THE EFFECT OF WELFARE-PROGRAM BENEFITS ON THE EARNINGS OF PUBLIC-HOUSING RESIDENTS

by

KAREN LEE TINSLEY

(Under the direction of Ronald S. Warren, Jr.)

ABSTRACT

The purpose of this dissertation is to investigate empirically the work disincentives of the cash-assistance program for public-housing residents. A two-equation system determining labor earnings and welfare benefits is estimated in a simultaneous-equations limited-dependent variable framework, where both earnings and welfare benefits are treated as endogenous, censored variables. With a sample of public-housing residents from the 1997 wave of the National Survey of American Families, a two-stage Tobit model of annual earnings is estimated. The predicted value from a Tobit regression determining welfare benefits is used as an explanatory variable in the earnings equation. Standard errors are corrected to account for use of this instrumental variable. The model is also estimated within a self-selection framework. Specifically, a bivariate probit selection mechanism determining work and welfare participation, which takes into account any correlation of the error terms due to unobserved characteristics that may affect both choices, is used to augment the annual earnings equation.

Accounting for welfare benefits endogeneity, the empirical results indicate that an increase in labor earnings replaces only 35 to 75 percent of a reduction in welfare benefits; a smaller effect than was found assuming exogenous benefits. The self-selection model suggests that unobserved characteristics that negatively affect labor supply (earnings) also positively affect the magnitude of welfare benefits. That is, women who are more likely to have higher welfare benefits are also more likely to have lower earnings, after controlling for measured determinants of both earnings and benefits. The findings imply that HUD's budget would absorb approximately 25 to 65 percent of any decrease in welfare benefits experienced by women living in public housing.

INDEX WORDS: Labor supply, public housing, welfare program, self-selection, female-eligible households.

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DEDICATION

This dissertation is dedicated to my mother, Judy Tinsley McPeak; my father, Roger Tinsley; my sister, Susan Schumer; and my stepfather, William McPeak. I am thankful for their endless, unconditional love.

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Chapter I: Introduction

On August 22, 1996 President Clinton signed into law the Personal Responsibility and Work Opportunity Reconciliation Act of 1996 (PRWORA). Title I of the Act, Temporary Assistance for Needy Families (TANF), replaced the long-standing Aid to Families with Dependent Children (AFDC) program. Unlike AFDC, TANF is a temporary cash-assistance program. TANF puts a cap of 60 months on receiving welfare, although states can choose to set a shorter time limit than this. (See Appendix A for a comparison of the AFDC and TANF programs.) Cash assistance to low-income households with minor children (less than 18 years old) is, therefore, no longer an unconditional, timeless entitlement based solely on income eligibility.[1] With the passage of PRWORA, households with children who meet the income requirement for receiving cash assistance are eligible to receive TANF, conditional on participation in work activities.

Much attention has been paid to evaluating the economic effects of this major change in welfare legislation. In its Fifth TANF Annual Report to Congress, the U.S. Department of Health and Human Services (HHS) (2003) measured the success of the reform by analyzing the employment and earnings changes of current and former cash

[1] The terms "cash assistance" and "welfare" are general in that they refer to either the AFDC or TANF program. When referring to the specific programs, the names AFDC and TANF will be used.

assistance recipients, and measuring the overall number of families receiving welfare (the caseload). The report analyzed several sources of data and concluded that, since the enactment of TANF, the employment rate of current and former TANF recipients initially increased substantially, but in recent years has leveled off and actually declined slightly between Fiscal Year (FY) 2000 and FY 2001. Among working welfare recipients, 83 percent were in paid employment in FY 2001. HHS reports that Current Population Survey (CPS) data reveal a significant increase in earnings for female-headed families from calendar year 1996 to 2000. Furthermore, according to state-reported data the average monthly earnings of employed welfare recipients increased from $466 to $686 from FY 1996 to FY 2001. The average caseload in the TANF program declined by 57 percent, to 5.4 million at the end of FY 2001, from the AFDC caseload in FY 1996. The AFDC caseload peaked in March 1994 at 14.4 million. Data for the first half of FY 2002, however, indicates that caseloads continued to fall, but at a notably slower rate. During this time caseloads only decreased from 5.4 to 5.3 million.

As measured by an increase in the employment rate of current and former TANF recipients and the decrease in state welfare caseloads, the 1996 welfare reform has been deemed an overwhelming success so far. The report concludes that the decrease in the number of welfare families is chiefly the result of welfare reform, while acknowledging that the robust economy of the 1990's added to the overall success of the program. According to a survey conducted by the Center for Law and Social Policy, however, from July to September of 2002 the District of Columbia and 38 states experienced slight increases in the number of families on welfare. This represents a 0.9 percent increase for the nation as a whole during the same time period.

With a renewal decision regarding the TANF program pending, these most recent data are noteworthy since they are in clear contrast to the remarkable decline in welfare recipients in the second half of the 1990's. On February 13, 2003 the House passed H.R.4, the Personal Responsibility, Work, and Family Promotion Act of 2003, that would extend the 1996 law for five years, while revising it to make work requirements even stricter and narrowing the definition of work. By 2008, the proportion of welfare recipients that must be working or engaged in job-preparation activities in each state would increase from 50 percent under the current law to 70 percent. Furthermore, welfare recipients would have to participate in supervised activities for 40 hours a week; this includes 24 hours a week of actual work. Currently these figures are 30 and 20 hours, respectively. With stricter work requirements, the House bill endorses President Bush's "Working Toward Independence" Welfare Reform Proposal Plan, which also includes experiments to promote marriage. Opponents of this proposal are pushing for an increased budget allocation to the states to cover child-care expenses since former welfare recipients who find work are often still living in poverty due to the high cost of child care. Those opposed to the Administration's reauthorization plan are pressing for more funds for education and training assistance as well. The original version of the law, which expired on September 30, 2002, has been renewed temporarily until Congress can agree on a new bill. The current debate is focused primarily on the issues of mandatory work requirements for welfare benefits and on child-care money for the states.

The federal government subsidizes food, child care, and medical care for low-income households through HHS-administered programs like Food Stamps, Medicaid and TANF. Housing assistance for low-income households, however, is provided through the

Department of Housing and Urban Development (HUD).[2] Approximately one-quarter of all welfare recipients receive housing rental assistance, and about one-half of the households with children living in public housing also receive welfare.[3] In general, the public-housing program rules require that residents pay 30 percent of their gross total income for rent. (See Appendix B for more information regarding the public-housing program.) Since AFDC benefits are counted as income in determining rental payments, the welfare program directly affects the rental subsidy received by public-housing residents. The Public Housing Authority's (PHA's) that operate and manage public housing dwelling units are partially funded by tenant rental payments (tenant rental income paid to the PHA). HUD compensates PHA's for operating expenses not covered by tenant rental payments through the Public Housing Operating Fund. Therefore, anything that causes the incomes of public-housing residents to decrease (increase) will, in turn, cause HUD's operating expenses to increase (decrease).[4]

Stemming mostly from news stories associated with large projects such as Chicago's Cabrini Green, public-housing projects tend to have a bad reputation and poor general public image [Currie and Yelowitz (2000)].[5] Stereotypes associated with residents of public-housing projects are often associated with their negative economic and social

[2] The U.S. Department of Agriculture also provides rental housing assistance through the Rural Housing Service. The "public-housing" residents referred to are those receiving a subsidy from HUD.

[3] As used in this dissertation, the term "public housing" refers to conventional public-housing projects. Unless otherwise stated, this term does not include dwellings in which residents receive Section 8 vouchers or certificates.

[4] The effect on the incomes of public-housing residents and on HUD's budget is true for other rental subsidy programs operated under HUD, such as the Section 8 program, except that the PHA may or may not be directly involved. The break-even point for PHA's occur where the increase in wage income from an increase in work participation exactly equals the decrease in welfare assistance; only then will the rent paid by public housing residents, and thus HUD's operating expenses, change.

[5] They point out, however, that 70 percent of the 3300 PHA's operate less than 300 units each and the 40 largest PHA's manage 36 percent of all public-housing units.

conditions, either as a result of living in public housing or as a reflection of those who choose to live there. Accordingly, there may be a stigma associated with living in public housing that is not necessarily associated with receiving a Section 8 voucher or certificate. If so, one might think that project residents are somehow different from other households receiving rental assistance with regard to their taste, or distaste, for living in public housing. Further, if this unobserved heterogeneity is correlated with the probability of participating in both the welfare program and the labor force, then the labor supply of public-housing residents and Section 8 participants cannot be directly compared without taking into account the housing participation choice.[6]

Living in public-housing projects may have beneficial effects, however, on the labor supply and earnings of working-age residents through their exposure to increased opportunities for taking advantage of work-assistance programs. PHA's can design and implement programs like the Residential Opportunities and Self Sufficiency Program to assist public-housing residents in becoming economically self-sufficient. Other programs designed to assist households in finding employment through job-search programs, job-training programs, or other services include Family Self-Sufficiency, Family Investment Centers, and Moving to Work.[7] Although Section 8 participants have access to many of these programs as well, locating the services at community centers within public-housing projects may better enable public-housing residents to find work. In addition, Newman and Harkness (2002) found that living in public housing as a child increased

[6] The housing participation choice is especially difficult to address empirically since it requires administrative data that is most often not available.

[7] Funds specifically from the public housing operating subsidy can be used to hire Family Self-Sufficiency Coordinators.

employment, raised earnings, and reduced welfare receipt as an adult. This may lead to a diminishing of the intergenerational transmission of welfare dependency.

The stated objectives of welfare reform are 1) to increase the work participation of low-income households, 2) to increase their labor earnings, and 3) to decrease welfare dependency. However, for families receiving both rental subsidies and cash assistance, an unintended consequence of the reform may be a decrease in total income and, therefore, a greater dependence on rental-housing assistance. Specifically, even if work effort increases, the increase in wage income may be less than the decline in the amount of cash assistance received, resulting in a net decrease in total income. For public-housing residents, this income reduction translates into an increase in their rental subsidy.[8] Therefore, the effect of welfare reform in the presence of rental-housing assistance may be merely to shift the subsidy cost from HHS to HUD, with no reduction in the federal government's budget outlay.

The purpose of this dissertation is to investigate empirically the work disincentives of the cash-assistance program for public-housing residents. Specifically, I use cross-sectional data on women living in public housing to estimate the effect of a change in cash benefits on labor supply (or earnings). The actual effect of PRWORA on labor supply cannot be reliably estimated at this point since many recipients have not yet exhausted the time limits for eligibility. The principle question I seek to answer is: "How much of the potential decrease in welfare assistance received by welfare-eligible

[8] In 1998 Congress passed federal housing legislation designed to promote work incentives of public housing residents through an earnings disregard. Any increase in earnings would be put in an interest-bearing account and not result in an increased rental payment. However, the Center on Budget and Policy Priorities states that, as of 2001, the majority of public housing authorities have not implemented the earnings disregard.

women living in public housing is likely to be replaced by increased earned income through higher labor supply?" Secondary questions of interest that will be examined are: "What are the federal budgetary implications of the answer to the previous question?" and "What is the correlation between welfare-program participation and earned income?"

The remainder of this dissertation is arranged in the following way. First, a review is presented of the empirical literature on the labor-supply effects of housing subsidies, the labor-supply effects of cash transfers, and the impact of welfare reform on housing assisted families. In the second chapter, a theoretical framework is introduced for analyzing the effect of welfare benefits on the labor supply of public housing residents. The labor-supply choice problem facing a woman living in public housing, who may or may not be eligible for welfare, is presented within a utility-maximizing context. Since welfare-eligible women may not choose to receive welfare benefits, the model incorporates the program-participation choice. Next, a description of the model specification and estimation techniques is presented that will be used to implement the empirical analysis of the labor supply equation derived in the previous section. The resulting model is a two-equation system determining labor earnings and welfare benefits. This system is estimated in a simultaneous-equations, limited-dependent-variable framework, since both earnings and benefits are endogenous left-censored variables. A description of the data is given, the sample inclusion criterion are discussed, and a list of the means and definitions of the variables are then presented. The empirical results of alternative specifications appropriate for analyzing the effects of welfare benefits on the labor earnings of public-housing residents are subsequently presented and discussed. The final section draws conclusions from these results regarding how much

of a decrease in welfare benefits public-housing residents will likely replace with increased earned income. Ancillary questions concerning the effects on the budget outlays of HUD and HHS are also addressed, and possible directions for future research are discussed.

The empirical results indicate that an increase in welfare benefits decreases the labor earnings of women living in public housing. The exogenous specification yields an overstatement of this negative effect. Taking into account the endogeneity of welfare benefits, an increase in labor earnings replaces only 35 to 75 percent of a reduction in welfare benefits. This implies that HUD's budget would absorb 25 to 65 percent of any decrease in welfare benefits experienced by women living in public housing.

Chapter II: Review of Empirical Studies

The primary objective of this dissertation is to estimate the effect of a change in cash-assistance benefits on the wage incomes of residents of public-housing projects. In addition to having a direct effect on labor supply, the receipt of the cash-assistance benefits operates on labor-supply choices through a change in the magnitude of the rental subsidy. There have been very few empirical studies of the labor-supply or earned-income effects of housing-assistance programs. Therefore, this literature is examined in detail. Olsen (2001) and Shroder (2002) review the empirical literature on the labor-supply effects of housing programs, discussing many of these same papers. There has been a considerable amount of empirical research investigating the labor-supply effects of cash-assistance programs. Moffitt (1992) and Danziger, Haveman, and Plotnick (1981) provide comprehensive reviews of this literature.

An important development in the welfare literature in recent years has been a recognition of, and the ability to incorporate, the significant number of welfare-eligible, but non-participating, households. With the development of econometric techniques that can control for program-participation endogeneity, or sample-selection bias, more reliable estimates of program impact have become possible. In addition, the overlap of program beneficiaries has become apparent and, therefore, researchers have allowed for multiple program participation when studying the economic effects of these programs. Studies estimating the labor-supply effects of the AFDC program are reviewed to the extent that they highlight the issues of welfare program self-selection and/or multiple

program participation. In general, this review is limited to static, cross-sectional empirical studies.

A. *Labor-Supply Effects of Housing Subsidies*

In a seminal paper on the labor-supply effects of housing subsidies, Murray (1980) presented a theoretical model from which one can infer the labor-supply effects of one in-kind subsidy program using data from another subsidy program. This study was conducted prior to the availability of labor-supply data for program participants. To analyze a commodity subsidy such as public housing, Murray alters the conventional income-leisure model, which treats income as a composite good, to a special (and restrictive) case of a utility function that is weakly separable with respect to leisure and all other commodities. The empirical implementation of the model utilized labor-supply data for participants in the income-maintenance experiments. Murray estimated that residents of public-housing projects reduce their labor earnings by four percent due to the subsidy program. The subsequent availability of data sets containing the appropriate labor-supply and program-participation data, including information on the receipt of housing subsidies, has allowed researchers to conduct more sophisticated econometric studies that account for self-selection and/or multiple program participation. Keane and Moffitt (1998), discussed in detail below, is the most important recent contribution to this literature.

Ong (1998) examined the relationship between the receipt of rent subsidies and employment rates for a sample of single, female, head-of-household AFDC recipients. Specifically, he investigated the difference in employment outcomes among those receiving rental subsidies either through the public-housing program or through the

Section 8 vouchers and certificates program and those renting in the private market.[9] He hypothesized that the concurrent existence of residential mobility and the receipt of Section 8 subsidies allows for greater employment opportunities, and therefore improved employment outcomes, among housing-subsidy recipients compared to those living in public-housing projects. Survey data were obtained from the December 1992 AFDC recipient caseload in four California counties that were diverse with regard to geographic location and population density. Utilizing observations for both workers and nonworkers, Ong estimated a Tobit hours-worked equation.

The income effect generated by the receipt of a housing subsidy (or living in a low-cost housing market) is captured empirically in the labor-supply equation by the coefficient on a variable representing monthly rent. Ong finds a small, negative, and statistically significant effect of an increase in the rent subsidy on hours worked. Specifically, a decrease of $200 in rent (or a corresponding increase in discretionary income) is predicted to decrease labor supply by about eleven hours per month. A dummy variable for housing-subsidy type was included to allow for independent program effects on the labor supply of AFDC recipients. Ong concluded that, after controlling for personal characteristics and the income effect, residents in Section 8 subsidized units work considerably more than do those renting in the private market or living in public-housing projects.

[9] The Section 8 certificate and voucher programs will be simply referred to as the Section 8 program. Households with a Section 8 certificate must rent a unit at the fair market rent (FMR) and pay 30 percent of their income for rent. Those with a Section 8 voucher may elect to lease a unit that rents for more or less than the fair market rent and keep or pay the difference in rent, respectively.

Many studies use characteristics of federal housing subsidy programs, such as the fair market rent (FMR) or the very-low-income limit, to estimate the effect of these subsidies on labor supply; see, for example, Keane and Moffitt (1998) and Yelowitz (2000). Fischer (2000), however, exploited state variation in AFDC benefits to investigate the labor-supply effects of federal housing subsidies (both public housing and Section 8), using data from the Panel Study of Income dynamics (PSID) between 1986 and 1992 on single women aged 25 to 49 whose households received AFDC benefits at some point during the preceding year. Fischer compared the labor supply of 555 AFDC recipients (comprising 1,620 observations over time) who received some form of housing assistance with the labor supply of those who did not by using the variation in housing benefits from state to state and over time caused by differences in AFDC benefits. Estimates are presented from both linear and logistic specifications of regression equations, with either annual work hours or labor-force participation as the dependent variable. Controlling for the magnitude of AFDC benefits and the housing subsidy attributable to family size, Fischer analyzed the effect of the interaction between receipt of housing assistance and the AFDC guarantee. In both sets of reported results, the coefficient on the interaction between the FHA dummy variable and AFDC benefits is positive and statistically significant at the 10 percent level. He concludes that receipt of federal rental subsidies reduces hours worked and labor-force participation among recipients. Specifically, Fischer's analysis indicates that a $30 decrease in the monthly housing subsidy that would result from a $100 increase in the maximum AFDC benefit induces a 16 percent increase in labor-force participation and an increase of 41 hours of work annually among welfare recipients who also receive housing assistance.

