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FINAL REPORT

THE EFFECTS OF FOOD STAMP BENEFITS ON THE MARKET LABOR OF FEMALE HEADS OF HOUSEHOLDS

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EXECUTIVE SUMMARY

This report presents results from an econometric study of the effects of the Food Stamp Program on work effort. A model of the household's joint decision regarding market labor and participation in the Food Stamp and AFDC programs is specified and estimated on a sample of female heads of households with dependent children. Estimates of the model's parameters are used to predict how work effort and program participation would be affected by selected hypothetical changes in rules governing food stamp benefit amounts. The feedback effects of these responses on average and aggregate benefit levels are also examined.

The Model

The empirical model is based on the microeconomic theory of household utility (satisfaction) maximization in the presence of a budget constraint. In this application of the theory, a household is assumed to weigh the tradeoff between leisure and income and to then chose the optimal hours of work per week. The Food Stamp and AFDC programs introduce complex nonlinearities into this tradeoff. These are incorporated into the empirical model, which consists of the following three equations:

1. A labor-supply equation, in which the food stamp guarantee amount and implicit tax rate on earnings are specified to affect work effort via the level of nonlabor income and the effective marginal wage rate.

2. A food stamp participation equation, in which the probability of participation in the Food Stamp Program is specified to be a positive function of the difference in household utility when participating in the program and when not participating.

3. An AFDC participation equation that is analogous to the FSP participation equation.

Data

The model was estimated on the basis of a 358-case extract from Wave V of the Income Survey Development Program. With reference period October 1979 through February 1980, Wave V is one of six quarterly surveys of approximately 7,500 households. The surveys obtained detailed information on income sources and amounts, employment, participation in transfer programs, and household characteristics. To avoid the severe modeling and estimation problems associated with multiple, interacting programs, an extract consisting only of households with dependent children that are headed by unmarried, nonelderly, and nondisabled women was drawn from the file. These households are unlikely to be eligible for transfer programs

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other than food stamps and AFDC (the Medicaid Program was not considered in this study).

Estimation Results

The model is such that the responsiveness of the market labor of female heads of households to changes in nonlabor income and the net-wage rate cannot be estimated directly. Rather, the elasticities of hours of work with respect to these factors must be computed on the basis of estimates of two critical parameters in the model. The computed elasticities can be used to assess the impact on work effort of changes in food stamp (or AFDC) regulations that affect the program's implicit tax rate on earnings or the effective guarantee amount.

Many variants of the empirical model were estimated, but four variants are believed to characterise most realistically the work effort and program participation of the target population. Estimates of the two critical parameters in these four model variants imply a wage elasticity of hours of work in the range of .18 to .30 and an income elasticity in the range of -.09 to -.11.[1] The underlying parameter estimates are significantly different from zero; however, the elasticities themselves are small. They imply that moderate changes in food stamp (or AFDC) regulations which alter the program's implicit tax rate on earnings or the effective guarantee amount have only small effects on the work effort of female heads of households.

Estimates of the model's food stamp and AFDC participation equations show that a program's guarantee amount has a statistically significant positive effect on participation in that program. Contrary to expectations, participation by female-headed households in either of these programs was not found to be significantly affected by the program's implicit tax rate on earnings; however, weak evidence of a inhibiting effect of implicit tax rates was found. Nonlabor income (excluding benefits from the Food Stamp and AFDC programs) was found to have a generally insignificant effect on participation in both programs. On the other hand, the wage rate (net of income and payroll taxes, but not net of food stamp and AFDC implicit taxes) has a significantly negative effect on participation in both programs, as expected.

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[1]A wage (or income) elasticity of hours of work of, say, .20 implies that a 100 percent change in the wage rate (or nonlabor income) causes a 20 percent change in hours of work.

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Simulation Results

Estimates of the parameters in the model were used to simulate the effects on hours of market labor and food stamp benefit amounts of three hypothetical changes in current Food Stamp Program regulations:

1. Increasing the benefit-reduction rate (BRR) from .30 to .33.

2. Replacing the uncapped 18 percent earned income deduction (EID) with a 100 percent deduction up to a maximum of $75 per month.

3. Eliminating the $10 minimum benefit for 1- and 2-person households.

The simulated work effort of female heads of households participating in the Food Stamp Program after each hypothetical change was compared to the simulated work effort of female heads of participating households before each change. The differences were small: the average simulated hours of work per week fell by 1 percent in response to the increase in the BRR, fell by 2 percent in response to the change in the EID, and was virtually unaffected by the change in the minimum benefit. The simulated effect of the combined changes is a 3 percent reduction in market labor. The simulated labor-supply responses are small for two reasons:

1. The program changes being considered are small.

2. The estimates of the model parameters which characterize the labor-supply responses to changes in the net wage rate and nonlabor income are small (but statistically different from zero).

The average household food stamp benefit and the total of benefits to all 358 households in the analysis file were simulated first under the assumption that participation and hours of work are completely unresponsive to the three hypothetical program changes and then under the assumption that households do respond behaviorally to the changes.[1] The decline in the average simulated benefit was 3 percent to 12 percent <u>less</u>, depending upon the specific change or combination of changes being considered, with the assumption of behavioral responses than with the assumption of no

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[1]Not all of the 358 households in the analysis file were simulated to participate in the hypothetical variants of the Food Stamp Program. The average food stamp benefit was computed on the basis of participating households only.

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responses (see Figure E.1). However, the decline in the total simulated benefit was 1 percent to 3 percent more with the assumption of behavioral responses (see Figure E.2). The different findings with respect to average and total benefits are attributable to the program-participation response: each of the hypothetical program changes was simulated to reduce participation in the Food Stamp Program, thereby enhancing the reduction in total benefits. This dominated the tendency for work-effort reductions to moderate the fall in the average benefit resulting from the program changes.

Implications for Policy and Future Research

The findings from this study should not be generalized beyond the population of low-income, female-headed households; however, this is the largest demographic segment of the food stamp population.

Several conclusions of interest to policymakers can be drawn from this study's findings. First, the market labor of low-income, female heads of households is relatively unresponsive to changes in nonlabor income and the net-wage rate, including changes attributable to reforms in the Food Stamp Program. This means that moderate changes in regulations governing food stamp benefit levels would be unlikely to result in substantial changes in the market labor of female heads of households. Second, because the work-effort and program-participation responses to most potential program reforms are relatively small, neglect of such responses in microsimulation analyses of program reforms is unlikely to be a major source of errors in estimates of the effects of the reforms on average and aggregate benefits. However, neglect of behavioral responses could introduce substantial errors into microsimulation estimates of the effects of radical changes in program tax rates and guarantees. For example, the effect on benefits of a change in the food stamp earned income deduction comparable to that mandated for the AFDC Program by the Omnibus Budget Reconciliation Act of 1981 would probably be estimated with substantial error if labor-supply responses were neglected.

In summary, the neglect of behavioral responses does not appear to seriously bias microsimulation estimates of typical changes in food stamp regulations. However, such estimates may be substantially in error if the changes in question radically alter program tax rates and guarantee amounts. If FNS forsees the need to predict the effects of such program changes, then it should consider the development of procedures for incorporating labor-supply responses into its microsimulation model. It should also consider conducting follow-on analysis of the labor-supply responses of other segments of the food stamp population, in order to determine whether the findings for female-headed households are typical of all food stamp participants.

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FIGURE E.1

SIMULATED REDUCTIONS IN THE AVERAGE HOUSEHOLD FOOD STAMP BENEFIT IN RESPONSE TO HYPOTHETICAL PROGRAM CHANGES, WITH AND WITHOUT THE ASSUMPTION OF BEHAVIORAL RESPONSES
(For 358 Sample Households)

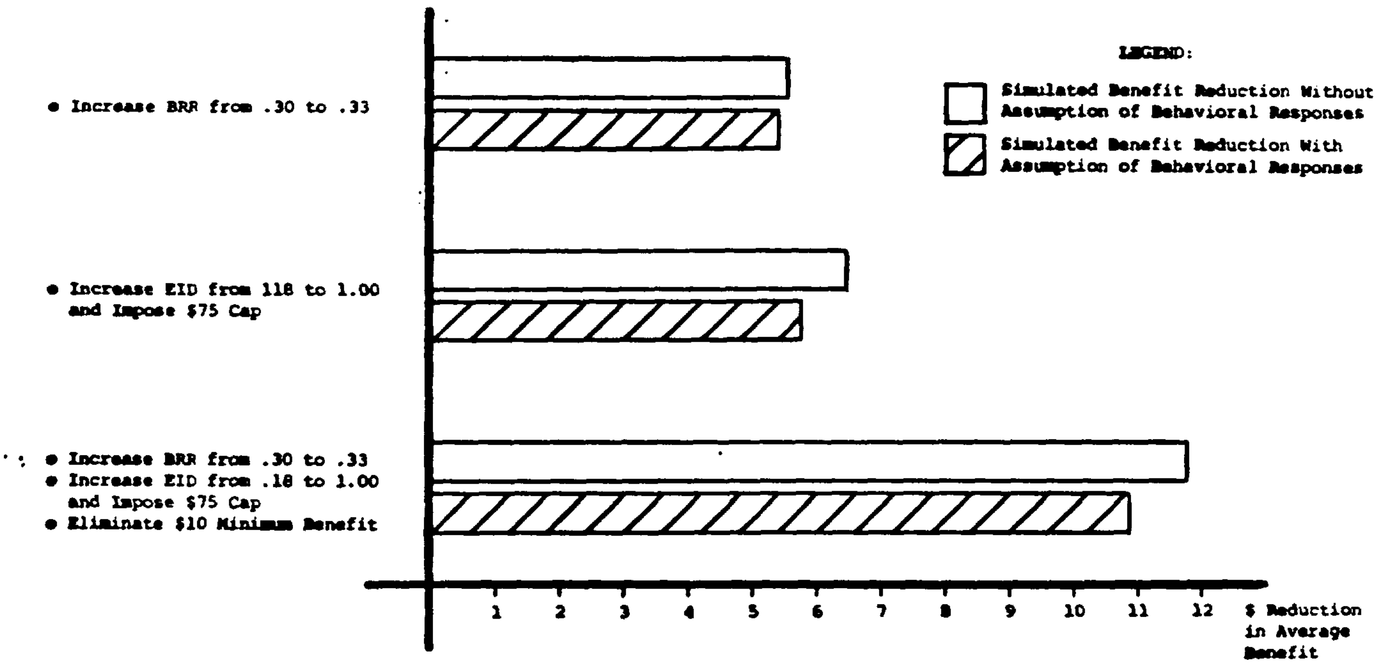
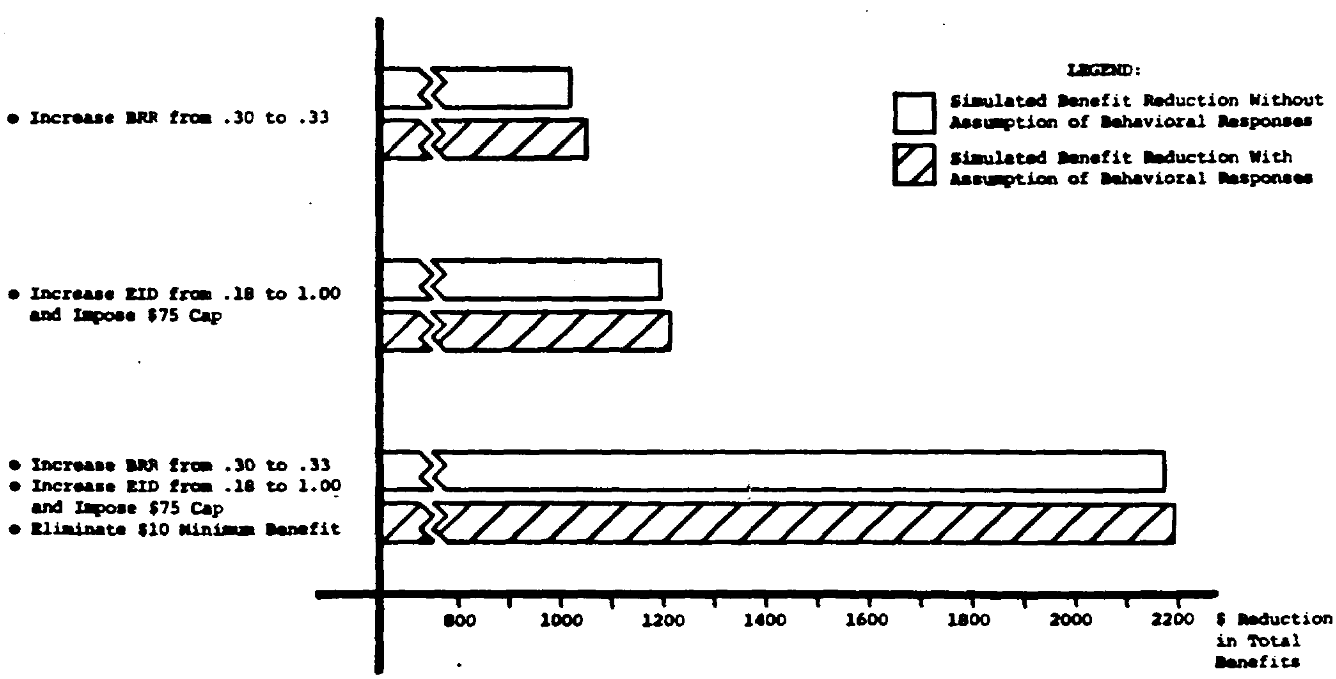


FIGURE E.2

SIMULATED REDUCTIONS IN TOTAL FOOD STAMP BENEFITS IN RESPONSE TO HYPOTHETICAL PROGRAM CHANGES, WITH AND WITHOUT THE ASSUMPTION OF BEHAVIORAL RESPONSES
(For 358 Sample Households)



I. INTRODUCTION

Studies on the effects of transfer programs on labor supply have generated a large body of literature. For instance, numerous studies have been conducted on the labor-supply effects of the Aid to Families with Dependent Children (AFDC), Social Security, Unemployment Insurance, and other existing programs (see Danziger et al., 1981, for a literature review), as well as studies on an experimental negative income tax and its effect on labor supply (see Moffitt and Kehrer, 1981, for a literature review). However, despite this wealth of literature, no formal econometric study on the labor-supply effects of the Food Stamp Program has been conducted to date. This report represents the first of such studies.

