1979

The impact of functional limitations on labor supply

Susan Carrithers Stephenson
Iowa State University

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by

Susan Carrithers Stephenson

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Major: Economics

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

For the Major Department

Signature was redacted for privacy.

For the Graduate College

Iowa State University
Ames, Iowa

1979

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CHAPTER I. INTRODUCTION

The Recent Growth in the Social Security Disability Insurance Program

The Social Security Disability Insurance program (DI) pays monthly cash benefits to disabled workers and their dependents, disabled spouses of deceased workers, and disabled children of workers when members of these groups meet program eligibility requirements. Currently about 4.9 million persons (including dependents) are receiving DI benefits [14, p. 36]. Average monthly benefits are $290 per disabled worker and $90 per dependent [14, p. 46]. Since 1970, the number of beneficiaries has increased by 81 percent, up from 2.7 million persons [14, p. 36]. The amount of cash benefits paid in 1970 was about $3 billion. In 1978, the amount paid was nearly $12 billion, a 400 percent increase [14, p. 45]. The share of social security tax revenues going to the DI trust fund was raised from 9.8 percent in 1977 to 12.8 percent in 1978. It is scheduled to increase to 14.4 percent by 1990. The amount of social security tax revenues going to the DI trust fund was $9.6 billion in 1977. This figure will rise to an estimated $15.7 billion in 1979 and an estimated $40.5 billion in 1987, a 422 percent increase in a decade [35, p. 8]. The burgeoning cost of DI in the early 1970's was so severe that it was estimated in 1976 that, with no legislative changes, the assets of the DI trust fund would run out in 1979 [36].

Although the growth of the DI program has been slower in the last several years and legislative changes forestalled the depletion of

the trust fund, the concern over the high cost of the program remains. The major reason for the growth of the program was the increase in the number of persons applying for and being awarded disability benefits. Several hypotheses have been suggested to explain this increase in the disability incidence rate. One that has received particular attention is that increases in benefit levels since 1970 relative to earnings may provide an incentive for people with disabilities to apply for benefits under DI. Between 1969 and 1975, there was an 82 percent increase in benefit levels [5]. In 1976 the average replacement rate (monthly DI benefits divided by predisability earnings) was 62 percent [4]. With replacement rates of this size, the opportunity cost of leaving the labor force is small and therefore applications higher.

Another factor that may explain the increase in application rates is the subjectivity and confusion surrounding the definition of disability. At its inception in 1954, the DI program defined disability as the "inability to engage in any substantial gainful activity because of any medically determinable physical or mental impairment that can be expected to be of long continued and indefinite duration" [9, p. 47]. In 1965, the definition of disability was changed such that the duration of the disability need only have lasted twelve months [9, p. 49]. The Social Security Administration is responsible for determining disability status when people apply for benefits. If the claim is denied, the claimant may request a judicial review. The judicial interpretation of the definition of disability has liberalized

the concept to include consideration of the residual capacities of the claimant, and what employment opportunities exist for a person with these capacities.[1]

In light of the above interpretation, the Social Security Administration evaluates the DI applicant on the basis of three tests. Insured workers who have physical or mental impairments included on medical listings provided by the Social Security Administration are automatically granted benefits unless their monthly income exceeds some maximum amount.[2] Most awards are made on this basis. If the applicant fails to qualify on the basis of the medical listings, his impairments may be judged to be the equivalent of the impairments included in the medical listings and therefore awarded benefits. If an applicant fails the first two tests, he may qualify if he is an older worker with little education, has a history of work in unskilled occupations, or if he is found unable to qualify for a job that exists in several regions of the U.S. whether or not it exists in the region in which he lives [9, 15].

Although the congressional definition of disability stresses the medical nature of disability, the legal interpretation of disability and the criteria by which disability claims are evaluated explicitly

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[1]This is a statement of the so-called Kerner doctrine. See Berkowitz, Johnson and Murphy [9] and Dixon [15].

[2]Persons who earned more than $140 a month in 1971 were presumed capable of "substantial gainful activity" and therefore were ineligible for DI benefits. Now this amount is $280.

recognize the interaction between physical impairments and other individual characteristics. This results in more claims being granted than if medical criteria alone were used. In addition, because the second and third tests involve a subjective evaluation, the awarding of DI benefits may be inconsistent.

