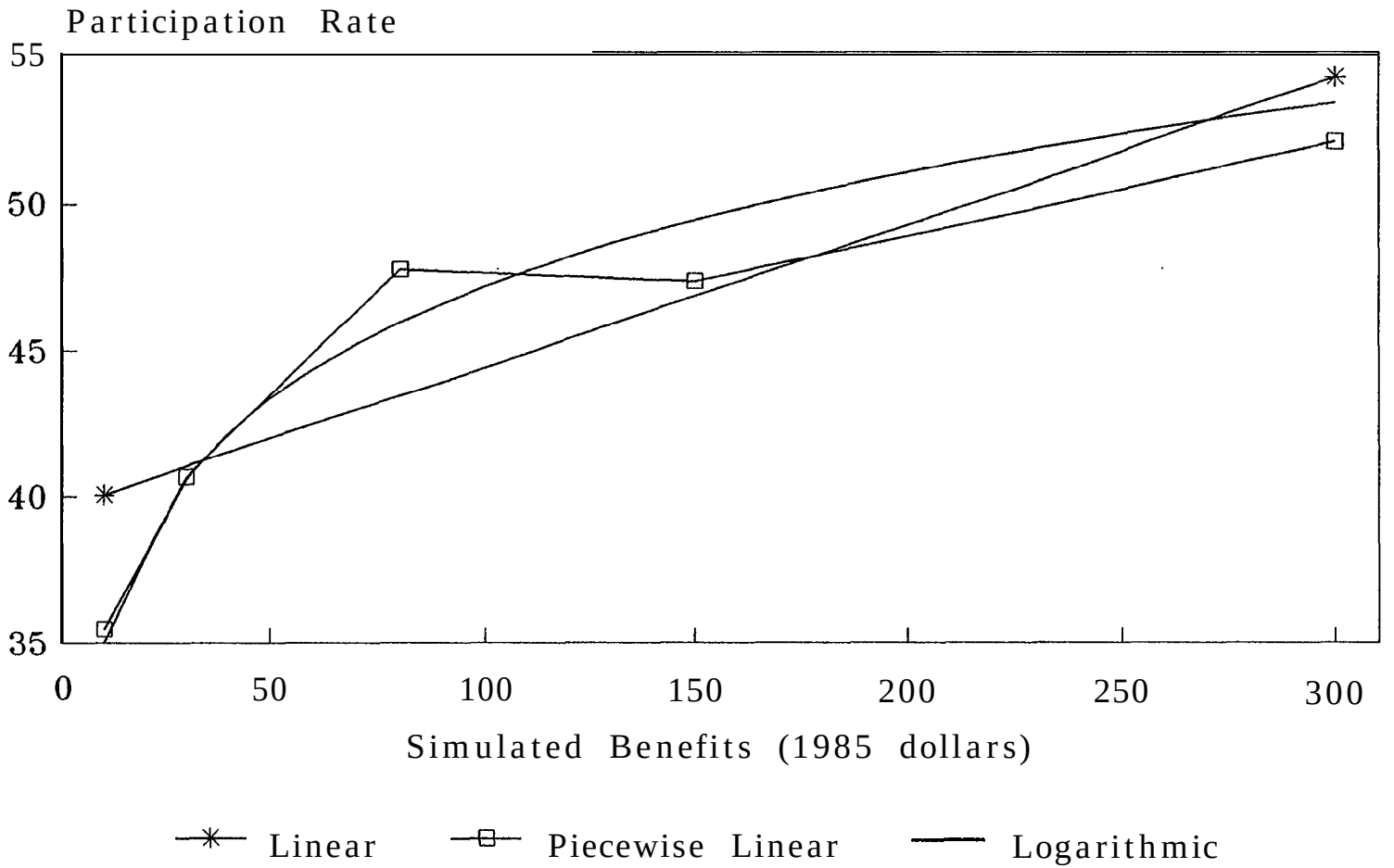
The patterns of participation implied by the two other specifications differ considerably from a linear one. The piecewise linear specification shows a more flexible pattern, but also an "irregular" (or nonmonotonic) one: the response to a change in benefits is positive and relatively large at low levels of benefits, negative (albeit very small) in the $80 to $150 range, and positive again at higher levels. This irregular pattern can be easily be seen in Figure V.l and in the middle panel of Table v.3.

The logarithmic specification yields an overall pattern very similar to the overall pattern of the piecewise linear (Figure V.1). In terms of the participation response to a $10 change in benefits, the logarithmic specification implies a 5 percentage point increase in the probability of participation for an (average) household currently entitled to $10 worth of benefits (for whom, in other words, benefits would double), but a much smaller response (a quarter of a percentage point) for a household entitled to a $220 benefit. This pattern--that is, the probability of participation increases at a decreasing rate--is a mathematical property of the logarithmic function. However, this is the pattern roughly followed by the piecewise linear specification. We believe that in this context the logarithmic

[7] These estimates are about half of those reported in Table V.1 and obtained from Devaney and Fraker (1987) and Smallwood and Blaylock (1985), adjusted for price change. If we used the rate of increase in the maximum allotment for a family of four between 1978 ($170) and 1985 ($264), the response to a $10 change in benefits in 1985 should be equivalent to the response to a $6.44 change in 1978. Therefore, the estimates comparable to those in Table V.3 become 1.1 percentage points for Devaney and Fraker, and 0.95 percentage points for Smallwood and Blaylock.

FIG. V. 1 ALTERNATIVE SPECIFICATIONS FOR THE BENEFIT-PARTICIPATION RELATIONSHIP

All Eligible Households



specification represents a defensible way to "smooth out" the irregular pattern created by the piecewise linear specification.

When simulating the participation response to a change in benefits, a nonmonotonic relationship can generate absurd results, such as a simulated *decrease* in the participation rate in response to an increase in benefits. We believe that the correct strategy for addressing this problem is to exploit the *overall* positive sign of the benefit-participation relationship implied by all specifications. The results of our specifications suggest that the logarithmic specification is an effective way to incorporate this positive relationship without the rigidity implicit in a linear specification.

b. Average Effect Across All Households

The bottom panel of Table V.3 presents estimates of the change in the participation rate among all households associated with two different types of "reforms": a $10 increase and an 8.6 percent increase in benefits given to all households. Although the federal budget impacts of such hypothetical (and perhaps implausible) reforms would be roughly similar, as argued before, their distributional impact would be very different. In 1985, a flat $10 increase would have doubled the level of benefits for a large number of eligible households, while these same households would have received less than a dollar in additional benefits following an 8.6 percent increase. Thus, we would expect that the "$10 reform" would generate a larger participation response than. the "8.6 percent reform." The bottom panel of Table V.3 shows that the linear specification is unable to capture this difference: both types of reforms would elicit roughly the same response--about a third of a percentage point increase in the overall participation rate. The piecewise and logarithmic specifications imply a larger response to the $10 reform (closer to one percentage point), and a much smaller one to the 8.6 percent reform (0.3 percentage points).