In many respects, the model presented herein represents an extension of the models and econometric techniques that have been developed in past studies on other programs. Specifically, we use the standard theoretical static, one-period model of labor supply in which hours of work are chosen subject to a budget constraint so as to maximize utility. In our econometric work, the nonlinearity of the constraint is treated in the most formal fashion--namely, by using a maximum-likelihood procedure that has been developed for piecewise-linear constraints (Hausman, 1983; Moffitt, 1982). However, in several respects, our model and estimating procedures go beyond past work. Most importantly, in examining the labor-supply response of female heads of households (the largest demographic category of food stamp recipients), we model and estimate the joint response to both AFDC and food stamps; because a significant fraction of female-headed households receive both, we cannot ignore AFDC. We also

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address problems pertaining to the nonparticipation of eligibles in transfer programs. Our model includes reduced-form equations for participation in AFDC and food stamps, which enables us to incorporate in the model the differential stigmatic effects of the two programs.

Consequently, the full model consists of three equations--one labor-supply equation (conditional upon program-participation choice) and two participation equations. The model is estimated on the basis of data on 358 low-income, female-headed households with dependent children which participated in Wave V (October 1979 to February 1980) of the Income Survey Development Program (ISDP).

The complexity of the model detracts from the intuitive meaning of its parameters. To illustrate the implications of our parameter estimates, we use the estimates to simulate work effort, AFDC and food stamp participation, and food stamp benefit amounts under alternative sets of program rules and demographic assumptions. The simulation exercises reveal small labor-supply responses to hypothetical program changes similar to those that are currently being considered by Congress. They show that the exclusion of the labor-supply and participation responses from a microsimulation model of the Food Stamp Program could create systematic errors in the predicted effects of program changes on average and aggregate food stamp benefits. However, these errors would not be large.

The necessity of excluding important demographic groups from our analysis file and the small size of the file mean that the findings presented in this report must be interpreted and used with caution. In particular, the behavior of the entire low-income population should not be inferred from our findings. Rather, our estimation and simulation results

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are only suggestive of the labor supply and program participation of low-income, female-headed households.

The next chapter explains the objectives of this study and presents background information that will enhance understanding our model. A graphical analysis of the labor-supply effects of the Food Stamp Program is presented in Chapter III. Our model is specified in Chapter IV. The ISDP Wave V analysis file is described in Chapter V. The empirical results of the study are presented in Chapter VI (estimation results) and in Chapter VII (simulation results).

II. BACKGROUND AND OBJECTIVES OF THE STUDY

A. BACKGROUND

Research on the effects of transfer programs on work effort has been motivated largely by debate among policymakers and social scientists about the proper goals of such programs. Four goals are widely acknowledged:

1. To provide adequate assistance to the needy
2. To use funds efficiently by targeting benefits to those who need them the most
3. To treat households that are similar in size and income equitably
4. To establish a benefit structure that encourages market labor

The fundamental inconsistency among these goals drives the ongoing policy debate. The first two goals could be achieved most directly by providing virtually all benefits to the most needy households. However, doing so would of course mean that marginally eligible households would receive substantial benefits, while marginally ineligible households would receive no benefits.[1] Aside from the obvious inequity of treating basically similar households in such extremes, this structure of benefits would provide strong incentives for ineligible households to reduce their market labor so as to qualify for benefits.

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[1]A large disparity in benefits between marginally eligible and marginally ineligible households is referred to as a "notch" in the benefit structure.

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The most important outcome of the policy debate and the research stimulated by it has been the adoption of implicit program tax rates on earnings and other income. These tax rates channel relatively large benefits to low-income households and smaller benefits to households whose earnings or other income are above minimal levels. The tax rates represent a compromise solution to the tradeoff between target efficiency on the one hand and equity and work incentives on the other. In the Food Stamp Program, this compromise is embodied in the benefit-reduction rate (BRR) and the earned income deduction (EID).

Concern about the target efficiency of transfer programs has been rising. The recent decrease in the food stamp EID from 20 percent of earned income to 18 percent is just one manifestation of this concern.[1] Given the above-mentioned tradeoff, increases in target efficiency have been achieved only with some reduction in the work incentives provided by program eligibility and benefit regulations.

Given the long-standing policy interest in the work incentives of transfer programs, it is revealing to consider why ours is the first econometric study on the effects of food stamp benefits on work effort. The dearth of research in this area may in part be explained by the fact that food stamp benefits typically represent a supplemental rather than a primary source of a recipient household's purchasing power. They supplement the earnings of the working poor, the AFDC benefits of households with dependent children, the SSI and OASDI benefits of the disabled

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[1]Recent proposals to tax social security benefits and unemployment compensation are also outgrowths of the heightened interest in the target efficiency of income-transfer programs.

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and elderly, and the unemployment compensation of laid-off workers. Policy analysts have properly directed their attention first to the labor-supply effects of the primary income sources. Furthermore, the fact that food stamp benefits are usually received in conjunction with more important sources of purchasing power means that those sources must not be neglected in a study on the labor-supply effects of food stamps. Such interaction constitutes a major barrier to research; it is very difficult to develop and estimate models on the labor-supply effects of multiple, interacting transfer programs.

B. OBJECTIVES

Early in the design phase of this research project, our objective was to specify and estimate a model of the labor-supply effects of food stamp benefits that would be generally applicable to the low-income population. However, in recognition of the fact that the interactions among the Food Stamp Program and other transfer programs are complex and, hence, cannot be neglected, we scaled-back our objectives. We adopted the goal of specifying and estimating a labor-supply model for a segment of the low-income population that is categorically eligible only for one major income-transfer program (Medicaid and Medicare are not considered in this study). As our target group, we selected households that are headed by nonelderly women with dependent children. Because, for the most part, these households are categorically eligible only for AFDC benefits, we developed and estimated a model of the interactive effects of the AFDC and Food Stamp programs on work effort. The model also incorporates the effects of federal payroll and income taxes (including the earned income tax credit).

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The labor-supply response to transfer programs is not independent of the program-participation decision. Indeed, the two may be very closely linked--for instance, when an ineligible household reduces its work effort so as to attain a lower level of income that will enable it to participate in a program. Furthermore, there is reason to believe that those who might participate in income-transfer programs would exhibit different levels of work effort than would nonparticipants with similar observable characteristics even if no program benefits were being provided. For these reasons, an important objective of the design phase of the project was to develop an integrated model of the simultaneous decisions regarding work effort, participation in the Food Stamp Program, and participation in the AFDC Program.

The complexity of the model and the nonlinear full-information maximum-likelihood procedure that was used to estimate it severely diminish the intuitive meaning of the model estimates. We believe that estimates of the model's parameters can best be interpreted for policymakers through microsimulation--that is, using the parameter estimates to predict the work effort and program participation of individual cases in the analysis file under alternative sets of program rules or demographic assumptions. The simulation results can be clearly summarized with simple descriptive statistics.

While the general goal of the simulation exercises is to present model estimates in a readily understandable format, the exercises also consist of four more specific objectives:

1. The simulation exercises will examine work effort and program participation under various Food Stamp Program reforms.

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2. The simulation exercises will also examine the effects of demographic factors on work effort and program participation. The reader will be able to assess whether program factors or demographic factors are the more important determinants of behavior.

3. Under alternative sets of program rules, total and average benefits paid to a sample of households will be simulated under two different assumptions: (a) that work effort and participation respond to program changes in magnitudes equal to those indicated by the estimated parameters in our model, and (b) that work effort and participation are unaffected by program changes. A comparison of the two sets of benefit estimates will provide a rough indication of the size and direction of the errors in benefit estimates produced by large-scale microsimulation models (e.g., MATH and TRIM2) when behavioral responses are neglected.

4. The simulation exercises will examine the differential impact of changes in specific Food Stamp Program rules on the benefits of nonworkers, part-time workers, and full-time workers.

In summary, the simulation results will enable the reader to understand the implications of the model estimates in terms of the responsiveness of work effort and program participation to Food Stamp Program reforms. Based on this understanding, the reader will be able to assess the desirability of conducting the additional research that would be necessary before such responses could be incorporated into large-scale microsimulation models of the Food Stamp Program.

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III. A GRAPHICAL ANALYSIS OF THE EFFECTS OF FOOD STAMPS ON WORK EFFORT

Our model of the work effort and program participation of female heads of households consists of three equations: a labor-supply equation, a food stamp participation equation, and an AFDC participation equation. These equations are described fully in the following chapter. The labor-supply equation is based upon the conventional economic theory of labor supply, which assumes that an individual chooses her hours of work so as to maximize the utility obtained from income and leisure. Heuristically, an individual is viewed as subjectively evaluating the utility (satisfaction) that she would derive from different hours of work and their associated income amounts. Her optimal level of market labor is the hours of work associated with the feasible labor and income combination that yields the maximum utility.[1]

In this theoretical framework, food stamp and AFDC benefits are treated as additional income. An individual is assumed to respond to a legislated change in these benefits by reevaluating her utility over the new set of feasible labor and income points. The effect of a change in benefits on an individual's work effort is the difference in hours worked at the utility-maximizing feasible point before and after the change in benefits.

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[1]A "feasible" combination of income and labor is one that is consistent with an individual's wage rate and nonlabor income. For example, 20 hours of work and $120 of income per week constitute a feasible combination for an individual with a wage of $5 per hour and nonlabor income of $20 per week. On the other hand, 20 hours of work and $200 of income per week do not constitute a feasible combination for this hypothetical person.

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A. THE BUDGET CONSTRAINT

An individual's budget constraint consists of all possible work hours in a given time period and their associated maximum feasible disposable income amounts. Disposable income at different hours of work is determined by the individual's wage rate, earnings of other family members, investment income, taxes, and the parameters of transfer programs for which she is categorically eligible. We have chosen to analyze the labor supply of individuals who are likely to be categorically eligible only for AFDC benefits: nonelderly, nondisabled female heads of households with dependent children. Of course, such individuals may also be eligible to receive food stamps.

The budget constraint underlying the empirical model that is specified in the following chapter incorporates private wage and nonwage income, food stamp and AFDC benefits, the social security payroll tax, and federal income taxes. State income taxes are not considered, nor are other transfer programs. The social security tax reduces the slope of the budget constraint (the change in disposable income in response to a change in hours of work) by a constant proportion, as long as earned income is less than the maximum taxable amount. The federal income tax reduces the slope of the budget constraint by proportions that increase with income, resulting in a convex, piecewise-linear budget constraint, as shown in Figure III.1.

The Food Stamp Program shifts the budget constraint upward by large amounts at low hours of work and by small amounts at higher hours of work (Figure III.1), reflecting the negative effect of income on food stamp benefits. The budget constraint with food stamps contains kinks that stem from the federal income tax and from regulations that govern food stamp

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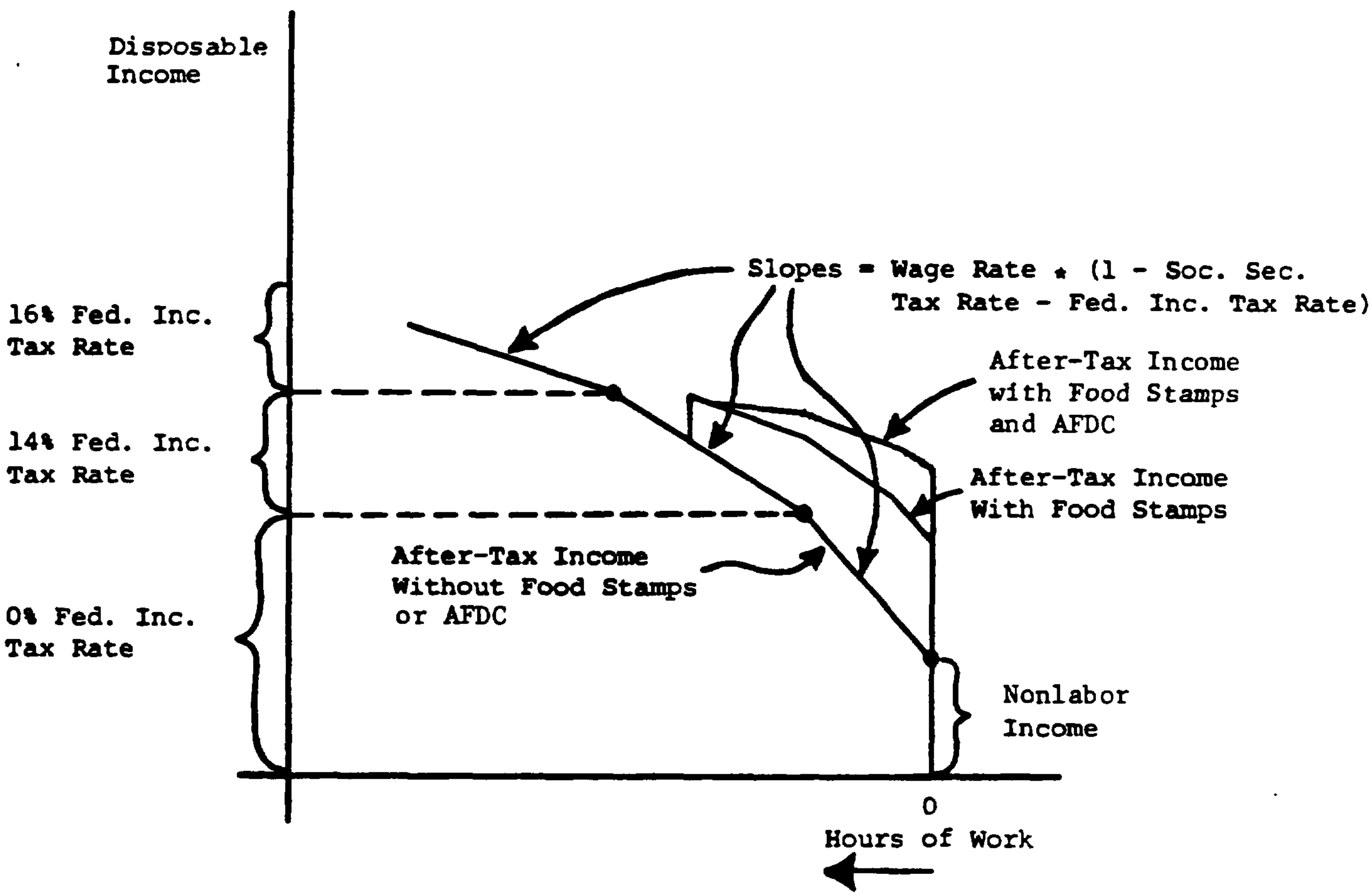
FIGURE III.1

THE BUDGET CONSTRAINT WITH AND WITHOUT THE FOOD STAMP AND AFDC PROGRAMS



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benefit amounts. The constraint shown in Figure III.1 is highly stylized. The Food Stamp Program is portrayed as introducing one additional kink and a "notch" in the budget constraint.[1] In actuality, food stamp regulations may induce as many as five new kinks.[2] The exact shape of the budget constraint with food stamps varies from to household to household according to their size and financial status.

