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ABSTRACT

This paper deals with the effects of labor and transfer incomes as determinants of older women's labor force participation. It examines the responsiveness of women aged 48-62 to the level of income available from both work and public transfer programs when deciding between work and nonwork options. The main focus is on whether the availability and generosity of disability-related transfers affects the labor supply of these women. A maximum-likelihood model is estimated separately for heads of household and wives. The results suggest income opportunities have a significant effect only on the work choices of wives. The responsiveness to the availability and generosity of public transfers is largest among older, disabled women who have low expected earnings.

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1. INTRODUCTION

A rapid upward trend in female labor force participation has been observed both in the United States and in other western industrialized countries. Analysis of the determinants of female labor force participation--labor supply--has been described as a major "cottage industry" (see, for example, Mincer, 1962; Cain, 1966 and 1985; Heckman, 1974 and 1978; Layard, Barton, and Zabalza, 1980; Smith, 1980; Smith and Ward, 1985). Empirical estimates of the influence of these determinants is important for several reasons. A practical reason for studying female labor supply is to evaluate the cost and caseload implications of responses of women to changes in the terms of access to and the generosity of income transfer programs, some of which are targeted on women.[1] A more basic reason is the benefits that derive from improved forecasts of the future size and structure of the labor force.[2] The primary motivation of this study relates to both of these reasons: To what extent are the work decisions of the radically larger future cohorts of older women covered by Social Security Disability Insurance (SSDI) and other transfer programs--attributable to the increased female labor force participation rates--likely to be influenced by the generosity and accessibility of benefits?

This study, then, focuses on a particular aspect of the female labor supply issue in the U.S.: To what extent do older women with work experience respond to market and transfer income opportunities when

deciding between work and nonwork options? Because the bulk of public transfers available to older women are targeted on workers with health problems or disabilities, this question concerns the effects of disability-related transfers on labor supply. The issue has been extensively studied in the case of older men, motivated by the observed secular decline in their labor force participation rates and assertions that this reduction in work effort has been caused by the growth and generosity of disability transfers (Leonard, 1979; Parsons, 1980 and 1984; Slade, 1984; Haveman and Wolfe, 1984a and 1984b). Although this effect is equally relevant for both older women and men, there has been no prior study of this response for women, its importance camouflaged by the generally increasing trend of women's work. Among older women however, this trend is less pronounced.

The issue of the effect of transfer income--especially disability transfers--on women's work has also seemed less urgent because, until recently, only a small percentage of women have worked sufficiently to accumulate the necessary quarters of coverage to be covered by Social Security Disability Insurance (SSDI) benefits, the largest source of disability-related transfer income.[3] In 1960 only 99,000 women aged less than 64 were SSDI beneficiaries on the basis of their own earnings record. By 1984, however, this had grown to 849,000, an eightfold increase. In 1960, the average age of these disabled workers was 56.7; in 1984 it was 53.2 (U.S. Social Security Bulletin, Annual Statistical Supplement, 1986).

As the incidence of women's work continues to grow, eligibility for SSDI will expand, as will the potential for disability transfers to influence women's work decisions. Hence, for both appraising the future

of older women's work patterns and forecasting the future costs and caseloads of public disability transfer programs, it is important that the work-transfer linkage for older women also be analyzed. The common finding that women's labor supply response to wage and other income changes is substantially larger than that for men suggests that future aggregate cost, caseload, and welfare impacts of various social security policies will be increasingly dominated by women and their choices.

In this paper, we estimate the responsiveness of older female labor supply to both the level of income available if not working--primarily disability-related public transfers--and expected income if working. Because the circumstances and the process of choice is likely to differ between married and unmarried women, we present estimates for both household heads and wives.

In Section 2 we present our model of the labor supply decision of older women. The model suggests that expected income flows if working or not working are primary determinants of the work choice. For female household heads younger than 62 who are working, the primary source of income is labor earnings. The bulk of income available if not working comes from public income transfers, primarily those providing income support if disabled.[4] The data are described and the results presented in Section 3. They are interpreted in Section 4. Section 5 offers conclusions.

2. A MODEL OF WORK STATUS CHOICE

Our model begins with the standard assumption of utility maximization in which individuals face a choice between working, with its associated income flow, and not working, with its available income flow. The income

associated with each option, together with other sources of utility (such as time spent in leisure and the stigma associated with public transfer recipiency), determines well-being.

Utility in the labor market, L, is

$$U_L = U_L(M + A + N, \overline{H}), \tag{1}$$

where M is the income flow in the labor market or work option, A is exogenous asset income, N is earned income of other family members and $\overline{H}$ is the hours of market work. In analogous fashion,

$$U_D = U_D(T + A + N, 0) \tag{2}$$

is the utility in the nonwork option, D, where T is the income flow and $\overline{H} = 0$. The partial derivatives of both functions with respect to $\overline{H}$ are negative and with respect to M, T, A, and N are positive.