Besides shedding more light on the appropriateness of nonlinear specifications of the benefit variable in a participation equation, these findings highlight another, and perhaps more important, fact: *the participation response to a benefit change implied by these specifications is small. Even* the

largest estimates (based on the logarithmic specification) suggest that a benefit increase of 8.6 percent for all eligible households would increase the participation rate only by a third of a percentage point.

VI. SUMMARY AND CONCLUSIONS

Policymakers have expressed considerable interest in the relationship between household characteristics and participation in the Food Stamp Program. Although several studies have used multivariate analysis to examine this relationship and have identified characteristics that are positively or negatively associated with FSP participation, most of them relied on data that were collected prior to the elimination of the food stamp purchase requirement in 1979. In this report, we have used 1985 SIPP data to update previous multivariate analyses of participation in the FSP. We conducted the analysis both for the entire eligible population and for the following four demographic subgroups: households with an elderly member, households with a disabled member, two-parent households with children, and female-headed households with children. In this chapter, we highlight the most important findings of this report.

A. THE DEMOGRAPHIC CHARACTERISTICS OF HOUSEHOLDS

We examined the relationship between several demographic characteristics (the age, education, and race and ethnicity of the reference person, the presence of children, and household size) and FSP participation. In general, households in which the reference person is younger than age 40 participate at higher rates than do households with an older reference person. Among the elderly, households headed by a person age 70 or older participate at a significantly lower rate than those headed by an individual 60 to 69 years, implying that the participation behavior of the elderly FSP-eligible population should not be viewed as homogeneous. Further, as we expected based on previous research, participation rates tend to decline as the education of the reference person increases, so that participation is generally lowest among households in which the head has more than a high school education. However, net differences in participation between black and white households are much less prevalent than indicated by previous research and seem to exist only between black and white households that contain a disabled member. Another finding that was

somewhat unexpected given the results of previous studies was that the presence of children younger than age 18, independent of other household characteristics, does not have a substantial effect on the probability of participation. Finally, larger households tend to participate at higher rates than do smaller households; in particular, participation is exceptionally low among one-person households.

Because so many elderly households contain only one person, we investigated the relationship between one-person households and elderly households and found that, excluding the effect of age, one-person households participate at very low rates, and, excluding the effect of household size, households that contain an elderly member participate at significantly lower rates than do households that do not contain an elderly member. However, being elderly and living alone does not appear to have any ***additional*** effect on the probability of participation.

B. THE ECONOMIC CHARACI'EFUSTICS OF HOUSEHOLDS

In addition to examining the demographic characteristics of households, we examined the relationship between several economic characteristics of households (the ratio of the household's income to the poverty threshold, whether the household receives public assistance, whether the household has earnings, and whether the household has positive assets) and FSP participation. We found that households that report receiving no income participate at rates that were lower than one would expect, given their lack of resources. However, this low rate of participation is probably due to the fact that income is underreported in SIPP. In general, the participation rates of households that reported positive incomes decline as the income to poverty ratio increases. We found that the receipt of public assistance is the strongest predictor of FSP participation--households that receive public assistance participate at substantially higher rates than those that do not. Although previous studies have consistently found that earnings are negatively associated with participation, we found that the effect of the presence of earnings was large and statistically significant only among female-headed households with children.

C. THE FSP BENEFIT AMOUNT

We also investigated the relationship between the probability of participation and the size of the benefit to which the household is entitled. Rather than merely providing descriptive information, the purpose of this analysis was to generate estimates that could be used in simulations of program reforms--that is, to predict how FSP participation would change under a reform that alters the size and distribution of the benefit across household types.

We found that the relationship between the FSP benefit amount and participation in the program is *positive* overall. However, when income, household size, and other demographic and economic characteristics are held constant, the net effect of the benefit amount on participation is rather *small*: the difference in the participation rate between households that are entitled to food stamp benefits worth $10 or less and those that are entitled to more than $220 is approximately 15 percentage points. An intuitive way to express the relationship between benefits and participation is the percentage point increase in participation associated with a $10 increase in benefits. The analysis suggests that such an increase elicits a different response according to the current level of benefits: at $30 of current benefits, the participation response to a $10 increase is 1.5 percentage points. However, the response drops to 0.35 percentage points at $150 of current benefits.

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APPENDIX A

TABLE A.1

THE DIRECTION AND SIGNIFICANCE OF THE ESTIMATED EFFECTS OF THE FSP BENEFIT AMOUNT AND SELECTED HOUSEHOLD CHARACTERISTICS ON THE PROBABILITY OF PARTICIPATION IN THE FSP, FROM EIGHT MULTIVARIATE ANALYSES

(Table 3 in Allin and Beebout, 1989)

	Study, Data Source, and Year(s) Data Collected							
	MacDonald (1977) 1972 PSID[a]	Czajka[b] (1981) 1979	Johnson, Chen, and Burt[d] (1982) ISDP[c] 1977-1978[e] NFCS-LI	Coe (1983) 1979 PSID[a]	Chen and Johnson[f] (1982) 1977-1978[e] NFCS-LI	Chen (1983) 1977-1978[e] NFCS-LI	Smallwood and Blaylock (1985) 1977-1978[e] NFCS-LI	Devaney and Fraker (1987) 1977-1978[e] NFCS-LI
FSP Benefit Amount	+ #	t	+ #	- #	g	+[h] #	+[i]	+ #
Household Income	j	t[k]	- #	- #	+[g]	- #	[l]	- #
Education of Household Head	-[m] #	_ #	_ #	- #	- #	-[n] #	- #	- #
Race Is Black/Nonwhite		+ #	+ #	t	+ #	+	+ #	+ #
Female Head of Household Only		+ #	+ #	-[o]	+ #	+ #	+ #	+[p] #
Male Head of Household Only			- #	-[o] #		- #		
Head of Household Employed	-[q] #	-[r]	- #	- #	- #	- #	- #	- #
Household Receives Other Welfare Assistance	+ #	+ #	+ #	+ #	+ #	+ #		
Household Head Is Elderly	- #	- #	- #	[0]	- #	- #		- #
Household Owns Home			- #		- #	- #	- #	- #
Household Located in Northeast	- #		+ #		+ #	+ #	+ #	+[s] #

NOTES: A "+" signifies that this variable was estimated to have a positive effect on the probability of participation in the FSP, while a "-" signifies that the estimated effect was negative. A "#" signifies that the estimated effect was significant at or below the .10 level. The variables included in this table are a subset of all of the variables that were included in these studies.

[a]Panel Study of Income Dynamics.

[b]Separate equations were estimated from two models for each of three months. One model (Model 1) included welfare income as an explanatory variable, while the other model (Model 2) did not. The sign and significance refer to the findings in the majority of the equations from Model 2.

[c]Income Survey Development Program Research Test Panel.

TABLE A.1 (continued)

[d]Results are for the LGT4 model, which the authors found to dominate the other models estimated.

[e]Low-Income Supplement to the Nationwide Food Consumption Survey.

[f]Results are for the logit-recursive model, which the authors found to dominate the other models estimated.