Painter (2001) measured the impact of the size of the rental subsidy as well as the rationing of units in low-income housing assistance programs (public-housing projects and Section 8) on the decisions of eligible, female household-heads to work and to participate in a housing subsidy program. Studying the effects of rationing requires knowledge of whether a household is on a waiting list, which previous studies did not have. Using wave four of the 1984 Survey of Income and Program Participation (SIPP) augmented by the exact geographic location of households, Painter constructs a measure of rationing that varies by metropolitan area. He then compares the impact of participation in the housing programs on the probability of labor-force participation with the combined effects of participating in three entitlement programs: AFDC, Food Stamps, and Medicaid.

Painter estimated several specifications of a single-equation, reduced-form labor-force-participation equation that differ by their inclusion or exclusion of various program variables (the housing benefit, the entitlement benefits, time on the waiting list, and discounted housing benefit), to assess the impact of program participation on the decision to work. In the first specification, the estimated coefficient on the sum of entitlement income is negative and statistically significant, while the estimated coefficient on the housing benefit is not significantly different from zero. The second set of specifications includes the rationing information. First, controlling for the housing benefit and the entitlement sum, the estimated coefficient on the household's time spent on the waiting list is positive and statistically significant. Then, the time spent on the waiting list is used to adjust the housing benefit. Holding constant the entitlement sum, the coefficient on this latter explanatory variable is negative and statistically significant. Using the

parameter estimates of the labor-force and housing-participation equations, Painter conducted simulations of changes in program variables on these participation rates. He finds that the inclusion of housing changes the estimated impact of the entitlement programs. In particular, within a model that includes housing, elimination of all entitlement transfer programs increases labor-force participation by more than does a similar simulation within a model that does not include housing. Painter concludes that participation in the housing-assistance programs lowers labor-force participation.

Yelowitz (2000) studies how public-housing and Section 8 rules affect the work behavior of non-elderly female heads of household, using data from the SIPP and the Current Population Survey (CPS) from 1990 to 1995. The empirical focus is on estimating the effects of three policy variables: the FMR, the "very-low" income limit, and the public-housing notch. The FMR, which is set by HUD and varies by geographic area, is the housing subsidy that a household with zero income would receive. Eligibility for public housing is defined by the "very-low" income limit. Specifically, a household is eligible if its income does not exceed 50 percent of the median area income. The public-housing notch arises when household income becomes greater than the eligibility level so that housing benefits are lost. For project residents, as opposed to recipients of subsidies in the form of vouchers or certificates, this notch does not exist since it is (almost) impossible for existing residents to be displaced for having too much income. The notch is only relevant, therefore, for those on the waiting list for public-housing units.

Labor-supply effects were estimated with both data sets, using two basic specifications for the public-housing policy variables; first, the FMR and the very-low

income limit were included as independent variables and, secondly, the notch was included. Utilizing the panel characteristic of the SIPP, regression models were specified and estimated with random and fixed effects. Overcoming a limitation of past studies, Yelowitz was able to control for fixed geographic (MSA) differences (for example, the degree of rationing by the PHA) by including a combination of three sources of variation in program generosity. Generosity varies by metropolitan area and over time due to changes in the subsidy and in the income eligibility limit, as well as the sex composition of children living in the unit.

The notch was constructed by combining information on the FMR and income limits. The magnitude of this variable is dependent on the household's actual housing choice. The notch is zero for those living in projects, greater for those living in Section 8 subsidized private housing, and greatest for those not receiving housing assistance.[10] Yelowitz attempted to correct for self-selection in two ways. The first approach entailed calculating the notch for a family in unsubsidized housing using the "very-low" income limit as the rent. This is valid to the extent that the income limit is binding for all individuals. The second method was an instrumental-variables strategy that calculated the notch level by using a weighted average of the notch in unsubsidized housing, the notch in the voucher program, and the notch in housing projects. The household's actual choice was not needed for either approach. For all specifications, increasing the FMR induced a statistically significant reduction in work effort and a statistically significant increase in welfare participation. Similarly, taking into account self-selection into public housing,

[10] The notch is zero for project residents, since even if their income exceeds the eligibility limit, they will not be removed from the unit. The notch is largest for those living in unsubsidized housing since the value of benefits lost is the entire rental subsidy.

Yelowitz concluded that the notch creates strong disincentives to work and strong incentives to collect other transfer income.

B. *Labor-Supply Effects of Cash Transfers*

In their comprehensive review article, Danziger *et al.* (1981) concluded that participation in the AFDC program induces a disincentive to work among female heads of household at a point in time. However, they note that considerable uncertainty exists as to the magnitude of this disincentive, since point estimates vary greatly across studies.

In a seminal paper, Moffitt (1983) models the welfare-program-participation behavior within the context of a state-dependent utility-maximizing model. An individual participates in the program if the utility on welfare is greater than the utility off welfare. He assumes that eligible, nonparticipating individuals would have experienced disutility, or "welfare stigma," from receiving welfare benefits since to forego an increase in income would otherwise violate the monotonicity assumption on preferences. The disutility of welfare receipt is assumed to have a flat component, arising simply from participating, and a variable component, which varies with the size of the benefit. Further, the existence of this "variable stigma" implies that the individual is not indifferent to the source of income. Specifically, for an individual receiving welfare the variable component of welfare stigma implies that the marginal utility of an additional dollar of welfare income is less than the marginal utility of an additional dollar of labor earnings (and also other nonlabor, nonwelfare income). In addition, the model implies that the labor-supply response to participation in the welfare program depends, in turn, on welfare stigma. With heterogeneity in the population in both the taste for work and the taste for welfare, only those with relatively low distaste for welfare or low taste for work

will participate in the welfare program. Therefore, welfare participants are a self-selected group who would have lower labor supply than nonparticipants even if they did not participate in the program.

Utilizing 1976 data from the Michigan Panel on Income Dynamics on female heads of household with no spouse present, Moffitt tests for the existence of welfare stigma. The sample is not confined to welfare-eligible households since program eligibility is endogenous in the model through the choice of labor supply. The stochastic specification of the equations determining hours of work and welfare participation takes into account unobserved heterogeneity within the sample with regard both to tastes for welfare and tastes for work. To determine the true labor-supply disincentives of welfare, one must estimate the hours of work of program participants had they not enrolled since their distaste for welfare also affects their labor-supply decision. To account for correlation in unobservable factors that affect both the decision to participation in the welfare program and the labor-supply choice, Moffitt estimates the two equations jointly. Moffitt's empirical results suggest the presence of strong flat stigma; the disutility of welfare-program participation affects the decision to enter the program. However, there is no evidence of variable stigma; given program participation, an increase in the benefit level has no additional labor-supply effect. Moffitt finds that participation in the AFDC program reduces work by four hours per week, on average.

Economists have also estimated the impact of participation in the food-stamp program and Medicaid on labor supply [for example, Moffitt and Wolfe (1990)]. Fraker and Moffitt (1988) studied the effects of the receipt of food stamps and AFDC on the labor supply of non-elderly, non-disabled, eligible female heads of household using 1980

data from the SIPP. Since a substantial proportion of eligible households receive neither food stamps nor AFDC, the benefits received from these programs are not exogenous. Ignoring the program-participation decision would yield biased estimates of the labor-supply effect of the program(s), since the variation in hours of work across individuals may be affected by the same unobserved characteristics that also affect program participation. Fraker and Moffitt specify a three-equation model consisting of a bivariate selection mechanism determining participation in the AFDC and food-stamp programs and a structural labor-supply equation that is conditional on the program-participation choices. Labor supply is modeled as a trichotomous variable with discrete categories defined as non-work, part-time (1 to 35 hours per week) employment, or full-time (more than 35 weekly hours) employment. Fraker and Moffitt find that participation in the food stamp program decreases labor supply by nine percent. Their empirical results indicate that selectivity bias would be present if program participation was taken to be exogenous, since the correlations between the error terms of the program-participation equations and the labor-supply equation are negative and statistically significant.

Keane and Moffitt (1998) estimate a structural model of labor supply and multiple transfer-program participation using simulation techniques. Analyzing data extracted from the fourth wave of the 1984 SIPP for a sample of welfare-eligible, female-headed households, they studied the effects of participation in the AFDC, food-stamp, and housing-assistance programs on labor-force participation. Participation in Medicaid is not modeled as a choice variable, but is included as a benefit automatically offered upon receipt of AFDC. Taking into account the correlation between the unobserved heterogeneity driving the selection mechanism into different program combinations and

the labor-supply decision, the authors estimate the full, four-equation model simultaneously. Labor supply is defined as the outcome of a discrete trichotomous choice among non-work, part-time (1 to 35 hours per week) employment, or full-time (more than 35 weekly hours) employment. The multinomial model of program-participation and labor supply, conditional on program-participation choice, has 24 possible outcomes.

Accounting for the in-kind and rationed nature of housing benefits in their model was difficult. Since housing assistance is an in-kind subsidy, the value of the subsidy is assumed to be worth less than its cash equivalent from the viewpoint of the recipient. Moreover, housing subsidies, unlike AFDC, food stamps, and Medicaid, are not legal entitlements and are, thus, rationed. Keane and Moffitt define the housing subsidy as the difference between the tenant rental payment and the FMR, and model the housing-participation choice by assuming that each household could choose to participate in a program that would provide a cash grant equal to an unknown fraction of the subsidy.[11] The FMR value was calculated by assuming that the required number of bedrooms is one less than the number of family members. Keane and Moffitt conclude that participation in subsidized housing is unrelated to the value of the housing benefit. They surmise that this result occurred because the rationing of units in the program is not directly correlated with the potential benefit from such housing, as opposed to a low cash-equivalent value of the subsidy. Since it was not known if a household that was not in subsidized housing

[11] Olsen (2001) and Shroder (2002), however, criticize this approach since it assumes that the FMR is the maximum potential benefit in an income entitlement program. Note that the FMR is only a parameter in the Section 8 program. In the public-housing program, the government offers a certain unit at a below-market price.

was offered such assistance, it was not possible to account for rationing. Ultimately, Keane and Moffitt abandoned this methodology and simply included the housing subsidy as part of nonlabor income, thus foregoing the attempt to explain housing-program participation. Using the estimated model to predict the effects of changes in the welfare system, they conclude that small to moderate increases in the cumulative implicit tax rates have little effect on labor supply, although such tax rates are high. This result is due to the offsetting decrease in labor supply induced by increased program entry.

C. *Welfare Reform and Housing Subsidies*

There are apparently no studies estimating the labor-supply effects of participation in the AFDC program using a sample of household heads living in public housing. Two studies, however, have simulated the effects of the 1996 welfare reform on the operating-subsidy budget for federal housing programs by analyzing the program data from a few PHAs.[12] The U.S. Department of Housing and Urban Development (HUD) (1998) projected the impact of welfare reform on tenant incomes and, consequently, on rent revenues at eight public housing authorities (PHAs).[13] Economic and geographic diversity, as well as differences in state welfare reform provisions, were dimensions along which the particular PHAs were chosen for this analysis. Data on household heads and their family members, as well as on PHA policies, were collected from the participating PHAs. State agencies responsible for administering the new TANF rules supplied additional data concerning welfare recipients residing in public housing in the

[12] The United States General Accounting Office (1998) reviewed formal studies that estimated welfare reform's financial impact on HUD and housing agencies and other informal estimates of the effect. The two papers discussed in this subsection are discussed.

[13] The PHA's examined were Richmond and Norfolk in Virginia; Los Angeles and San Francisco in California; Cleveland, Columbus, and Toledo in Ohio; and Dallas, Texas.

study area, as well as for welfare recipients living in unsubsidized housing. Data on welfare beneficiaries not receiving housing assistance were used to describe women who would most likely be competing with "mandated" public-housing residents (those required by reform to find jobs) in the job market.

Two methods were used to estimate the labor-supply effects of welfare reform on mandated public-housing residents. First, using a prediction of entry-level job growth in the study area, a "job seekers-to-jobs ratio" was created. The usefulness of this measure of the probability of finding work for mandated residents relies on predictions of both the number of jobs available and the number of job competitors when welfare benefits end. Using data extracted from the five percent sample of the 1990 Census of Population and Housing Public Use Microdata Samples (PUMS), the second method involved estimating work-participation rates by logistic regression. This method was carried out under the assumption that the mandated public-housing head-of-household residents will exhibit work behavior that mirrors similar PUMS respondents. The full impact of welfare reform is assumed to occur in the year benefits are terminated, which varies by state. It is assumed also that when TANF benefits are terminated, the number and demographic characteristics of mandated public-housing residents will be the same as for the current population.

In all PHAs studied, it was estimated that there were approximately 3.5 times more entry-level job seekers than entry-level jobs in the respective metropolitan labor markets. Mandated public-housing residents probably face even greater odds of finding jobs due to long commuting distances, unavailable or unaffordable child care, and inadequate education and experience. Roughly one-fourth of the PHA residents are TANF-

mandated recipients and contribute 9 to 30 percent of total rent revenue. The break-even work-participation rate, the percent of mandated households that must find full-time employment for the PHA to maintain current rent contributions, varied from 0 to 60 percent. A low rate could indicate low rents paid by mandated residents and the use of minimum rents by the PHA.

The second method yielded a break-even work-participation rate ranging from 40 to 72 percent. The expected wage income of mandated households was calculated using logistic-regression estimates of the probability of finding work and the wage rate of currently working public-housing residents who were not receiving cash assistance. Depending on which estimate was used, it was concluded that, collectively, the PHAs would be anywhere between $5 million above to $4 million below their current rent revenue.

Newman and Harkness (1999) extracted data from the 1994 file of the AFDC-Quality Control database to estimate the magnitude of the impact of welfare reform on the employment and income of AFDC households also receiving housing assistance. They simulated future TANF effects by analyzing program data from four AFDC waiver programs: Florida, Michigan, Vermont, and Virginia.[14] Among programs with available data and provisions that are likely to have sizable effects on income, these states were selected to encompass a mix of conservative and liberal program provisions. In addition, these four states were viewed as most likely to continue similar programs after TANF

[14] Prior to the federal welfare reform, many states had implemented, for as many as 15 years, an AFDC waiver program. The names of the specific programs used in their analysis are: Florida Family Transition Program, Michigan To Strengthen Michigan Families, Vermont Welfare Restructuring Program, and Virginia Independence Program.

reform and also to serve as model programs for other states to follow. Under the assumption that a state's current waiver program is applied nationally and is in effect for five years, the effects of time limits, family caps, earnings disregards, and work requirements on the profiles of both assisted and unassisted households were estimated. Newman and Harkness assume that a decrease, for example, in welfare (or any safety-net program) benefits will induce an increase in out-of-pocket payments for basic necessities like housing.

Using the simulated out-of-pocket change in tenant rent payments, the effect on HUD's budget was estimated. Simulation results indicate that all four programs increase the proportion, and number, of housing-assistance recipients employed in unsubsidized jobs five years after program implementation. However, few households are expected to attain self-sufficiency and leave welfare. Furthermore, a very small proportion of households under the two programs with time-limits are projected to leave welfare before hitting the time constraint on welfare receipt.

Finally, Newman and Harkness analyzed the effects of the TANF simulation on the cash income of assisted households; the Michigan and Vermont programs induce an increase, and Florida and Virginia a decrease, in such income. Therefore, the Michigan and Vermont waivers induce an out-of-pocket tenant rent payment increase that results in a budget savings for HUD. In contrast, the Florida and Virginia programs induce a decrease in tenant rent payments and a budget increase for HUD. The authors conclude that if one-half of the states follow reforms similar to those in Michigan and Vermont, while the remaining states' programs resemble those of Virginia and Florida, HUD would

experience an annual net cost increase of one-half to one-and-one-half percent five years after implementation.

While the two studies by HUD (1998) and Newman and Harkness (1999) are similar in spirit to the motivation for one aspect of this dissertation, their methodologies are very different. These papers seek to answer how the 1996 welfare reform will impact the labor supply and earnings of public-housing residents and, subsequently, the federal budget. Rather than estimate the future impact of specific TANF provisions of this reform on the labor supply and income of public-housing residents, I use cross-section data on women living in public housing to estimate the effect of a change in cash benefits, from whatever source, on labor supply (or earnings). This point-in-time estimate can be used to predict how much of a decrease in welfare assistance received by welfare-eligible women living in public housing is likely to be replaced by increased earned income through higher labor supply. Such an estimate of the effect of a change in welfare benefits on labor supply and earnings is potentially important since, during the 60-months lifetime eligibility period that a household may receive welfare benefits, the magnitude of these benefits may change due to changes in other parameters. For instance, depending on the family-cap provision in state welfare programs, allowable deductions may change over time due to changes in the number and ages of children residing in the household since the family unit is no longer eligible to receive cash assistance for children older than 18. Additionally, there will be future generations of households assisted by both welfare and housing subsidies who will also have a full 60 months of lifetime benefits.