We approximate the utility functions by assuming that they are linear in their arguments. Hence, the utility-maximizing individual follows the decision function,

$$\begin{aligned} I^* &= U_L(M + A + N, \overline{H}) - U_D(T + A + N, 0) \\ &\cong \underline{\alpha}(M + A + N) - \underline{\gamma}(T + A + N) + \omega X + V, \end{aligned} \tag{3}$$

where X is a vector of parameters of the utility function and V is a random error term with a zero mean measuring tastes and other unobserved variables. Given this rule, and assuming $\overline{H}$ is fixed for those choosing the labor market option,

$$I = \begin{cases} 1 \text{ if } I^* > 0 \\ \\ 0 \text{ if } I^* \leq 0, \end{cases}$$

where 1 represents the labor market or work option and 0 represents the nonwork or transfer recipiency option.

Equation (3) could be directly estimated if all of the right-hand side variables were observed. The expected coefficient signs are positive for M and negative for T, if leisure is a normal good. However, the income flows (M, T) are observed only if the respective choice was made. Hence, we need to explicitly or implicitly determine M for those with I = 0 and T for those with I = 1. Equations (4) and (5) describe the determination of M and T as a function of variables $\underline{z}$, including both exogenous individual characteristics expected to influence income flows in the work and nonwork options and the characteristics of labor and transfer markets describing the terms on which the respective flows are available. In this theoretical representation we simplify, letting M represent M + N and T represent T + N:

$$M_j = \underline{\beta}_1' \underline{z}_{1j} + \varepsilon_{1j}, \tag{4}$$

$$T_j = \underline{\beta}_2' \underline{z}_{2j} + \varepsilon_{2j}. \tag{5}$$

Since $\underline{z}_j$ is assumed to be exogenous, $E(\varepsilon_{ij} \mid \underline{z}_i) = 0$ for $i = 1,2$.

From this, we can write the model as a simultaneous equation system in (6), (7), and (8):

$$M_j = \underline{\beta}_1' \underline{z}_{1j} + \varepsilon_{1j} \quad \text{iff } I_j^* > 0, \tag{6}$$

$$T_j = \underline{\beta}_2' \underline{z}_{2j} + \varepsilon_{2j} \quad \text{iff } I_j^* \leq 0, \tag{7}$$

$$\begin{aligned} I_j^* &= \alpha \underline{\beta}_1' \underline{z}_{1j} - \gamma \underline{\beta}_2' \underline{z}_{2j} + \omega' \underline{X}_j + (\alpha - \gamma) A_j + V_j \\ &\quad + (\alpha \varepsilon_{1j} - \gamma \varepsilon_{2j}) \\ &= \psi_j + \varepsilon_{3j}, \end{aligned} \tag{8}$$

where $\psi_j = \alpha \underline{\beta}_1' \underline{z}_{1j} - \gamma \underline{\beta}_2' \underline{z}_{2j} + \omega' \underline{X}_j + (\alpha - \gamma) A_j$, $\varepsilon_{3j} = \frac{1}{\sigma^*} (V_j + \alpha \varepsilon_{1j} - \gamma \varepsilon_{2j})$, and $\sigma^{*2} = E(V_j + \alpha \varepsilon_{1j} - \gamma \varepsilon_{2j})^2$, implying $E\varepsilon_{3j}^2 = \sigma_{33} = 1$.

The selection rule presumes that individuals know the outcome if either the work or the transfer recipiency option is chosen, implying that search activity in both options has been engaged in, and that a long-run equilibrium has been achieved. The selection equation, however, recognizes that for some individuals search may be incomplete, so that the realized income flow in an option may fall short of or exceed the *ex ante* estimate of expected income. The equation also reflects the cost of application and the discretionary role of employers and administrators to the extent they depend on observed characteristics, $\underline{z}$.

Since M_j and T_j are involved in the decision process but our observation of them depends on the final choice, the observed values are truncated and OLS estimates of (6) and (7) will be biased. However, given sample separation, we observe the final choice. Hence, β_1, β_2, σ_{11}^2 and σ_{22}^2 are identified and can be consistently estimated by maximum likelihood techniques or a two-stage method involving modified least squares and probit maximum likelihood.

This, then, is an example of a "switching regression," where the switch is endogenous. Our model has been discussed by Lee (1979), who has shown that the system can be estimated by the following maximum likelihood procedures. The relevant likelihood function is:

$$\mathcal{L} = \prod_{j=1}^{J} \left(\int_{-\infty}^{\psi_j} f_1(M_j - \underline{\beta}_1' \underline{z}_{1j}, \varepsilon_{3j}) d\varepsilon_{3j} \right)^{I_j} \times$$

$$\left(\int_{\psi_j}^{\infty} f_2(T_j - \underline{\beta}_2' \underline{z}_{2j}, \varepsilon_{3j}) d\varepsilon_{3j} \right)^{1-I_j}, \tag{9}$$

where f_1 and f_2 are joint normal density functions for ε_{1j}, ε_{3j} and ε_{2j}, ε_{3j}, respectively. However, to ensure identification, some of the variables in $[\underline{z}_{1j}; \underline{z}_{2j}]$ are excluded from the decision function. Thus, (4) and (5) become, respectively:

$$M_j = \underline{\beta}_{10}' \underline{W}_{1j} + \underline{\beta}_{11}' \underline{O}_{1j} + \varepsilon_{1j}, \tag{10}$$

$$T_j = \underline{\beta}_{20}' \underline{W}_{2j} + \underline{\beta}_{21}' \underline{O}_{2j} + \varepsilon_{2j}, \tag{11}$$

where W_1 and W_2 consist of decision variables, while O_1 and O_2 are variables whose sole use is in income determination.