[g]Chen and Johnson included the FSP benefit amount in the measure of household income. Thus, the separate effect of the benefit cannot be determined, and this measure of household income may not be comparable to the measures used in the other studies. The authors did include a measure of the maximum food stamp allotment, and found that it had a significant positive effect on the probability of participation.

[h]Chen included the FSP maximum allotment, not the FSP benefit amount.

[i]We obtained the sign of the.food stamp benefit effect from the derived reduced form of Smallwood and Blaylock's participation equation. No level of significance is available.

[j]MacDonald did not include household income in the study but did include a four-year (1968-1971) sum of the household's decile position in the size distribution of a family income-needs ratio.

[k]The household income measure used in this paper was household income divided by the value of the household's poverty threshold.

[l]Household income was included in Smallwood and Dlaylock's structural model, but a reduced-form estimate of the effect of this variable on participation is not available.

[m]The effect of an education of 9 to 11 years on the probability of participation was not significant.

[n]The coefficient on the indicator for high school education was not significant, but the coefficient on the indicator for college education was significant.

[o]Coe combined the age, gender, and martial status variables into a composite variable. He found that households headed by unmarried women were less likely to participate in the FSP than married couples ages 30 to 39 years, and this effect was significant for women 60 or older. Households headed by men 30 or older were significantly less likely to participate than those in other groups.

[p]This effect was not significant when the estimated equation was unweighted.

[q]This indicator is for whether the household head was in the labor force and does not differentiate between employed and unemployed.

[r]The indicator equals 1 if the household received any employment income.

[s]The category is Northeast and Central.

APPENDIX B

TABLE B.1

FREQUENCY DISTRIBUTIONS OF THE EXPLANATORY VARIABLES
(unweighted frequencies)

	All Eligible Households	Households with Elderly Person	Households with Disabled Person	Female-Headed Households	Two-Parent Households
Age of Reference Person:					
15 to 29 years	.226		.108	.371	.309
30 to 39 years	.200	-	.187	.356	.362
40 to 59 years	.216	-	.583	.225	.263
Less than 60 years	-	.054			
60 to 69 years	.141	.372			
70 years or older	.216	.572	-	-	-
60 years or older			.120	.046	.064
Race/Ethnicity of Reference Person:					
White non-Hispanic	.616	.678	.586	.444	.649
Black non-Hispanic	.270	.251	.314	.407	.169
Hispanic	.112	.070	.099	.147	.181
Education of Reference Person:					
Less than high school	.584	.778	.634	.367	.489
High school	.286	.155	.262	.514	.360
More than high school	.129	.066	.102	.118	.149
Size of Household:					
1 person	.343	,603	.317	-	-
2 persons	.209	.237	.283	.241	-
3 persons	.157	,069	.148	.311	.208
4 persons	.130	.035	.105	.218	.318
5 persons	.159	.053	.145	.228	,473
Presence of Children:					
Children present	.480	-	-	-	-
Children not present	.520				
Household Income/Poverty Threshold:					
Zero	.044	.052	-	.021	.046
1 to 50 percent	.182	.058	.048	.340	.200
51 to 75 percent	.183	.142	.262	.259	.160
76 to 100 percent	.255	.363	.262	.167	.239
101 percent and more	.332	.430	.425	.211	.353
Receipt of Public Assistance:					
Does receive	.411	.395	.770	.637	.258
Does not receive	.589	.605	.230	.363	.742
Presence of Assets:					
Has assets	.439	.502	.386	.246	.574
Does not have assets	.561	.498	.614	.754	.426
Presence of Earnings:					
Has earnings	.353	.147	.208	.397	.661
Does not have earnings	.647	.853	.792	.603	,339
FSP Benefit Amount:					
$10 or less	.197	.395	.343	-	-
$11-$50	.191	,261	.208	-	-
$50 or less	-	-	-	.143	.173
$51-$80	.224	-	.184	.124	.139
$81-$150	.197	-	.166	.347	.272
$151-$220	.111	-		.252	.193
$221 or more	.080	-		.132	.223
$80 or more		.110			
$151 or more		-	.099	-	

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The frequency distributions of some variables do not sum up to unity due to rounding.

APPENDIX C

TABLE C.1

EFFECTS OF A UNIT CHANGE IN THE EXPLANATORY VARIABLES ON THE PROBABILITY OF FSP PARTICIPATION: ALL FSP-ELIGIBLE HOUSEHOLDS

	Probit Coefficients x Normal Density Evaluated at the Mean x 100 (t-Statistics of the Probit Coefficients)							
Age of Reference Person:								
15 to 29 years			-6.24	(1.99)	1.81	(0.58)	3.88	(0.97)
30 to 39 years	6.24	(1.99)			8.06	(2.53)	10.1	(2.50)
40 to 59 years	-1.81	(0.58)	-8.06	(2.53)			2.06	(0.59)
60 to 69 years	-3.88	(0.97)	-10.1	(2.50)	-2.06	(0.59)		
70 years and older	-16.6	(4.18)	-22.9	(5.60)	-14.8	(4.37)	-12.7	(3.86)
Race/Ethnicity of Reference Person:								
White non-Hispanic			-5.03	(2.16)	2.90	(0.89)	2.90	(0.89)
Black non-Hispanic	5.03	(2.16)			7.93	(2.29)	7.93	(2.29)
Hispanic	-2.90	(0.89)	-7.93	(2.29)				
Education of Reference Person:								
Less than high school			4.77	(1.99)	16.0	(4.80)	16.0	(4.80)
High school	-4.77	(1.99)			11.2	(3.29)	11.2	(3.29)
More than high school	-16.0	(4.80)	-11.2	(3.29)				
Size of Household:								
1 person			-11.1	(3.72)	-18.6	(4.50)	-14.1	(2.98)
2 persons	11.1	(3.72)			-7.51	(2.09)	-3.00	(0.73)
3 persons	18.6	(4.50)	7.51	(2.09)			4.51	(1.22)
4 persons	14.1	(2.98)	3.00	(0.73)	-4.51	(1.22)		
5 persons	14.5	(3.03)	3.39	(0.82)	-4.13	(1.16)	.383	(0.10)
Presence of Children:								
Children present	6.53	(1.74)	6.53	(1.74)	6.53	(1.74)	6.53	(1.74)
Household Income/Poverty Threshold:								
Zero			-16.8	(3.27)	-14.0	(2.71)	-.505	(2.59)
1 to 50 percent	16.8	(3.27)			2.86	(.849)	4.41	(14.2)
51 to 75 percent	14.0	(2.71)	-2.86	(.849)			3.84	(11.4)
76 to 100 percent	2.59	(.505)	-14.2	(4.41)	-11.4	(3.84)		
101 percent and more	-12.1	(2.29)	-29.0	(8.79)	-26.1	(8.73)	-5.6;	(14.7)
Receipt of Public Assistance:								
Does receive	47.7	(21.9)	47.7	(21.9)	47.7	(21.9)	47.7	(21.9)
Presence of Assets:								
Has assets	-14.1	(6.77)	-14.1	(6.77)	-14.1	(6.77)	-14.1	(6.77)
Presence of Earnings:								
Has earnings	-9.11	(3.40)	-9.11	(3.40)	-9.11	(3.40)	-9.11	(3.40)
Constant	-27.4	(5.28)	8.27	(1.68)	-20.3	(3.33)	-32.59	(5.38)
Normal Density Evaluated at the Mean	.3943		.3943		.3943		.3943	

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The estimates presented in different columns are based on algebraically equivalent specifications of the same participation equation: each specification uses a different excluded level for each multi-level variable. The fifth specification has been omitted in order to make the table more legible: the same information can be gathered from the last row for each variable. The underlying probit coefficients can be calculated by dividing the marginal effects shown in the table by the normal density function evaluated at the sample means, reported at the bottom of each column.