The literature reviewed previously highlights two main issues in estimating the effect of welfare benefits on the labor supply of women who also receive housing assistance. First, the program-participation choice should be endogenized in the model of labor supply since unobserved characteristics affecting the former are likely to be correlated with the latter. Secondly, the selection issue with regard to the public-housing program, and other rental-subsidy programs, is especially difficult to model since housing assistance is not an entitlement. Since explaining housing-program participation is not the objective here, the theoretical and empirical problems associated with rationing on behalf of the PHA and self-selection into public housing on the part of households are not relevant. Prior studies that have endogenized welfare participation in models of labor supply have done so by specifying and estimating a binary welfare-participation equation. The empirical equation determining welfare benefits in this dissertation uses more information by taking into account the amount of welfare benefits received, rather than just the binary choice between participation or nonparticipation.

Chapter III: The Theoretical Model

The theoretical framework for the subsequent empirical analysis is a one-period, static model of labor supply. A representative consumer living in public housing maximizes utility, given by the function

$$U(h, c, p), \tag{3.1}$$

by choosing labor supply, h, and the quantity of a composite consumption good, c, which serves as numeraire, subject to a financial budget constraint.[15] The consumer also makes a program-participation decision whether or not to accept welfare benefits (cash assistance) b, subject to eligibility restrictions.[16] Thus, p is a binary variable that equals zero for a nonparticipant and equals one for a participant. The model allows for welfare stigma by permitting utility to depend directly on the welfare-participation decision.

The utility function is assumed to be increasing in consumption, $U_c > 0$, and decreasing in labor supply, $U_h < 0$. The budget constraint requires that total expenditures, c, be less than or equal to wage income plus non-labor, non-welfare income, I, plus transfer income consisting of a rental subsidy, S, and welfare benefits, pb.

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[15] Note that U is a derived utility function that incorporates the time constraint. Specifically, U is derived from the utility function $U(l,c,p)$ defined on leisure, l, by substituting for l from the time constraint $l + h = T$, where T is the consumer's time endowment.

[16] In the empirical implementation of the model, all individuals satisfy eligibility requirements with respect to household composition. Income-eligibility is introduced endogenously, below.

Thus, the consumer's budget constraint can be written as

$$-Wh + c \leq I + S + pb, \tag{3.2}$$

where W denotes the real after-tax wage rate.[17]

In addition to the welfare-participation choice, the amount of benefits is also endogenous since it is affected by the choice of labor supply. Receipt of the public-housing subsidy is exogenous to the model, but the magnitude of the subsidy is endogenous since it, too, depends on the consumer's wage income, Wh. Assuming the individual pays more than the minimum rent, the formula for the rental subsidy is[18]

$$S = R - s\left(Wh + I + pb - D^R\right), \tag{3.3}$$

where R is the market rental value of the consumer's publicly provided housing, s is the fraction of gross income that public-housing residents are required to pay for rent (usually 30 percent), and D^R represents allowable deductions. The formula for welfare benefits is

$$b = \min\left\{P, \max\left[0, r\left(G - Wh - I + D^W\right)\right]\right\} \tag{3.4}$$

where P is the state's maximum AFDC payment, $r \in (0,1)$ is the "rateable reduction," G is the state's guarantee amount, and D^W represents allowable deductions.[19]

By combining the formulas for S and b with the financial budget constraint, the consumer's non-wage income can be defined as an exogenous variable conditional on the welfare-participation decision. Assuming that welfare benefits are below the maximum

[17] The "tax" in this instance is the earned income tax credit since low-income workers do not pay income taxes.

[18] If this formula yields less than $25 the individual is charged a minimum rent of at least $25. The PHA can charge up to $50 minimum rent.

[19] When the term multiplying r is negative, the consumer is income-ineligible.

allowed, P, the financial budget constraint can be rewritten as

$$-(1-s)(1-pr)Wh + c \leq Y(p), \tag{3.5}$$

where

$$Y(p) \equiv (1-s)(1-pr)I + R + sD^R + (1-s)pr(G + D^W), \tag{3.6}$$

is the consumer's exogenous net non-labor income, conditional on the welfare-participation decision.[20]

The consumer maximizes utility with respect to labor supply and consumption, conditional on the welfare-participation decision. At a utility maximum, the budget constraint holds as an equality and the consumer's marginal rate of substitution equals the effective wage rate:

$$MRS_{c,h} \equiv {-U_h}/{U_c} = W(1-s)(1-pr). \tag{3.7}$$

Notice that the decision to accept welfare benefits ($p = 1$) reduces the effective wage rate, thereby influencing the labor-supply decision. In addition, labor supply is influenced by welfare stigma if the consumer's marginal rate of substitution depends on the program-participation decision.

The consumer's welfare-participation decision is dictated by comparing utility on and off welfare. Define h^* to be the utility-maximizing choice of labor supply, and denote by c^* and b^* the corresponding amounts of consumption and welfare income, respectively, given the participation decision. Substituting h^*, c^*, and b^* into the direct utility

[20] In the empirical implementation of the model, data limitations dictate an assumption that no consumer receives the maximum allowable payment. For consumers who are income-ineligible, b equals zero and p equals zero as well, while for consumers who choose not to participate even though they are income-eligible, p is also equal to zero. Hence, the effective wage rate and net nonwage income defined in these equations correctly account for income-ineligibility and nonparticipation caused by stigma effects.

function yields the indirect utility function, the arguments of which are welfare participation, the effective wage rate, and net non-wage income, as follows:

$$V\left[p, W(1-s)(1-pr), Y(p)\right]. \tag{3.8}$$

An individual participates in the welfare program *(p = 1)* if utility on welfare is greater than utility off welfare, *(p* > 0),* where p^* is defined as:

$$p^* = V\left[1, W(1-s)(1-r), Y(1)\right] - V\left[0, W(1-s), Y(0)\right]; \tag{3.9}$$

conversely, the individual does not participate in the program *(p = 0)* if $p^* \leq 0$. Thus, p^* can be interpreted as a normalized measure of the "taste for welfare" or, alternatively, welfare stigma.

Denoting the labor-supply function by *H*, the consumer's labor supply, conditional on the welfare-participation decision, is given by

$$h^* = H\left[p; (1-s)(1-pr)W, Y(p)\right]. \tag{3.10}$$

Hence, the model yields two state-dependent labor-supply equations, one pertaining to consumers who choose to receive welfare benefits *(p = 1)* and the other pertaining to those who choose not to receive these benefits *(p = 0)*. Public-housing residents on welfare face a lower effective wage rate and a higher net non-wage income than residents not receiving cash assistance. This dissertation presents estimates of the labor-supply effects of a change in welfare benefits for public-housing residents, taking into account the welfare-participation decision. However, the empirical implementation of the model involves estimating an earnings equation determining *Wh* rather than a labor-supply equation determining *h*.

Figure 1 illustrates the labor-leisure decision of the representative consumer discussed above. The diagram highlights the effect of a cash-assistance program on the

budget constraint in the choice problem. Leisure (hours worked) is measured along the horizontal axis. Consumption, the sum of wage and exogenous income, is measured on the left-hand side vertical axis. The right-hand side vertical axis measures exogenous income, which is a function of whether or not the individual is enrolled in the welfare program. An individual located at point B on the diagram is not working, but is receiving welfare. Each additional hour of work yields the real wage rate, *W,* (net of taxes) minus a fraction *s* for rent and a fraction *r* that is subtracted due to the cash assistance program rules.[21] Exogenous income is equal to the rental subsidy plus welfare benefits. As the individual increases hours of work, moving up and to the left on the budget constraint, she eventually becomes ineligible at point D to receive welfare benefits due to her higher income. The individual's exogenous income is lower, but she receives a greater wage rate. An individual who does not work and is not receiving welfare is pictured at point A. Her total exogenous income, *Y[0]*, equals the value of her rental subsidy. Each additional hour of work yields the real wage rate, *W*, (net of taxes) minus a fraction, *s*, for rent. As the individual increases hours worked, moving up and to the left on the budget constraint, she is income-eligible for welfare until point D, where increasing hours further would render her income-ineligible.

In general, it is not utility maximizing to pick an hours-of-work and welfare-participation combination on line segment AD since, without giving up additional leisure, one could increase utility by simply accepting welfare payments. That is, a person could attain a higher indifference curve on line segment BD by working the same number of

[21] Since the amount is miniscule, the interaction term between the rental subsidy and the welfare wage rate deductions is ignored.

hours but opting to receive welfare. The presence of welfare stigma, however, may render a point on this section of the budget constraint optimal for an individual who has a strong distaste for welfare. A person located at a point along AD is eligible to receive welfare, but is not participating in the program due to the presence of welfare stigma. In other words, someone with strong welfare stigma is willing to forgo the additional exogenous income to avoid being on the welfare rolls. During the era of welfare reform, however, it is possible that, due to the time-limit provision which puts a cap on lifetime welfare benefits, women may opt to waive receipt of welfare benefits now to preserve future eligibility.

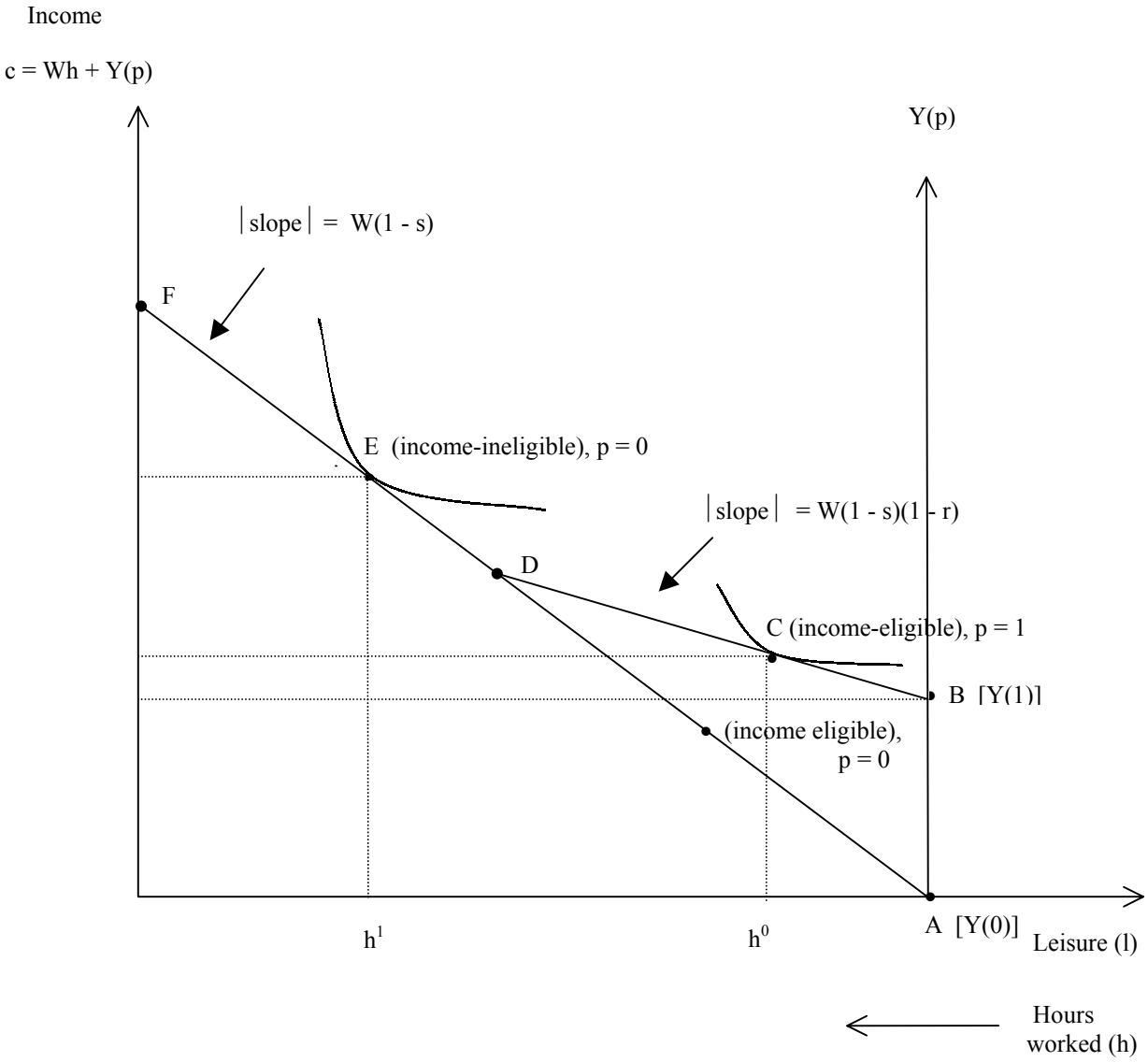

FIGURE 1—THE EFFECT OF WELFARE ON THE LABOR-LEISURE DECISION

Chapter IV: Econometric Specification and Estimation Techniques

This section describes the econometric method used to estimate the effect on labor supply of a change in welfare benefits. The theoretical section described a two-equation system determining intensive labor supply (hours worked), where transfer income consists of the rental subsidy received and, if the woman decides to participate in the welfare program, the amount of welfare benefits received. However, an earnings equation, rather than a labor-supply equation, is estimated since the former is the variable of interest. Therefore, it is not possible to disentangle the separate effects of welfare benefits on hours worked and on the wage rate. Further, since it is desirable to use all information regarding the extensive and intensive decision margins, the labor-supply and welfare-benefits variables are defined as censored continuous variables in the empirical specification.

The resulting system is a simultaneous-equations Tobit model of desired labor earnings and desired welfare benefits. That is, the model simultaneously determines these two variables which are left-censored at zero and each endogenous variable is a right-hand-side regressor in the other equation. Estimation of the model, therefore, must address the joint problems of censoring and simultaneity.

The issue of identification must be resolved before estimation proceeds to ensure that unique estimates of the structural parameters of the labor-earnings equation, of primary interest, can be obtained. If the two endogenous variables were not censored, but rather

continuously observed along the real number line, the system would simply be a classical simultaneous-equations model, and the usual rank-and-order identification conditions would apply. In general, the (sufficient) rank condition is satisfied if, among the exogenous variables in the system, there is at least one variable determining earnings that is not an explanatory variable in the welfare-benefits equation and, similarly, there is at least one variable determining earnings that is not in the welfare-benefits equation. Because of the intrinsic nonlinearity of the Tobit model, however, identification is achieved through the functional form rather than the standard exclusion restrictions.

Instead of the usual identification conditions, in a system of censored dependent variables there is a coherency condition that must be imposed since, otherwise, the nonlinearity implicit in the censoring precludes unique solutions for the reduced forms. Consider a simultaneous, two-equation Tobit model where both the latent and observed versions of the dependent variables appear on the right-hand side: [22]

$$y_1^* = \beta_1 y_2^* + \gamma_1 y_2 + \boldsymbol{\delta_1 x_1} + \varepsilon_1 \tag{4.1}$$

$$y_2^* = \beta_2 y_1^* + \gamma_2 y_1 + \boldsymbol{\delta_2 x_2} + \varepsilon_2 . \tag{4.2}$$

The relationship between the observed and unobserved variables is the usual Tobit specification with left censoring; that is, $y_1 = y_1^*$ if $y_1^* > 0$ and $y_1 = 0$ if $y_1^* \leq 0$ for y_1, and similarly for y_2. The system can be described as a model with mixed latent and observed variables.[23] Amemiya (1974) was the first to consider such mixed models, and

[22] Schmidt (1982) indicates that, although it is conceivable to incorporate both the truncated and untruncated versions of the explanatory variables, no one has proposed such models.

[23] These simultaneous Tobit models can be viewed as special cases of a general nonlinear model with unobserved variables. Both involve a right-hand side variable which is a function of an unobservable endogenous variable.

showed that the coefficient restriction $1-\gamma_1\gamma_2 > 0$ is necessary for internal consistency, or unique solvability, of the model. Schmidt and Sickles (1978) also considered models of this general type. Following the exposition in Schmidt (1982), this "logical-consistency condition" is discussed in more detail in Appendix E. Such conditions are inherent in all simultaneous-equation models that involve a mixture of latent variables and their partially observed realizations. Notice that the restriction involves only the coefficients on the observed variables, and does not pertain to the coefficients associated with the latent, continuous endogenous variables. Therefore, in models with mixed latent and observed variables, the form of the dependent variables appearing on the right-hand side of the other equation is important. For variations of the above specification, the consistency condition(s) can be checked by examining the reduced-form equations.

The specification and estimation of simultaneous-equation models with latent dependent variables are also discussed by Amemiya (1985) and Maddala (1983). Nelson and Olson (1978) and Amemiya (1979) analyzed models in which only the latent versions of endogenous variables are present as explanatory variables, and thus the consistency condition (or restriction) discussed here does not apply. Smith and Blundell (1986) and Blundell and Smith (1989, 1994) considered the identification and estimation of simultaneous-equation models that involve a censored (Tobit) dependent variable in the equation of primary interest and an endogenous, continuous right-hand-side variable that is observed.

For a simultaneous-equation model with two censored endogenous variables, there are three possibilities for the endogenous variables appearing on the right-hand-side: both variables are latent, both are observed, or one is observed and one is latent. The logical-

consistency condition must be imposed in the second and third situations, but not in the first. Therefore, to avoid forcing an inappropriate constraint on the model, the structural form, represented by

$$y_2^* = \beta_2 y_1^* + \boldsymbol{\delta_2 x_2} + \varepsilon_2 \tag{4.3}$$

$$y_1^* = \beta_1 y_2^* + \boldsymbol{\delta_1 x_1} + \varepsilon_1, \tag{4.4}$$

is estimated, where $y_2^* = Wh^*$ is desired labor earnings, $\mathbf{x}_2$ is a vector of exogenous variables determining y_2^*, $y_1^* = p^* b$ is desired welfare income, $\mathbf{x_1}$ is a vector of exogenous variables determining y_1^*, $\boldsymbol{\delta_2}$ and $\boldsymbol{\delta_1}$ are vectors of parameters associated with the variables in $\mathbf{x}_2$ and $\mathbf{x_1}$, respectively, β_2 and β_1 are scalar parameters, and ε_2 and ε_1 are distributed as bivariate normal random variables with correlation ρ. The random variables y_2, actual earnings, and y_1, actual welfare income, are the observed realizations of their latent (unobservable) counterparts, y_2^* and y_1^*, and are left-censored at zero. The latent dependent variables are defined as "desired earnings" and "desired welfare benefits" since the model determines variables which incorporate unobserved preferences for welfare and work. That is, the model described by equations 4.3 and 4.4 implies that desired, rather than actual, welfare benefits and earnings are simultaneously determined by the exogenous variables in $\mathbf{x_1}$ and $\mathbf{x_2}$. So, it is the magnitude of the distaste (preference) for receiving welfare, rather than the actual amount of benefits received, that affects desired earnings.