With this modification, the likelihood function becomes

$$\mathcal{L} = \prod_{j=1}^{J} \left(\int_{-\infty}^{\psi_j} f_1(M_j - \underline{\beta}_{10}' \underline{W}_{1j} - \underline{\beta}_{11}' \underline{O}_{1j}, \varepsilon_{3j}) d\varepsilon_{3j} \right)^{I_j} \times$$

$$\left(\int_{\psi_j}^{\infty} f_2(T_j - \underline{\beta}_{20}' \underline{W}_{2j} - \underline{\beta}_{21}' \underline{O}_{2j}, \varepsilon_{3j}) d\varepsilon_{3j} \right)^{1-I_j}. \tag{12}$$

All coefficients, including the error covariance matrix, are estimated by iterative maximization of the log of the likelihood defined by

(12). Asymptotic standard errors of these estimates are obtained from the inverse of the Hessian of this log-likelihood with respect to the coefficients.[5] This procedure provides consistent and asymptotic efficient estimates, with the sole restriction that the possibly non-zero covariance of ε_1 and ε_2 cannot be estimated.

Starting values for the full maximum likelihood (ML) estimation of equation (12) are from the two-stage procedure defined by Lee (1979), which utilizes modified least squares in the first stage and probit maximum likelihood in the second. This probit-OLS model has gained popularity for its computational ease. It is, however, less efficient, and may underestimate the standard errors of the estimates of the coefficients α and γ in the decision function (8).[6]

This approach to modeling the work-nonwork choice is the result of simplifications--such as the use of one global nonwork income variable and a linear utility function--which preclude specification of the complete and nonlinear budget constraint and the estimation of utility maximizing work-nonwork choices with respect to it (Hausman, 1981). These simplifications are dictated by the complexity of market-transfer-family income-generation systems. For example, in the United States there is no single transfer program providing support to older nonworking or working women. Instead, several interdependent programs, each with its own budget set and eligibility criteria, provide cash and in-kind support to working-age people. Some of these programs are income conditioned (e.g., SSI); others are not. Some of these limit earnings (e.g., SSDI and SSI); others do not (e.g., Workers' Compensation). For some programs, eligibility depends on past work history (e.g., SSDI); for

others, eligibility depends on the nature of an impairment and its cause (e.g., Workers' Compensation and Black Lung Compensation); for still others, the presence of the impairment is sufficient to confer benefits. The cost of applying for benefits is very high in some programs (e.g., SSDI); application cost for others is effectively zero. Any person can receive benefits from a number of the programs simultaneously, depending on widely disparate coverage and eligibility provisions. Indeed, benefits awarded in one program often automatically grant eligibility for benefits in another. Moreover, the system is ill-defined, so that information regarding the availability of benefits from the several interdependent programs, and the conditions under which benefits can be received, is poor. Similar complexities affect the labor market and interspousal income flow options.

In addition to the complex and interdependent nature of the process by which income is determined in the L and D options, the processes by which individuals apply and are found eligible for income flows in each of the options is not well understood. In particular, the process by which individuals move from disability transfer recipiency status to the labor market is a complex one, though such return to work choices are in evidence in the U.S. These processes involve decisions by both those who ultimately determine eligibility for income flows in these options--employers, transfer program administrators and husbands, each with their own objectives and decision rules--and women with their own unique characteristics and objectives.[7] Our reduced-form model attempts to accommodate all of this complexity.

3. DATA AND MODEL SPECIFICATION

The ML model which we estimate employs static, cross-sectional data of the sort used in a wide variety of recent studies of the behavioral responses to incentives implicit in tax and tranfer programs (Danziger, Haveman, and Plotnick, 1981). The data are for women aged 45-62 in 1978 who have worked full time for 7 years or more, indicating a strong labor market attachment.[8] This work history provides them with coverage by the Social Security system. The observations are from the Michigan Panel Study of Income Dynamics. The choice of work status in a given year (1978) is taken as dependent on the value of the expected income flow in each option in that year,[9] as well as taste, health, and stigma factors, implying that the choice of income or transfers is reversible. Being a labor market participant (i.e., as having chosen option L) is defined as having income flows or labor market characteristics defined by at least one of (1) labor income (earnings plus hours unemployed or on strike times average hourly earnings) greater than zero and no disability-related transfers, (2) being self-employed and reporting 500 or more hours worked last year, or (3) having disability-related transfers greater than zero but labor income greater than $3,360.[10] Its complement, option D, is defined as not meeting the criteria for having chosen the L option. The panel character of the data allows the use of time-related information before and beyond 1978 to reflect both prior work history and expectations of future outcomes (e.g., variables related to expected future income flows in the L and D options. See Willis and Rosen, 1979). (The specific variables employed are described in Appendix A.)