AFDC benefits cause a further upward shift and flattening of the budget constraint, as shown in Figure III.1. These benefits are countable income under food stamp regulations, and this interaction must be considered in deriving the budget constraint in the presence of both programs.

B. DETERMINING THE LEVEL OF WORK EFFORT

A graphical representation of the model of labor supply can be used to illustrate the theoretical effect of the Food Stamp Program on an individual's work effort. To do so, it is necessary to determine which point on the budget constraint a woman would choose in the absence of the program and which point she would choose in its presence. This determination requires a knowledge of the shape of her utility function, which is represented in Figure III.2 by a series of indifference curves. Any single indifference curve consists of a collection of all combinations of disposable income and hours of work that provide equal utility. Higher indifference curves (i.e., those further to the northeast) represent higher levels of utility. In Figure III.2, the utility-maximizing point on the

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[1]The minimum food stamp benefit introduces a notch into the budget constraints of 1-and 2-person households.

[2]Deductions from food stamp gross income are responsible for the additional kinks and slopes in the budget constraint with food stamps.

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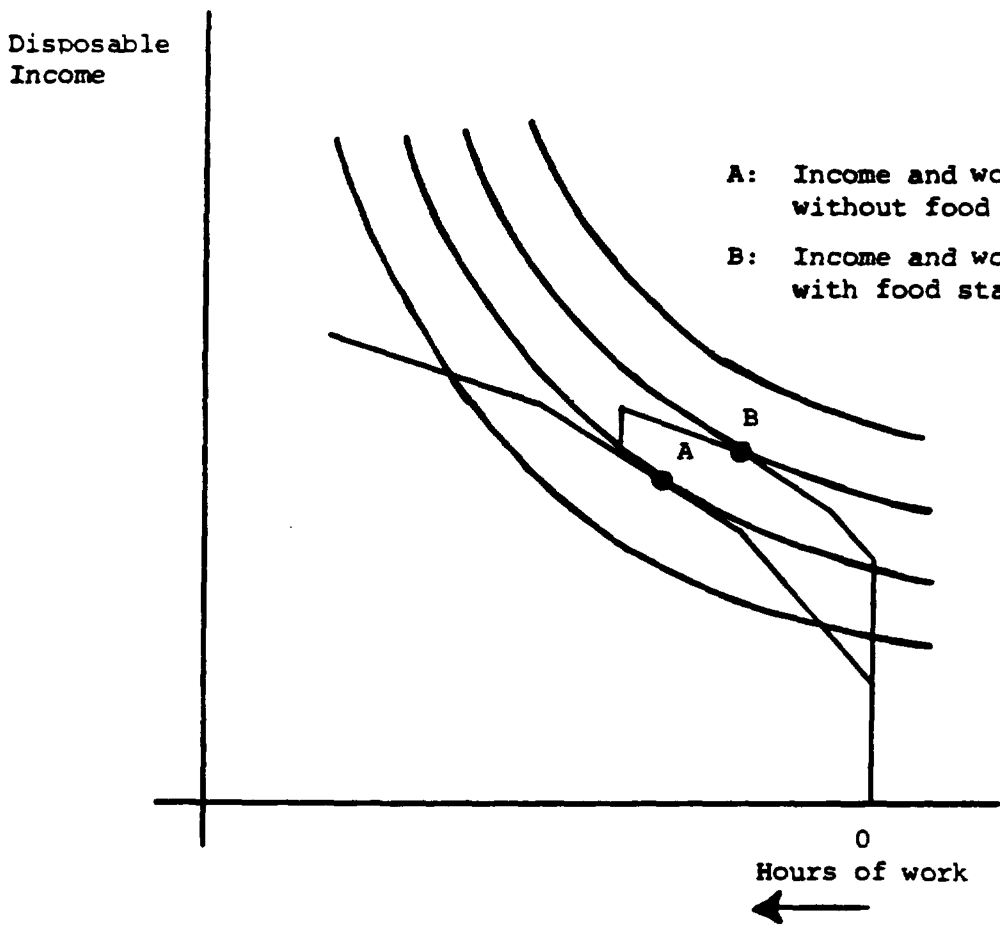
FIGURE III.2

UTILITY MAXIMIZATION WITH AND WITHOUT A FOOD STAMP PROGRAM



budget constraint shifts from point A to point B with the introduction of food stamps, indicating a program-induced reduction in work effort. The effects of reforms to the existing Food Stamp Program could similarly be analyzed.

An individual's relative preferences for income and leisure are reflected in her utility function. The shape of the function is determined by her wage rate, nonwage income, personal characteristics, the characteristics of her household, and the parameters associated with these variables. The following chapter describes a procedure for estimating the parameters in the utility function on the basis of micro data for female heads of households. In the chapter, we show that an individual's labor-supply function can be derived from her utility function, and that the same set of parameters appears in each function. Thus, estimates of the utility function can be directly transformed into estimates of the labor-supply function.

In Chapter VII, we use estimates of the parameters in the utility function to simulate the effects of hypothetical reforms to the current Food Stamp Program. The simulation process first requires that the budget constraint for each household in a micro data file be identified under alternative assumptions about Food Stamp Program eligibility and benefit rules. Estimates of the utility function parameters, combined with survey data on household characteristics, provide information on the shape of each household's utility function. The computer model then uses the budget constraint and utility function information to predict the optimal hours of work for household heads under the various Food Stamp Program reforms. The optimization procedure in the simulation model is thus analogous to that which is displayed in Figure III.2.

IV. ECONOMETRIC MODEL SPECIFICATION

In the preceding chapter, we used graphs to show the theoretical effect of the Food Stamp Program on the labor supply of individuals. The goal of this study is to estimate the effect of the FSP on labor supply econometrically by using the data set we describe in the following chapter. That data set, Wave V of the ISDP, yields a cross-section of the U.S. population of female-headed households in 1979 by providing information on Food Stamp and AFDC program participation, hours of work, income, and other variables for each individual. In this chapter, we discuss how such a cross-sectional data set can be used to estimate a model of the labor-supply effects of the Food Stamp Program.

A. THE GENERAL STRUCTURE OF THE MODEL

We wish to formulate a model that describes an individual's utility-maximizing choice of hours of work, given the types of constraints created by the Food Stamp and AFDC programs. The general structure of our model is based upon the simple realization that the choice made by a female head can be broken down into two separate decisions: (1) choosing the programs in which she will participate (the "choice of budget constraint") and (2) choosing the number of hours of work, given that she has chosen a combination of programs. While this distinction provides the basis for our model, we should note immediately that the two decisions are not made separately by the individual--that is, an individual does not first choose a program in which to participate independently of the hours she will work under that program, and then subsequently choose the hours of work. Rather, the two decisions are made jointly and simultaneously; the decision

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to participate in a program is made in knowledge of the hours she will work under that program. This distinction implies that we should formulate a multiple-equation model that contains an equation for the hours of work that a woman would choose under each participation choice and separate equations that determine which participation choices she will make. Not only will the hours-of-work equation contain participation outcomes, but the participation equation will contain hours of work in the various participation categories.

Our model consists of four possible participation categories: (1) participation in both AFDC and food stamps, (2) participation in AFDC alone, (3) participation in food stamps alone, and (4) participation in neither. Our model takes the following general form:

(1) $H = f(P_A, P_F)$

(2) $P_A = g(H)$

(3) $P_F = h(H)$

where: H = hours of work
P_A = 1 if on AFDC, and 0 if not
P_F = 1 if on food stamps, and 0 if not

Equation (1) specifies that the hours-of-work choice is a function of participation in the AFDC and Food Stamp programs. Equations (2) and (3) specify that the program-participation choices are functions of hours of work.

B. THE HOURS-OF-WORK EQUATION

In most models of labor supply, hours of work are considered to be a function of two variables: the net wage and nonwage income. In graphical terms, the net wage is the slope of the budget constraint, and nonwage income is its intercept. If the budget constraint consists of segments and kinks, as do the constraints of food stamp and AFDC participants, such functions must be modified. Specifically, labor supply along any segment of the constraint must be considered a function of both the slope of the segment upon which the individual is located and the intercept of the particular segment (Moffitt, 1983). An individual must also be seen as choosing a segment (or kink) of the constraint upon which to locate.

1. Description of the Budget Constraint

In our case, the analysis of all possible hours of work (and, hence, the consideration of all segments and kinks in the budget constraint) is conceptually feasible but is not practical, since the constraints under consideration are too complex to model in such a fashion. First, the number of segments and their locations under the Food Stamp Program benefit formula vary and are difficult to determine, depending as they do upon the sizes of the individual's shelter deduction, standard deduction, gross and net income, household size, and the relationships among them. Consequently, the constraint will not take the same form for all individuals--some will be "missing" some segments that others have, while others will have additional segments.

Second, for an individual who also receives AFDC, the constraint is more complex and will again differ across individuals. Since the AFDC benefit is treated as income for the food stamp benefit calculation, the location of the kinks and the segments will change. In fact, some kinks and some segments may disappear altogether.

Third, the constraints contain even more kinks and segments when income and payroll taxes are introduced. The basic federal income tax

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system is progressive, providing a series of brackets with rising marginal tax rates. The earned income tax credit increases the progressivity at the lower end of the income distribution but reduces it in the middle portion, and introduces two additional segments and kinks. The social security payroll tax is proportional up to some very high earnings level and, hence, does not add any new segments or kinks. Since we wish to consider the effects of these taxes as well, the constraint obviously becomes more complicated.

Fourth, we also wish to consider the degree to which the hourly wage rate varies over hours of work. Most statistical studies show that the hourly wage rate is lower for part-time work than it is for full-time work. Because this implies that the slope of the constraint is not constant but instead varies with hours of labor, it is another source of nonlinearity in the constraint (Moffitt, 1984). Indeed, this fact presumably would make the constraint curvilinear, rather than consisting of constant-slope segments.

2. Specification of the Hours-of-Work Equation

In light of the complexity of the budget constraint, our strategy is not to model the choice of continuous hours of work but, instead, to model a simple three-way choice: the choice of zero hours of work (i.e., non-work), the choice of part-time work, and the choice of full-time work. Modeling this three-way choice is relatively simple because we can view individuals as choosing one of three points on the constraint--say, the points at H = 0, H = 20, and H = 40 hours of work per week. To model three points, we need only calculate net income (the food stamp and AFDC benefits, plus other income net of taxes) at those three points. We thus avoid the necessity of calculating the location and slope of every segment and every kink over the individual's constraint.

This simplication is of course only an approximation, but it is not likely to be seriously in error. Although hours of work do vary within the part-time and full-time categories, that variance is small relative to the variance across the three categories. The variance is particularly small in the full-time category because hours of work are often institutionally fixed; most individuals work in a very narrow range (from about 37 to about 43 hours per week). Thus, the error in approximating their hours of work by $H = 40$ is not likely to be large. In the part-time category, less concentration exists at $H = 20$, so the approximation error in our sample caused by the $H = 20$ assumption for part-timers is likely to be somewhat larger than that caused by the $H = 40$ assumption for full-timers. On top of these narrow considerations is the more general issue about whether we need be concerned with exact hours of work in any case. If we are concerned primarily with whether any nonzero labor-supply response occurs to the Food Stamp Program, then we should be able to detect such a response by examining movements across the three hours-of-work categories. Our results would be in error only if the labor-supply response to food stamps occurred within the part-time and full-time categories, and not among these two categories and nonwork.

To implement this approach, let H_i ($i = 0, 1, 2,$) be the three hours of work points at, respectively, zero, part-time, and full-time labor. Let Y_i be disposable income at each of the three points, where Y_i is equal to the sum of wage income, nontransfer nonwage income, the AFDC benefit, and the food stamp benefit, less positive taxes, all calculated

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separately at each of the three points. Let the individual's utility function be $U(H_i, Y_i)$, yielding utility at each of the three points. The labor-supply choice then boils down to a simple comparison of utility at the three points, where we assume that the individual will pick the category with the highest utility. The labor-supply "equation" is thus:

$$
\begin{aligned}
(4) \qquad H &= H_0 \text{ if } U(H_0, Y_0) > U(H_1, Y_1) \text{ and } U(H_0, Y_0) > U(H_2, Y_2) \\
&= H_1 \text{ if } U(H_1, Y_1) > U(H_0, Y_0) \text{ and } U(H_1, Y_1) > U(H_2, Y_2) \\
&= H_2 \text{ if } U(H_2, Y_2) > U(H_0, Y_0) \text{ and } U(H_2, Y_2) > U(H_1, Y_1).
\end{aligned}
$$

The calculation of disposable income can be written as follows, where $W(H_i)$ is the hourly wage rate (which varies with H, as discussed previously), N is nontransfer, nonwage income, $T(H_i)$ is the amount of positive taxes, $B_A(H_i)$ is the AFDC benefit, and $B_F(H_i)$ is the food stamp benefit:

$$
(5) \qquad Y(H_i) = W(H_i)H_i + N - T(H_i) + B_A(H_i) + B_F(H_i).
$$

This completes our general discussion on the specification of the hours-of-work equation. When we specify a precise mathematical form of the utility function (see below), equation (4) will become a specific type of three-category, polytomous-choice model. With an assumed normally distributed error term appended, the equation can be estimated with a modified probit technique (a set of additional variables for individual characteristics will be added to the equation).