Single-equation estimation of the earnings equation (4.3) ignores the simultaneous determination of welfare benefits and earnings. This procedure would yield a biased and inconsistent coefficient estimate of the focal parameter β_2 if the error term in the

equation determining welfare benefits (4.4) is correlated with labor earnings. The direction of this bias, theoretically, depends on whether the correlation is positive or negative. If the two are negatively correlated, as presumed, the single-equation estimator of the welfare-benefits coefficient in the earnings equation would be biased downward, overstating the true negative effect of welfare benefits on earnings. An alternative way to describe the source of this bias is as an omitted-variables specification error. The direction of the bias depends on the correlation between the two explanatory variables: welfare benefits, the included variable, and welfare stigma, the omitted variable. Again, the single-equation estimator of the welfare-benefits coefficient in the earnings equation would be biased downward.

If unobserved characteristics of individuals that raise desired work hours (for example, a high "work ethic") are also associated with latent characteristics that lower desired welfare income (for example, a high "welfare stigma"), then ε_2 and ε_1 will be negatively correlated. It is possible to estimate this model by full-information maximum likelihood (FIML). However, to avoid the transmission of a possible misspecification of the equation determining welfare benefits to the earnings equation, the procedure used here is limited-information maximum likelihood (LIML). The limited-information framework is natural in this setting since the parameter of prime interest appears in the earnings equation.

Amemiya (1974) proposed a two-stage estimation procedure, which uses only the observations that have positive values for both dependent variables. However, it is desirable to use all of the observations when, as is the case with the NSAF dataset, a substantial number of individuals are nonworkers or nonparticipants in the welfare

program, or both. The reduced form of the model is

$$y_2^* = \boldsymbol{\pi}_2' \mathbf{X} + v_2 \tag{4.5}$$

$$y_1^* = \boldsymbol{\pi}_1' \mathbf{X} + v_1, \tag{4.6}$$

where $y_1 = y_1^*$ if $y_1^* > 0$ and $y_1 = 0$ if $y_1^* \leq 0$ for y_1, and similarly for y_2, and $\mathbf{X}$ is a vector of all of the exogenous explanatory variables in the model. Again, since the earnings equation is of principal interest, only the equation determining welfare benefits will be estimated in its reduced form.

The model is estimated in two stages. In the first stage, equation 4.6 is estimated by Tobit ML. The reduced-form coefficient estimates are then used to create the instrument $\hat{y}_1^* = \hat{\boldsymbol{\pi}}_1' \mathbf{X}$. $\hat{y}_1^*$ is a consistent estimator of y_1^*, and is asymptotically uncorrelated with the disturbance term in the second equation. In the second stage, equation 4.3 is estimated by Tobit ML, using the instrument from stage one in place of y_1^*. This two-step procedure yields a consistent estimate of the focal parameter, β_2. Following Murphy and Topel (1985), the standard errors are corrected for the use of an instrument as an explanatory variable.

Chapter V: Description of the Data

The data are taken from the National Survey of American Families (NSAF). The NSAF is a survey of the economic, health, and social characteristics of children, non-elderly adults, and their families. It is the outcome of an Urban Institute project, *Assessing the New Federalism*, initiated in response to policy changes that shifted responsibility for administering social programs for low-income families from the federal government to state and local governments. The project focuses on evaluating social programs regarding health care, income security, employment, training, and social services.

Rounds one and two of the survey were completed in 1997 and 1999, respectively. A third round was also scheduled. In each wave, over 40,000 households were interviewed, yielding information on more than 100,000 people. However, the same households were not necessarily interviewed every year; therefore, this is not a panel data set. To produce reliable estimates at the state level, and nationally, the NSAF oversampled the populations of thirteen states. The thirteen targeted states, which account for over one-half of the U.S. population, were Alabama, California, Colorado, Florida, Massachusetts, Michigan, Minnesota, Mississippi, New Jersey, New York, Texas, Washington, and Wisconsin. These states were chosen in order to obtain a representative array of government programs, fiscal capacities, demographic characteristics, and child well-being. Each round of the survey produced large, representative sample of the civilian

noninstitutionalized population under the age of 65 in these thirteen states and for the nation as a whole.

Section M of the survey obtained information pertaining to housing and economic hardships. Survey questions that were designed to determine if the respondent lived in government-assisted housing are listed in Table 1. In both 1997 and 1999, the

TABLE 1— GOVERNMENT HOUSING ASSISTANCE QUESTIONS, NSAF PUBLIC USE FILES, 1997 AND 1999

Year (Survey Question Number)	Question
1997 (M7), 1999 (M7)	Are you/you and your family paying lower rent because federal, state, or local government is paying part of the rent?
1997 (M7A)	Is this house in a public housing project?
1999 (M7A)	Is the building owned by a public housing authority?
1999 (M7B)	Did a public housing authority or some similar agency give (you/your family) a certificate or voucher to help pay the rent for this apartment or home?

interviewer asked, "Are you or your family paying a lower rent because the government pays a portion of your rent?"(M7).[24] Since tenant-based, government-subsidized housing is delivered in two forms, survey respondents were asked if the house was "in a public housing project" (M7A) to distinguish further the type of housing assistance the respondent was receiving in 1997. Item M7A was revised in 1999 to inquire whether "the building is owned by a public housing authority." In the second round of the survey, an additional question, M7B, was added concerning receipt of "a certificate or voucher to help pay the rent." This question was designed to identify those individuals receiving

[24] Although only the 1997 wave of the survey will be used in this dissertation, it is beneficial to describe the 1999 data, since it will be useful in future research if local geographic identifiers become available. Geographic variables for the NSAF are discussed below in detail.

housing assistance through the Section 8 program, which allows the recipient to choose any qualified apartment available in the private market in a given area. In contrast, the public-housing program offers a specific apartment to an eligible household.

A. *Sample*

In the 1997 wave of the survey, 1,377 respondents indicated that they resided in a public-housing project. The 1997 wave was used since, in addition to indicators for Census region and state of residence, it contained a local geographic variable which is useful for estimating the annual earnings equation. The issue of residential mobility is not addressed in this dissertation since the data do not identify individuals by receipt of Section 8 assistance. In addition, Shroder (2002) reports that, according to a survey conducted by HUD in 1995, households living in public housing are much more likely than those receiving Section 8 to accurately report receipt of housing assistance. Thus, by examining only public housing residents this potential bias can be eliminated. Further, identification of behavioral responses to the implementation of TANF through use of both the 1997 and 1999 wave is not possible since the survey is not a true longitudinal study. That is, although it is possible for an individual to be interviewed each year, the same persons did not necessarily participate in the survey. Although there are identifiers that would allow one, in principle, to match households across years, the construction of a panel data set from the NSAF is not practical.

Since female heads of household are, overwhelmingly, the largest demographic category to receive welfare benefits, it is sensible to restrict the sample to this group. The survey, however, did not obtain household-head information from the respondents. Instead, under the assumption that the lessee and the head of household are identical,

women were included in the sample only if their name appeared on the lease. Disabled women were excluded since they are eligible for other major government transfer programs not analyzed here. Households with no children younger than 18 years of age are categorically ineligible for welfare and, therefore, were also not included in the sample. The final sample consists of 745 non-disabled, non-elderly, single women who were public-housing lessees with a family member present who is less than 18 years old.

Table 2 presents the distribution of respondents by welfare-program participation and labor supply for the year 1996. (The 1997 survey provides data for welfare-program benefits, labor-market earnings, and labor supply data for the previous year.)

TABLE 2 — WELFARE AND LABOR-FORCE PARTICIPATION IN 1996

	Did not work	Worked	Row Total
Did not receive AFDC	117	349	466
	25.1%	74.9%	100%
	45.0%	72.0%	62.6%
	15.7%	46.8%	62.6%
Received AFDC	143	136	279
	51.3%	48.7%	100%
	55.0%	28.0%	37.4%
	19.2%	18.3%	37.4%
Column Total	260	485	745
	34.9%	65.1%	
	100.0%	100.0%	
	34.9%	65.1%	

Cell count
Row percentage
Column percentage
Percentage of total

Approximately two-thirds (65.1 percent) of the sample worked and almost forty percent (37.4 percent) received welfare (AFDC) benefits for at least one month during the year. Examining the joint distribution of labor supply and welfare-program participation, the

largest proportion of survey respondents in the sample (46.8 percent) were employed but not enrolled in the welfare program. Among all respondents receiving welfare, about one-half were working.

B. *Descriptive Statistics*

Table 3 presents the sample means and definitions of the variables used in the empirical analysis. In general, the means of the variables are as expected. On average, nonworking women were more likely to receive welfare and less likely to have a high-school diploma than those who were employed. The average age of both groups is 33 years. Workers were less likely than non-workers to have children less than 5. A larger proportion of the non-working women reported being in fair or poor health at the time of the interview. One-third (33.0 percent) lived in the South Census region.

Non-labor, non-transfer income consists of an individual's income from capital assets and the earnings of other family members. The data provide information regarding the amount of interest from savings accounts, money-market funds and certificates of deposits, and government bonds. Since 97 percent of the respondents indicated having zero capital income, however, this component will not be utilized in the analysis. The average annual earnings of other family members, the variable used to approximate non-labor non-transfer income, is approximately $900. The sample from which this mean was calculated includes individuals whose family members had zero income.

TABLE 3 — MEANS AND DEFINITIONS OF VARIABLES

Variable	Means			Definition
	All (N = 745)	Workers (N_1 = 485)	Non-workers (N_2 = 260)	
Dependent				
Work participation	0.65	1.00	0.00	Equals 1 if total earnings > 0 in 1996
Earnings	$5351.26	$8219.98	$0.00	Total earnings in 1996
Welfare participation	0.37	0.28	0.55	Equals 1 if individual received AFDC for at least one month in 1996
Welfare benefits	$1456.26	$882.26	$2526.98	Amount of AFDC benefits received in 1996
Independent				
High-school diploma	0.70	0.77	0.58	Equals 1 if individual possesses at least a high-school diploma
Family earnings	$901.61	$705.76	$1266.96	Total earnings of other family members
Age	33.06	33.07	33.05	Age in years
Black	0.52	0.55	0.46	Equals 1 if individual is black
Poor or fair health	0.23	0.20	0.30	Equals 1 if health is poor or fair
Family members less than age 5	0.82	0.72	0.99	Number of family members less 5 years old
Family members 5-17 years old	1.38	1.29	1.54	Number of family members between 5 and 17 years old
Midwest	0.24	0.28	0.16	Equals 1 if current residence in Midwest
South	0.33	0.35	0.29	Equals 1 if current residence in South
West	0.14	0.14	0.15	Equals 1 if current residence in West
Other				
Weeks worked	24.18	37.15	0.00	Number of weeks worked in 1996
Hours worked	22.19	34.09	0.00	Number of hours per week worked in 1996
Hourly wage rate	$5.13	$7.87	0.00	Derived hourly wage rate
Months on welfare	4.77	3.05	7.98	Number of months on AFDC in 1996

Chapter VI: Empirical Results

The purpose of this dissertation is to investigate empirically the work disincentives of welfare benefits (the cash-assistance program) for public-housing residents. In particular, the effect of welfare benefits on the labor earnings of women living in public housing is estimated using cross-sectional data. The empirical results are then used to predict the effect of a reduction or elimination of cash assistance that is the centerpiece of recent welfare reform. The principal question is: " How much of a potential decrease in welfare assistance of welfare-eligible women living in public housing is likely to be replaced by increased earned income through higher labor supply?"

Since the income and program-participation data are for 1996, the actual effect of the 1996 welfare reform is not being evaluated. In 1996, AFDC was technically still the relevant federal cash-assistance program, but welfare recipients and those in charge of state welfare programs were certainly anticipating the impending federal welfare reform. TANF became effective on July 1, 1997. Many states were already operating programs similar to what the TANF program became through the waiver provision of the 1981 legislation. With these data, therefore, it is not possible to estimate the actual effects of the subsequent reform.

The empirical results are divided into four sections. The first presents the results of estimating a baseline, annual earnings equation by Tobit ML assuming that welfare participation, or welfare benefits, in separate specifications, are exogenous. The second section contains the main empirical results. The estimation procedure, discussed at

length in Section IV, is two-stage Tobit ML applied to an annual earnings equation that takes into account the endogeneity of welfare benefits. The model is also estimated utilizing the survey respondents' opinions about the effect of welfare on work behavior, a proxy for welfare stigma, as an explanatory variable. Using the same estimation method, the third section extends this analysis by examining the effect of the FMR on earnings, while controlling for local labor market diversity. The instrumental variable used for welfare benefits in the earnings equation is estimated controlling for state differences in the welfare program. Only a subsample of data is utilized in this section, however, since the geographic information required for implementation is not available for everyone in the full sample. In section four, lastly, the model is estimated within a self-selection framework. Bivariate probit selection equations determining both work and welfare participation are used to augment the annual earnings equation. The two selection equations are estimated jointly to take into account the correlation of the error terms arising from unobserved characteristics that may affect both welfare and work participation.

A. *Baseline Regressions*

The distribution that applies to the sample data of a censored dependent variable is a mixture of discrete and continuous distributions. The ordinary least squares (OLS) estimator does not take into account the qualitative difference between the limit and non-limit observations of the dependent variables. It is assumed that, in the absence of censoring the data would constitute a representative sample from the population of interest. The model required for the analysis of a censored sample is defined in terms of a new random variable that is defined by way of an index function, denoted by a

superscript star, and is referred to as a "latent" or unobserved variable. Tobit analysis is appropriate for estimating such a censored regression model.

In the latent-variable framework, the Tobit model is $y_i^* = \boldsymbol{\beta}'\mathbf{x}_i + \varepsilon_i$ where $\varepsilon_i \sim N[0,\sigma^2]$ and the variable y_i^* is unobserved. The observed response is $y_i = \max(0, y_i^*)$. This technique utilizes observations in the sample both at and above the limit to estimate the regression function. In this case, the limit is zero. Utilizing both the, censored and noncensored observations, there are two conditional-mean functions one might consider;

$$E[y_i^*] = \boldsymbol{\beta}'\mathbf{x}_i, \tag{6.1}$$

for the latent variable; and, for an observation randomly drawn from the population which may or may not be censored,

$$E[y_i|\mathbf{x}_i] = \Phi(\boldsymbol{\beta}'\mathbf{x}_i/\sigma)(\boldsymbol{\beta}'\mathbf{x}_i + \sigma\lambda_i), \tag{6.2}$$

where $\lambda_i = \phi(\boldsymbol{\beta}'\mathbf{x}_i/\sigma)/\Phi(\boldsymbol{\beta}'\mathbf{x}_i/\sigma)$. The parameters that determine the probability of a limit observation are the same as those that determine the density of the positive, non-limit observations. Therefore, anything that increases the probability of observing a non-zero value must also increase the mean of the positive values. This seems to be a reasonable assumption in analyzing earnings (and also welfare benefits). In the following tables, the estimates presented in the "coefficient" column are the marginal effects for the conditional-mean function of the latent variable, $\partial E[y_i^*|\mathbf{x}_i]/\partial\mathbf{x}_i = \boldsymbol{\beta}$. The marginal effect for an observation randomly drawn from the population, $\partial E[y_i|\mathbf{x}_i]/\partial\mathbf{x}_i = \boldsymbol{\beta}\Phi(\boldsymbol{\beta}'\mathbf{x}_i/\sigma)$, which is simply the coefficient vector scaled by the probability of the observation being in the uncensored region, is given in the column

labeled "marginal effect." All marginal effects are evaluated at the overall sample means of the associated explanatory variables.

A naïve way to analyze the difference in earnings between those on welfare and those not on welfare is to specify a dummy variable indicating receipt or nonreceipt of benefits. An alternative method would use the additional information given by the magnitude of the benefits received by welfare recipients. Assuming welfare participation (benefits) is (are) exogenous, equation 4.3 determining earnings is estimated by single-equation Tobit maximum likelihood.[25]

Two sets of results are presented in Table 4, and differ only in their definition of the welfare variable; the first utilizes a binary welfare-participation indicator, and in the second the welfare variable is defined as the dollar amount of benefits received.[26] The latter is zero, of course, for those who did not participate in the welfare program. The dependent variable for both regressions is annual earnings measured in $1,000's. The estimates of the coefficients on the exogenous, control variables are, generally, as expected. An increase in the number of children less than 5, having poor health, and additional family earnings all decrease earnings, whereas an increase in age and having a high-school diploma both increase labor income. Compared to those residing in the East Census region, public-housing residents in the Midwest earn more. Within this sample of women residing in public housing black females earn approximately $1,000 a year more than observationally equivalent whites.

[25] All results were obtained with the software package LIMDEP 7.0, Greene (1998). For the Tobit model, Newton's method was used to solve the nonlinear optimization problem, and the estimated asymptotic covariance matrix is the Hessian.