TABLE C.2

EFFECTS OF A **UNIT CHANGE IN** THE **EXPLANATORY** VARIABLES
ON THE **PROBABILITY OF FSP PARTICIPATION:**
HOUSEHOLDS WITH AN ELDERLY PERSON

	Probit Coefficients x Normal Density Evaluated at the Mean x 100 (t-Statistics of the Probit Coefficients)							
Age of Reference Person:								
Less than 60 years			-4.29	(0.69)	4.36	(0.68)	4.36	(0.68)
60 to 69 years	4.29	(0.69)			8.66	(2.92)	8.66	(2.92)
70 years and older	-4.36	(0.68)	-8.66	(2.92)				
Race/Ethnicity of Reference Person:								
White non-Hispanic			-1.78	(0.33)	-4.99	(1.56)	-4.99	(1.56)
Hispanic	1.78	(0.33)	-		-3.20	(0.57)	-3.20	(0.57)
Black non-Hispanic	4.99	(1.56)	3.20	(0.57)				
Education of Reference Person:								
Less than high school			4.29	(1.07)	4.40	(0.72)	4.40	(0.72)
High school	-4.29	(1.07)			.109	(0.01)	.109	(0.01)
More than high school	-4.40	(0.72)	-.109	(0.01)				
Size of Household:								
1 person			-6.12	(1.77)	-16.7	(3.00)	-21.4	(2.78)
2 persons	6.12	(1.77)			-10.6	(1.87)	-15.3	(1.98)
3 persons	16.7	(3.00)	10.6	(1.87)			-4.71	(0.56)
4 persons	21.4	(2.78)	15.3	(1.98)	4.71	(0.56)	-	
5 persons	24.1	(3.55)	18.0	(2.65)	7.45	(0.99)	2.73	(0.30)
Household Income/Poverty Threshold:								
Zero			-9.85	(.455)	-20.3	(.951)	-17.7	(.843)
1 to 50 percent	9.8;	(.455)			-10.4	(1.55)	-7.89	(1.27)
51 to 75 percent	20.3	(.959)	10.4	(1.55)			2.58	(.629)
76 to 100 percent	17.7	(.843)	7.89	(1.27)	-2.58	(.623)		
101 percent and more	1.00	(.048)	-8.84	(1.40)	-19.3	(4.49)	-16.;	(5.04)
Receipt of Public Assistance:								
Does receive	32.0	(11.35)	32.0	(11.35)	32.0	(11.35)	32.0	(11.35)
Presence of Assets:								
Has assets	-13.4	(4.71)	-13.4	(4.71)	-13.4	(4.71)	-13.4	(4.71)
Presence of Earnings:								
Has earnings	-.164	(0.03)	-.164	(0.03)	-.164	(0.03)	-.164	(0.03)
Constant	-39.5	(1.82)	-20.9	(2.36)	-7.39	(0.84)	-22.8	(2.22)
Normal Density Evaluated at the Mean	.3492		.3492		.3492		.3492	

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The estimates presented in different columns are based on algebraically equivalent specifications of the same participation equation: each specification uses a different excluded level for each multi-level variable. The fifth specification has been omitted in order to make the table more legible: the same information can be gathered from the last row for each variable. The underlying probit coefficients can be calculated by dividing the marginal effects shown in the table by the normal density function evaluated at the sample means, reported at the bottom of each column.

TABLE C.3

EFFECTS UF A UNIT CHANGE IN THE EXPLANATORY VARIABLES ON THE PROBABILITY OF FSP PARTICIPATION: HOUSEHOLDS WITH A DISABLED PERSON

	Probit Coefficients x Normal Density Evaluated at the Mean x 100 (t-Statistics of the Probit Coefficients)							
Age of Reference Person:								
15 to 29 years			-3.59	(0.30)	13.8	(1.33)	23.1	(1.75)
30 to 39 years	3.59	(0.30)			17.4	(2.01)	26.7	(2.29)
40 to 59 years	-13.8	(1.33)	-17.4	(2.01)			9.23	(0.97)
60 years or older	-23.1	(1.75)	-26.7	(2.29)	-9.23	(0.97)		
Race/Ethnicity of Reference Person:								
White non-Hispanic			-7.26	(0.70)	-15.7	(2.28)	-15.7	(2.28)
Hispanic	7.26	(0.70)			-8.45	(0.78)	-8.45	(0.78)
Black non-Hispanic	15.7	(2.28)	8.4;	(0.78)				
Education of Reference Person:								
Less than high school			5.52	(0.75)	8.40	(0.80)	8.40	(0.80)
High school	-5.5;	(0.75)			2.88	(0.26)	2.88	(0.26)
More than high school	-8.40	(0.80)	-2.88	(0.26)				
Size of Household:								
1 person			-11.1	(1.42)	-2.81	(0.28)	-24.3	(2.12)
2 persons	11.1	(1.42)			8.33	(0.86)	-13.2	(1.16)
3 persons	2.81	(0.28)	-8.33	(0.86)			-21.5	(1.75)
4 persons	24.3	(2.12)	13.2	(1.16)	21.5	(1.75)		
5 persons	23.4	(2.17)	12.2	(1.16)	20.6	(1.82)	-.934	(0.07)
Household Income/Poverty Threshold:								
1 to 50 percent			-5.49	(.365)	4.02	(.263)	15.1	(.985)
51 to 75 percent	5.49	(.365)			9.51	(1.12)	20.6	(2.56)
76 to 100 percent	-4.02	(.263)	-9.5;	(1.12)			11.0	(1.40)
101 percent and more	-15.1	(.985)	-20.6	(2.56)	-11.0	(1.40)		
Receipt of Public Assistance:								
Does receive	29.4	(3.99)	29.4	(3.99)	29.4	(3.99)	29.4	(3.99)
Presence of Assets:								
Has assets	-6.00	(0.95)	-6.00	(0.95)	-6.00	(0.95)	-6.00	(0.95)
Presence of Earnings:								
Has earnings	-16.1	(1.80)	-16.1	(1.80)	-16.1	(1.80)	-16.1	(1.80)
Constant	-8.16	(0.41)	9.58	(0.60)	-24.0	(1.57)	-19.6	(1.06)
Normal Density Evaluated at the Mean	.3945		.3945		.3945		.3945	

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The estimates presented in different columns are based on algebraically equivalent specifications of the same participation equation: each specification uses a different excluded level for each multi-level variable. The fifth specification has been omitted in order to make the table more legible: the same information can be gathered from the last row for each variable. The underlying probit coefficients can be calculated by dividing the marginal effects shown in the table by the normal density function evaluated at the sample means, reported at the bottom of each column.