The variables included in (12) reflect those demand-side and supply-side characteristics of both the labor market and the transfer recipiency "market" which are likely to affect the presence of an individual in either group. Education, family background, and disability status capture the individual's perception of potential work capacity and productivity, as does age. They also describe important determinants of eligibility for transfers. The presence of children reflects the income requirements of the household as well as influencing the opportunity cost of working. The area-specific unemployment rate, region, and urban-rural background reflect the employment opportunities open to the individual, and hence the likelihood of both obtaining a job or gaining eligibility for transfers.

The location variables also proxy the differential application of the criteria for determining the eligibility for transfer benefits. Previous usual occupation and the cause of single status (for household heads) proxies transfer program coverage, past earnings and the probability of receiving child support or alimony income. The race variable captures the effect of potential labor market discrimination in both employment opportunities and the determination of eligibility for transfers. Religion is entered as a taste variable. In the estimate for wives, the effect of joint household considerations on the woman's work choice is captured by the age difference between the wife and her husband, the asset income of the family, and by the earnings capacity of the husband (as opposed to his actual earnings, which tend to be endogenous to the wife's labor market decision).

Because choice of the nonwork option, D, depends on expected public transfer income if not working, and because disability-related transfers weigh so heavily in this expected value, it is essential that a disability or health status variable which is exogenous to the work decision be included in the set of independent variables. We use a multidimensional "true" disability measure obtained as an unobservable in a separate latent variable structural model (LISREL) estimation (Joreskog and Sörbom, 1983). This measure was developed in Haveman and Wolfe (1985), and is briefly described in Appendix B.

4. EMPIRICAL RESULTS

Tables 1-3 present the empirical results from the maximum likelihood estimation. The determinants of labor market income (M) and nonwork income (T) are shown in Tables 1 and 2 for heads and wives, respectively. Table 3 contains the structural probability portion of the model and shows the determinants of the work (M) or no work (D) choice.

The determinants of market income for household heads are as predicted by standard human-capital-based theory. Age, work experience, and health status are all positively related to M and all are significant. The education and education-squared variables indicate that market income falls with education up to year 7, but rises thereafter. Being white and growing up outside the South both contribute positively to M, but only race is significant at the .05 level.

The underlying process of nonwork income determination for household heads is murkier. While the signs on the coefficients are all reasonable and consistent with expectations, only race is significant. Being white

tends to be associated with greater transfer income because public Social Security benefits are a positive function of earnings while working.

The labor market income determinants for wives have much the same pattern as for heads, although in this case growing up outside the South is both positive and significant. The nonwork income determinants for wives again parallel those for heads. The additional variable in the estimation for wives--the age difference between the wife and her husband--is positive and significant. Having a disabled husband adds positively to the wife's labor income, and significantly so to nonwork income. The former suggests that a woman may work more if she is the primary earner; the latter that this increased work leads to higher pension income. This nonwork income is likely to be further increased by dependents' benefits for a disabled spouse.

The estimates in Table 3 allow us to measure the work response of older women to the income incentives in both the labor market and in the market for income transfers. These estimates also indicate the role of other factors, including alternative time demands and stigma considerations on the choice of whether or not to work.

For both heads and wives, expected income if working positively affects the decision to work outside of the home; it is statistically significant for wives. While income expectations if not working appear to deter a decision to work outside the home for both female heads and wives, the coefficient is not significant in either case. Older females, then, appear somewhat responsive to income incentives in both the labor market and the "transfer" market in making their labor force participation choice; however, in 3 of the 4 cases, these concurrent market incentives are not significant.[11]

The response to income incentives is also captured by the expected growth or change in income variables[12] as well as the income level variables. The change is included to reflect the long-term consequences of the work-nonwork choice at any point in time. Choices made will generally include an expectation of future income in each option. These expectations are based on actual experiences to 1981 (a three-year period). Again, the responses of both female heads and wives are as expected, but are not statistically significant for either group.

A likelihood ratio test for the joint significance of the expected labor market income variables (M and change in M) was run for both heads and wives, and indicates that the combination is statistically significant (at the 1 percent level) for wives, but not for heads. Similar tests for the expected nonwork income variables (T and change in T) and for the joint significance of the change in market and transfer incomes were not significant (at the 5 percent level) for either group except the joint change of both incomes for wives. Finally, a likelihood ratio test for the joint significance of all of the expected income variables (both levels and changes) was performed. For wives, this test was significant at the 1 percent level, justifying the conclusion that the choice of whether or not to work is significantly affected by income expectations for this group. It was not significant for heads, suggesting that their work choice is not significantly affected by income expectations.

Other coefficients in Table 3 are also of interest. For both female heads and wives, health status is an important determinant of the decision of whether or not to work; those women with health problems are less

likely to be labor force participants than healthier women. This effect is in addition to the impact of the health variables on the work choice, which operates through the expected income and income-change terms. The number of children borne by a woman before age 25 years is a significant determinant of the labor supply decision in later years, but has a quite different impact for heads and wives. For female heads, births early in life tend to discourage labor supply in later years; female headship proxies for widow, and suggests an income effect from the availability of survivors' and dependent benefits from Social Security. For wives, having children early in life tends to encourage work in later years; for such women, child-rearing responsibilities have been significantly reduced by age 40. In the estimate for wives, the husband's permanent wage rate[13] and asset income are designed to control for the effect of nonwork income on the labor supply choice; both are correctly signed and significant.