[26] This and subsequent tables are located at the end of the associated section.

TABLE 4 — ANNUAL EARNINGS EQUATION: EXOGENOUS WELFARE PARTICIPATION AND WELFARE BENEFITS

	(1)		(2)	
	Marginal effect	|t-statistic|	Marginal effect	|t-statistic|
Welfare	-4.522***	10.246	-1.222***	12.136
	(0.441)		(0.101)	
Age	0.280**	1.806	0.334**	2.208
	(0.155)		(0.151)	
Age squared	-0.003*	1.465	-0.004**	1.858
	(0.002)		(0.002)	
Black	1.018**	2.385	0.891**	2.140
	(0.427)		(0.417)	
High-school diploma	2.071***	4.448	2.148***	4.720
	(0.466)		(0.455)	
Number of children less than 5	-0.860***	3.215	-0.928***	3.547
	(0.268)		(0.262)	
Poor or fair health	-1.337***	2.652	-1.260***	2.548
	(0.504)		(0.494)	
Family earnings (in $1000's)	-0.143**	2.325	-0.135**	2.219
	(0.061)		(0.061)	
Midwest	1.991***	3.525	1.986***	3.585
	(0.565)		(0.554)	
South	-0.273	0.515	-0.864*	1.654
	(0.530)		(0.522)	
West	0.832	1.230	0.898	1.346
	(0.677)		(0.667)	
Intercept	-3.149	1.096	-3.850	1.375
	(2.872)		(2.800)	
σ	7.755		7.556	
Log of the likelihood function	-1872.93		-1850.02	
N	745		745	

Notes: The dependent variable in (1) and (2) is annual earnings measured in $1000's. The welfare variable is a dichotomous variable in (1) and a left-censored continuous variable in (2) measured in $1000's. Standard errors are parentheses under the associated coefficient estimates. The equations were estimated by Tobit ML.

*** Significant at the 1-percent level, for the appropriate (one- or two-tailed) test.

** Significant at the 5-percent level, for the appropriate (one- or two-tailed) test.

* Significant at the 10-percent level, for the appropriate (one- or two-tailed) test.

Both welfare-program participation and the amount of welfare received have a negative effect on earnings and the coefficient estimates are statistically significant at the 1-percent level. Moreover, the magnitude of the estimated effects is economically significant. Compared to public-housing residents who do not receive welfare benefits, those receiving welfare benefits are predicted to have $4,522 less in yearly earnings on average (column 1). Similarly, the results from the second specification (column 2) indicate that a $1,000 increase in welfare benefits received decreases annual earnings by $1,222 on average. Since participation in the welfare program or, alternatively, the amount of benefits received is endogenous, these single-equation estimates are inconsistent. These baseline regressions are, however, an instructive place to begin the empirical analysis of the effect of welfare participation (or welfare benefits) on earnings.

B. *Two-Stage Tobit*

As noted previously, the estimates of the coefficients in the earnings equation reported in Table 4 are inconsistent if welfare participation or benefits are endogenous since the welfare variable would then be correlated with the error term in the earnings equation. To obtain consistent estimates, a two-stage, limited-information maximum likelihood (LIML) procedure is utilized. The first stage involves estimating a reduced-form equation determining welfare participation or benefits. The set of explanatory variables in this equation consists of the exogenous regressors in the system. Second, the predicted value from this first-stage regression is used as an instrument for observed welfare participation (or benefits) in the earnings equation. This method of estimation will yield consistent estimates of the coefficients in the earnings equation.

If the error terms are correlated, however, the two-stage estimates will not be efficient. Obtaining efficient estimates would require use of a joint estimation method (for example, a three-stage or FIML procedure). There are several reasons, however, for estimating the system equation-by-equation rather than jointly. The most important reason is that, when all equations are estimated simultaneously, the coefficient estimates in each equation are affected by any specification errors in the other equations. That is, if the system is estimated as a whole, and the equation determining welfare benefits is misspecified, then all of the estimated coefficients in the model are adversely affected, including the focal parameter in the earnings equation. Since the earnings equation is of primary interest, a LIML approach will be used. Another reason for using a two-stage procedure is that the formulation and estimation of the joint likelihood function for the two-equation system may be difficult. Finally, with two censored dependent variables, FIML may be computationally infeasible as well.

To assess the statistical significance of the estimated coefficients when a two-stage estimation procedure is used, the estimated asymptotic covariance matrix must be corrected since the predicted value of the endogenous variable obtained from the first stage is measured with sampling error. The greater sampling error in the first-stage, the more severely affected is the hypothesis testing with regard to the estimated coefficients in the primary equation of interest. Following the procedure developed by Murphy and Topel (1985), the estimated asymptotic covariance matrix for the earnings equation was corrected.[27] The correction involves summing the individual observations on the cross

[27] Murphy and Topel (1985) refer to their method as a "two-step," rather than "two-stage" procedure, as does Greene (1997). Greene characterizes a "two-step" procedure as one model embedded in another.

products of the derivatives of the likelihood function with respect to the parameter vectors.

The model determining annual earnings, taking into account the endogeneity of welfare benefits, consists of two marginal densities: $f_1\left(y_{i1}^*|\mathbf{z}_i,\boldsymbol{\delta}\right)$ for welfare benefits, and $f_2\left(y_{i2}^*|\mathbf{x}_i,\mathbf{z}_i,\boldsymbol{\beta},\gamma,\boldsymbol{\delta}\right)$ for earnings. The reduced-form, first-stage model determining welfare benefits,

$$y_{i1}^* = \mathbf{z}_i'\boldsymbol{\delta} + e_{i1} \tag{6.3}$$

is estimated by Tobit maximum likelihood. (See Appendix C for an analysis based on a first-stage probit ML.) The log-likelihood function is

$$\ln L_1 = \sum_{y_{i1}>0} -\frac{1}{2}\left[\ln(2\pi) + \ln\sigma^2 + \frac{(y_{i1}-\mathbf{z}_i'\boldsymbol{\delta})^2}{\sigma^2}\right] + \sum_{y_{i1}=0}\ln\left[1-\Phi\left(\mathbf{z}_i'\boldsymbol{\delta}/\sigma\right)\right], \tag{6.4}$$

where Φ is the cumulative density function of the standard normal distribution. The two parts of the likelihood function correspond to the classical regression model for the positive, non-limit observations and the probabilities for the limit observations clustered at zero. The results from estimating the reduced-form welfare-benefits model are shown in Table 5. The number of children and region of residence variables have a statistically significant effect on welfare benefits received. In particular, an increase in the number of children less than 5 years old, as well as an increase in the number of children between the ages of 5 and 17 increases welfare benefits. The marginal effect of these variables indicates that the addition of one more child increases welfare benefits by about $360 per year. Compared to living in the East region, residing in the South has a negative effect

TABLE 5 — REDUCED-FORM WELFARE BENEFITS EQUATION

	Coefficient	Marginal effect	|t-statistic|
Age	-0.196	-0.075	1.203
	(0.163)		
Age squared	0.002	0.001	0.970
	(0.002)		
Black	0.288	0.111	0.680
	(0.424)		
High-school diploma	0.320	0.123	0.700
	(0.457)		
Number of children less than 5	0.949***	0.366	3.706
	(0.256)		
Number of children 5-17 years	0.941***	0.363	4.896
	(0.192)		
Poor or fair health	0.214	0.082	0.431
	(0.495)		
Family earnings (in $1000's)	-0.078	-0.030	1.367
	(0.057)		
Midwest	-0.076	-0.029	0.142
	(0.538)		
South	-3.048***	-1.175	5.658
	(0.539)		
West	1.337**	0.516	2.170
	(0.616)		
Intercept	1.063	0.410	0.366
	(2.904)		
σ	4.568		
N	745		
Log of the likelihood function	-1075.11		

Notes: The dependent variable is annual welfare benefits in $1000's. Standard errors are shown in parentheses under the associated coefficient estimates. The equation was estimated by Tobit ML.

*** Significant at the 1-percent level.

** Significant at the 5-percent level.

* Significant at the 10-percent level.

on earnings ($1,175 a year), whereas being a resident within the West region has a positive effect on annual welfare benefits ($516 a year).

The predicted value of desired welfare benefits, $\hat{y}_{i1}^{*} = \hat{\boldsymbol{\delta}}'\mathbf{z}_i$, obtained from this model is used as a regressor in the second-stage earnings equation,

$$y_{i2}^{*} = \mathbf{x}_i'\boldsymbol{\beta} + \hat{y}_{i1}^{*}\gamma + e_{i2}. \tag{6.5}$$

The log likelihood for the second-stage Tobit annual earnings model is

$$\ln L_2 = \sum_{y_{i2}>0} -\frac{1}{2}\left[\ln(2\pi) + \ln\sigma^2 + \frac{(y_{i2} - \mathbf{x}_i'^{*}\boldsymbol{\theta}_2)^2}{\sigma^2}\right] + \sum_{y_{i2}=0} \ln\left[1 - \Phi\left(\mathbf{x}_i'^{*}\boldsymbol{\theta}_2 \big/ \sigma\right)\right], \tag{6.6}$$

where $\mathbf{x}_i^{*} = \left[\mathbf{x}_i', \mathbf{z}_i'\hat{\boldsymbol{\delta}}\right]$ and $\boldsymbol{\theta}_2 = \left[\boldsymbol{\beta}, \gamma\right]'$. The empirical results, with the uncorrected standard errors, are shown in Column 1 of Table 6. The number of children in the age range of 5 to 17 years old is omitted from the earnings equation, and age squared is excluded from the welfare-participation (benefits) equation. These exclusion restrictions aid in the identification of the model but are not necessary, because of the inherent nonlinearities in the Tobit model.

Following the notation in Greene (1997), the asymptotic covariance matrix of the two-step maximum likelihood estimator (MLE) developed by Murphy and Topel is

$$\mathbf{V}_2^{*} = \mathbf{V}_2 + \mathbf{V}_2\left[\mathbf{C}\mathbf{V}_1\mathbf{C}' - \mathbf{R}\mathbf{V}_1\mathbf{C}' - \mathbf{C}\mathbf{V}_1\mathbf{R}'\right]\mathbf{V}, \tag{6.7}$$

where $\mathbf{V}_1 = Asy.Var\left[\hat{\boldsymbol{\delta}}\right]$ is based on $\ln L_1$, $\mathbf{V}_2 = Asy.Var\left[\hat{\boldsymbol{\theta}}_2\right]$ is based on $\ln L_2 | \boldsymbol{\delta}$, $\mathbf{C} = E\left[\left(\frac{\partial \ln L_2}{\partial \boldsymbol{\theta}_2}\right)\left(\frac{\partial \ln L_2}{\partial \boldsymbol{\delta}'}\right)\right]$, and $\mathbf{R} = E\left[\left(\frac{\partial \ln L_2}{\partial \boldsymbol{\theta}_2}\right)\left(\frac{\partial \ln L_1}{\partial \boldsymbol{\delta}'}\right)\right]$. The matrices ***R*** and ***C*** are

TABLE 6 — ANNUAL EARNINGS EQUATION: ENDOGENOUS WELFARE BENEFITS

	(1) Original s.e.		(2) Corrected s.e		
	Coefficient	|t-statistic|	Coefficient	Marginal effect	|t-statistic|
$\hat{y}_{i1}^{*} = \hat{\boldsymbol{\delta}}'\mathbf{z}_i$	-1.166***	3.311	-1.166***	-0.756	2.786
	(0.352)		(0.419)		
Age	0.520**	2.051	0.520	0.337	0.976
	(0.254)		(0.533)		
Age squared	-0.006**	1.775	-0.006	-0.004	0.771
	(0.003)		(0.008)		
Black	1.745**	2.414	1.745	1.131	1.626
	(0.723)		(1.073)		
High-school diploma	3.247***	4.283	3.247***	2.103	2.800
	(0.758)		(1.160)		
Number of children less than 5	-0.982**	1.973	-0.982**	-0.636	1.654
	(0.498)		(0.594)		
Poor or fair health	-1.700**	2.049	-1.700*	-1.100	1.341
	(0.829)		(1.266)		
Family earnings (in $1000's)	-0.258***	2.515	-0.258*	-0.167	1.425
	(0.103)		(0.181)		
Midwest	2.953***	3.210	2.953***	1.913	2.642
	(0.920)		(1.118)		
South	-2.810**	2.054	-2.810	-1.820	1.428
	(1.368)		(1.967)		
West	2.039*	1.720	2.039*	1.321	1.709
	(1.185)		(1.193)		
Intercept	-10.161**	2.135	-10.161	-6.583	1.141
	(4.759)		(8.902)		
σ	8.361		8.361		
N	745		745		
Log of the likelihood function					

Notes: The dependent variable is annual earnings in $1000's. The standard errors, shown in parentheses under the associated coefficients, have not been corrected for the two-stage estimation procedure in column 1. Column 2 presents the corrected standard errors following Murphy and Topel (1985). The equation was estimated by Tobit ML.

*** Significant at the 1-percent level, for the appropriate (one- or two-tailed) test.

** Significant at the 5-percent level, for the appropriate (one- or two-tailed) test.

* Significant at the 10-percent level, for the appropriate (one- or two-tailed) test.

estimated by $\hat{\mathbf{C}} = \sum_{i=1}^{n}\left(\frac{\partial \ln f_{i2}}{\partial \hat{\boldsymbol{\theta}}_2}\right)\left(\frac{\partial \ln f_{i2}}{\partial \hat{\boldsymbol{\delta}}'}\right)$ and $\hat{\mathbf{R}} = \sum_{i=1}^{n}\left(\frac{\partial \ln f_{i2}}{\partial \hat{\boldsymbol{\theta}}_2}\right)\left(\frac{\partial \ln f_{i1}}{\partial \hat{\boldsymbol{\delta}}'}\right)$. The derivatives needed to compute these matrices are

$$\frac{\partial \log L_1}{\partial \boldsymbol{\delta}} = \frac{1}{\sigma^2}\sum_{y_{i1}>0}\left(y_{i1} - \mathbf{z}_i'\boldsymbol{\delta}\right)\mathbf{z}_i - \sum_{y_{i1}=0}\frac{\mathbf{z}_i}{\sigma}\frac{\phi\left(\mathbf{z}_i'\boldsymbol{\delta}/\sigma\right)}{1-\Phi\left(\mathbf{z}_i'\boldsymbol{\delta}/\sigma\right)}, \tag{6.8}$$

$$\frac{\partial \log L_2}{\partial \boldsymbol{\theta}_2} = \frac{1}{\sigma^2}\sum_{y_{i2}>0}\left(y_{i2} - \mathbf{x}_i'^{*}\boldsymbol{\theta}_2\right)\mathbf{x}_i^{*} - \sum_{y_{i2}=0}\frac{\mathbf{x}_i^{*}}{\sigma}\frac{\phi\left(\mathbf{x}_i'^{*}\boldsymbol{\theta}_2/\sigma\right)}{1-\Phi\left(\mathbf{x}_i'^{*}\boldsymbol{\theta}_2/\sigma\right)}, \text{ and} \tag{6.9}$$

$$\frac{\partial \log L_2}{\partial \boldsymbol{\delta}} = \frac{1}{\sigma^2}\sum_{y_{i2}>0}\left(y_{i2} - \mathbf{x}_i'^{*}\boldsymbol{\theta}_2\right)\gamma\mathbf{z}_i - \sum_{y_{i2}=0}\frac{\gamma\mathbf{z}_i}{\sigma}\frac{\phi\left(\mathbf{x}_i'^{*}\boldsymbol{\theta}_2/\sigma\right)}{1-\Phi\left(\mathbf{x}_i'^{*}\boldsymbol{\theta}_2/\sigma\right)}. \tag{6.10}$$

Table 6, column 2 shows the estimated coefficients and marginal effects with the corrected standard errors. A comparison of the results in columns 1 and 2 of Table 6 reveals that the t-statistics computed from the uncorrected standard errors are greater in absolute value for every coefficient. Moreover, in several instances the differences in the standard errors affects the outcomes of the hypothesis tests, revealing the importance of using the correct standard errors in this context. To calculate the marginal effects for the explanatory variables in the Tobit model, each coefficient is scaled by the probability of having positive earnings. Given that the coefficient is statistically significant, the magnitude of the effect of increased welfare benefits on earnings must be examined to determine its economic significance.

When the appropriate alternative to the null of no effect has a specific sign a one-tailed t-test will be used throughout. Specifically, one expects increased age and having a

high-school diploma will positively affect earnings, but age squared, the number of children less than 5, poor health, and greater family earnings will have a negative effect. Age and age squared no longer affect annual earnings when the welfare-benefits variable is modeled endogenously. Possessing a high-school diploma continues to have a positive and statistically significant effect on earnings at the 1-percent level. The coefficient on the number of children less than 5 is negative and statistically significant at the 5-percent level, whereas having poor or fair health and greater family earnings each has a negative effect on earnings at the 10-percent level. Using a two-tailed significance test for the regional variables, the results show that, compared to living in the East, residing in either the Midwest or the West regions has a positive effect on earnings.

To assess the estimated coefficients' economic significance, the marginal effect on annual earnings of a one-unit increase in the explanatory variables are presented. A $1,000 increase in welfare benefits yields a decrease in annual earnings of $756, after taking into account welfare endogeneity. Assuming exogeneity with respect to welfare, in contrast, the model predicts a decrease in annual earnings of $1,222 (Table 4, column 2), implying a substantial overstatement of the estimated effect of increased welfare benefits compared to the results obtained when such benefits are treated as endogenous. This confirms the theoretical prediction that, if the unobserved characteristics which affect welfare benefits are correlated with labor earnings the single-equation estimate of the negative effect of a change in welfare benefits on labor-market earnings will be overstated. The exogenous specification mistakenly attributes all of the negative effect on labor earnings of a change in welfare benefits to the amount of welfare benefits received.