C. THE FOOD STAMP AND AFDC PARTICIPATION EQUATIONS

Here, we consider the specification of the participation equations. First note that the participation variables P_A and P_F are

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implicitly contained in the hours equation (4) because AFDC and food stamp benefits will be positive only if the individual participates in those programs. To make these variables explicit, the formula for disposable income in equation (5) can be rewritten as follows:

(6) $$Y(H_i) = W(H_i)H_i + N - T(H_i) + P_A B_A(H_i) + P_F B_F(H_i).$$

In this form, the benefit variables B_A and B_F could be interpreted as the potential benefit for any individual, even if she is not participating. The values of P_A and P_F determine the values of $Y(H_i)$ and, hence, determine the values of utility at the three hours points in equation (4).

As stressed previously, the participation decision is not made independently of the hours decision. In terms of the hours equation, this co-decision implies that P_A and P_F cannot be treated as exogenous in estimating equation (4); P_A and P_F are affected by H in two different concrete ways. First, we know that not all eligibles participate in the programs, presumably because of the stigmatic costs of participating, the monetary and nonmonetary costs of going through the procedures of applying for and receiving benefits, a lack of knowledge, and other reasons. But whatever the reason, we expect that higher benefits will induce more individuals to participate in the program. Individuals with higher hours of work have lower benefits on average and, hence, have less incentive to participate in the programs. Second, at sufficiently high hours of work, an individual's income is such that she is not initially eligible to participate in food stamps or AFDC. This does not mean that the individual cannot participate, since she can reduce hours of work to become eligible.

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However, we expect that fewer of such individuals would join the programs than would individuals with lower initial hours of work.[1]

1. Structural Participation Equations

One way to build the dependency of the AFDC and food stamp participation decisions on the hours-of-work decision into the model would be to specify the participation equations formally as the utility differences between participation and nonparticipation:

(7) $P_A^* =$ (Utility if on AFDC) − (Utility if not on AFDC)

(8) $P_F^* =$ (Utility if on FS) − (Utility if not on FS)

(9) $P_A = 1$ if $P_A^* \geq 0$; $P_A = 0$ if $P_A^* < 0$

(10) $P_F = 1$ if $P_F^* \geq 0$; $P_F = 0$ if $P_F^* < 0$

Here, the "latent" indicators P_A^* and P_F^* are defined as the utility gain (or loss) from participation. Since the utility function is $U(H_i, Y_i)$, these could be inserted into equations (7) and (8). Unfortunately, implementing this approach would be very cumbersome, since we do not know which of the three hours points an individual would select in the participation categories in which she is not observed. For example, if we observe a full-time worker who receives food stamps but not AFDC, the P_A equation

---

[1]To elaborate, consider two different groups of individuals: individuals in Group 1 would perform a great amount of market labor in the absence of the Food Stamp and AFDC programs, while individuals in Group 2 would perform little market labor. If these programs were suddenly introduced, and if there were no labor-supply responses, we would assume that Group 1 individuals would be income-ineligible for the programs, while Group 2 individuals would be income-eligible. Individuals in Group 1 could become eligible by reducing their hours of work. However, because we expect that many would choose not to do so, proportionally fewer Group 1 than Group 2 individuals would participate in the programs.

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would have to be formulated as the difference between utility on AFDC and food stamps at three different hours points (H_0, H_1, and H_2) and utility off AFDC (but still on food stamps) at hours points H_2, her observed point. That is, she chooses not to participate in AFDC only if utility at all three hours points on the AFDC-FS budget constraint is less than her current utility without AFDC. The food stamp participation equation would take a similar form.

2. Reduced-Form Participation Equations

To avoid these difficulties, we shall instead specify only reduced-form participation equations. Conceptually, we assume that the participation equations to take form of equations (7) through (10). We then take our assumed functional form of the utility function (given below) and substitute it into equations (7) and (8), yielding participation equations with several Y_i's and H_i's on the right-hand side. Since the H_i's are constant numbers (0, 20, and 40), they need not be shown explicitly on the right-hand side of the participation equations. However, the error term in the labor-supply equation (4) will be on the right-hand side of the participation equations. In our specification of the participation equations, we do not explicitly include this error term, but allow it instead to be subsumed within the usual error terms that are already contained in the participation equations. In this sense, our participation equations are "reduced forms"; we imagine that the labor-supply equation has been substituted into the right-hand side of the participation equations and solved down for the remaining independent variables. The remaining independent variables will be (1) a set of exogenous socioeconomic characteristics, such as education, age, etc. (some of which not only affect

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participation indirectly through their effect on hours of work, but may also affect participation directly), and (2) disposable income Y_i at the three hours points under participation and nonparticipation. For the latter variables, we assume that, other things being equal, an increase in disposable income at any hours point in any participation category will increase the probability of participating in that category. Let Z be the set of socioeconomic characteristics and C be the set of disposable-income variables. Our participation equations then take the following forms:

(11) $$P^*_A = C_A\pi_A + Z_A\theta_A + u_A$$

(12) $$P^*_F = C_F\pi_F + Z_F\theta_F + u_F,$$

where π is the set of coefficients on the disposable income variables, θ is the set of coefficients on the socioeconomic characteristics, and u is an error term.

In implementing these equations, we make one further modification in the specification of the C variables. Specifically, we allow the components of disposable income to have different effects on participation rates, as should be intuitive. We shall disaggregate disposable income into three components: (1) the food stamp benefit, (2) the AFDC benefit, and (3) all other income (other nonwage income and earnings, both net of taxes). Each component can be calculated at the three different hours points, yielding a total of nine possible "financial" variables. Potentially, all nine could be included in both equations (11) and (12); however, in actuality, we shall enter only a subset of them in the equations. Together, these variables will indicate the effect of income and benefits on the participation decisions.

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D. FUNCTIONAL FORM AND DETAILED SPECIFICATION OF THE MODEL

1. The Form of the Utility Function

The main functional-form assumption required for our estimation is the utility function U(H, Y). We have chosen the quadratic utility function as follows:

$$(13) \qquad U(H, Y) = \alpha H - \beta H^2 + \nu Y - \delta Y^2,$$

where $\alpha < 0$, $\beta > 0$, $\delta > 0$. The quadratic function assumes that utility falls as H increases (holding income constant), and that it falls at an increasing rate. It also assumes that utility rises as Y rises (holding H constant) but at a decreasing rate (decreasing marginal utility). The function has been discussed extensively in the economics literature (see Goldberger, 1967, for a full discussion). Its only general disadvantage is a mathematical one that stems from the quadratic assumption--that if H or Y is sufficiently high, the sign of its effect on utility reverses (that is, it reverses when one is beyond the peak of the quadratic function).

However, this problem is not likely to be serious in an empirical study, assuming that H and Y are in normal ranges.

The advantage of the quadratic form for our purposes is that it is simple and easy to use, since the difference between the utilities at any two hours points is a linear function of the differences in H, H^2, Y, and Y^2 at the two points. Thus, for example, the choice between H = 0 and H = 20 would involve the following equations:

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(15) $I = 1 \text{ if } I^* \geq 0; \; I = 0 \text{ if } I^* < 0.$

Here, I is a dummy variable that indicates whether the individual works part-time or not at all. The I^* equation is a function of only two variables: the difference in disposable income at the two points and the difference in the squares of disposable income. Since the H points are constants, they together form the constant term in the equation. Equations (14) to (15) could be estimated with any standard probit package.

If we wish to compare our estimates with those of prior estimates of hours-of-work equations, we can use the labor-supply equation implied by the quadratic utility function. If an individual has a constant wage rate W, has income N not attributable to her own earnings, pays no taxes, and receives no income transfers (so that the budget constraint is linear), the labor-supply function is as follows:

$$H = \frac{\alpha + W(1-2\delta N)}{2(\beta + \delta W^2)}$$

Thus, hours of work is a nonlinear function of the wage rate and nonwage income. The implied wage elasticity and total income elasticity are as follows:

$$\text{Wage elasticity} = \frac{W[1 - 2\delta(2WH + N)]}{2H(\beta + \delta W^2)}$$

$$\text{Total Income Elasticity} = \frac{-\delta W^2}{\beta + \delta W^2}$$

After we have obtained estimates of α, β, and δ, these wage and income elasticities can be computed and thence compared with those in past studies of the labor supply of female heads of households.

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To provide an error term, we assume that the parameter α varies from individual to individual. It thus captures the "heterogeneity of preferences (or tastes)," implying that different individuals will make different choices even though they have the same values of Y at the various points. In equation (14), for example, someone with a more negative value of α is less likely to work part-time. The parameter thus measures the strength of the disutility of work for an individual. To formulate our model, we shall calculate for each individual the values of α that will equate utility at both hours points in either of the two sets of adjacent points (H_o and H_1, H_1, and H_2). Values of α that are different than the utility-equilibrating values will then throw the individual into one of the three hours categories. The cutoff value of α between H = 0 and H = 20, for example, can be obtained by setting equation (14) equal to 0 and solving for α.

2. <u>Specification of the Full Model</u>

The full model specification is as follows:

(16) $$H = H_0 \text{ if } \alpha < \alpha_1$$
$$= H_1 \text{ if } \alpha_1 < \alpha < \alpha_2$$
$$= H_2 \text{ if } \alpha_2 < \alpha$$

(17) $$\alpha_1 = \beta(H_1) - (Y_1 - Y_0)/H_1 + \delta(Y_1^2 - Y_0^2)/H_1$$

(18) $$\alpha_2 = \beta(H_1 + H_2) - (Y_2 - Y_1)/(H_2 - H_1) + \delta(Y_2^2 - Y_1^2)/(H_2 - H_1)$$

(19) $$\alpha = X\psi + \varepsilon$$

(20) $$P_A^* = C\pi_A + Z\theta_A + u_1$$

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(21) $P_A = 1$ if $P_A^* > 0$; 0 otherwise

(22) $P_F^* = C\pi_F + Z\theta_F + u_2$

(23) $P_F = 1$ if $P_F^* > 0$; 0 otherwise.

In the labor-supply equation, equation (16), individuals are sorted into one of the three categories, H_0, H_1, or H_2, according to their values of α. The cutoff values of α are shown in equations (17) and (18). They are simply the values of α that make utility equal at H_0 and H_1 and at H_1 and H_2. (Note that the parameter ν in the quadratic utility function is redundant and, as required by the function, has thus been set equal to one.) In equation (19) we allow the "taste" parameter α to be a function of a set of socioeconomic characteristics, X, with coefficients ψ, plus an error term. Thus, altogether, the hours choice will be a function of three factors--the values of disposable income (Y_0, Y_1, and Y_2) at each of the three hours points; the variables X; and the error term ε. Equations (20) through (23) are our participation equations. These are the same as were previously shown.

Three equations are implicitly contained in the model--one labor-supply equation and two participation equations. Three error terms are also contained in the model: ε, u_1, and u_2. We assume that $\varepsilon \sim N(0,\sigma_\varepsilon^2)$, $u_1 \sim N(0,1)$, and $u_2 \sim N(0,1)$, with the following correlation matrix:

$$\begin{matrix} \varepsilon \\ u_1 \\ u_2 \end{matrix} \begin{bmatrix} 1 & \rho_{\varepsilon 1} & \rho_{\varepsilon 2} \\ & 1 & \rho_{12} \\ & & 1 \end{bmatrix}$$

Our estimates of the correlation matrix will tell us whether the error terms across equations are correlated. On intuitive grounds, we expect that $\rho_{12} > 0$ (that is, above-average probabilities of participation in the AFDC Program will be correlated with above-average probabilities of participation in the Food Stamp Program). We also expect that $\rho_{\varepsilon 1} < 0$ and $\rho_{\varepsilon 2} < 0$ (that is, high values of labor supply will be correlated with low values of participation in the two programs).

3. Estimation Procedure

To estimate the equation system, we use the maximum-likelihood technique. We form a log-likelihood function, representing the logs of the probabilities of observing the H_i, P_A, and P_F values for each individual, which are trivariate normal probabilities. We then maximize the likelihood function with respect to the unknown parameters of the model (β, δ, ψ, π_A, θ_A, π_F, θ_F, σ_ε, and the three correlations). The estimation results are presented in the following chapter.

4. Preview of Simulation Procedure

Although we shall discuss our simulation methodology in Chapter VII, we note at this point that simulation with the model, once the parameters are estimated, is fairly intuitive. For any individual, we can use the estimated labor-supply equation to calculate the probability of working zero hours, part-time, or full-time. The input to this calculation will include the values of disposable income at the three hours points. We can calculate these three hours probabilities separately for all four program combinations (on both programs, on one but not the other, and on neither). Using our participation equations, we can also calculate the probabilities of participation in each of the programs. As input into this calculation we will use the values of program benefits. Using the results from calculating the hours and participation probabilities, we can compute several elements: the average work hours of participants in each of the four participation categories; the probabilities of being in each of the four participation categories; and the average food stamp or AFDC benefit for participants in those programs. Each can be calculated for any food stamp benefit formula, thereby enabling us to investigate the effects of hypothetical reforms to the Food Stamp Program.