Table 4 presents the response elasticities of expected M and expected T for both heads and wives,[14] and the predicted probability of working. At the mean of the variables in the model, the elasticity of response to labor market income (M) is very close to unity for both heads and wives. As with the models' coefficients, the elasticity of response to expected transfer income (T) is smaller for both heads and wives: -.73 and -.24, respectively.[15] At the mean, the predicted probability of working is nearly .6 for heads, and nearly .5 for spouses. The remainder of the table presents calculated response elasticities and predicted work probabilities at other points in the distribution. The patterns are not unexpected. The better (worse) the health or disability status of older women, the higher (lower) is their predicted probability of working and

the lower (higher) is their response to income incentives, whether offered in the labor or "transfer" markets.

The final comparison shows the responsiveness of women of varying earning capacities. Those with skills and, hence, earnings expectations one standard deviation below the mean are only about one-half as likely to be labor market participants as those lying one standard deviation above the mean earnings capacity. More significantly, those with poorer labor market prospects (and hence superior income transfer opportunities) are about twice as sensitive to income incentives as are those well up in the potential earnings distribution. Changes in income opportunities--either from working or through transfers--appear to elicit a substantially greater response from low-skilled women than from those with skills and high earnings potential. The low labor force participation probabilities for less-skilled women (.4 for heads and .31 for wives) appear to be rational responses to the income opportunities available to them in both the labor market and the "transfer" market.

A test of the accuracy of our estimates is possible by comparing the predicted results to the actual participation-nonparticipation decision of the older workers in the sample. Of the 196 heads and 264 wives in the sample who are participants, 75 percent and 72 percent, respectively, are predicted by the estimated model to have a probability of more than .5 of being participants. Of the 148 heads and 278 spouses who are nonparticipants, 64 percent and 71 percent, respectively, have a predicted probability of more than .5 of being nonparticipants. Thus, our predictions are "correct" for 71 percent of the sample. The accuracy of these predictions suggests that our model does identify the significant

determinants of the labor force participation decision of older women, including expected incomes in the labor and "transfer" markets.

To obtain a rough estimate of the potential effects of changed expectations regarding both current transfer incomes and changed expectations regarding future transfer income prospects, we simulate the effect of a 20 percent increase and a 20 percent decrease in both T and change in T for each observation in the sample. The results, which are based on our nonlinear ML estimates shown in Table 5, suggest that a 40 percent increase in total non-work income flows could account for a five-percentage-point decrease in older wives' labor force participation, and a 13 point decrease in older heads' participation. Since Social Security disability benefits account for approximately 40 percent of this income flow, this is equivalent to raising these benefits by 100 percent, or 2 1/3 times the 43 percent increase that actually occurred over the 1968-1978 period. Recall however that the head's simulation is based on a statistically insignificant coefficient and so should be treated with caution.

5. CONCLUSION

These estimates of response suggest that income opportunities, whether in the labor market or the "transfer" market, have an effect on the work choices of older women, whether household heads or wives. The rapid increase in female labor force participation during the 1970s, which accompanied increased relative female wage rates and an improved outlook for women's work opportunities, are consistent with these results (Killingsworth, 1983).

These results are also important for anticipating potential problems associated with changes in income transfer policy. For older women at present, a primary source of income in the "transfer" market is SSDI, yet a relatively small percentage of these women have worked for a sufficient number of quarters to qualify for recipiency. Given recent trends in women's work patterns, a far greater proportion of older women in the 1990s will be eligible for benefits. Our results suggest that eligible women--especially low earners, wives, and those with health problems--do respond to changes in the generosity and availability of transfer income. Sizable increases in expected benefits, deriving from increases in either generosity or leniency, may well have substantial impacts on older women's work patterns.

Nevertheless, many questions remain unanswered. Little insight is gained into the relative contribution of other variables to the observed increase in female labor force participation rates. While our results suggest that improvements in labor market incomes and opportunities in the 1970s have contributed to the increase, the effect of changes in tastes for work, social expectations regarding work, the physical demands of occupations, the incidence of impairments, and income from husbands and other sources remains unexplained.

Notes

[1]A number of studies have focused on this issue (Garfinkel and Orr, 1974; Levy 1979; Barr and Hall, 1981; Hausman, 1981; Burtless and Moffitt, 1984).

[2]In addition to these reasons, however, the extensive study of female labor supply has been driven by the knotty conceptual and econometric problems which dominate this topic. They include the interdependence of the husband's and the wife's labor supply decisions in two-adult households, and the need to account for the process by which some women select labor market participation while others, with apparently similar characteristics, do not. Indeed, the female labor supply issue has motivated important developments in both consumption (joint utility maximization in household choice) and econometric (techniques for dealing with selection bias) theory.

[3]A woman requires one quarter of coverage for each year after 1950 up to the year the woman attains age 62. Thus, a woman reaching 62 in 1979 would need 28 quarters of coverage, acquired anytime after 1936.