It is often extremely difficult to find an exogenous observable variable to serve as a proxy for an unobserved, latent characteristic (such as welfare stigma or "distaste for welfare") in micro survey data. Family background data may serve this purpose since these variables are, by definition, exogenous to the current generation. One piece of potentially relevant background information is whether or not a woman was reared in a household receiving welfare. It is plausible to assume that a woman who was raised in a welfare household as a child is more likely to be on the welfare roll as an adult than is a woman who was raised in a household that did not receive welfare. Unfortunately, data regarding the respondents' childhood family environment are not available in the NSAF. The survey does, however, ask the respondents about their attitudes towards welfare. Specifically, the survey question asks whether or not the respondent agrees with the statement, "Welfare makes people work less than they would if there wasn't a welfare system." Zedlewski (2002) suggests that welfare stigma affects the decision of TANF-eligible single parents to participate in the welfare program. Zedlewski found evidence supporting this hypothesis among those whose potential annual benefit was between $500 and $1,500 (the medium-benefit category) since 63 percent of non-participants in this group agreed with the survey's statement about welfare and work, compared with only 50 percent of welfare-program participants.

Using respondents' opinions about the relationship between welfare and work as a proxy for welfare stigma, the model was re-estimated. The four possible responses to the statement (strongly agree, agree, disagree, or strongly disagree) were recoded into the binary responses agree or disagree to create a single dummy indicator of the distaste for welfare. Sixty-five percent of the sample either strongly agreed or agreed with the

statement. *A priori*, one would expect a distaste for welfare to have a negative effect on the receipt of welfare benefits and a positive effect on earnings. The empirical results presented in Table D.1 of Appendix D reveal that a distaste for welfare does not affect whether a public-housing resident receives welfare. Table D.2 reports the results of estimating the structural model determining labor earnings, with welfare benefits treated as an endogenous variable and welfare stigma added as an explanatory variable.

The effect of increased welfare benefits on earnings is similar to that of the original specification (Table 6); specifically, a $1,000 increase in welfare benefits yields a decrease in annual earnings of $767. The estimated coefficients on the other explanatory variables in the earnings equation also yield the same qualitative results as the previous specification. In particular, possessing a high-school diploma has a positive and statistically significant effect on earnings, as does residing in either the Midwest or the West region compared to living in the East. Moreover, an increase in the number of children less than 5 and greater family earnings each has a negative effect on earnings. However, the empirical results imply that having a distaste for welfare does not affect the annual earnings of women living in public housing. This variable may not be a good proxy for welfare stigma or individuals may not reveal their true opinion of the relationship between welfare and work.

C. *Local Geographic Data*

Identification of individuals by region of residence is useful since economic conditions that affect work behavior and welfare-program participation may vary geographically. In addition, the theoretical model indicates that labor earnings are affected by the rent that public-housing residents would have paid in the private market

had they not lived in public housing. Empirically, this is approximated by the FMR, which varies across metropolitan areas and non-metropolitan counties. The NSAF database classifies individuals by Census region and state of residence. A variable that identifies respondents by "sub-state geographic area (SGA)" is also available for the 1997 wave, but only for observations in the thirteen over-sampled states.[28] The Urban Institute created the SGA variable by placing each household into a grouping of one or more counties.[29]

Using this locally specific geographic identifier, an unemployment-rate variable was constructed for each SGA to control for differences in labor-market conditions. County unemployment rates for 1996 were obtained from the Local Area Unemployment Statistics (LAUS) Program of the U.S. Department of Labor, Bureau of Labor Statistics (BLS). The BLS uses disaggregation techniques (either the population-claims or the census-share method) to obtain current labor force estimates of employment and unemployment for counties within multi-county labor market area's (LMA's). LMA unemployment rate estimates, which are produced using the "Handbook" method, could not be used since the definition of LMA'a and SGA's are not necessarily the same.[30] The unemployment rate used for one-county SGA's is simply the county unemployment rate published by the BLS in the Local Area (LA) series, which includes data for all counties

[28] These data are not available for the 1999 wave as yet.

[29] The main criterion for constructing the SGAs was for the area to have a total census population projection for 1997 of above 100,000 for persons under age 65.

[30] The "Handbook" procedure uses data from several sources, including the Current Population Survey, the Current Employment Statistics program, State Unemployment Insurance (UI) systems, and the decennial census, to create estimates that are adjusted to the statewide measures of employment and unemployment. The disaggregation techniques uses data obtained from the decennial census, annual population estimates, and current UI data. Since these estimates are influenced to some degree by the generosity of the UI programs the unemployment-rate variable may be correlated with the characteristics of the state/local welfare programs.

and cities of 25,000 or more. For multiple-county SGA's, the unemployment rate was constructed by averaging the county unemployment rates obtained from the LA series.

The FMR, obtained from the "Historic Fair Market Rent Database" (HUDUSER, a division of HUD), was used to approximate the rent that public-housing residents would have paid in the private market had they not lived in public housing.[31] The FMR varies by the number of bedrooms in the housing unit and geographic location. For all counties and MSA's in the 13 states, the 1996 two-bedroom FMR and the current, 2003 FMR for each bedroom size (0 – 4 bedrooms) were used to construct the appropriate FMR for each observation. The ratio of each 2003 bedroom-size FMR to the 2003 two-bedroom FMR was applied to the 1996 two-bedroom FMR to estimate the 1996 FMR for each bedroom size. Using information on the SGA and the number of bedrooms for each household, an FMR was assigned.

Utilizing the FMR, or some form of it, as an explanatory variable in an equation determining labor supply or earnings follows Keane and Moffitt (1998), Painter (2001), and Yelowitz (2000).[32] Since this dissertation does not seek to address issues associated with the selection into public housing, the fact that a public-housing unit is not available to every household is not relevant.[33] Further, since the focal parameter of this research is the effect of welfare benefits on earnings and not that associated with the housing program parameter, the FMR is used solely to account for differences in the budget

[31] Note, the FMR is technically a parameter in only the Section 8 program. Since in the public-housing program the government offers a certain unit at below-market price it is not pertinent.

[32] The latter two studies utilized the FMR, as well as other program parameters, to capture labor-supply effects of housing programs.

[33] There exists the potential for selection bias associated with both administrative selection on the part of the PHA and self-selection by the low-income household.

constraints of residents due to the vitality of the local housing market with regard to rental rates. The FMR depends not only on state of residence, but also on urban or rural location.

Almost 90 percent (663 individuals) of the entire sample resides in one of these 13 states. The means and definitions of the variables for this subsample are provided in Table 7. The largest proportion (12.8 percent) of respondents resided in Wisconsin. New York and Massachusetts were the second and third most represented states, with approximately 11 percent of the sample living in each. Only 3.6 percent of this sample lived in California. The average local unemployment rate and average FMR were 5.9 percent and $661, respectively. The distribution of the subsample by various demographic characteristics (age, race, education, health status, etc.) is almost identical to that of the sample as a whole. In addition, the percentage receiving welfare and the percentage working in 1996 were essentially the same. The annual earnings and welfare benefits were similar; however, the households in the subsample had $90 a year higher earnings and received $58 a year more benefits, on average.

Equations 4.3 and 4.6 were estimated for this subsample by two-stage Tobit ML, controlling for differences in state welfare programs in the reduced-form welfare-benefits equation (4.6) and for local conditions of the labor market and housing market in the annual earnings equation (4.3). The baseline single-equation Tobit ML estimates of the annual-earnings equation, assuming exogenous welfare participation or benefits, are reported in Table 8. The estimated coefficients on the welfare variables in both specifications (binary and censored) are statistically significant at the 1-percent level. Compared to public-housing residents who do not participate in the welfare program,

TABLE 7 — MEANS AND DEFINITIONS OF VARIABLES FOR RESPONDENTS RESIDING IN THE 13 OVERSAMPLED STATES

Variable	Means (N = 663)	Definition
Dependent		
Work participation	0.66	Equals 1 if total earnings > 0 in 1996
Earnings	$5441.49	Total earnings in 1996
Welfare participation	0.38	Equals 1 if individual received AFDC for at least one month in 1996
Welfare benefits	$1514.63	Amount of AFDC benefits in 1996
Independent		
High-school diploma	0.71	Equals 1 if individual possesses a high-school diploma
Family earnings	$883.56	Total earnings of other family members
Age	33.07	Age in years
Black	0.52	Equals 1 if individual is black
Poor or fair health	0.23	Equals 1 if health is poor or fair
Family members less than age 5	0.82	Number of family members less than 5 years old
Family members 5-17 years old	1.37	Number of family members between 5 and 17 years old
Alabama	0.076	Dummy indicating Alabama is state of residence
California	0.036	Dummy indicating California is state of residence
Colorado	0.066	Dummy indicating Colorado is state of residence
Florida	0.069	Dummy indicating Florida is state of residence
Massachusetts	0.110	Dummy indicating Massachusetts is state of residence
Michigan	0.049	Dummy indicating Michigan is state of residence
Minnesota	0.057	Dummy indicating Minnesota is state of residence
Mississippi	0.098	Dummy indicating Mississippi is state of residence
New Jersey	0.081	Dummy indicating New Jersey is state of residence
New York	0.111	Dummy indicating New York is state of residence
Texas	0.072	Dummy indicating Texas is state of residence
Washington	0.042	Dummy indicating Washington is state of residence
Wisconsin	0.128	Dummy indicating Wisconsin is state of residence
Unemployment rate	5.94	Unemployment rate in 1996 of county of residence
Fair market rent	$661	Section 8 fair market rent for area of residence
Other		
Weeks worked	24.62	Number of weeks worked in 1996
Hours worked	22.54	Number of hours per week worked in 1996
Hourly wage rate	$5.27	Derived hourly wage rate
Months on welfare	4.79	Number of months on AFDC in 1996

TABLE 8 — ANNUAL EARNINGS EQUATION WITH STATE AND LOCAL VARIABLES: EXOGENOUS WELFARE PARTICIPATION AND WELFARE BENEFITS

	(1)		(2)	
	Marginal effect	|t-statistic|	Marginal effect	|t-statistic|
Welfare	-4.758***	10.058	-1.248***	11.820
	(0.473)		(0.106)	
Age	0.269*	1.618	0.311**	1.915
	(0.166)		(0.162)	
Age squared	-0.003	1.242	-0.003*	1.564
	(0.002)		(0.002)	
Black	0.875*	1.915	0.684	1.535
	(0.457)		(0.446)	
High-school diploma	1.699***	0.498	1.860***	3.824
	(0.498)		(0.486)	
Number of children less than 5	-0.889***	3.141	-0.964***	3.476
	(0.283)		(0.277)	
Poor or fair health	-1.188**	2.203	-1.050**	1.988
	(0.539)		(0.528)	
Family earnings (in $1000's)	-0.168***	2.470	-0.162***	2.407
	(0.068)		(0.067)	
Midwest	1.409*	1.929	1.647**	2.292
	(0.730)		(0.719)	
South	-0.645	0.869	-0.993	1.368
	(0.743)		(0.726)	
West	0.720	0.982	0.832	1.149
	(0.733)		(0.724)	
Unemployment rate	-0.294***	3.218	-0.291***	3.247
	(0.091)		(0.089)	
FMR (in 1000's)	-0.165	0.107	0.695	0.460
	(1.541)		(1.511)	
Intercept	-0.439	0.136	-1.617	0.514
	(3.224)		(3.149)	
σ	7.673		7.472	
N	663		663	
Log of the likelihood function	-1677.57		-1656.97	

Notes: The dependent variable in (1) and (2) is annual earnings measured in $1000's. The welfare variable is a dichotomous variable in (1) and a left-censored continous variable in (2), measured in $1000's. Standard errors are shown in parentheses under the associated coefficient estimates. The equations were estimated by Tobit ML.

*** Significant at the 1-percent level, for the appropriate (one- or two-tailed) test.

** Significant at the 5-percent level, for the appropriate (one- or two-tailed) test.

* Significant at the 10-percent level, for the appropriate (one- or two-tailed) test.

those receiving welfare benefits have $4,758 less in yearly earnings on average (column 1). Similarly, the estimated coefficient on welfare in the second specification (column 2) indicates that a $1,000 increase in benefits received decreases annual earnings by $1,248 on average. Compared to the results from the estimated earnings equation that did not control for the unemployment rate or the FMR and assumed exogenous welfare benefits (Table 4, column 2), the negative effect of increased welfare benefits on earnings is slightly larger.

The number of children less than 5, poor or fair health, and greater family earnings all decrease earnings, whereas age and having a high school diploma increase labor income. Compared to those residing in the East Census region, public-housing residents in the Midwest earn more. Black women living in public housing earn about $900 more than observationally equivalent whites. The estimated coefficient on the unemployment rate is statistically significant and negative. Specifically, a one-percentage point increase in the local unemployment rate yields about a $290 decrease in annual earnings. The coefficient estimate associated with the FMR is not statistically significant in either naïve specifications.

Since state welfare programs differ in generosity with regard to (most importantly) the needs standards, twelve dummy variables are introduced as explanatory variables in the reduced-form welfare equation. The empirical results are shown in Table 9. Holding constant the number of children less than 5 years of age and the number of children between the ages of 5 and 17, women living in public housing in Alabama, Florida, Mississippi, New Jersey, and Texas receive fewer welfare benefits than those residing in

TABLE 9 — REDUCED-FORM WELFARE BENEFITS EQUATION (WITH STATE AND LOCAL VARIABLES)

	Coefficient	Marginal effect	|t-statistic|
Age	-0.980	-0.079	0.321
	(3.054)		
Age squared	0.002	0.001	0.954
	(0.002)		
Black	1.167***	0.457	2.561
	(0.456)		
High-school diploma	0.181	0.709	0.397
	(0.456)		
Number of children less than 5	0.798***	0.313	3.085
	(0.259)		
Number of children 5-17 years	0.710***	0.278	3.359
	(0.211)		
Poor or fair health	0.079	0.031	0.156
	(0.506)		
Family earnings (in $1000's)	-0.054	-0.021	0.962
	(0.056)		
Alabama	-4.058***	-1.589	3.842
	(1.056)		
California	2.500**	0.979	2.082
	(1.201)		
Colorado	-0.667	-0.261	0.719
	(0.928)		
Florida	-2.354**	-0.922	2.454
	(0.960)		
Massachusetts	1.577*	0.618	1.874
	(0.841)		
Michigan	-1.437	-0.563	1.382
	(1.040)		
Minnesota	1.709**	0.669	1.819
	(0.940)		
Mississippi	-5.204***	-2.038	4.899
	(1.062)		
New Jersey	-2.645**	-1.036	2.491
	(1.062)		
New York	2.743***	-1.074	2.588
	(1.060)		
Texas	-2.428**	-0.951	2.444
	(0.993)		
Washington	2.117*	0.829	1.965
	(1.077)		
Unemployment rate	0.173*	0.068	1.789
	(0.097)		
FMR (in 1000's)	3.056*	1.120	1.827
	(1.672)		
Intercept	-0.980	-0.384	0.321
	(3.054)		

TABLE 9 (continued) — REDUCED-FORM WELFARE BENEFITS EQUATION (WITH STATE AND LOCAL VARIABLES)

σ	4.242
N	663
Log of the likelihood function	-941.54

Notes: The dependent variable is annual welfare benefits in $1000's. Standard errors are shown in parentheses under the associated coefficient estimates. The equation was estimated by Tobit ML.
[***]Significant at the 1-percent level.
[**] Significant at the 5-percent level.
[*] Significant at the 10-percent level.

Wisconsin, the omitted state, whereas California, Massachusetts, Minnesota, New York, and Washington public-housing residents receive greater benefits. Black women annually receive $1,167 more in welfare benefits than observationally equivalent whites. The FMR is positive and statistically significant at the 10-percent level. A $1,000 increase in the FMR increases the amount of welfare benefits received by $1,120.

The predicted value of welfare benefits was used as an explanatory variable in the second-stage annual earnings equation, along with the local unemployment rate and the FMR (Table 10). The qualitative conclusions regarding the effects of the explanatory variables are the same as the results from estimating the specification that assumed exogenous benefits. That is, an increase in the number of children less than 5, having poor or fair health, a higher unemployment rate, and greater family earnings decrease earnings, whereas increased age and having a high school diploma increase labor income. There was no difference, however, in region of residence of public-housing residents in this specification. There was also no difference in annual earnings between black and white women living in public housing.

This specification, which controlled for the unemployment rate and the FMR in the equation determining earnings also predicted a negative effect on labor earnings of increased welfare benefits. In particular, a $1,000 increase in welfare benefits received decreases earnings by about $349 (Table 10). Compared to the exogenous specification (Table 8) this negative effect is about $900 smaller. The findings presented in Table 6 and Table 10 imply that the work disincentives of welfare-program benefits for public-housing residents is overstated when differences in the local economy (the labor market

TABLE 10 — ANNUAL EARNINGS EQUATION: ENDOGENOUS WELFARE BENEFITS (WITH STATE AND LOCAL VARIABLES)

	Coefficient	Marginal effect	|t-statistic|
$\hat{y}_{i1}^{*} = \hat{\boldsymbol{\delta}}'\mathbf{z}_i$	-0.532**	-0.349	2.035
	(0.261)		
Age	0.458*	0.300	1.489
	(0.308)		
Age squared	-0.005	-0.003	1.161
	(0.002)		
Black	1.093	0.717	1.268
	(0.862)		
High-school diploma	2.735***	1.792	2.961
	(0.924)		
Number of children less than 5	-1.424***	-0.933	2.782
	(0.512)		
Poor or fair health	-1.632*	-1.069	1.562
	(1.044)		
Family earnings (in $1000's)	-0.236**	-0.155	1.923
	(0.123)		
Midwest region	2.135	1.400	1.604
	(1.331)		
South region	-1.390	-0.911	0.872
	(1.593)		
West region	0.943	0.618	0.734
	(1.285)		
Unemployment rate	-0.442**	-0.290	2.388
	(0.185)		
FMR (in 1000's)	-0.381	-0.250	0.118
	(3.227)		
Intercept	-4.777	-3.131	0.867
	(5.510)		
σ	8.326		
N	663		
Log of the likelihood function	-1723.97		

Notes: The dependent variable is annual earnings in $1000's. The standard errors are shown in parentheses under the associated coefficients and have been corrected following Murphy and Topel (1985). The equation was estimated by Tobit ML.