TABLE C.4

EFFECTS OF A UNIT CHANGE IN THE EXPLANATORY VARIABLES
ON THE PROBABILITY OF FSP PARTICIPATION:
FEMALE-HEADED HOUSEHOLDS WITH CHILDREN

	Probit Coefficients x Normal Density Evaluated at the Mean x 100 (t-Statistics of the Probit Coefficients)							
Age of Reference Person:								
15 to 29 years			.289	(0.07)	12.1	(2.84)	12.7	(1.76)
30 to 39 years	-.289	(0.07)			11.8	(2.79)	12.4	(1.73)
40 to 59 years	-12.1	(2.84)	-11.8	(2.79)			.588	(0.08)
60 years or older	-12.7	(1.76)	-12.4	(1.73)	-.588	(0.08)	-	
Race/Ethnicity of Reference Person:								
White non-Hispanic	-		.953	(0.18)	-.488	(0.13)	-.488	(0.13)
Hispanic	-.953	(0.18)			-1.44	(0.28)	-1.44	(0.28)
Black non-Hispanic	.488	(0.13)	1.44	(0.28)				
Education of Reference Person:								
Less than high school			8.37	(2.31)	4.84	(0.93)	4.84	(0.93)
High school	-8.3;	(2.31)			-3.52	(0.68)	-3.52	(0.68)
More than high school	-4.84	(0.93)	3.52	(0.68)				
Size of Household:								
2 persons			-5.99	(1.40)	-10.1	(2.10)	-11.2	(2.28)
3 persons	5.99	(1.40)			-4.20	(0.92)	-5.27	(1.17)
4 persons	10.1	(2.10)	4.20	(0.92)			-1.07	(0.21)
5 persons	11.2	(2.28)	5.27	(1.17)	1.07	(0.21)		
Household Income/Poverty Threshold:								
Zero	-		-26.3	(2.70)	-22.7	(2.32)	-9.48	(.932)
1 to 50 percent	26.3	(2.70)			3.51	(.747)	16.8	(3.33)
51 to 75 percent	22.7	(2.32)	-3.5;	(.745)			13.3	(2.78)
76 to 100 percent	9.48	(.934)	-16.8	(3.33)	-13.3	(2.78)		
101 percent and more	4.82	(.466)	-21.4	(4.11)	-17.9	(3.75)	-4.66	(1.01)
Receipt of Public Assistance:								
Does receive	41.2	(11.68)	41.2	(11.68)	41.2	(11.68)	41.2	(11.68)
Presence of Assets:								
Has assets	-9.25	(2.54)	-9.25	(2.54)	-9.25	(2.54)	-9.25	(2.54)
Presence of Earnings:								
Has earnings	-15.2	(3.74)	-15.2	(3.74)	-15.2	(3.74)	-15.2	(3.74)
Constant	-13.1	(1.37)	10.6	(1.54)	-1.06	(0.14)	-1.06	(0.14)
Normal Density Evaluated at the Mean	.2871		.2871		.2871		.2871	

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The estimates presented in different columns are based on algebraically equivalent specifications of the same participation equation: each specification uses a different excluded level for each multi-level variable. The fifth specification has been omitted in order to make the table more legible: the same information can be gathered from the last row for each variable. The underlying probit coefficients can be calculated by dividing the marginal effects shown in the table by the normal density function evaluated at the sample means, reported at the bottom of each column.

TABLE C.5

EFFECTS OF A UNIT CHANGE IN THE EXPLANATORY VARIABLES UN THE PROBABILITY OF FSP PARTICIPATIUN: TWO-PARENT HOUSEHOLDS WITH CHILDREN

	Probit Coefficients x Normal Density Evaluated at the Mean x 100 (t-Statistics of the Probit Coefficients)							
Age of Reference Person:								
15 to 29 years			-12.0	(2.11)	-1.30	(0.21)	-13.8	(1.39)
30 to 39 years	12.0	(2.11)			10.7	(1.90)	-1.82	(0.19)
40 to 59 years	1.30	(0.21)	-10.7	(1.90)			-12.5	(1.31)
60 years or older	13.8	(1.39)	1.82	(0.19)	12.5	(1.31)		
Race/Ethnicity of Reference Person:								
White non-Hispanic			13.3	(2.17)	-.348	(0.05)	-.348	(0.05)
Hispanic	-13.3	(2.17)			-13.7	(1.83)	-13.7	(1.83)
Black non-Hispanic	.348	(0.05)	13.;	(1.83)				
Education of Reference Person:								
Less than high school			-5.59	(1.13)	10.9	(1.58)	10.9	(1.58)
High school	5.59	(1.13)			16.5	(2.38)	16.5	(2.38)
More than high school	-10.9	(1.58)	-16.5	(2.38)	-			
Size of Household:								
3 persons			8.47	(1.38)	8.57	(1.40)	8.57	(1.40)
4 persons	-8.47	(1.38)	-		.097	(0.01)	.097	(0.01)
5 persons	-8.57	(1.40)	-.097	(0.01)				
Household Income/Poverty Threshold:								
Zero			-11.7	(1.06)	-13.0	(1.12)	11.5	(1.00)
1 to 50 percent	11.;	(1.06)			-1.25	(.174)	23.2	(3.45)
51 to 75 percent	13.0	(1.12)	1.25	(.174)			24.5	(3.50)
76 to 100 percent	-11.5	(1.00)	-23.2	(3.45)	-24.;	(3.50)		
101 percent and more	-18.3	(1.55)	-30.1	(4.45)	-31.3	(4.55)	-6.85	(1.15)
Receipt of Public Assistance:								
Does receive	61.0	(10.33)	61.0	(10.33)	61.0	(10.33)	61.0	(10.33)
Presence of Assets:								
Has assets	-15.0	(3.20)	-15.0	(3.20)	-15.0	(3.20)	-15.0	(3.20)
Presence of Earnings:								
Has earnings	6.49	(1.15)	6.49	(1.15)	6.49	(1.15)	6.49	(1.15)
Constant	-12.7	(1.17)	-4.15	(0.43)	-30.6	(2.88)	-30.6	(2.88)
Normal Density Evaluated at the Mean	.3912		.3912		.3912		.3912	

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The estimates presented in different columns are based on algebraically equivalent specifications of the same participation equation: each specification uses a different excluded level for each multi-level variable. The fifth specification has been omitted in order to make the table more legible: the same information can be gathered from the last row for each variable. The underlying probit coefficients can be calculated by dividing the marginal effects shown in the table by the normal density function evaluated at the sample means, reported at the bottom of each column.