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V. THE DATA

The primary source of data for this study is the 1979 research test panel of the Income Survey Development Program (ISDP). The ISDP, a longitudinal, nationally representative survey of about 7,500 households, was a pretest of the Survey of Income and Program Participation.[1] The ISDP sample was interviewed in six successive quarters, beginning with the first quarter of 1979. The survey obtained information on household composition, income sources and amounts (including food stamps), and participation in income transfer programs—information that is more detailed than that which is obtained through the Current Population Survey (see Ycas and Lininger, 1980, for a description of the ISDP).

A. WAVE V OF THE ISDP

Two waves of the 1979 ISDP were considered in selecting the data source for this study: Wave II, with data for the period from February to June 1979, and Wave V, with data for the period from October 1979 to February 1980. Both files contain detailed person-level and household-level information on demographics, income, employment, assets, and program participation. Wave II provides additional food-stamp-specific information on deductible expenses and on food units within households, which Wave V does not. However, Wave V was selected as the data source for the study because that survey was fielded after the implementation of several major

[1]The Survey of Income and Program Participation is a major, ongoing data collection effort. The first wave of this new longitudinal survey was fielded early in 1984.

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changes in the Food Stamp Program during the first half of 1979, as mandated by the Food Stamp Act of 1977.[1] Errors in the empirical results that are introduced by the assumption that every household in the Wave V file constitutes a food unit and by the imputation of shelter expenditures are believed to be smaller than those that would be introduced by the program changes that were implemented during the Wave II reference period.

At the request of the Food and Nutrition Service, the Bureau of the Census made available to MPR a version of the Wave V file which includes a variable that identifies the state of residence for each respondent household. This information was essential, because, as discussed in Chapter II, the work-effort effect of food stamps on the target population for this study (nonelderly, female heads of households with dependent children) is inextricably linked to the work-effort effect of AFDC benefits. While the AFDC Program is partially funded and regulated by the federal government, benefit levels are set by the individual states. Most important for this study is the fact that states select the level of work incentives embodied in the AFDC benefit structure. On the basis of a 1979 survey of approximately 23,000 AFDC case records, we estimated AFDC benefit equations for households in each of 33 of the largest states and in the District of Columbia as a function of the number of children, earned income, and unearned income.[2] Effective benefit-reduction rates on earned

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[1]These changes include the elimination of the food stamp purchase requirement and the replacement of a number of deductions from gross income with a standard deduction based on househol1 size.

[2]Our estimation methodology and results are discussed in Fraker and Moffitt (1984).

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income ranged from a low of .13 to a high of .55. The estimated AFDC benefit equations were used in conjunction with the ISDP state identifiers to assign AFDC guarantee amounts and benefit-reduction rates to households in the Wave V file.

B. THE ANALYSIS FILE

Our analysis file was extracted from the ISDP Wave V file in three stages:

1. Information on the employment and earnings of household heads was merged with information on households.

2. Female-headed households that were categorically eligible for AFDC but not for SSI or Social Security were selected.

3. Households without large amounts of income or assets were selected.

Additional details on each of these steps are provided in the following subsections.

1. Merging Household and Person Information

The ISDP files are hierarchical, providing information on households and on the persons who comprise those households. For each survey wave, two types of data files exist: a file in which the household is the unit of observation and a file in which the person is the unit of observation. Case records in files of both types include a household identifier that permits linking cases between the person and household files.

Data on the age, employment, and earnings of household members are stored in the person files. This information was necessary in order to create one of the dependent variables in our analysis (weekly hours of market labor by the household head), as well as wage rate and age variables for the household head. Age information on dependents was necessary in order to determine a household's categorical eligibility to receive AFDC benefits.

The household identifier was used to merge the required variables from the 18,588-case Wave V person file with a larger set of variables from the 7,197-case Wave V household file.

2. Screening for Categorical AFDC Eligibility

A set of screens that identify households which are categorically eligible for AFDC but not for other programs was applied to the merged Wave V file, so as to avoid complications in the empirical analysis that would have been created by the presence of households eligible for multiple, interacting transfer programs. Households headed by nonelderly, nondisabled women with children less than 18 years old were selected. Another screen excluded from the analysis file those households which did not reside in the 33 states and District of Columbia for which reliable estimates of the AFDC benefit equation had been obtained. A total of 417 Wave V households satisfied these screens.

3. Screening for Income and Assets

The model presented in the previous chapter recognizes that households may adjust their market labor so as to qualify for food stamp or AFDC benefits. If, for example, food stamp benefits had been more generous, some ineligible households might have chosen to work less (or spend down their assets) in order to qualify for those benefits. Thus, program-eligibility status is an endogenous variable in this analysis. As a general rule, econometric estimates are biased when the sample is selected on the basis of the value of an endogenous variable. For this reason, a number of households that were not financially eligible for food stamps or AFDC benefits at the time of the Wave V survey were included in our analysis file.

Some of the Wave V households that were categorically (but not financially) eligible for AFDC benefits reported such large incomes or assets that it is unlikely that any plausible changes in the AFDC or Food Stamp programs could have induced them to alter their behavior so as to become financially eligible for benefits. For these households, program eligibility is not an endogeneous variable in any practical sense. It was feared that the inclusion of these households in our analysis would cause biased estimates of the labor-supply and program-participation equations in our model. Consequently, they were excluded from the final analysis file by a set of screens on financial variables.

Briefly, the financial screens excluded households whose assets were more than $1,000 in excess of the food stamp asset limits. They also excluded households with either transfer income (excluding food stamp and AFDC benefits) or other unearned income that exceeded $1,000 per month. Households which contained female heads whose wage rates exceeded $15 per hour or other adults who earned more than $2,500 per month were also excluded. These financial screens were binding for 59 of the 417 Wave V households that were categorically eligible to receive AFDC benefits, leaving 358 cases in the final analysis file.

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4. Descriptive Statistics

Table V.1 provides descriptive statistics for the variables in the final analysis file that were actually included in the empirical specification of our model of work effort and program participation. The statistics shown in this table are the means and standard deviations of values that were reported by Wave V respondents to ISDP surveyors. In contrast, Table V.2 provides the means and standard deviations of predicted values of net income, AFDC benefits, and food stamp benefits at three different levels of market labor. The procedures that generated these predictions are explained at the bottom of the table.

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TABLE V.1

MEANS AND STANDARD DEVIATIONS OF
NONFINANCIAL VARIABLES IN THE ANALYSIS FILE
(N = 358)

Variable	Mean (Standard Deviation)
Hours of Market Labor per Week by Household Head	21.60 (19.06)
AFDC Participation Flag (1 = Yes, 0 = No)	0.41 (0.49)
Food Stamp Participation Flag (1= Yes, 0 = No)	0.48 (0.50)
Years of Schooling of Household Head	11.19 (2.67)
Age of Household Head	33.63 (8.89)
Minority Status of Household Head (1 = Minority, 0 = Nonminority)	0.50 (0.50)
South Census Region (1 = Yes, 0 = No)	0.37 (0.48)
Household Size	3.41 (1.45)
Number of Children Ages 0 to 5	0.52 (0.74)
Number of Children Ages 6 to 11	0.79 (0.81)

SOURCE: Computed by Mathematica Policy Research from Wave V of the ISDP.

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TABLE V.2

MEANS AND STANDARD DEVIATIONS OF PREDICTED VALUES OF FINANCIAL VARIABLES AT THREE DIFFERENT LEVELS OF MARKET LABOR (N = 358)

Variable	Weekly Hours of Market Labor by the Household Head: 0 Hours, Mean (Standard Deviation)	20 Hours, Mean (Standard Deviation)	40 Hours, Mean (Standard Deviation)
Net Monthly Income (Excluding AFDC and Food Stamp Benefits)	$228* (362)	$545 (361)	$893 (402)
Monthly AFDC Benefit	$173 (139)	$103 (110)	$40 (71)
Monthly Food Stamp Benefit (Assuming no AFDC Benefit)	$138 (78)	$91 (80)	$26 (53)

SOURCE: Computed by Mathematica Policy Research from Wave V of the ISDP.

NOTES: (i) Income amounts net of positive taxes were predicted on the basis of reported nonlabor income, the predicted wage rate of the household head, and reported earnings of other adult family members.

(ii) AFDC benefits were predicted on the basis of reported number of children, reported nonlabor income, and predicted earnings, using benefit equations estimated for individual states.

(iii) Food stamp benefits were predicted on the basis of reported household size, reported nonlabor earnings, predicted shelter costs, and predicted earnings, using 1979 food stamp regulations.

*All dollar amounts are in 1979 dollars.

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VI. RESULTS OF THE ESTIMATION

Table VI.1 presents the results of our maximum-likelihood estimation of the three-equation model of labor supply and program participation. The table shows four "final," or "best," estimates in the last four columns, columns (6) through (9).[1] The first five columns show the results of intermediate estimations that we obtained in the process of building the final models. In an estimation problem as difficult as this, the final model must be built up from small models that contain very few parameters to large models that contain many parameters. Not all of our intermediate estimations are shown in the table, but only those of some independent interest.

A. ESTIMATES OF INTERMEDIATE MODELS

Column (1) shows the results of estimating the simplest possible model--a six-parameter model in which the values of the three parameters of the utility function (β, δ, and the constant term in the labor-supply equation, representing α) are estimated, along with the standard deviation of the error term in the labor-supply equation (σ_ε) and the two constant terms in the participation equations. No other independent variables enter into any of the three equations, and, more importantly, the cross-equation correlations (ρ_{12}, $\rho_{\varepsilon 1}$, and $\rho_{\varepsilon 2}$) are constrained to be zero. The latter restriction implies that each of the three equations in this simple model were in effect estimated separately.

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[1]The columns of Table VI.1 define different versions of our three-equation model. Thus, column (1) defines Model 1, and so on.

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TABLE VI.1

RESULTS OF ESTIMATING NINE VARIANTS OF THE
MODEL OF LABOR SUPPLY AND PROGRAM PARTICIPATION

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Labor Supply									
βa/	.946**	.982**	1.989*	2.370*	1.760**	2.393**	2.624*	3.028*	2.087**
	(.191)	(.195)	(1.217)	(1.836)	(1.012)	(1.356)	(1.652)	(2.226)	(1.104)
δb/	.238**	.237**	.300**	.410**	.344**	.249**	.261**	.297**	.260**
	(.034)	(.035)	(.114)	(.193)	(.112)	(.110)	(.125)	(.156)	(.101)
Education		.295**	.930*	1.202	.821*	.932*	1.055*	1.265	.831*
		(.088)	(.632)	(1.015)	(.531)	(.578)	(0.728)	(1.024)	(.503)
South		1.986**	4.199*	4.250*	3.413**	3.318**	3.619*	3.355*	2.317**
		(0.519)	(2.630)	(3.281)	(2.017)	(1.907)	(2.330)	(2.569)	(1.390)
Minority		-1.735**	-4.284*	-3.970	-2.858*	-3.357*	-3.668*	-4.086	-2.862*
		(0.463)	(2.809)	(3.337)	(1.875)	(2.088)	(2.573)	(3.291)	(1.751)
HH Size			.517*	1.209*	.746**	.780*	.822*	1.138*	.908**
			(.379)	(0.936)	(.449)	(.504)	(.584)	(0.869)	(.513)
Kids, 0-5				-5.568	-3.982**	-4.808**	-5.371*	-6.450*	-4.304**
				(4.355)	(2.318)	(2.659)	(3.348)	(4.775)	(2.315)
Kids, 6-11				-1.863	-1.215*	-1.312*	-1.467	-2.041	-1.419*
				(1.673)	(0.890)	(0.977)	(1.168)	(1.763)	(0.971)
Constant	-.172	-3.253	-9.331	-9.481	-6.682	-6.753	-7.256	-8.480	-6.467
	(.278)	(0.965)	(5.227)	(6.889)	(3.657)	(3.875)	(4.593)	(6.193)	(3.600)
AFDC Participation									
Education			-.112**	-.132**	-.118**	-.055*	-.057*	-.086**	-.081**
			(.034)	(.035)	(.037)	(.039)	(.041)	(.040)	(.040)
Minority			.528**	.489**	.421**	.637**	.608**	.597**	.582**
			(.184)	(.181)	(.197)	(.200)	(.197)	(.195)	(.195)
Age				-.014	-.020*	-.016	-.018*	-.014	-.014
				(.012)	(.014)	(.013)	(.013)	(.013)	(.012)
Kids, 0-5				.474**	.361**	.530**	.518**	.613**	.655**
				(.152)	(.168)	(.177)	(.180)	(.169)	(.166)
Kids, 6-11				.218**	.062	.099	.101	.270**	.223**
				(.127)	(.154)	(.155)	(.156)	(.131)	(.126)
Constant	-.240	-.240	-.539	.417	-.128	.379	.405	.833	1.011
	(.096)	(.098)	(.447)	(.716)	(.820)	(.763)	(.796)	(.725)	(0.715)
I_0				-.164	.296	.164	.201	-.315	-.370
				(.350)	(.436)	(.458)	(.428)	(.331)	(.329)
$I_1 - I_0$						-.456**		-.353**	
						(.143)		(.117)	
$I_2 - I_0$							-.167**		-.174**
							(.065)		(.057)
B_{A0}			.333**	.301**	.338**	.373**	.396**	.299**	.330**
			(.080)	(.085)	(.095)	(.118)	(.160)	(.102)	(.141)
$B_{A1} - B_{A0}$						-.248		-.164	
						(.300)		(.258)	
$B_{A2} - B_{A0}$							-.016		.011
							(.233)		(.200)
B_{F0}			.371**		.416**	.261	.430*		
			(.150)		(.206)	(.228)	(.280)		
$B_{F1} - B_{F0}$						-.019			
						(.355)			
$B_{F2} - B_{F0}$							.298		
							(.286)		