*** Significant at the 1-percent level, for the appropriate (one- or two-tailed) test.

** Significant at the 5-percent level, for the appropriate (one- or two-tailed) test.

* Significant at the 10-percent level, for the appropriate (one- or two-tailed) test.

and the housing market) are not taken into account.[34] The reduced form welfare-benefits equation was also estimated without controlling for state program differences. When this predicted effect was used as the instrumental variable in the earnings equation the welfare variable was still statistically significant and negative, but the magnitude of the marginal effect was larger.

D. *Bivariate Probit Sample-Selection Model*

Endogenous censored regressors and sample-selection bias are frequently encountered in econometric models utilizing micro data, and they are generated by the same underlying mechanism [Heckman (1976)]. While the previous section employed a limited-dependent variable, simultaneous-equation framework, the problem is analyzed in this section as one of estimation from nonrandom samples. This approach originated with Heckman (1974, 1976, 1979), and follows Fraker and Moffitt (1988), Moffitt and Wolfe (1990), and Keane and Moffitt (1998) by examining the effects of multiple-program participation.[35]

The purpose of this section is to analyze the effect of increased welfare benefits on earnings for those individuals who are both receiving welfare and working. Since only the mean of the positive observations is of concern, the procedure will yield an estimate of the effect of increased welfare benefits on the expected labor-market earnings, given that the observation is positive. This approach must still account for the qualitative effect of whether or not a woman participates in welfare and the decision to enter the labor

[34] Note that the findings in Table 6 utilized the full sample, whereas the results shown in Table 10 were obtained from the subsample residing in the 13 oversampled states.

[35] Heckman (2001) provides an overview of the broad discipline often called "microeconometrics," where issues confronted in estimation of micro data, especially unobserved heterogeneity, are discussed.

market to yield consistent estimates. The estimates would otherwise suffer from sample-selection bias since the joint probability of observing positive welfare benefits and positive earnings involves nonrandom choices of the individuals. Given the individual chooses to participate in the welfare program the magnitude of the benefits received is assumed exogenous.

Because both the earnings and welfare variables are censored as a result of underlying work- and welfare-participation decisions, respectively, a selectivity model of earnings is an alternative framework for estimating consistently the effects of these endogenous variables. This approach allows one to model the actual process that generates positive values for earnings and benefits, and permits the parameters that determine the probability of a limit observation and those that determine the density of the positive, non-limit observations to be different. Since the unobserved characteristics that affect these decisions are likely to be correlated, the selection mechanism is estimated with a bivariate probit model of welfare and work participation, and yields full-information, maximum likelihood (FIML) estimates of the parameters determining the joint decision, assuming the model is correctly specified. Estimates from this first-stage are subsequently used to augment the earnings equation of interest.

Consider the following selectivity model of earnings

$$y_{i2} = \mathbf{x}_i'\boldsymbol{\beta} + y_{i1}\gamma + e_i \tag{6.11}$$

$$d_{i2}^* = \boldsymbol{\alpha}_2'\mathbf{v}_{i2} + u_{i2} \tag{6.12}$$

$$d_{i1}^* = \boldsymbol{\alpha}_1'\mathbf{v}_{i1} + u_{i1} \tag{6.13}$$

where the labor-force participation variable is $d_{i2} = 1$ if $d_{i2}^* > 0$, and 0 otherwise, the variable describing welfare-program participation is $d_{i1} = 1$ if $d_{i1}^* > 0$, and 0 otherwise; e, u_2, and u_1 have a trivariate normal distribution with variances σ^2, 1, and 1, respectively, and correlations $\rho_{12} = corr(u_1, u_2)$, $\rho_{2e} = corr(u_2, e)$, and $\rho_{1e} = corr(u_1, e)$; $\mathbf{v}_2$ and $\mathbf{v}_1$ are vectors of exogenous variables determining d_2^* and d_1^*, respectively and $\boldsymbol{\alpha}_2$ and $\boldsymbol{\alpha}_1$ are the parameter vectors associated with these variables. This procedure estimates ρ_{12} in isolation. The scalar parameter γ is the coefficient on welfare benefits. The augmented earnings regression is

$$y_{i2} = \mathbf{x}_i'\boldsymbol{\beta} + y_{i1}\gamma + \lambda_{i1}\beta_{\lambda 1} + \lambda_{i2}\beta_{\lambda 2} + \eta, \tag{6.14}$$

where η satisfies the assumptions for classical regression analysis. $\beta_{\lambda 2} = \rho_{12}\sigma_{2e}$ and $\beta_{\lambda 1} = \rho_{12}\sigma_{1e}$ are the parameters associated with the selectivity variables

$$\lambda_2 = \phi(-\boldsymbol{\alpha}_2'\mathbf{v}_2)\Phi\left[(-\boldsymbol{\alpha}_2'\mathbf{v}_2 - \rho_{12}\mathbf{v}_2)/(1-\rho_{12}^2)^{1/2}\right]/\Phi_2 \text{ and} \tag{6.15}$$

$$\lambda_1 = \phi(-\boldsymbol{\alpha}_1'\mathbf{v}_1)\Phi\left[(-\boldsymbol{\alpha}_1'\mathbf{v}_1 - \rho_{12}\mathbf{v}_1)/(1-\rho_{12}^2)^{1/2}\right]/\Phi_2, \tag{6.16}$$

respectively. The asymptotic covariance matrix is corrected for selection.

Table 11 presents the means and definitions of the variables used for the subsample of women who both work and receive welfare. Compared to the entire sample (Table 3), those who work and receive welfare have slightly lower earnings and receive more than twice the amount of welfare. This subsample is more likely to be black and less likely to be in poor health. The average age of those working and receiving welfare is approximately a year and a half lower than the mean for the whole sample.

TABLE 11 — MEANS AND DEFINITIONS OF VARIABLES FOR THE SAMPLE THAT WORKS AND RECEIVES WELFARE

Variable	Means (N = 136)	Definition
Dependent		
LF participation	1.00	Equals 1 if total earnings > 0 in 1996
Earnings	$5138.16	Total earnings in 1996
Welfare participation	1.00	Equals 1 if individual received AFDC for at least one month in 1996
Amount of welfare	$3146.30	AFDC benefits in 1996
Independent		
High-school diploma	0.76	Equals 1 if individual possesses at least a high-school diploma
Family earnings	$531.82	Total earnings of other family members
Age	31.62	Age in years
Black	0.63	Equals 1 if individual is black
Poor or fair health	0.17	Equals 1 if health is poor or fair
Family members less than age 5	0.93	Number of family members less than age 5
Family members 5-17 years old	1.37	Number of family members between 5 and 17 years old
Midwest	0.34	Equals 1 if current residence in Midwest
South	0.26	Equals 1 if current residence in South
West	0.18	Equals 1 if current residence in West
Tenure	2.44	Number of months on current job
Other		
Weeks worked	26.54	Number of weeks worked in 1996
Hours worked	31.55	Number of hours per week worked in 1996
Hourly wage rate	8.75	Derived hourly wage rate
Months on welfare	8.99	Number of months on AFDC in 1996

The selection mechanism determining the joint decisions of work and welfare are presented in Table 12. In general, the qualitative results are as anticipated. Graduation from high school increases the probability that a women in public housing works, whereas poor health has a negative effect. The number of children less than 5 has both a positive effect on welfare participation and a negative effect on the probability of working. An increase in the number of children between the ages of 5 and 17 residing in the household also increases the likelihood that a women in the sample will be on the welfare roll. The results indicate that, all other things constant, black women are more likely to work than whites. As indicated by the sign and statistical significance of ρ_{12}, the equation error terms are negatively correlated. That is, unobserved individual characteristics that increase the probability of working also decrease the probability of receiving welfare.

The earnings equation (6.14) was estimated by ordinary least squares including the selectivity variables (6.15 and 6.16) as explanatory variables. The results are presented in Table 13. The estimated marginal effects of the regressors on earnings consist of two components: a direct effect on mean earnings and; and an indirect effect, for those explanatory variables that affect the probability of selection, by their influence on earnings through the two selectivity variables. The selectivity-corrected earnings regression takes into account these 'omitted variables' that affect welfare participation and work. The statistical significance of λ_1, the welfare selectivity variable, in the earnings equation indicates that self-selection into the welfare program is present. The model predicts that, for women in public housing who work and receive welfare, a $1,000 increase in benefits decreases expected earnings by $816. The magnitude of the

TABLE 12 — WORK AND WELFARE PARTICIPATION

	Work		Welfare	
	Coefficient	|t-statistic|	Coefficient	|t-statistic|
Race	0.228**	2.336	0.008	0.078
	(0.010)		(0.963)	
High-school diploma	0.506***	4.989		
	(0.102)			
Number of children less than 5	-0.225***	4.096	0.223***	3.950
	(0.055)		(0.056)	
Number of children 5-17			0.087**	2.147
			(0.401)	
Poor or fair health	-0.260**	2.299		
	(0.113)			
Intercept	0.180	1.555	-0.633***	5.973
	(0.116)		(0.106)	
ρ_{12}	-0.403***	7.386		
	(0.545)			
N	745			
Log of the likelihood function	-914.06			

Notes: Standard errors are shown in parentheses under the associated coefficient estimates. The model was estimated by bivariate probit ML.

*** Significant at the 1-percent level.

** Significant at the 5-percent level.

* Significant at the 10-percent level.

TABLE 13 — ANNUAL EARNINGS EQUATION: BIVARIATE WORK AND WELFARE PARTICIPATION SAMPLE-SELECTION MECHANISM

	Coefficient	|t-statistic|
Welfare benefits (in $1000's)	-0.816***	3.486
	(0.234)	
Age	-0.476	1.201
	(0.396)	
Age squared	0.010	1.628
	(0.006)	
Black	0.203	0.165
	(1.227)	
High-school diploma	1.191	0.610
	(1.951)	
Tenure	0.129	0.990
	(0.130)	
Family earnings (in $1000's)	-0.031	0.218
	(0.142)	
Midwest region	0.015	0.013
	(1.139)	
South region	-4.361***	3.394
	(1.285)	
West region	-0.944	0.728
	(1.296)	
Intercept	18.923	1.544
	(12.256)	
λ_2	5.315	1.289
	(4.123)	
λ_1	-8.788**	2.228
	(3.945)	
N	136	
Log of the likelihood function	-387.950	

Notes: Standard errors are shown in parentheses under the coefficient estimates. The equation was estimated by OLS.

*** Significant at the 1-percent level, for the appropriate (one- or two-tailed) test.

** Significant at the 5-percent level, for the appropriate (one- or two-tailed) test.

* Significant at the 10-percent level, for the appropriate (one- or two-tailed) test.

welfare effect on earnings is slightly greater in absolute terms than was obtained using the Tobit two-stage model.

Chapter VII: Conclusions

The primary question this dissertation sought to answer is "How much of the decreased welfare assistance of welfare eligible individuals living in public housing is likely to be replaced by increased earned income through higher labor supply?" To address this question, a theoretical model of the labor-supply problem facing a woman living in public housing, who may or may not be eligible for welfare, was presented within a utility maximization context. Since welfare-eligible women may not choose to receive welfare benefits, because of the stigma of doing so perhaps, the model incorporates the welfare-program-participation choice. The resulting empirical model is a two-equation system determining labor earnings and welfare benefits. This system is estimated in a simultaneous-equations, limited-dependent variable framework, where both earnings and benefits are treated as endogenous censored variables.

Using a sample of public-housing residents from the 1997 wave of the NSAF, an annual earnings equation is estimated by two-stage Tobit. The predicted value from a Tobit regression determining welfare benefits is used as a regressor in the earnings equation, and the standard errors are corrected accordingly. In addition, the model is estimated within a self-selection framework. A bivariate probit selection model jointly determining work and welfare participation is used to correct the annual earnings equation for selection bias. Since the selection mechanisms are estimated jointly, this procedure allows for correlation of the error terms capturing unobserved characteristics that affect participation in the welfare program and in the labor market.

Table 14 presents a summary of the point estimates of the effect of increased welfare benefits on the labor earnings of public-housing residents. In general, all specifications imply that welfare-program benefits reduce the labor earnings of women living in public housing. Overall, the endogenous specifications of welfare benefits suggest that between 35 and 75 percent of any decrease in cash assistance for welfare-eligible individuals living in public housing would be replaced by increased earned income through higher labor supply.

TABLE 14 — SUMMARY OF RESULTS: MARGINAL EFFECT OF WELFARE BENEFITS ON EARNINGS

Table	Estimation method	Sample size and Controls	Marginal effect
Table 4	Tobit, exogenous welfare benefits	N=745 Control variables[1]	-1.222
Table 6	Tobit , endogenous welfare benefits	N=745 Control variables	-0.756
Table D.2	Tobit , endogenous welfare benefits, controlling for opinion about welfare	N=745 Control variables, opinion about welfare	-0.767
Table 8	Tobit, exogenous welfare benefits	N=663 Control variables, unemployment rate, FMR	-1.248
Table 10	Tobit, endogenous welfare benefits, including state dummies	N=663 Control variables, unemployment rate, FMR	-0.349
Table 13	OLS; bivariate sample selection for work and welfare	N=136 Control variables (without number of children less than 5 and health), tenure	-0.816

[1] The control variables included in all earnings equations are: age, age squared, black, high-school diploma, number of children less than 5, poor or fair health, family earnings, and regional dummies.

The welfare coefficient in the baseline regression, assuming exogenous welfare benefits, indicates that a $1,000 increase in benefits received decreases annual earnings by $1,222 on average (Table 4). Taking into account welfare endogeneity, a $1000 increase in welfare income yields a decrease in annual earnings of only $756 (Table 6).

The standard errors in this model were corrected for the sampling error introduced by use of a predicted value as an explanatory variable in the earnings equation. These results indicate that ignoring the endogeneity of welfare-program participation overstates the disincentives of program benefits on earnings of public-housing residents.

Using a subsample of the data consisting of those respondents living in the thirteen oversampled states, I reestimated the earnings equation by two-stage Tobit ML. This specification allowed me to control for differences in the local labor market and the housing market by including the unemployment rate and the FMR as explanatory variables in the equation determining earnings. The predicted effect of welfare benefits on labor earnings was again negative; in particular, a $1,000 increase in welfare benefits received decreases earnings by about $349 (Table 10). This estimated effect is roughly $400 smaller in magnitude than the estimated effect found from the endogenous specification utilizing the full sample without these controls (Table 6). Specifically, taking into account welfare endogeneity, a $1000 increase in welfare income yields a decrease in annual earnings of only $756. These results imply that the work disincentives of welfare-program benefits for public-housing residents are exaggerated when differences in the local economy (both labor and housing markets) are not taken into account.

The earnings equation, augmented by the bivariate probit sample-selection mechanism, indicates that, for women in public housing who work and receive welfare, a $1,000 increase in benefits decreases expected earnings by $816 (Table 13). The negative (and statistically significant) estimated correlation coefficient in the selection mechanism determining jointly the probabilities of receiving welfare and working

provides evidence of a negative correlation between welfare-program participation and earned income (Table 12). This shows that the unobserved characteristics of public-housing residents that positively affect labor supply also reduce welfare benefits and is consistent with the theory that women with a high work ethic also have a high distaste for welfare.

Of secondary interest are the federal budgetary implications of the effect of increased welfare benefits on the earnings of public-housing residents. The PHA's and, subsequently HUD would experience no change in their budget outlays if labor earnings replaced exactly 100 percent of a decrease in welfare benefits. The exogenous specifications indicate that increased labor earnings would replace between 100 and 120 percent of any decrease in welfare benefits, implying either no change or an increase in the overall income of public-housing residents. If the latter came to pass, the PHA would require less operating expenses from HUD due to increased rental income. These results indicate that, for households living in public housing who are also eligible for welfare, a policy that decreases welfare benefits would benefit both HHS and HUD through decreased budgetary outlays for cash assistance and decreased PHA operating subsidies, respectively. Taking into account the endogeneity of welfare benefits (and program self-selection), however, only approximately 35 to 75 percent of a reduction in welfare benefits would be replaced by an increase in labor-market earnings. In this instance, the overall income of public-housing residents would decline. With a decrease in its revenue through lower tenant rental payments, the PHA's would require a larger subsidy from HUD to cover operating expenses. This scenario implies that HUD would absorb

roughly 25 to 65 percent of the decrease in the outlay of HHS due to the decrease in public-housing residents' welfare benefits.