[4]In the Michigan Panel Study of Income Dynamics 1978 wave, 91 percent of nonworking female heads received public transfer income; 60 percent received SSDI or Supplementary Security Income (SSI) Disabled benefits.

[5]The derivatives of the log-likelihood with respect to the coefficients are in the Appendix of Lee (1979), which contains a few errors. The correct derivatives are available from the authors on request.

[6]This is related to the assumption that each individual takes the value of his expected income in the work (M_j) and nonwork (T_j) options from individuals with similar characteristics in these options.

[7]If these objectives and rules have changed over time, the analysis at a point in time would reflect both past and current conditions. This is unlikely to be significant in this case, as leniency had increased for most disability programs from their inception to 1978. Since one can reapply if denied, the 1978 data are likely to reflect 1978 rules and objectives.

[8]We exclude workers older than 62 because most are eligible for Social Security early retirement benefits at 62. Inclusion of older workers would further complicate the estimation problem and mask the role of disability transfers in the early retirement decisions. Evidence suggests that the availability of disability transfers is less likely to alter the work status of individuals below 45 years of age. Extensive research on the effect of disability transfers on men's labor supply choices also focuses on this age group.

[9]The data set for the ML procedures--a BMDP-routine (P3RFUN) with a self-supplied supplement--contains twice the same vector of (work or nonwork) income observations. However, for wives some of the observations of nonwork income are missing owing to the occasional failure of the data to record the existence and magnitude of interspousal transfers. We used an "adjusted tobit"-model to fill these gaps with the expected values of nonwork income. This entailed running a selectivity-corrected OLS on the positive nonwork income observations, while the Heckman selectivity term was calculated from a probit explaining the presence and report of nonwork income. The probit and OLS-results were combined to predict:

$$E(T_j) = P(T_j > 0)\ E(T_j/T_j > 0).$$

For details, see Nelson (1977), Heckman (1979) and Maddala (1983, pp. 158-60).

[10]Recipients of SSDI benefits are allowed $280 of earned income per month without calling into question their eligibility status. Earnings beyond this amount is considered "substantial gainful employment" and is viewed as inconsistent with being "totally and permanently disabled."

[11]The correlations between expected nonwork income (T) and expected labor income (M) are .69 (wives) and .86 (heads). The large value for heads may account for the large-but-insignificant income coefficients for heads.

[12]The two expected change-in-income variables (Change in M; Change in T) are calculated for each observation from expected income variables in 1978 and 1981: Change in $M = (M_{1981} - M_{1978})/M_{1978}$; Change in $T = (T_{1981} - T_{1978})/T_{1978}$. For each of the two years, M and T are predicted from income regressions fit over observations in the labor market (L) and "transfer" market (D) categories. The right-hand variables in the income regressions include age, education, occupation, race, region, marital status, disability status, and a Heckman selectivity correction calculated from a probit regression explaining the presence of observations in the L and D categories. For spouses, a stepwise tobit regression was fit in order to predict T_{1981} and T_{1978}, as a substantial number of spouses in the D category reported zero income (see note 9).

[13]The husband's hourly wage rate is a predicted value based on a log wage rate regression run on husbands with a reported wage rate. The explanatory variables are age, education, work experience, race, region,

religion, and a Heckman selection variable constructed from a probit regression fit over all husbands explaining the presence of a wage rate.

[14]Insofar as the underlying income and expected income coefficients are not significant, these elasticities are only suggestive of the relative differences in the response to income incentives.

[15]These elasticities are substantially greater than those estimated for older men in a related study (Haveman and Wolfe, 1984b). There, men's work choice was modeled as a function of expected labor income, expected disability transfer income, and a variety of taste and stigma variables in a two-stage probit framework. The work decision of older men was significantly related to expected income, but the elasticities there ranged from .006 to .0003. Here the elasticities are larger for both groups of women but are not significant for household heads. While the direction of the difference in response elasticities and significance is consistent with findings generally, the substantial magnitude of the difference suggests a greater labor force attachment of males and female heads relative to female spouses than may be generally recognized (Killingsworth, 1983).

Table 1

Determinants of Labor Market Income, M, and Nonwork Income, T, from Maximum Likelihood Model for Female Household Heads

Explanatory Variables	Labor Market Income		Nonwork Income	
	Coefficient	(t-Statistic)	Coefficient	(t-Statistic)
Age Dummy ($\geq$ 60 = 1)	2.490	(2.21)*	.572	(0.70)
Education	-.727	(1.20)	-.351	(0.68)
Education Squared	.050	(2.04)*	.023	(0.91)
Work Experience	.068	(2.01)*	.007	(0.33)
Occupational Dummies				
Professional	.666	(0.53)	.541	(0.49)
Managerial	3.865	(3.11)*	.749	(0.32)
Clerical Sales	-.241	(0.23)	-.422	(0.59)
Operative	1.469	(1.50)	.282	(0.41)
Race (White = 1)	2.077	(2.38)*	1.285	(2.36)*
Region (South = 1)	-.304	(0.46)	-.423	(0.88)
Marital Status				
Widowed	.164	(0.17)	.474	(0.54)
Divorced or separated	.436	(0.43)	-.418	(0.44)
Disability Indicator	-.606	(2.87)*	-.260	(1.81)
Constant	-1.245		.612	