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TABLE VI.1 (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Food Stamp Participation									
Education			-.140**	-.161**	-.158**	-.091**	-.093**	-.124**	-.126**
			(.033)	(.037)	(.037)	(.040)	(.039)	(.038)	(.040)
Minority			.641**	.576**	.565**	.774**	.726**	.666**	.664**
			(.179)	(.184)	(.192)	(.188)	(.192)	(.183)	(.183)
Age				-.020*	-.022**	-.020**	-.022**	-.022**	-.020**
				(.012)	(.013)	(.012)	(.011)	(.011)	(.011)
Kids, 0-5				.355**	.275**	.496**	.483**	.475**	.520**
				(.156)	(.166)	(.150)	(.151)	(.147)	(.149)
Kids, 6-11				.258**	.172*	.245**	.241**	.280**	.338**
				(.123)	(.132)	(.124)	(.124)	(.119)	(.117)
Constant	-.035	-.035	.397	1.389	1.042	1.619	1.581	2.051	2.210
	(.099)	(.098)	(.428)	(0.681)	(0.744)	(0.713)	(0.719)	(0.679)	(0.693)
I_0				-.118	.196	-.013	.081	-.379	-.490*
				(.347)	(.405)	(.438)	(.425)	(.350)	(.355)
$I_1 - I_0$						-.464**		-.309**	
						(.134)		(.104)	
$I_2 - I_0$							-.178**		-.156**
							(.067)		(.059)
BA0			.067		.053	.181**	.200*		
			(.072)		(.084)	(.108)	(.147)		
BA1 - BA0						-.159			
						(.286)			
BA2 - BA0							.014		
							(.216)		
BF0			.447**	.265**	.479**	.195	.348*	.284**	.283*
			(.130)	(.139)	(.160)	(.176)	(.240)	(.143)	(.185)
BF1 - BF0						-.152		.032	
						(.309)		(.233)	
BF2 - BF0							.143		.157
							(.286)		(.236)
Error Terms									
σ_ε	2.868**	2.773**	6.766**	7.812**	5.601**	6.807**	7.637**	8.962**	6.104**
	(0.463)	(0.476)	(2.211)	(3.004)	(1.899)	(1.976)	(2.357)	(3.059)	(1.795)
ρ_{12}			.844**	.853**	.851**	.851**	.852**	.885**	.862**
			(.307)	(.301)	(.330)	(.325)	(.325)	(.369)	(.344)
$\rho_{\varepsilon 1}$			-.516**	-.532**	-.515**	-.622**	-.629**	-.658**	-.661**
			(.166)	(.172)	(.189)	(.180)	(.191)	(.209)	(.207)
$\rho_{\varepsilon 2}$			-.624**	-.684**	-.629**	-.827**	-.804**	-.819**	-.816**
			(.193)	(.236)	(.225)	(.360)	(.341)	(.356)	(.349)
LOG LF	-837.40	-808.73	-581.69	-552.24	-554.87	-546.58	-547.44	-556.27	-560.67

SOURCE: Computed by Mathematica Policy Research from Wave V of the ISDP.

NOTES: (i) Asymptotic standard errors in parentheses.
(ii) All coefficients on financial variables in the participation equations have been multiplied by 100, except for those on I_0, which have been multiplied by 1,000.

a/ β parameter multiplied by 100.
b/ δ parameter multiplied by 1000.

**Significant at the 10% level.
*Significant at the 20% level.

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The results show significant estimates of the β and δ parameters but a constant term in the labor-supply equation that is insignificantly different from zero. Using the formula for wage and income elasticities given in Chapter IV and using the mean values of the net wage and net income (excluding the head's earnings) in the sample, the parameter estimates imply a wage elasticity of .66 and a total income elasticity of -.21. These elasticities imply a compensated wage elasticity of .87. Thus, net-wage rates have a positive impact on labor supply, and net income has a negative impact. These impacts in turn imply a negative impact on labor supply of increasing the benefit-reduction rate or increasing the guarantee level in the Food Stamp Program.

Column (2) shows the results of adding three independent variables to the labor-supply equation--education, residence in the South, and belonging to a racial or ethnic minority group. Education has a positive effect on work effort, residence in the South a positive effect, and minority status a negative effect; all are statistically significant. Note that the estimates of β and δ are virtually unaffected by these additions.

Column (3) shows the results of adding one more variable to the labor-supply equation and a few variables to the participation equations, but, more importantly, shows that the cross-equation correlations are non-zero. As indicated by the estimates of ρ_{12}, $\rho_{\varepsilon 1}$, and $\rho_{\varepsilon 2}$, a strong positive correlation (.844) exists between the error terms in the two participation equations, and strong negative correlations (-.516 and -.624) exist between the error term in the labor-supply equation and those in the two participation equations. The signs of these correlations are as we expected (see Chapter IV), and their magnitudes show that the correlations are not at all close to zero. This finding is important because it implies that the labor-supply and participation equations are indeed simultaneous, and that single-equation techniques applied to each will yield biased and inconsistent coefficients. In particular, since the labor-supply equation contains the participation variables on the right-hand side, the labor-supply estimates in columns (1) and (2) are biased.

This suspicion is confirmed by the large difference between the estimates of β and δ in column (3) and those in columns (1) and (2). The estimate of the β parameter more than doubles. The fact that these two parameters are more or less inversely related to the wage and income elasticities implies lower elasticities than previously calculated. Specifically, the wage elasticity in Model 3 is .25, and the total income elasticity is -.13 (the compensated wage elasticity is .38). The wage elasticity is about one-third of its value in Models 1 or 2, and the income elasticity is about two-thirds of its value in the smaller models. The drop in the elasticities is a direct result of incorporating the endogeneity of the participation variables into the estimation procedure via the three correlation coefficients. Participation is endogenous because AFDC and food stamp participants have both low hours of work and low net-wage rates (because they face high benefit-reduction rates), whereas nonparticipants have high hours of work and high net-wage rates (because they face no benefit-reduction rates). Consequently, models that omit the cross-equation correlations impart a positive bias to the net-wage elasticity [illegible] income (because of the program guarantees) and low hours of work, imparting a negative bias to the income elasticity.

Model 3 also contains variables in the participation equation for the AFDC and food stamp benefits at zero hours of work (B_{A0} and B_{F0}). Models 4 and 5 contain larger sets of socioeconomic characteristics in the labor-supply and participation equations, but also a few additional financial variables which suggest that the basic AFDC benefit has a significantly positive effect on AFDC participation, and that the basic food stamp benefit has a positive effect on food stamp participation. In addition, the Model 5 food stamp benefit contains a positive coefficient in the AFDC participation equation (indicating a cross-program effect), but the AFDC benefit is not significant in the food stamp participation equation. Thus, although many AFDC participants apparently take food stamps into consideration when deciding whether or not to participate in the AFDC Program, fewer food stamp recipients take into account the AFDC benefit in making their food stamp participation decisions. Columns (4) and (5) also indicate that net income at zero hours of work by the household head (I_0) has no significant effect on participation rates, a consistent finding virtually throughout the table.

The pattern of the effects of the socioeconomic characteristics in columns (3) through (5) is also consistent throughout the table. As indicated in the table, our full model contains six exogenous independent variables in the labor-supply equation and five in each of the participation equations. Four of these variables appear in both the labor-supply equation and the two participation equations. All the variables in both sets were tried in all equations, but many were insignificant and were deleted. The results in the table show our final sets of significant variables after considerable experimentation and testing.

The results show that labor supply is positively affected by education, residence in the South, having a nonminority status, and having a larger household size. The number and presence of children reduce labor supply, with younger children having a more negative impact than do older children. In the participation equations, each characteristic has the same sign in both equations. Participation rates are higher among households with lower levels of education, among minorities, among younger age groups (although this is rarely significant in the AFDC equation), and among households with more children. Again, those with younger children are different than those with older children; the former have higher participation probabilities.

B. ESTIMATES OF FINAL MODELS

In columns (6) through (9) we show estimates of our final models. These models explore the effects of adding more financial variables to the participation equations--in particular, financial variables at part-time and full-time work. In these explorations, we entered not the levels of income and benefits at part-time and full-time hours of work, but rather their differences with income and benefits at zero hours. Since all of these variables are linear in the equations, this representation is equivalent to entering level variables only. However, it is somewhat more convenient in its interpretation. The net-income-difference variables ($I_1 - I_0$ and $I_2 - I_0$) are multiples of the net-wage rate of the individual (that is, net of positive taxes), while the benefit-difference variables ($B_{A1} - B_{A0}$ and $B_{A1} - B_{A0}$ for AFDC, $B_{F1} - B_{F0}$ and $B_{F2} - B_{F0}$ for food stamps)

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are (negative) multiples of the average benefit-reduction rates in the AFDC and Food Stamp programs. The underlying benefit-reduction rates are only average rates because they are derived from calculating the benefit at part-time or full-time work (these benefits may be zero) and from calculating the benefit at zero hours of work; scaling the difference by the difference in hours would yield an average benefit-reduction rate. Thus, the net-income-difference variables can be taken as proxies for the net-wage rate, and the benefit-difference variables can be taken as proxies for the (negative of the) benefit-reduction rate.

With Models 6 through 9, we explored four different combinations of such financial variables, by entering either the full-time or the part-time difference variables (but not both) in the participation equations, and by including in two of the models (Model 8 and 9) only the own-benefit variables and not the cross-program-benefit variables. The results across the equations are generally consistent. In terms of net income (exclusive of AFDC and food stamp benefits), we again find that the level of net income at zero hours of work by the household head (I_0) rarely has a significant impact. However, in the one model in which it is significant (Model 9, in the food stamp participation equation), it has the expected negative sign--additional net income at zero hours of work by the household head leads to a lower food stamp participation rate. However, the net-income-difference variables show a strong negative effect of the net-wage rate on program participation rates. This effect occurs in both the AFDC and food stamp participation equations, regardless of whether the full-time or part-time net-wage (net-income-difference) variables are entered. Interestingly, the hourly wage over the part-time range ($I_1 - I_0$) has a stronger effect than the hourly wage over the full-time range ($I_2 - I_0$), suggesting that part-time work is more relevant than full-time work to female heads.

The results of entering benefit-difference variables in the participation equations are also fairly uniform across Models 6 through 9. Specifically, all the coefficients on these variables are insignificant at conventional levels. Thus, we have found no detectable effects of benefit-reduction rates on participation rates. The "expected" sign for the coefficients on the own-benefit-difference variables is positive, but it occurs only half the time. The coefficients on the own-benefit-difference variables in the food stamp equation ($B_{F1} - B_{F0}$ and $B_{F2} - B_{F0}$) are generally positive, but those in the AFDC equation ($B_{A1} - B_{A0}$ and $B_{A2} - B_{A0}$) are rarely so. From the standpoint of obtaining coefficients with the expected signs, the results for Model 9 are the best--both own-benefit-difference coefficients are positive. The levels of the own-benefits at zero hours of work remain significant and positive throughout.

The labor-supply elasticities in the final four models remain in the same range as those previously examined. Although the β and δ coefficients vary somewhat across the four equations, the elasticities fall into a narrow range. The wage elasticities vary from .18 to .30, and the total income elasticities vary from -.09 to -.11 (the compensated wage elasticity varies from .27 to .41). Thus, we continue to find small but significant and detectable disincentive effects of food stamp and AFDC benefits on labor supply.

Our explorations with larger models than those in columns (6) through (9) provided no additional significant results. Most of our attempts involved entering additional financial variables into the participation equations, such as both the part-time and full-time income-difference and benefit-difference variables. However, the collinearity between these variables is quite high, making it difficult to distinguish their separate effects. In any case, since the difference variables are already largely insignificant in the simpler models, as shown in columns (6) through (9), one should not expect that even more detailed specifications of such variables would lead to significant coefficients.

VII. RESULTS OF SIMULATION EXERCISES

Because of the complexity of our model of work effort and program participation and because the dependent variables in the model are not specified to be linear functions of the independent variables, estimates of the parameters in the model are difficult to interpret directly. We have chosen to use microsimulation procedures to generate household-level predictions of work effort and program participation on the basis of the parameter estimates. These predicted outcomes can be presented to policy-makers in the form of easily understandable descriptive tables. Micro-simulation is a procedure whereby estimates of the parameters in the model are applied to survey data on individual households to predict their behavior and financial status under alternative assumptions about program rules and demographic conditions. The following section describes the microsimulation methodology, and subsequent sections present our substantive findings.

A. SIMULATION OBJECTIVES AND LIMITATIONS

The simulation results reported in this chapter were obtained by applying estimates of the parameters in Model 9 (see Table VI.1) on a case-by-case basis to financial and demographic data on the 358 female-headed households that constitute our analysis file. For each household, the model generates the probabilities of being in 12 cells defined by the following:

- o A dichotomous food stamp participation variable (participates/does not participate)
- o A dichotomous AFDC participation variable (participates/does not participate)

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- o A trichotomous measure of work effort (no market labor/works part-time/works full-time)

The cell probabilities for any case can be combined to obtain the probabilities of participating in the Food Stamp or AFDC programs, the expected hours of work per week, and (with the addition of some program data) the expected food stamp benefit.

Each simulation exercise was conducted in two steps. In the first step, program rules and survey information on household characteristics were used to impute nontransfer income, AFDC benefits, and food stamp benefits to every household. Separate imputations were for made each of the 12 combinations of work effort and program participation. In the second step, estimates of the model's parameters were applied to the observed and imputed attributes of the sample households to compute the probabilities of being in the 12 cells and to generate additional information on work effort and food stamp benefit amounts based on these probabilities.