TABLE C.6

EFFECTS OF A CHANGE IN THE BENEFIT AMOUNT ON THE PROBABILITY OF FSP PARTICIPATION

FSP Benefit Amount	Probit Coefficients x Normal Density Evaluated at the Mean x 100 (t-Statistics of the Probit Coefficients)							
All Eligible Households	(Normal density at the mean = .3943)							
$10 or less			-7.18	(2.17)	-12.6	(3.69)	-9.56 (2.19)	-16.1 (2.86)
fll-$50	7.18	(2.17)						-9.00 (1.78)
$51-$80	12.6	(3.69)	5.4;	(1.73)	-5.42	(1.73)	-2.38 3.03 (0.63) (0.87)	-3.57 *(0.77)*
$81-$150	9.56	(2.19)	2.38	(0.63)	-3.03	(0.87)		*-6.61 (1.61)*
$151-$220	16.1	(2.86)	9.00	(1.78)	3.57	(0.77)	6.6; (1.61)	-
$221 or more	17.5	(2.61)	10.3	(1.68)	4.91	(0.86)	7.95 (1.55)	1.33 *(0.26)*
Households with an Elderly Person	(Normal density at the mean = .3492)							
$10 or less	-		-6.54	(1.83)	-9.37	(2.42)	-5.13 (.868)	-5.13 (.868)
$11-$50	6.54	(1.83)	2.82	(.726)	-2.82	(.726)	4.23 1.40 (.749) (.246)	1.40 (.246)
$51-$80	9.37	(2.42)						4.23 (.749)
$80 or more	5.13	(0.86)	-1.40	(.246)	-4.23	(.749)	-	
Households with a Disabled Person	(Normal density at the man = .3954)							
$10 or less			-17.7	(2.04)	-20.8	(2.34)	-32.5 (2.88)	-46.1 (2.87)
$11-$50	17.;	(2.04)	3.09	(0.32)	-3.09	(0.32)	-11.6 -14.7 (1.32)	-28.3 (1.80)
$51-$80	20.8	(2.34)					(1.03)	-25.3 (1.62)
$81-$150	32.5	(2.88)	14.7	(1.32)	11.6	(1.03)		-13.6 (0.93)
$151 or more	46.1	(2.87)	28.3	(1.80)	25.3	(1.62)	13.6 (0.93)	
Female-Beaded Households with Children	(Normal density at the man = .2871)							
$50 or less			-1.72	(.313)	-2.70	(.449)	-1.11 (.140)	-.550 (.054)
$51-$80	1.77	(.313)	.932	(.171)	-.932	(.171)	1.59 .659 (.092)	1.22 (.128)
$81-$150	2.70	(.449)					(.314)	2.15 (.282)
$151-$220	1.11	(.140)	-.659	(.092)	-1.59	(.314)	-	.561 (.081)
$221 or more	.550	(.054)	-1.22	(.128)	-2.15	(.282)	-.561 (.081)	
Two-Parent **Households with Children**	(Normal density at the mean = .3912)							
$50 or less			-17.1	(2.08)	-16.1	(1.96)	-28.3 (2.85)	-23.8 (2.09)
$51-$80	*17.1*	(2.08)	-1.03	(0.12)	1.03	(0.12)	-11.2 -12.2 (1.14)	-6.65 (0.58)
$81-$150	16.1	(1.96)			-		(1.56)	*-7.69* (0.80)
$151-$220	28.3	(2.85)	11.2	(1.14)	12.2	(1.56)		4.54 (0.58)
$221 or more	23.8	(2.09)	6.65	(0.58)	7.69	(0.80)	-4.54 (0.58)	

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

NOTES: The estimates presented in different columns are based on algebraically equivalent specifications of the same participation equation: each specification uses a different excluded level for each multi-level variable. The fifth specification has been omitted in order to make the table more legible: the same information can be gathered from the last row for each variable. The underlying probit coefficients can be calculated by dividing the marginal effects shown in the table by the normal density function evaluated at the sample means, reported separately for each demographic subgroup.

APPENDIXD

The purpose of this appendix is to explain why the predicted participation rate computed for a household with average characteristics diverges from the observed rate computed for all households in the same population. An example of this divergence was found in Chapter III, where, among female-headed households with children, the predicted participation rate for an average household was 78.9 percent, while the observed participation rate was only 69.6 percent. This discrepancy is essentially due to a mathematical property of nonlinear functions.

In order to explain in intuitive terms how this property affects the results presented in the report, we must first introduce some terminology. Let the predicted participation rate for a household with characteristics that are summarized by the vector of sample means $\bar{X}$ be:

(1) predicted participation rate for an average household = $\Phi(\bar{X}B)$

which we refer to as the "predicted rate at the mean," We compute this rate by first multiplying each element of the vector $\bar{X}$ by the corresponding probit coefficients in the vector B, and then computing the cumulative normal distribution at the value $\bar{X}B$.

The same method can be applied to compute the predicted participation rate for ***each household,*** using its vector of characteristics X_i. In this case, the predicted rate for household ***i*** will be $\Phi(X_iB)$. These household-specific participation rates can be averaged across households to create the ***average predicted participation rate,*** that is:

(2) average predicted participation rate = $(1/N)\ \Sigma_i \Phi(X_iB)$

where N is the size of the sample.' It is important to recognize that the ***average*** *predicted* ***rate*** bears close resemblance to the ***observed rates*** shown in the report. We obtained the observed rates simply

'Rather than a simple average, we actually compute a weighted average, where the weights reflect the differences in the probability of sample selection and in the probability of nonresponse across households.

by dividing the weighted number of households reporting participation by the weighted number of households simulated to be eligible for the FSP, that is:

$$(3) \qquad \text{observed participation rate} = \frac{\Sigma \text{participants}}{\Sigma \text{eligibles}}$$

The rates in (2) and (3) differ only to the extent that the probit model does not correctly predict participation on average. Table D.l shows that average predicted participation rates and the observed rates are very similar for all of the four demographic subgroups. Thus, explaining the divergence between observed rates and rates predicted at the mean is tantamount to explaining the divergence between average predicted rates and rates predicted at the mean. As stated above, the latter divergence can be explained as a mathematical property of nonlinear functions, which says that a function evaluated at the mean generally differs from the mean of the function.

TABLE D.l

AVERAGE PARTICIPATION RATES COMPUTED WITH DIFFERENT METHODS

	All Eligible Households	Elderly Households	Disabled Households	Female-Headed Households	Two-Parent Households
Predicted Rates for an Average Household	43.7	30.2	55.8	78.9	42.3
Average Predicted Rates for All Households	44.8	32.6	55.4	69.9	41.5
Observed Rates	44.2	32.2	55.7	69.6	41.0

SOURCE: August 1985 SIPP Food Stamp Eligibility File.