*Significant at .05 level

Table 2

Determinants of Labor Market Income, M, and Nonwork Income, T, from Maximum Likelihood Model for Wives

Explanatory Variables	Labor Market Income		Non-Work Income	
	Coefficient	(t-Statistic)	Coefficient	(t-Statistic)
Age Dummy ($\geq$ 60 = 1)	2.047	(0.91)	.736	(1.13)
Education	-1.825	(2.45)*	-.013	(0.03)
Education Squared	.102	(3.40)*	.011	(0.05)
Work Experience	.182	(4.55)*	.023	(0.96)
Occupational Dummies				
Professional	1.625	(0.53)	-.636	(0.64)
Managerial	2.091	(0.66)	-1.306	(0.82)
Clerical-Sales	1.615	(0.55)	-.644	(0.81)
Operative	3.120	(0.99)	-1.308	(1.41)
Laborer-Service worker	1.614	(0.55)	-.945	(1.08)
Race (White = 1)	1.225	(1.23)	1.070	(1.31)
Region (South = 1)	-1.756	(2.21)*	.121	(0.22)
Disabled Spouse	1.795	(1.66)	2.140	(3.22)*
Husband-Wife Age Difference	.131	(1.82)	.106	(2.41)*
Disability Indicator	-.812	(3.87)*	.047	(0.38)
Constant	-.759		-.635	

*Significant at .05 level

Table 3

Determinants of Work Choice (L=1), Maximum Likelihood Results from Structural Probability Portion of Model, for Female Household Heads and Wives

Explanatory Variables	Heads		Wives	
	Coefficient	(t-Statistic)	Coefficient	(t-Statistic)
Expected Nonwork Income (T)	-.302	(1.25)	-.103	(0.71)
Expected Labor Market Income (M)	.159	(1.07)	.136	(2.34)*
Change in T	-.326	(0.50)	-.184	(1.20)
Change in M	.660	(0.54)	.421	(1.35)
Work Experience	.012	(0.85)	.026	(2.00)*
Unemployment Rate	-.180	(1.69)	.108	(1.48)
Age Dummy ($\geq$ 60 = 1)	.222	(0.50)	-.235	(0.52)
Disability Indicator	-.232	(2.23)*	-.114	(1.90)
Number of Children--1-12	-.192	(1.90)	-.058	(0.81)
Number of Children before Age 25	-.130	(2.26)*	.146	(2.86)*
Mother's Education	-.021	(0.69)	-.036	(1.71)
Religion Dummies				
Protestant	-.498	(1.50)	.038	(0.17)
Catholic	-.229	(0.59)	.254	(0.95)
Jewish	-.220	(0.30)	.850	(2.27)*
Origin Dummies				
Farm	.298	(1.47)	-.117	(0.72)
Urban	.052	(0.24)	-.457	(2.74)*
Wage Rate of Spouse	-	-	-.112	(2.04)*
Asset Income	-	-	-.147	(2.88)*
Disabled Spouse	-	-	.271	(0.68)
Race (White = 1)	.206	(0.49)	-.214	(0.78)
Constant	.553		.031	
-2 Log Likelihood Ratio[a]	252.16*		331.44*	
Number of Observations	344		542	

*Significant at .05 level

[a]This test refers to the complete ML-result, which is the combination of Table 1 and this table (first column) for heads, and Table 2 and the second column of this table for wives.

Table 4

Response Elasticities of M (η_M) and T (η_T) and Predicted Probabilities of Working [$\bar{P}$(Work)], Calculated at Means and Selected Other Points in the Distribution for Household Heads and Wives

	Heads			Wives		
	$\bar{P}$(Work)	η_M	η_T	$\bar{P}$(Work)	η_M	η_T
At Means	.57	1.03	-.73	.49	1.09	-.24
Disability Indicator - σ	.81	.50	-.36	.63	.81	-.18
Disability Indicator + σ	.30	1.72	-1.23	.35	1.41	-.32
Expected Labor Market Income - σ	.40	1.45	-1.03	.31	1.53	-.34
Expected Labor Market Income + σ	.73	.67	-.48	.67	.71	-.16

Table 5

Simulated Effects of Changes in Expected Transfer Incomes and Expected Transfer Income Changes on the Work Effort Choice

	Percent of Predicted T	Change of T (ΔT) Values	Means of Individually Predicted Probabilities of Working	
			Heads	Wives
1.	100M; 100T;	100ΔM; 100ΔT	.551	.496
2.	100M; 120T;	100ΔM; 100ΔT	.488	.478
3.	100M; 120T;	100ΔM; 120ΔT	.483	.470
4.	100M; 80T;	100ΔM; 100ΔT	.609	.514
5.	100M; 80T;	100ΔM; 80ΔT	.613	.522