1. Objectives

The overall objective of the simulation exercises is to provide readily understandable illustrations of the implications of our estimated model. Attaining this objective depends on several procedural components:

- o Using baseline (December 1979) simulation results to assess the model's predictive accuracy
- o Simulating work effort, food stamp participation, and food stamp benefits under current (FY 1985) program rules
- o Simulating the effects of reforms to the current Food Stamp Program

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- Assessing the errors in existing microsimulation procedures (which typically neglect behavioral responses) for predicting the effects of program reforms on benefits

- Comparing the simulated effects of program reforms on work effort, participation, and benefits with the simulated effects of changes in household characteristics

- Examining the impacts of program reforms on benefit amounts, disaggregated by the work status of the household head

2. Limitations

It would be inappropriate to infer the total effects of changes in the Food Stamp Program on the basis of the simulation results presented below. Underlying the data, model, and simulation methodology are choices or assumptions that have made the analysis more tractable but may have reduced the generalizability or reliability of the findings. These choices and assumptions are described in this subsection.

The Data. Our analysis file consists of 358 cases from Wave V of the ISDP. These cases are all low-income households that contain dependent children and nonelderly female heads. They were selected because they are categorically eligible for AFDC but are unlikely to be receiving SSI or OASDI benefits. Thus, with some confidence in terms of not biasing our results, we developed a model of work effort and program participation that omits a consideration of SSI and OASDI and focuses upon the effects of AFDC and food stamps. Taking into account the omitted programs would greatly complicate modeling the behavior of households that are eligible to participate in them.

Because our analysis file includes information only on female-headed households that are categorically eligible for AFDC, the findings cannot be assumed to be representative of all low-income households. How-

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ever, the most recent available tables based on the Food Stamp Quality Control Sample show that 45 percent of the food-stamp caseload consists of female-headed households that contain children who are less than 18 years old.[1] Thus, while our analysis file omits several segments of the food-stamp-recipient population by necessity, it includes cases from the largest single demographic segment of that population.

Several additional features of the analysis file could detract from either the generalizability or reliability of our findings. First, Wave V of the ISDP provides no information on shelter expenditures. Since such expenditures represent a major deductable expense in determining food stamp eligibility and benefits, it was necessary to impute shelter expenditures on the basis of an equation that was estimated by ordinary least squares regression on Wave II data. The equation specifies that shelter expenditures are a function of household size, income, tenancy status, and other variables. It was also necessary to impute potential wages to nonworking household heads, on the basis of a joint model of hours of work and wages that was estimated by a full-information maximum-likelihood procedure. Using imputed rather than actual data on shelter expenses and wages introduces some error into the microsimulation results for individual cases; however, there is no reason to believe that these errors are systematic or that the overall results are thus biased.

Finally, the sampling weights available in the Wave V file were not used in our analysis. To do so would have introduced additional complexity

[1] See Table 30 of "Characteristics of Food Stamp Households: August 1982," preliminary report, Office of Analysis and Evaluation, Food and Nutrition Service, USDA.

into the estimation and simulation procedures. The absence of the weights calls into question the extent to which the estimates and simulation results of our model are representative of the population of female-headed, low-income households with dependent children. A comparison of descriptive statistics based on the analysis file revealed only small differences between the weighted and unweighted mean values of household size, household income, and the age, education, and wages of the household head. More substantial differences were found in AFDC and food stamp participation rates. We conclude that some caution should be exercised in extrapolating from the simulation results presented below to the behavior of all low-income, female-headed households.

The Model. To facilitate estimating the model of program participation and work effort, the hours of work decision was specified as a choice between working full-time, working part-time, and not working. Female heads who reported 1 to 34 hours of work per week were classified as part-time workers, while those who reported 35 or more hours of work were classified as full-time workers. In computing the average simulated hours of work under alternative Food Stamp Program rules, we assumed that part-time and full-time workers worked 20 and 40 hours per week, respectively. Focusing upon just three hours of work points greatly simplifies estimating the labor-supply responses to highly nonlinear budget constraints. However, this simplification reduces the level of detail in our simulation results, and may lead to biased predictions if the 20 and 40 hours per week assumptions are incorrect.

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Simulation Methodology. Wave V of the ISDP provides data for a five-month period centering on December 1979; however, most of our simulations explore the effects of variations in Food Stamp Program rules that are in effect in fiscal year 1985. To simulate program eligibility and benefit amounts from 1979 data under 1985 rules, we used the following procedures:

- If a benefit or deduction rate changed between 1979 and 1985, the 1985 rate was used to simulate eligibility and benefits (e.g., the earned income deduction was set at .18 rather than .20).
- Any new rule governing eligibility or benefits that was introduced between 1979 and 1985 was used in the simulations (e.g., the gross income screen and the medical deduction).
- Indexed components of the eligibility and benefit rules were held constant at their 1979 levels (e.g., the Thrifty Food Plan and the net income screen). Accordingly, no inflation adjustments were made to the reported 1979 income and expense amounts.

The latter procedure is a potential source of systematic error in simulating eligibility and benefits. Such error would occur if, for example, delays in implementing inflation adjustments between 1979 and 1985 led to gradual changes in the relationship between program specifications and household financial conditions. Some error from this source is probably present in the simulation results presented below; however, we do not believe that the error is large, and we know of no cost-effective way to avoid it.

B. ASSESSING THE MODEL'S PREDICTIVE ACCURACY

We will assess the model's predictive accuracy in two different ways. First, we will compare simulated work effort and program participa-

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tion under the baseline (1979) Food Stamp Program with actual work effort and participation as observed in the analysis file. Second, we will compare the mean simulated household food stamp benefit under the baseline program with the mean benefit for a comparable demographic group in the 1979 Food Stamp Quality Control Sample.

1. Predictions of Work Effort and Program Participation

Panel 1 of Table VII.1 shows the observed percentage distribution of the 358 analysis file cases across 12 cells defined by the trichotomous work status variable and the dichotomous food stamp and AFDC participation variables. This panel should be compared with the corresponding predicted percentage distribution of these cases shown in Panel 2. The predictions were generated by the estimated model under the assumption that the baseline (1979) Food Stamp Program was in effect. For no cell do the actual and predicted relative frequencies differ by more than 2 percentage points, and for most cells the differences are much smaller than that. Summary statistics show that the predicted food stamp and AFDC participation rates exceed the observed rates by 3.2 and 3.5 percentage points, respectively. Predicted and actual hours of work are virtually identical. Although this comparison is a rather weak test of the model's predictive accuracy, we conclude that our model adequately replicates the program participation and work effort behavior that is observed in the analysis file.

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TABLE VII.1

AN ASSESSMENT OF THE PREDICTIVE ACCURACY OF THE MODEL: BASELINE COMPARISON OF PREDICTED AND ACTUAL PERCENT DISTRIBUTIONS OF FEMALE-HEADED HOUSEHOLDS BY WORK STATUS AND FOOD STAMP AND AFDC PARTICIPATION STATUS[a]

PANEL 1: OBSERVED DATA

Work Status	Program Participation Status: Food Stamps Only	AFDC Only	Food Stamps and AFDC	Neither	Total
Nonworker	5.3	0.8	27.9	4.7	38.7
Part-Time	3.4	0.6	5.3	9.2	18.5
Full-Time	2.8	2.0	3.9	34.1	42.8
Total	11.5	3.4	37.1	48.0	100.0

Food Stamp Participation Rate = 48.6%
AFDC Participation Rate = 40.5%
Average Hours of Work[b] = 20.8/wk.

PANEL 2: PREDICTED DATA

Work Status	Program Participation Status: Food Stamps Only	AFDC Only	Food Stamps and AFDC	Neither	Total
Nonworker	5.0	0.6	28.8	3.3	37.7
Part-Time	3.6	1.2	7.3	8.1	20.2
Full-Time	3.1	2.1	4.0	32.9	42.1
Total	11.7	3.9	40.1	44.3	100.0

Food Stamp Participation Rate = 51.8%
AFDC Participation Rate = 44.0%
Average Hours of Work[b] = 20.9/wk.

SOURCE: Computed by Mathematica Policy Research from Wave V of the ISDP.

[a]The baseline Food Stamp Program is the program that was in existence at the midpoint of the reference period for Wave V of the ISDP, December 1979. Aside from inflation adjustments in the TFP, the net income screen, and certain other criteria for determining eligibility and benefits, the FY 1985 program differs from the December 1979 program in three respects: the FY 1985 program has a gross income screen for households without elderly or disabled persons, the earned income deduction is 18 percent (rather than 20 percent in 1979), and households with elderly or disabled persons can deduct medical expenses in excess of $35 per month.

[b]Average hours are computed on the assumption that part-time workers (1-34 hours per week) work 20 hours per week, while full-time workers (35 or more hours per week) work 40 hours per week.

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2. Predictions of Food Stamp Benefits

The baseline mean predicted food stamp benefit for households in the analysis file that are simulated to receive both food stamp and AFDC benefits is $112. Some of these households are simulated to have earnings, and they may have income from other sources as well. The mean food stamp benefit for households in the November 1979 Quality Control Sample that reported receiving AFDC benefits (and possibly income from other sources as well) is $107.[1] Given that no attempt was made to calibrate our estimated model to the QC results, the $5 difference between the average predicted and observed benefits represents a high level of predictive accuracy for the model.

C. EFFECTS OF HYPOTHETICAL CHANGES IN THE FOOD STAMP PROGRAM

The preceding section demonstrated that the model of program participation and work effort can accurately replicate observed behavior. Therefore, we can now examine with confidence the model's predictions of the effects of several hypothetical changes in the current (FY 1985) Food Stamp Program.

As modeled, the features of the current Food Stamp Program that distinguish it from the baseline (1979) program are a medical deduction for households with elderly or disabled persons, a gross income screen for households without elderly or disabled persons, and an 18 (rather than 20) percent earned income deduction. Three hypothetical modifications or

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[1]See Table 7 of "Characteristics of Food Stamp Households: November 1979," Office of Policy, Planning, and Evaluation, Food and Nutrition Service, USDA, June 1981.

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reforms of the current program will be considered in this section:

1. Increasing the benefit-reduction rate (BRR) from .30 to .33

2. Replacing the uncapped 18 percent earned income deduction (EID) with a 100 percent deduction up to a maximum of $75 per month

3. Eliminating the $10 minimum benefit for 1- and 2-person households

The effects of these program changes were simulated individually and as a group. We will compare simulated behavior under the reform programs with simulated behavior under the current program. Specifically, we will examine the effects of program changes on work effort, participation in the Food Stamp Program, and food stamp benefit amounts.

1. Effects on Work Effort

Program reforms that increase the food stamp guarantee amount (the food stamp benefit received by households with zero net income) or that increase the implicit tax rate on earnings are expected to lead to less work effort by those food stamp recipients who, after the program changes, choose to continue in the program.[1] Opposite changes in the same program parameters are expected to lead to greater work effort. An increase in the benefit-reduction rate increases the tax rate on earnings and is thus expected to reduce work effort. The hypothetical change in the earned income deduction that we are considering would decrease the tax rate on the first $75 of earnings, but would increase it on earnings in excess of

[1]Households that choose to stop participating in response to the program changes are expected to increase their work effort.

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$75. Although, consequently, its effect on work effort cannot be determined a priori from economic theory, it can be determined by using microsimulation. The elimination of the $10 minimum benefit increases the tax rate on earnings for the affected households and is thus expected to lead to less work effort by those who remain in the program.[1]

The first row of Table VII.2 shows the simulated work effort of female heads of households who receive benefits under the current Food Stamp Program. Slightly less than two-thirds of the women are predicted to be nonworkers. The average hours of market labor per week is 9.6. Row 2 shows that an increase in the benefit-reduction rate from .30 to .33 would have a small effect on work effort (-.1 hours per week, on average) in the anticipated downward direction.[2] The hypothetical change in the earned income deduction would have a larger negative impact on work effort. Row 3 of the table shows that this change would cause a modest shift from part-time and full-time labor to no market labor and a corresponding reduction in average hours worked per week to 9.4. The elimination of the $10 minimum benefit is a small program change that could affect at most 30 percent of our sample (households consisting of one woman and one dependent child). Consequently, it is not surprising that the simulated reduction in work effort is not perceptible in row 4.

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[1]Some households might choose to leave the Food Stamp Program and increase their work effort upon losing their $10 minimum benefit.

[2]The comparisons discussed here are between the behavior of participants under the current Food Stamp Program and the behavior of participants under reforms of the current program.

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TABLE VII.2

SIMULATED HOURS OF WORK OF FEMALE HEADS OF FOOD-STAMP-RECIPIENT HOUSEHOLDS UNDER ALTERNATIVE PROGRAM RULES

Food Stamp Program	Percent Distribution of FS Households by Head's Work Status			Average Hours Per Week
	Nonworker	Part-Time	Full-Time	
1. FY 1985	65.5	20.9	13.5	9.60
2. FY 1985, but with BRR = .33	65.8	20.7	13.5	9.54
3. FY 1985, but with Max. EID = $75	66.4	20.3	13.3	9.38
4. FY 1985, but with Min. Benefit = $0	65.5	20.9	13.5	9.60
5. FY 1985, but with BRR = .33 Max. EID = $75 Min. Benefit $0	66.6	20.1	13.3	9.33

SOURCE: Computed by Mathematica Policy Research from Wave V of the ISDP.

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The model predicts that the three proposed program changes, considered as a group, would increase the proportion of nonworkers among the sample household heads by 1 percentage point, and would reduce work effort by about .3 hours per week. The simulated labor-supply responses are small for two reasons:

1. The program changes being considered are small.

2. Our estimates of the model parameters b and w, which characterize the labor-supply responses to changes in effective wage rates and nonlabor income, are small (but significantly different from zero in a statistical sense).

2. Effects on Food Stamp Program Participation and Benefits

Table VII.3 shows the simulated effects of the three hypothetical changes in the FY 1985 Food Stamp Program on participation and benefit amounts. Like the labor-supply response, the participation response (shown in the first column) is predicted to be small. As a group, the proposed program changes are predicted to reduce the participation of low-income, female-headed households in the program by one-half of one percentage point. Most of this response is attributable to the change in the earned income deduction.