Future research in this area includes analyzing the effect of welfare benefits on the labor earnings of a sample of both public-housing residents and Section 8 participants to assess whether these two groups of assisted households exhibit different labor-supply responses to a change in welfare benefits. If so, HUD may be able to reallocate its program resources to mitigate the budgetary effect of decreases in cash assistance received by its subsidy recipients. Taking into account the housing-participation choice would also be desirable since it may be correlated with the welfare and work participation choices. This would require waiting list data from PHA's and other Section 8 voucher administrators, however, since housing subsidies are not entitlements. Further, correctly measuring the value of the in-kind housing subsidy to public-housing residents is especially problematic. The customary methodology is to use the FMR as an explanatory variable in the earnings equation as I did here, but this is technically only a parameter in the Section 8 program. Including poverty and crime rates as explanatory variables in the welfare-benefits and earnings equations to control for neighborhood effects would also enhance the analysis of the effect of welfare-program benefits on the labor earnings of public-housing residents.

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Appendices

Appendix A. *Comparison of the AFDC and TANF Programs*

TABLE A.1 — AFDC AND TANF PROGRAM RULES

Item	AFDC	TANF
Financing	Matching grant	Block grant
Eligibility	Children deprived of support of one parent or children in low-income two-parent families (AFDC-UP)	Children in low-income families as designated by state; AFDC-UP abolished. Minor mothers must live with parents and also attend school
Immigrants	Illegal aliens ineligible	Aliens ineligible for five years after entry and longer at state option
Form of Aid	Almost exclusively cash payment	States free to use funds for services and non-cash benefits
Benefit Levels	At state option	At state option
Entitlement Status	Federal government required to pay matched share of all recipients	No individual entitlement
Income Limits	Family income cannot exceed gross income limits	No provision
Asset Limits	Federal limits	No provision
Treatment of Earnings disregard	After 4 months of work, only a lump sum $90 deduction plus child care expenses; and nothing after 12 months	No provision
Time Limits	None	Federal funds cannot be used for payments to adults for more than 60 months lifetime (20 percent of caseload exempt)
JOBS Program	States must offer a program that meets federal law	JOBS program abolished
Work Requirements	Parents without a child under 3 required to participate in JOBS	Exemptions from work requirements are narrowed and types of qualified activities are narrowed and prespecified (generally excludes education and classroom training) and must be 20 hours/week rising to 30 hours/week for single mothers
Work Requirement Participation Requirements	JOBS participation requirements	Participation for work requirements rise to 50% by FY 2002
Child Care	Guaranteed for all JOBS participants	No guarantee but states are given increased child care funds
Sanctions	General provisions	Specific provisions mandating sanctions for failure to comply with work requirements, child support enforcement, schooling attendance, an other activities

TABLE A.1 (continued) — AFDC AND TANF PROGRAM RULES

Child Support	States required to allow first $50 of child support received by mother to not reduce benefit	No provision

Source: Burke (1996), Table 2: Moffitt (2000)

Appendix B. *The Public Housing Program*

Enabled by the Housing Act of 1937, the Public Housing Program was the first national program to provide housing subsidies for low-income families and individuals in the United States. The purpose of this program is to provide "decent, safe, and sanitary dwellings" for low-income families, the elderly, and persons with disabilities. Public-housing projects are multi-family rental units owned and operated by local Public Housing Authorities (PHA's). For non-elderly, non-disabled households, eligibility is limited to those households classified as "low-income." Local PHA's determine eligibility based on localities' income limits developed by the U.S. Department of Housing and Urban Development (HUD). In general, the income limit for a family of four is 80 percent of the median income of all area families. Adjustments are made to this income limit to account for differences in household size.

According to HUD (1998), in 1997 approximately 1.3 million households lived in almost 14,000 public-housing projects. Families with children less than 18 years of age occupied nearly one-half (45 percent) of all units, and the remaining units were occupied by elderly and disabled households. Eighteen percent of all public-housing households received more than one-half of their income from welfare. The average income of households residing in public housing was $8,900.

Appendix C. *Annual Earnings Equation: Endogenous Welfare Participation*

Table C.2 presents the results of estimating the effect of welfare participation (0/1) on the labor earnings of women residing in public housing, taking into account the endogeneity of the decision to participate. The reduced-form auxiliary equation is estimated by Probit maximum likelihood, and the results are presented Table C.1. Specifically, the model is

$$y_{i1}^{*} = \boldsymbol{\delta}'\mathbf{z}_i + e_{i1} \tag{C.1}$$

where $e_{i1} \sim N[0,1]$. Only the sign of the latent dependent variable is observed; $y_{i1} = 1$ if $y_{i1}^{*} > 0$, and $y_{i1} = 0$ otherwise. The log-likelihood function and its derivatives for the Probit model are:

$$\ln L_1 = \sum_{y_{i1}=0} \ln\left[1 - \Phi\left(\boldsymbol{\delta}'\mathbf{z}_i\right)\right] + \sum_{y_{i1}=1} \ln \Phi\left(\boldsymbol{\delta}'\mathbf{z}_i\right) \text{ and} \tag{C.2}$$

$$\frac{\partial \log L_1}{\partial \boldsymbol{\delta}} = \sum_{y_{i1}=0} -\frac{\phi\left(\boldsymbol{\delta}'\mathbf{z}_i\right)}{1 - \Phi\left(\boldsymbol{\delta}'\mathbf{z}_i\right)}\mathbf{z}_i + \sum_{y_{i1}=1} \frac{\phi\left(\boldsymbol{\delta}'\mathbf{z}_i\right)}{\Phi\left(\boldsymbol{\delta}'\mathbf{z}_i\right)}\mathbf{z}_i \,. \tag{C.3}$$

The predicted probability of receiving welfare, $\hat{y}_{i1}^{*} = \Phi\left(\hat{\boldsymbol{\delta}}'\mathbf{z}_i\right)$, is used as a regressor in the second-stage earnings equation. The empirical results are given in Table C.2. The system is identified by omitting the number of children in the age range of 5 to 17 years old from the earnings equation and omitting age squared from the welfare-participation equation. The log-likelihood function and its derivatives for the Tobit model are:

$$\ln L_2 = \sum_{y_{i2}>0} -\frac{1}{2}\left[\ln(2\pi) + \ln\sigma^2 + \frac{(y_{i2} - \boldsymbol{\beta}'\mathbf{x}_i^{*})^2}{\sigma^2}\right] + \sum_{y_{i2}=0} \ln\left[1 - \Phi\left(\boldsymbol{\beta}'\mathbf{x}_i^{*} \big/ \sigma\right)\right] \tag{C.4}$$

$$\frac{\partial \log L_2}{\partial \boldsymbol{\beta}} = \frac{1}{\sigma^2} \sum_{y_{i2}>0} \left(y_{i2} - \boldsymbol{\beta}' \mathbf{x}_i^* \right) \mathbf{x}_i^* - \sum_{y_{i2}=0} \frac{\mathbf{x}_i^*}{\sigma} \frac{\phi\left(\boldsymbol{\beta}' \mathbf{x}_i^* / \sigma \right)}{1 - \Phi\left(\boldsymbol{\beta}' \mathbf{x}_i^* / \sigma \right)} \tag{C.5}$$

$$\frac{\partial \log L_2}{\partial \boldsymbol{\delta}} = \frac{1}{\sigma^2} \sum_{y_{i2}>0} \left(y_{i2} - \boldsymbol{\beta}' \mathbf{x}_i^* \right) \boldsymbol{\beta}_2 \phi\left(\hat{\boldsymbol{\delta}}' \mathbf{z}_i \right) - \sum_{y_{i2}=0} \frac{\boldsymbol{\beta}_2 \phi\left(\hat{\boldsymbol{\delta}}' \mathbf{z}_i \right)}{\sigma} \frac{\phi\left(\boldsymbol{\beta}' \mathbf{x}_i^* / \sigma \right)}{1 - \Phi\left(\boldsymbol{\beta}' \mathbf{x}_i^* / \sigma \right)}. \tag{C.6}$$

When welfare participation is modeled endogenously, the estimated coefficient and marginal effect on earnings of an increase in the predicted probability of receiving welfare are negative and statistically significant. That is, an increase in the probability of participating in welfare has a depressing effect on labor earnings. Possessing a high-school diploma has a positive and statistically significant effect on earnings at the 1-percent level, whereas greater family earnings has a negative effect on earnings at the same level. Being in poor or fair health negatively affects earnings (1-percent significance level). Black females earn more than observationally equivalent whites. Age and the number of children less than 5 do not affect annual earnings. Compared to the East, living in the Midwest has an independent positive effect on earnings.

TABLE C.1 — REDUCED-FORM WELFARE-PARTICIPATION EQUATION

	Coefficient	Marginal effect	|t-statistic|
Age	-0.049	-0.018	1.240
	(0.039)		
Age squared	0.001	0.000	1.039
	(0.001)		
Black	0.124	0.047	1.212
	(0.103)		
High-school diploma	0.039	0.015	0.358
	(0.110)		
Number of children less than 5	0.220***	0.083	3.535
	(0.062)		
Number of children 5-17 years	0.166***	0.062	3.484
	(0.048)		
Midwest region	-0.014	-0.005	0.104
	(0.132)		
South region	-0.492***	-0.185	3.898
	(0.126)		
West region	0.324**	0.122	2.101
	(0.154)		
Health status	0.008	0.003	0.070
	(0.120)		
Family earnings (in $1000's)	-0.023*	-0.009	1.710
	(0.014)		
Intercept	0.261	0.098	0.372
	(0.700)		
N	745		
Log of the likelihood function	-464.04		

Notes: The dependent is a dummy variable for welfare participation. Standard errors are shown in parentheses under the associated coefficient estimates. The equation was estimated by Probit ML.

*** Significant at the 1-percent level

** Significant at the 5-percent level.

* Significant at the 10-percent level.

TABLE C.2 — ANNUAL EARNINGS EQUATION: ENDOGENOUS WELFARE PARTICIPATION

	Coefficient	Marginal effect	|t-statistic|
$\Phi(\hat{\boldsymbol{\delta}}'\mathbf{z})$	-17.162**	-11.120	1.991
	(8.618)		
Age	0.431	0.279	1.196
	(0.360)		
Age squared	-0.005	-0.003	0.983
	(0.005)		
Black	2.125**	1.377	2.354
	(0.902)		
High-school diploma	3.144***	2.037	3.516
	(0.894)		
Number of children less than 5	-0.700	-0.451	0.873
	(0.800)		
Poor or fair health	-1.903**	-1.233	1.973
	(0.964)		
Family earnings	-0.301***	-0.200	2.450
(in $1000's)	(0.123)		
Midwest region	2.982***	1.932	2.727
	(1.093)		
South region	-2.172	-1.407	1.284
	(1.691)		
West region	2.588	1.677	1.579
	(1.639)		
Intercept	-1.167	-0.756	0.155
	(7.528)		
σ	8.365		
N	745		
Log of the likelihood function			

Notes: The dependent variable is annual earnings in $1000's. The standard errors are shown in parentheses under the associated coefficients and have been corrected following Murphy and Topel (1985). The equation was estimated by Tobit ML.

*** Significant at the 1-percent level, for the appropriate (one- or two-tailed) test.

** Significant at the 5-percent level, for the appropriate (one- or two-tailed) test.

* Significant at the 10-percent level, for the appropriate (one- or two-tailed) test.

Appendix D. *Welfare Stigma Proxy*

TABLE D.1 — REDUCED-FORM WELFARE-BENEFITS EQUATION (WITH WELFARE STIGMA PROXY)

	Coefficient	Marginal effect	|t-statistic|
Distaste for welfare	0.064	0.025	0.152
	(0.418)		
Age	-0.195	-0.075	1.195
	(0.163)		
Age squared	0.002	0.001	0.964
	(0.002)		
Black	0.289	0.111	0.682
	(0.424)		
High-school diploma	0.324	0.125	0.707
	(0.458)		
Number of children less than 5	0.950***	0.366	3.709
	(0.256)		
Number of children 5-17 years	0.940***	0.363	4.892
	(0.192)		
Poor or fair health	0.218	0.084	0.440
	(0.496)		
Family earnings (in $1000's)	-0.078	-0.030	1.373
	(0.057)		
Midwest region	-0.766	-0.030	0.142
	(0.538)		
South region	-3.054***	-1.178	5.654
	(0.540)		
West region	1.338**	0.516	2.171
	(0.616)		
Intercept	0.997	0.384	0.339
	(2.937)		
σ	4.568		
N	745		
Log of the Likelihood function	-1075.10		

Notes: The dependent variable is annual welfare benefits measured in $1000's. Standard errors are in parentheses under the associated coefficient estimates. The equation was estimated by Tobit ML.

*** Significant at the 1-percent level.

** Significant at the 5-percent level.

* Significant at the 10-percent level.

TABLE D.2 — ANNUAL EARNINGS EQUATION: ENDOGENOUS WELFARE BENEFITS (WITH WELFARE STIGMA PROXY)

	Coefficient	Marginal effect	|t-statistic|
$\hat{y}_{i1}^{*} = \hat{\boldsymbol{\delta}}'\mathbf{z}_i$	-1.184***	-0.767	2.819
	(0.420)		
Distaste for welfare	1.232	0.798	1.224
	(1.006)		
Age	0.538	0.348	1.000
	(0.538)		
Age squared	-0.006	-0.004	0.792
	(0.008)		
Black	1.772	1.148	1.639
	(1.081)		
High-school diploma	3.306***	2.143	2.808
	(1.177)		
Number of children less than 5	-0.950*	-0.615	1.594
	(0.596)		
Poor or fair health	-1.603	-1.039	1.257
	(1.274)		
Family earnings (in $1000's)	-0.267*	-0.173	1.439
	(0.185)		
Midwest region	2.943***	1.908	2.635
	(1.117)		
South region	-2.992	-1.939	1.506
	(1.987)		
West region	2.065*	1.338	1.721
	(1.200)		
Intercept	-11.346	-7.354	1.258
	(9.017)		
σ	8.345		
N	745		
Log of the likelihood function	-1917.21		

Notes: The dependent variable is annual earnings in $1000's. The standard errors are shown in parentheses under the associated coefficients and have been corrected following Murphy and Topel (1985). The equation was estimated by Tobit ML.

*** Significant at the 1-percent level, for the appropriate (one- or two-tailed) test.

** Significant at the 5-percent level, for the appropriate (one- or two-tailed) test.

* Significant at the 10-percent level, for the appropriate (one- or two-tailed) test.

Appendix E. *The Logical-Consistency Condition*

To demonstrate the logical-consistency or "coherency" problem inherent in models that involve the censored versions of latent endogenous variables as explanatory variables, consider the following two-equation model

$$y_1^* = \gamma_1 y_2 + \boldsymbol{\beta}_1' \mathbf{X} + \varepsilon_1 \tag{E.1}$$

$$y_2 = \gamma_2 y_1 + \boldsymbol{\beta}_2' \mathbf{X} + \varepsilon_2, \tag{E.2}$$

where $y_1 = y_1^*$ if $y_1^* > 0$ and $y_1 = 0$ if $y_1^* \leq 0$, $\mathbf{X}$ is a vector of exogenous variables, and ε_1 and ε_2 are disturbances. This is a simultaneous-equations model determining one censored variable (y_1^*) and one variable that is continuously observed (y_2). The observed counterpart of the censored variable (y_1) is also an explanatory variable determining the continuously observed endogenous variable. It is this specification that causes the coherency problem. If y_2 were also a censored variable, the presence of the observed, censored version of y_2 in equation E.1 would raise the same issues. If the unobserved, latent version of y_2, y_2^*, were on the right-hand side of equation E.2, there would be no coherency problem to address.

Using the subscript *t* to index observations, for *t* such that $y_{1t}^* > 0$, $y_{1t} = y_{1t}^*$ the reduced form for y_{1t}^* or y_{1t} is

$$y_{1t}^* = \frac{1}{1-\gamma_1\gamma_2}\left[\left(\boldsymbol{\beta}_1 + \gamma_1\boldsymbol{\beta}_2\right)' \mathbf{X}_t + \left(\varepsilon_{1t} + \gamma_1\varepsilon_{2t}\right)\right] \tag{E.3}$$

and for *t* such that $y_{1t}^* \leq 0$, $y_{1t} = 0$, the reduced form for y_{1t}^* is

$$y_{1t}^* = \left[\left(\boldsymbol{\beta}_1 + \gamma_1\boldsymbol{\beta}_2\right)' \mathbf{X}_t + \left(\varepsilon_{1t} + \gamma_1\varepsilon_{2t}\right)\right]. \tag{E.4}$$

To ensure that, for any $\mathbf{X}$, ε_1, and ε_2, the model yields one and only one y_{1t}, and is, therefore, internally consistent, it is required that $1-\gamma_1\gamma_2 > 0$.

To clarify the necessity of this condition, assume that the opposite, $1-\gamma_1\gamma_2 < 0$, is true and examine the reduced forms of the dependent variables. If the right-hand side of E.4 is positive, the right-hand side of E.3 is negative, which implies two solutions for y_{1t}^*, but none for y_{1t}. If the right-hand side of E.4 is negative, the right-hand side of E.3 is positive, yielding two different solutions for y_{1t}^* and two solutions for y_{1t}. If the condition $1-\gamma_1\gamma_2 > 0$ holds then neither difficulty arises. If the right-hand side of E.4 is positive, then the right-hand side of E.3 is also positive, yielding a unique solution for y_{1t} from E.3. On the other hand, if the right-hand side of E.4 is negative, the right-hand side of E.3 is also negative. This yields a solution for y_{1t} from E.4 and a solution for y_{1t}^* from E.3. If y_{1t}^* were on the right-hand side of E.2 instead of y_{1t}, there would be no consistency problem since E.3 would be the reduced form for every observation.

Therefore, if only the latent variables appear on the right-hand side, the logical-consistency condition is not needed to ensure unique solutions for the endogenous variables. Which variables are included on the right-hand side should be, of course, dictated by economic theory. It is important to remember that forcing this condition to hold when the censored variables are specified as explanatory variables may not entail an intuitive economic interpretation of the model.