Appendix A

Variable Descriptions, Means and Standard Deviations

Variable	Description	Mean (Standard Deviation) Heads	Wives
Dependent			
Work Status	Dummy variable equals if 1 if woman has labor income (earnings + hours on strike or unemployed x wage rate) > $3360 or is self-employed and worked > 500 hours or has labor income > 0 and no disability transfers	.57(.5)	.49(.5)
Independent			
Income	Woman's labor earnings and Unemployment Compensation + SSD + SSDI + AFDC + other welfare and transfer and help from relatives in 1977 in $1000's	6.9(5.0)	6.2(6.7)
Expected (1) Nonwork (T) and (2) Labor Market (M) Income	Estimated value of woman's income if in (1) nonwork or (2) work options in $1000's	(1) 3.5(1.4) (2) 9.4(2.8)	4.0(2.3) 8.7(3.6)
Change in M and T	Percentage change in expected (1) T and (2) M from 1978 to 1981	-6.2(13.3) -11.9(25.2)	-38.9(27.3) -68.9(57.5)
Education and Education Squared	Woman's years of education and years of education squared	10.5(3.1)	11.4(2.8)
Work Experience	Years of full-time work experience	21.2(11.3)	15.1(9.5)
Mother's Education	Woman's mother's years of education	7.3(3.2)	8.5(3.6)
Disability Indicator	Disability measure created by a latent variable estimation model (see Appendix B)	19.9(3.0)	17.7(3.1)
Age Dummy	Dummy variable equals 1 if woman is $\geq$ 60 in 1978	.19(.4)	.10(.3)

Appendix A (continued)

Variable	Description	Mean (Standard Deviation) Heads	Wives
Husband-Wife Age Difference	Difference in years between ages of husband and wife	NA	3.26(5.2)
Race	Dummy variable equals 1 if woman is white	.40(.5)	.73(.4)
Religion Dummies			
Protestant	Dummy variables that equal	.76(.4)	.64(.5)
Catholic	1 if woman's reported	.15(.4)	.21(.4)
Jewish	religion is specified group	.02(.1)	.05(.2)
Unemployment Rate	1977 unemployment rate in area in which woman resided	3.6(.8)	3.4(.9)
Occupation Dummies			
Professional	Occupation dummy variables = 1	.09(.3)	.11(.3)
Managerial	if usual occupation is	.04(.2)	.05(.2)
Clerical-Sales	specified occupation. Omitted	.19(.4)	.34(.5)
Operative	group is no recorded	.14(.3)	.18(.4)
Laborer-Service Worker	occupation	.52(.5)	.30(.4)
Number of Children before Age 25	Number of children the woman had before she was 25 years old	1.6(1.6)	1.4(1.3)
Number of Children--1-12	Number of children $\leq$ 12 woman has as of 1976	.49(.9)	.49(.9)
Origin Dummies			
Farm	Dummy variables that equal 1	.35(.5)	.32(.5)
Urban	if woman was raised on a farm or in an urban area respectively	.30(.5)	.31(.5)
Region (South =1)	Woman currently resides in Southern part of country	.42(.5)	.35(.5)

Appendix A (continued)

Variable	Description	Mean (Standard Deviation) Heads	Wives
Marital Status Dummies			
Divorced or Separated,	Dummy variable equals 1 if woman is currently divorced	.59(.5)	NA
Widowed	or separated or is currently widowed	.34(.5)	NA
Disabled Spouse	Woman's husband disabled as of 1977	NA	.17(.3)
Asset Income	Family income from assets in $1000's	.00(.0)	.25(1.1)
Wage Rate of Spouse	Husband's earnings capacity estimated from an OLS wage rate equation including race, unemployment, South, disability status and work experience	NA	7.2(2.0)

Appendix B

An Indicator of Disability and Health Status Measured as an Unobservable

The indicator used in this work is designed to be a multipurpose indicator of true disability that emphasizes the functional and work-related character of impairments (a loss in physiological, anatomical or mental capacity). True disability is viewed as an unobservable and its value is estimated as a latent variable from a system of structural equations. The structure of the model is presented in equations 1 and 2:

$$(1) \qquad D^* = \underline{B'X} + e_1$$

$$(2) \qquad \underline{I}_i = \underline{a}_i D^* + e_i,$$

where D^* is the unobservable variable measuring true disability status; $\underline{X}$ is a vector of observable exogenous variables; $\underline{I}_i$ is a vector of indicators for the unobservable variable D^*; $\underline{a}_i$ is the vector of coefficients relating D^* to each indicator; and e_i are the vectors of error terms assumed to be normally distributed.

The model was estimated using LISREL full-information, maximum likelihood procedure. The data used were persons 18-64 in the 1978 Social Security Administration Survey of the Disabled. The model and results are described more fully in Haveman and Wolfe (1985).

The X vector includes the socioeconomic characteristics of the individual, family income, personal habits, and the requirements and characteristics of an individual's normal occupation. The I vector of indicators includes variables which are expected to reflect the presence or absence of impairing conditions or functional limitations. They

include the extent of self-reported and interviewer-reported work limitations, medical care utilization, specific health problems, general health, mobility, and the percentage of weighted occupations for which a person is qualified based on a comparison of job requirements with individual capabilities.

The results are used to calculate an imputed value of D* for each observation.

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