Other reasons discussed for the recent increase in the growth of the DI program include the extension of benefits to workers aged 31-50 in 1960 and to workers aged 21-30 in 1967 [9, pp. 49-50]; the higher unemployment rate in recent years which may induce impaired persons who are unemployed to apply for benefits [19]; and increased awareness of the availability of disability benefits, perhaps coupled with a reduction in the stigma attached to accepting benefits ("living on welfare") [5].

In general, the question this thesis addresses is what causes a person to become disabled? One person who has a physical impairment such as the inability to walk may continue to work in spite of his limitation. Another may choose to withdraw from the labor force and apply for disability benefits. More specifically, the objectives are first to determine the relative importance of social/demographic, economic, and health variables in the labor supply decisions of physically impaired persons. This analysis would provide guidelines for policy making. If health variables are the more important determinants of labor supply, then granting of DI benefits on medical grounds alone is appropriate. If social and/or economic variables are more important,

the expansion of income maintenance programs financed through general revenues might be investigated.

The second objective is to assess the importance of benefit levels on the probability that an impaired person will apply for DI. The expectation is that the higher benefit levels are relative to earnings, the greater the probability of application. If this hypothesis is correct, one way to control the costs of the DI program is to reduce benefits. The third objective is to examine the awards process to gain some insight as to what variables increase the probability of being accepted as a DI beneficiary.

Finally, we wish to compare our results to results reported by Berkowitz, Johnson and Murphy (BJM) [9] who constructed and tested similar models using 1965 data.

Plan of the thesis

Chapter two discusses the estimation of the reservation wage variable that is used in the labor supply models in Chapter three. The use of actual wages presents some statistical problems which are avoided when reservation wages are used [21]. Chapter three presents the results obtained from testing labor supply models which include social, economic, and health variables. These models are designed to assess the relative importance of the three groups of variables. A comparison is made between results using 1965 data and 1971 data. Chapter four discusses the results of the estimations of the demand for and the supply of DI benefits. Chapter five concludes with a

summary of the results and a discussion of the policy implications, avenues for further research, and the shortcomings of the analysis.

Description of the data

The data used are from the 1972 Survey of Disabled and Nondisabled Adults [29] conducted by the Bureau of the Census for the Social Security Administration. This was the second national survey designed to provide information on the disabled population in the United States. The first was the 1966 Survey of Disabled Adults. The 1972 survey included nondisabled persons as well as the disabled. The sample in the 1972 survey consisted of 17,997 persons, aged 20-64, 11,700 of whom indicated they were disabled before October 1969 in the 1970 5 percent Census sample.[1] Of the 11,700 people, 4264 no longer considered themselves disabled in 1971 and 1200 of the people who were not disabled in 1969 considered themselves disabled in 1971. The final sample consisted of 8633 persons who were disabled and 9364 who said they were nondisabled.

The 1972 survey contained a wide variety of information on things such as work experience, health conditions, work limitations, personal attitude, knowledge of government programs, family income and wealth and social relations [34]. In addition, the information on the survey was matched with the Social Security Administration master beneficiary record so that covered earnings were available back to 1951 [1].

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[1]The description of the survey is from Allen [1].

The disabled sample consisted of 3903 men and 4733 women. We limited our analysis to disabled men for two reasons. First, the labor force behavior of women is not as well understood as that of men,[1] and second, because of a budget constraint which did not permit the analysis of both sexes.

The 1972 survey was constructed such that positive responses to questions about health are not associated with reduced labor supply which has been a problem in other research.[2] Respondents were asked if they had difficulty performing a variety of activities and if so whether they could perform the activity at all [29]. These responses were independent of the measures of labor supply.[3]

For a further discussion of details about the data we used see [1].

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[1]But see Cain [12] and Bowen and Finegan [11]. Also see the suggestions for future research in Chapter five.

[2]See Cullinan and Curington [13, pp. 2-5] for a discussion.