The average simulated food stamp benefit of households participating in the various hypothetical modifications of the current Food Stamp Program are shown in the third column of Table VII.3. The framework of our model contains two mechanisms by which a program reform may affect the average food stamp benefit:

1. The program reform may alter eligibility for benefits or the generosity of benefits and, consequently, alter the average benefit of participating households independently of any behavioral response.

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TABLE VII.3

SIMULATED FOOD STAMP PARTICIPATION RATES AND FOOD STAMP BENEFITS FOR FEMALE-HEADED HOUSEHOLDS UNDER ALTERNATIVE PROGRAM RULES

Food Stamp Program	Participation Rate For Low-Income Households (Percent)	Food Stamp Benefit: Index of Aggregate Benefits	Food Stamp Benefit: Average Benefit (1979 Dollars)
1. FY 1985	51.6	100.0	$107.18
2. FY 1985, but with BRR = .33	51.5	94.7	$101.78
3. FY 1985, but with Max. EID = $75	51.2	93.9	$101.40
4. FY 1985, but with Min. Benefit = $0	51.6	99.9	$107.10
5. FY 1985, but with: BRR = .33; Max. EID = $75; Min. Benefit = $0	51.1	88.9	$96.31

SOURCE: Computed by Mathematica Policy Research from Wave V of the ISDP.

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2. The program change may induce households to alter their market labor, resulting in changes in net income and benefits. Typically, this response dampens (i.e., tends to offset) the change in the average benefit that is directly attributable to the program change.

Table VII.3 shows the combined impact of program changes transmitted through both of these mechanisms on benefits. Subsequent tables disentangle the two effects.

The third column of Table VII.3 shows that the simulated effect of the three proposed program changes on the average food stamp benefit of female-headed households is a reduction of about $11 per month (in 1979 dollars). The reduction is equally attributable to the increase in the benefit-reduction rate and the change in the earned income deduction. Elimination of the minimum benefit is predicted to reduce the average benefit by only $0.08.

Changes in the average benefit and in the participation rate combine to determine the change in the aggregate benefit caused by a program reform. For the set of three reforms being considered here, these changes are reinforcing effects. The 11 percent decline in the aggregate benefit is proportionally greater than the 10 percent decline in the average benefit, with the difference attributable to the small decline in participation that is predicted to occur in response to the program reforms.

D. EFFECTS OF PROGRAM CHANGES ON BENEFITS, WITH AND WITHOUT BEHAVIORAL RESPONSES

Existing large-scale microsimulation models, such as MATH and TRIM2, either assume no behavioral responses (in participation or work effort) to changes in Food Stamp Program rules or make very simple

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assumptions about the responses. Thus, predictions of the impacts on benefits of program changes generated by these models are subject to errors arising from treating behavioral feedback inadequately. Our model of program participation and work effort was used to investigate the possible magnitudes of these errors, and the findings are reported in this section. The discussion in the preceding section on the small participation and work-effort responses to program changes suggests that neglecting behavioral feedback is unlikely to be a source of large errors in predictions of average and aggregate benefits.

When participation and work effort are treated as endogenous, our model predicts that an increase from .30 to .33 in the benefit-reduction rate reduces the average food stamp benefit received by female-headed households by $5.40 (see row 1 Table VII.4). Conversely, if participation and work effort are assumed to be exogenously determined, then the model predicts a reduction of $5.56 in the average benefit. Thus, if large microsimulation models neglect behavioral feedback from this subgroup of food stamp recipients, it could lead to overpredictions of about 3 percent in the benefit savings per household of an increase in the benefit-reduction rate. When aggregate benefits for the subgroup are considered (row 1 of Table VII.5), the estimated error is 2.9 percent.[1]

As was shown in the previous section, the simulated labor-supply response to the hypothetical change in the earned income deduction is larger than the response to the hypothetical increase in the benefit-

[1]Recall that these results are based on an unweighted sample, which introduces some unknown error into our inferences about population error rates for large microsimulation models.

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TABLE VII.4

IMPLICATIONS OF NEGLECTING BEHAVIORAL RESPONSES WHEN SIMULATING THE EFFECTS OF PROGRAM CHANGES ON AVERAGE HOUSEHOLD FOOD STAMP BENEFITS

	Average Benefit for Sample			Change in Average Benefit (Reform Program - FY 1985 Program)		
		Reform Program				
Reform Program	FY 1985 Program	With Behavioral Response	Without Behavioral Response	With Behavioral Response	Without Behavioral Response	Percent Error Without Behavioral Response
1. FY 1985, but with BRR = .33	$107.18*	$101.78	$101.62	-$5.40	-$5.56	3.0%
2. FY 1985, but with Max. EID = $75	$107.18	$101.40	$100.72	-$5.78	-$6.46	11.8%
3. FY 1985, but with: BRR = .33 Max. EID = $75 Min. Benefit = $0	$107.18	$96.31	$95.42	-$10.87	-$11.76	8.2%

SOURCE: Computed by Mathematica Policy Research from Wave V of the ISDP.

*All dollar amounts are in 1979 dollars.

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TABLE VII.5

IMPLICATIONS OF NEGLECTING BEHAVIORAL RESPONSES
WHEN SIMULATING THE EFFECTS OF PROGRAM CHANGES
ON AGGREGATE FOOD STAMP BENEFITS

	Aggregate Benefit for Sample			Change in Aggregate Benefit (Reform Program - FY 1985 Program)		
		Reform Program				Percent Error
Reform Program	FY 1985 Program	With Behavioral Response	Without Behavioral Response	With Behavioral Response	Without Behavioral Response	Without Behavioral Response
1. FY 1985, but with BRR = .33	$19,810*	$18,760	$18,790	-$1,050	-$1,020	2.9%
2. FY 1985, but with Max. EID = $75	$19,810	$18,600	$18,620	-$1,210	-$1,190	1.7%
3. FY 1985, but with: BRR = .33 Max. EID = $75 Min. Benefit = $0	$19,810	$17,620	$17,640	-$2,190	-$2,170	0.9%

SOURCE: Computed by Mathematica Policy Research from Wave V of the ISDP.

*All dollar amounts are in 1979 dollars.

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reduction rate. Thus, we might expect that errors in predicted benefits caused by neglecting behavioral feedback would be greater when modeling a change in the earned income deduction. Our simulations confirm this expectation for the average benefit but refute it for the aggregate benefit.

As shown in row 2 of Table VII.4, if participation and work effort are assumed to be exogenously determined, then the predicted reduction in the average food stamp benefit caused by the hypothetical change in the earned income deduction is 11.8 percent larger than if that behavior is assumed to be endogeneously determined. That is, current microsimulation modeling procedures would exaggerate the average savings per female-headed household attributable to the change in the EID by about 11.8 percent.

When we consider the aggregate benefit, existing procedures would exaggerate the savings to be gained from the hypothetical modification in the earned income deduction by only 1.7 percent (row 2 of Table VII.5). The highly divergent findings for average and aggregate benefits are explained by the offsetting effects of the participation and work-effort responses to the modification on the aggregate benefit:

1. The proposed change in the earned income deduction would reduce work effort, which would dampen the reduction in the average benefit. Failure to account for this dampening effect would overestimate the reduction in the average benefit by 11.8 percent.

2. The change in the earned income deduction would reduce participation in the Food Stamp Program and, consequently, reduce aggregate benefits.

3. Together, points 1 and 2 imply that the average predicted benefit under the hypothetical earned income deduction is higher when behavioral responses are considered than when behavioral responses are neglected, but that program participation is lower. These are offsetting influences on the aggregate benefit. Therefore, the total error from neglecting behavioral

responses in predicting the effect of a change in the earned income deduction on the aggregate benefit is small.

Row 3 of Tables VII.4 and VII.5 shows that the errors caused by neglecting behavioral responses to the three proposed program changes, considered as a group, are 8.2 percent for the average predicted benefit and 0.9 percent for the aggregate predicted benefit.[1]

E. DISTRIBUTIONAL EFFECTS OF PROGRAM CHANGES

Because it incorporates behavioral feedback, our model has the capacity to produce more accurate estimates of the effects of changes in the Food Stamp Program on average and aggregate benefits than those of a comparable model that omits such feedback. However, our model's potential utility extends beyond a relatively modest increase in the precision of benefit predictions. It also has the capacity to predict the benefit effects of program changes disaggregated by the work status of the household head.

As shown in Table VII.6, the model predicts that an increase in the benefit-reduction rate from .30 to .33 would reduce total average and aggregate food stamp benefits by amounts approximately equal to those that could be attained by adopting a 100 percent earned income deduction with a $75 cap. However, the effects of these two program changes are distributed

[1]The implications for the average and aggregate food stamp benefits of neglecting behavioral responses to the elimination of the $10 minimum benefit (isolated from other program changes) are not shown in Tables VII.4 and VII.5. This is because the simulated responses of participation and work effort to this change are very small, as shown in Tables VII.2 and VII.3.

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TABLE VII.6

SIMULATED IMPACTS OF TWO PROGRAM REDUCTIONS ON THE FOOD STAMP BENEFITS OF FEMALE-HEADED HOUSEHOLDS, DISAGGREGATED BY THE WORK STATUS OF THE HOUSEHOLD HEAD

	Work Status of the Household Head			
FS Program	Nonworker	Part-Time	Full-Time	Total
FY 1985				
Average Household Benefit	$127.29*	$80.65	$50.86	$107.18
Aggregate Benefit for the Sample	$15,420	$3,120	$1,270	$19,810
FY 1985, but with BRR = .33				
Average Household Benefit	$122.51	$73.11	$44.71	$101.78
Aggregate Benefit for the Sample	$14,850	$2,700	$1,110	$18,760
FY 1985, but with Max. EID = $75				
Average Household Benefit	$125.99	$64.19	$35.41	$101.40
Aggregate Benefit for the Sample	$15,340	$2,390	$860	$18,600

SOURCE: Computed by Mathematica Policy Research from Wave V of the ISDP.

*All dollar amounts are in 1979 dollars.

quite differently by the work status of the female head. The burden of the simulated increase in the benefit reduction rate is shared rather equally by food stamp recipient households, regardless of the work status of their female heads. The reduction in the average benefit ranges from $5 to $7 per month. Conversely, the burden of the change in the earned income deduction is predicted to fall overwhelmingly on households that contain working heads. The reduction in the average benefit is about $1 for households with nonworking female heads and $15 for households with female heads who work part-time or full-time.[1] Such distributional information is useful because of interest both in the efficiency with which benefits are targeted to the most needy households (those with nonworking heads) and in the work incentives provided by the benefit and eligibility formulas.

A serious inherent contradiction exists in using existing microsimulation models to produce estimates of the effects of program changes disaggregated by work status (such as those shown in Table VII.6). The contradiction arises because these models either assume that no labor-supply response to the program changes occurs or make simplistic assumptions about the response. This contradiction is especially disconcerting when the program change in question (e.g., a change in the earned income deduction) is designed to alter work incentives.

F. EFFECTS OF HOUSEHOLD CHARACTERISTICS

Simulations of the effects of changes in the Food Stamp Program parameters that govern eligibility and benefits revealed no large partici-

[1]Households with nonworking heads may have labor earnings attributable to other household members.

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pation or work-effort responses. In contrast, simulations of the effects of changes in the characteristics of low-income, female-headed households revealed substantial participation and work-effort responses. Policymakers can exercise little control over the characteristics of food-stamp-recipient households; however, these simulations might be useful in predicting the effects of demographic trends. The simulations also have instructional value in demonstrating the extent to which work effort and participation in the Food Stamp Program are determined by factors other than the economic incentives provided by the program's eligibility and benefit formulas.

Tables VII.7 and VII.8 are similar in structure to Tables VII.2 and VII.3. They show that, if female heads of low-income households had an additional year of education, the model would predict that their participation rate in the FSP would be 4 percentage points lower, and that they would provide about 1 additional hour per week of market labor. If each of these households had an additional child under the age of 6, a dramatic increase of 15 percentage points in the food stamp participation rate would occur. An additional young child would also cause the work effort of female heads of food-stamp-recipient households to fall by more than 3 hours per week, on average, with a marked increase in the proportion of nonworking heads.

Simulations of the effects of changes in other household characteristics (e.g., household size, age of head, and race) were also conducted. The results consistently showed that household characteristics are more important in determining work effort and participation in the Food Stamp Program than are the parameters in the food stamp benefit formula.

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TABLE VII.7

SIMULATED HOURS OF WORK OF FEMALE HEADS OF FOOD-STAMP-RECIPIENT HOUSEHOLDS UNDER FY 1985 PROGRAM RULES AND ALTERNATIVE ASSUMPTIONS ABOUT HOUSEHOLD CHARACTERISTICS

Household Characteristics	Percent Distribution of FS Households by Head's Work Status			Average Hours Per Week
	Nonworker	Part-Time	Full-Time	
1. Observed 1979 Characteristics	65.5	20.9	13.5	9.60
2. 1979 Characteristics, but with 1 Additional Year of Education	62.8	22.1	15.2	10.48
3. 1979 Characteristics, but with 1 Additional Child Age 0-5	75.7	16.2	8.1	6.47

SOURCE: Computed by Mathematica Policy Research from Wave V of the ISDP.

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TABLE VII.8

SIMULATED FOOD STAMP PARTICIPATION RATES AND FOOD STAMP BENEFITS FOR FEMALE-HEADED HOUSEHOLDS UNDER FY 1985 PROGRAM RULES AND ALTERNATIVE ASSUMPTIONS ABOUT HOUSEHOLD CHARACTERISTICS

Food Stamp Program	Participation Rate For Low-Income Households (Percent)	Food Stamp Benefits: Index of Aggregate Benefits	Food Stamp Benefits: Average Benefits (1979 Dollars)
1. Observed 1979 Characteristics	51.6	100.0	$107.18
2. 1979 Characteristics but with 1 Additional Year of Education	47.6	92.2	$107.17
3. 1979 Characteristics but with 1 Additional Child Age 0-5	66.5	159.5	$132.81

SOURCE: Computed by Mathematica Policy Research from Wave V of the ISDP.

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