We believe that a graphical explanation is the most effective explanation for this property. The curve shown in Figure D.l is the standard normal cumulative distribution function (CDF), which is a nonlinear function of the quantity shown on the horizontal axis, the quantity $X_i B$. On the vertical axis we have the probability of participation, expressed as a percentage. Let us take a simplified case

with only two households, having characteristics whose values are X_1 and X_2. The predicted participation rates of these households are:

(4) $P_1 = \Phi(X_1B)$ and $P_2 = \Phi(X_2B)$.

In numerical terms, the quantities in (4) are taken to be as follows:

$P_1 = 95.5$, $X_1B = 1.7$, $P_2 = 46.02$, and $X_2B = -0.1$.

The rates in (4) can be averaged to form the average predicted rate:

(5) $\bar{P} = (P_1 + P_2)/2$

whose numerical value is 70.8.

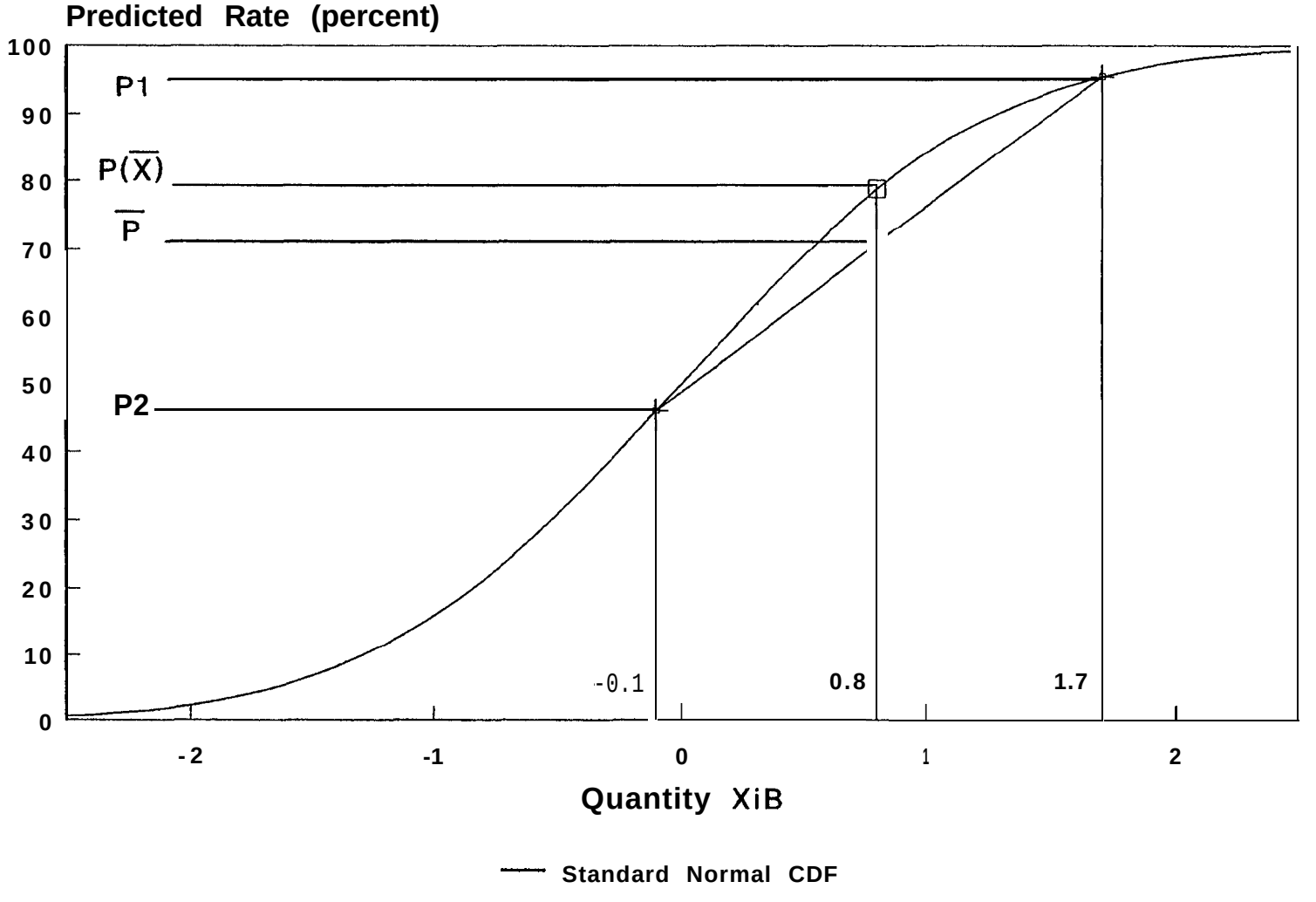
On the other hand, the arithmetic average of the two X_iB is equal to 0.8. The predicted rate that corresponds to this value--that is, the predicted rate at the mean--is computed as:

(6) $P(\bar{X}) = \Phi(\bar{X}B)$

and is equal to to 78.8, which is larger than the average predicted rate $\bar{P}$.

If the function between P_1 and P_2 were linear--that is, 'if it were a straight line--the quantities $\bar{P}$ and $P(\bar{X})$ would coincide, as can be easily seen in Figure D.1. But, due to the S-shape of standard normal distribution function, the two quantities differ. In particular, if the predicted rate at the mean is above 50 percent, it would also be higher than the average predicted rate. Just around 50 percent, the standard normal CDF is close to a straight line, while the curvature increases as the predicted rate moves away from 50 percent. This pattern explains why the discrepancy between average predicted rates and rates predicted at the mean is so much larger for female-headed households than, for example, for households with a disabled member.

FIG D.I THE AVERAGE PREDICTED RATE VERSUS THE RATE PREDICTED AT THE MEAN



APPENDIX E

The purpose of this appendix is to provide the mathematical formulas and the probit coefficients used to derive the results presented in Table V.3. We begin by reporting the probit coefficients and other diagnostic information obtained from the estimation of the participation equation based on the three different functional form specifications of the benefit variable: linear, piecewise linear, and logarithmic.

TABLE E.1

ESTIMATION RESULTS BASED ON ALTERNATIVE SPECIFICATIONS OF THE BENEFIT VARIABLE

Specification	Probit Coefficients	t-statistics	Log Likelihood	Normal Density at the Mean
Linear	β_{LIN} = +.00124	2.26	-1700.7	.3864
Piecewise Linear	β_{PLbase} = +.00681	1.37		
	β_{PL30+} = -.00320	.487	-1694.4	.3722
	β_{PL80+} = -.00375	1.23		
	β_{PL150+} = +.00092	.491		
Logarithmic	β_{LOG} = +.1398	3.79	-1696.1	.3694

Explanation of symbols:

β_{LIN} = coefficient on the benefit variable, linear specification
β_{PLbase} = coefficient on the benefit variable in the $0-$30 range, piecewise linear specification
β_{PL30+} = coefficient on the benefit variable in the $30-$80 range, piecewise linear specification
β_{PL80+} = coefficient on the benefit variable in the $80-$150 range, piecewise linear specification
β_{PL150+} = coefficient on the benefit variable in the $150 and above range, piecewise linear specification
β_{LIN} = coefficient on the benefit variable, logarithmic specification

The coefficients of the piecewise specifications should be interpreted in the following way. The "kink" points were set at $30, $80, and $150, which generates four segments with (potentially) four different slopes. The first coefficient, indicated by β_{PLbase}, corresponds to the slope of the first segment, or base-segment (from zero to $30 of benefits).' The second coefficient, β_{PL30+}, corresponds to the *difference* between the slope of the second segment (between $30 and $80 of

'More precisely, to obtain the slopes of the segments shown in Figure V.l, one must multiply the probit coefficients by the normal density evaluated at the means for all other variables in the participation equation. To obtain the slope of the logarithmic curve in Figure V.1, one must divide the probit coefficient by the level of benefits at each point along the curve.

benefits) and that of the base segment. Thus, to obtain the slope of the second segment, one must sum the first two coefficients. The third and fourth coefficients have a similar interpretation.