[3]The conceptual framework for the relationship between health and labor supply we use distinguishes among pathology, impairment, functional limitation and disability. Pathology is an illness or injury which may or may not result in an impairment. For example, a cold is an illness which is unlikely to result in any permanent damage, whereas cancer may result in a loss of limbs or organs. The loss of a leg may result in a functional limitation (inability to stoop, say) while the loss of a breast would not. The existence of functional limitation may or may not result in reduced labor supply (disability). Whether or not functional limitations result in disability depends on other social and economic factors except in extreme cases. For instance, the availability of other forms of income (transfer payments, asset income) may provide an incentive for a person with limitations to reduce labor supply. See BJM [9], Haber [17], and Cullinan and Curington [15] for more discussion of this point.

CHAPTER II. ESTIMATING RESERVATION WAGES

Introduction

In this chapter we specify the procedure to estimate the wage variable which is used in the labor supply equations as an independent variable. The process involves three steps. First we use probit to obtain estimates of a coefficient that will correct for bias in the wage estimation equation for those who work. Next we use ordinary least squares regressions (including a bias correction variable) to get unbiased estimates of the coefficients that determine wage offers. Finally we combine the estimates in steps one and two to derive estimates of the coefficients of the reservation wage equation.

The Problem

The appropriate wage variable to use in labor supply regressions is the reservation wage rather than actual wages. The reservation wage is the wage that must be paid in order to induce labor force participation. The reason that reservation wages are preferable is because variations in actual wages have little effect on labor supply. For example, changes in actual wages are unlikely to change the hours worked of participants (as long as actual wages are above reservation wages), because institutional factors, custom, etc., determine the length of the work day or week. Similarly, changes in actual wages would not be expected to have an effect on nonparticipants until the reservation wage is reached. The problem is that the reservation wage for participants and nonparticipants is unobservable.

One way of estimating reservation wages is to regress actual wages on various independent variables such as age, education, geographic location, etc., for those people who work.[1] The estimates of the parameters are then used to calculate wages for those who do not work. The problem here is one of sample selection bias which occurs when observations on the dependent variable are missing. Only those people who work are selected into the sample to estimate wages. This causes biased estimates of the coefficients and/or coefficients which appear to be significant when they are not. For example, if the above procedure is used to estimate wages for nonworking women, one of the significant variables is the presence of children. Women with children are shown to earn lower wages than women without children. The interpretation of these results might be that discrimination exists against such women. This is not necessarily so, given the procedure used to estimate the wages. It may be that women who work have fewer children [21]. That is, the characteristics of the working women may not fit the characteristics of the nonworking women.

The Procedure

Consider the following model:[2]

$$W_{1_i} = X_{1_i}\alpha + \varepsilon_1 \tag{1}$$

$$W_{2_i} = X_{2_i}\beta + \varepsilon_2 \tag{2}$$

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[1] See Boskin [10] and Hall [18].

[2] The following discussion of sample selection bias is taken from Heckman [21].

where W_{1_i} is the reservation wage and W_{2_i} is the wage offer for the ith individual, and X_{1_i} and X_{2_i} are vectors of explanatory variables. We cannot use the wage offer equation to estimate reservation wages because there are missing observations. We observe W_2 if and only if people work. Given this sample selection rule,

$$E(W_{2_i}/X_{2_i}\beta, W_{2_i} > 0) = X_{2_i}\beta + E(\varepsilon_{2_i}/W_{2_i} > 0)$$

$$= X_{2_i}\beta + E(\varepsilon_{2_i}/\varepsilon_{2_i} > -X_{2_i}\beta). \qquad (3)$$

In general we expect that the second term on the right will <u>not</u> be equal to zero and therefore estimation of the wage offer omits a variable.

If we assume ε_1 and ε_2 are jointly normally distributed then

$$E(\varepsilon_{2_i}/\varepsilon_{2_i} > -X_{2_i}\beta) = \frac{\sigma_{22}}{(\sigma_{22})^{1/2}}\lambda_i \qquad (4)$$

where $$\lambda_i = \frac{\frac{1}{\sqrt{2\pi}} e^{\frac{-\phi_i}{2}}}{\int_{\phi_i}^{\infty} \frac{1}{\sqrt{2\pi e}} \frac{-t^2}{2}\, dt}$$

and $$\phi_i = -\frac{X_{2_i}\beta}{(\sigma_{22})^{1/2}}.$$

The denominator of λ_i is the distribution function and the numerator is the density function for the standard normal random variable. If one could estimate ϕ_i and therefore λ_i, one could enter it into equation (3) and use ordinary least squares to obtain unbaised estimates of β.