We now turn to the mathematical formulas used to derive the results in Table V.3. Each panel in Table E.2 refers to a different way to represent the benefit-participation relationship. Within each panel, we present the formulas based on each of the three specifications of the benefit variable. Finally, we replicate the formulas for two or three "representative" levels of benefits.

TABLE E.2

FORMULAS USED TO CONVERT PROBIT COEFFICIENTS INTO DIFFERENT MEASURES OF THE BENEFIT-PARTICIPATION RELATIONSHIP

Type of Measure	Specification	Level of Benefits	Formula used to derive results presented in Table V.3
Predicted Participation Rates for an Average Household	Linear	10	$100*\Phi(\bar{X}B + \beta_{LIN}*10)$
		300	$100*\Phi(\bar{X}B + \beta_{LIN}*300)$
	Piecewise Linear	10	$100*\Phi(\bar{X}B + \beta_{PLbase}*10)$
		80	$100*\Phi(\bar{X}B + \beta_{PLbase}*80 + \beta_{PL30+}*50)$
		300	$100*\Phi(\bar{X}B + \beta_{PLbase}*300 + \beta_{PL30+}*270 + \beta_{PL80+}*220 + \beta_{PL150+}*150)$
	Logarithmic	10	$100*\Phi(\bar{X}B + \beta_{LOG}*\log(10))$
		300	$100*\Phi(\bar{X}B + \beta_{LOG}*\log(300))$
Change for an Average Household, $10 Increase in Benefits	Linear	10	$100*[\Phi(\bar{X}B + \beta_{LIN}*20) - \Phi(\bar{X}B + \beta_{LIN}*10)]$
		300	$100*[\Phi(\bar{X}B + \beta_{LIN}*310) - \Phi(\bar{X}B + \beta_{LIN}*300)]$
	Piecewise Linear	10	$100*[\Phi(\bar{X}B + \beta_{PLbase}*20) - \Phi(\bar{X}B + \beta_{PLbase}*10)]$
		80	$100*[\Phi(\bar{X}B + \beta_{PLbase}*90 + \beta_{PL30+}*60 + \beta_{PL80+}*10) - \Phi(\bar{X}B + \beta_{PLbase}*80\ \beta_{PL30+}*50)]$
		300	$100*[\Phi(\bar{X}B + \beta_{PLbase}*310 + \beta_{PL30+}*280 + \beta_{PL80+}*230 + \beta_{PL150+}*160) - \Phi(\bar{X}B + \beta_{PLbase}*300 + \beta_{PL30+}*270 + \beta_{PL80+}*220 + \beta_{PL150+}*150)]$
	Logarithmic	10	$100*[\Phi(\bar{X}B + \beta_{LOG}*\log(20)) - \Phi(\bar{X}B + \beta_{LOG}*\log(10))$
		300	$100*[\Phi(\bar{X}B + \beta_{LOG}*\log(310)) - \Phi(\bar{X}B + \beta_{LOG}*\log(300))$

TABLE E.2 (continued)

Change for All Households, $10 Increase in Benefits	Linear	10	$100*(1/N)*\Sigma_i [(\Phi(X_i\Gamma + \beta_{LIN}*10) - \Phi(X_i\Gamma)]$
		300	$100*(1/N)*\Sigma_i [(\Phi(X_i\Gamma + \beta_{LIN}*300) - \Phi(X_i\Gamma)]$
	Piecewise Linear	10	$100*(1/N)*\Sigma_i [\Phi(X_i\Gamma + 10*\{\beta_{PLbase}\}) - \Phi(X_i\Gamma)]$
		80	$100*(1/N)*\Sigma_i [\Phi(X_i\Gamma + 10*\{\beta_{PLbase}+\beta_{PL30+}+\beta_{PL80+}\}) - \Phi(X_i\Gamma)]$
		300	$100*(1/N)*\Sigma_i [\Phi(X_i\Gamma + 10*\{\beta_{PLbase}+\beta_{PL30+}+\beta_{PL80+}+\beta_{PL150+}\}) - \Phi(X_i\Gamma)]$
	Logarithmic	10	$100*(1/N)*\Sigma_i[\Phi(X_i\Gamma + \beta_{LOG}*(\log(20)-\log(10)) - \Phi(X_i\Gamma))$
		300	$100*(1/N)*\Sigma_i[\Phi(X_i\Gamma + \beta_{LOG}*(\log(310)-\log(300)) - \Phi(X_i\Gamma))$
Change for All Households, 8.6% Increase in Benefits	Linear	10	$100*(1/N)*\Sigma_i [\Phi(X_i\Gamma + \beta_{LIN}*10*0.086) - \Phi(X_i\Gamma)]$
		300	$100*(1/N)*\Sigma_i [\Phi(X_i\Gamma + \beta_{LIN}*300*0.086) - \Phi(X_i\Gamma)]$
	Piecewise Linear	10	$100*(1/N)*\Sigma_i [\Phi(X_i\Gamma + 0.086*10*\{\beta_{PLbase}\}) - \Phi(X_i\Gamma)]$
		80	$100*(1/N)*\Sigma_i [\Phi(X_i\Gamma + 0.086*80*\{\beta_{PLbase}+\beta_{PL30+}+\beta_{PL80+}\}) - \Phi(X_i\Gamma)]$
		300	$100*(1/N)*\Sigma_i [\Phi(X_i\Gamma + 0.086*300*\{\beta_{PLbase}+\beta_{PL30+}+\beta_{PL80+}+\beta_{PL150+}\}) - \Phi(X_i\Gamma)]$
	Logarithmic	any	$100*(1/N)*\Sigma_i [(\Phi(X_i\Gamma + \beta_{LOG}*\log(1.086) - \Phi(X_i\Gamma))$

Explanation of symbols:

$\Phi(\ )$ = standard normal cumulative distribution function
$\bar{X}$ = vector of means of the explanatory variables, *excluding* the benefit variable
B = vector of probit coefficients, comformable to the vector $\bar{X}$
X_i = vector of explanatory variables for the ith observation, including current benefits
Γ = vector of probit coefficients, comformable to the vector X_i
N = sample size