In the case of censored sample one can use probit analysis to estimate ϕ_i and thus λ_i. A censored sample is one where it is possible to use the sample to estimate the probability that any observation will be observed. In terms of our model, we can estimate the probability of observing wage offers by estimating the probability that people work. People work if and only if the wage offer is greater than the reservation wage ($W_2 > W_1$) and $W_2 - W_1$ is greater than zero only if people work.

$$E(W_{2_i} > W_{1_i} / X_{2_i}\beta - X_{1_i}\alpha,\ W_{2_i} > 0) = X_{2_i}\beta - X_{1_i}\alpha + \frac{\sigma_{12} - \sigma_{22}}{(\sigma_{22})^{1/2}}\ \lambda_i$$

We can use probit to estimate

$$\phi_i = \frac{X_{2_i}\beta - X_{1_i}\alpha}{(\sigma_{22})^{1/2}}$$

which can then be used to estimate λ_i.

The probit can be specified as follows

$$LFP = \beta_0 + \frac{\beta_j - \alpha_j}{(\sigma_{22})^{1/2}} X_j + \frac{\beta_k}{(\sigma_{22})^{1/2}} X_k + \frac{\alpha_\ell}{(\sigma_{22})^{1/2}} X_\ell$$

where the X_j are independent variables which appear in both the wage offer and reservation wage equation and the X_k are variables which appear only in the wage offer equation and the X_ℓ are variables which appear only in the reservation wage equation. From the probit we get estimates of $\frac{\beta_j - \alpha_j}{(\sigma_{22})^{1/2}}$, $\frac{\beta_k}{(\sigma_{22})^{1/2}}$ and $\frac{\alpha_\ell}{(\sigma_{22})^{1/2}}$. Using the first estimate,

we can get estimates of lambda to be used as an independent variable in the wage offer equation. Ordinary least squares estimation of the wage offer equation (including lambda) yield unbiased estimates of β_j and β_k. With estimates of β_k from OLS and the estimates of $\frac{\beta_k}{(\sigma_{22})^{1/2}}$ from the probit we can calculate estimates of $(\sigma_{22})^{1/2}$ [1]. With this estimate of $(\sigma_{22})^{1/2}$ and probit estimates of $\frac{\alpha_\ell}{(\sigma_{22})^{1/2}}$, we can derive estimates of α_ℓ. With estimates of $\frac{\beta_j - \alpha_j}{(\sigma_{22})^{1/2}}$ from probit and estimates of β_j from OLS we can obtain estimates of the α_j.

The Model

The model consists of three equations; the probit equation, the wage offer equation, and the derived reservation wage equation. The probit equation is:

$$\begin{aligned} LFP = {} & \frac{\beta_0 - \alpha_0}{\sigma} + \frac{\beta_1 - \alpha_1}{\sigma} EX1 + \frac{\beta_2 - \alpha_2}{\sigma} EX2 + \frac{\beta_3 - \alpha_3}{\sigma} EX3 \\ & + \frac{\beta_4 - \alpha_4}{\sigma} EX4 + \frac{\beta_5}{\sigma} EDUC + \frac{\beta_6 - \alpha_6}{\sigma} SICK + \frac{\beta_7 - \alpha_7}{\sigma} MARST \\ & + \frac{\beta_8 - \alpha_8}{\sigma} MSPABS + \frac{\beta_9 - \alpha_9}{\sigma} RURE + \frac{\alpha_{10}}{\sigma} SPINC - \frac{\alpha_{11}}{\sigma} NDEPC \\ & - \frac{\alpha_{12}}{\sigma} INCFA - \frac{\alpha_{13}}{\sigma} PUBTR - \frac{\alpha_{14}}{\sigma} PRVTR; \end{aligned}$$

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[1] This estimate is an average if there is more than one different independent variable in the wage offer equation.

where

EX1 = 1 if 2 < (age - education - 5) < 15, 0 otherwise,

EX2 = 1 if 14 < (age - education - 5) < 26, 0 otherwise,

EX3 = 1 if 25 < (age - education - 5) < 37, 0 otherwise,

EX4 = 1 if 36 < (age - education - 5) < 48, 0 otherwise,

EDUC = years of education,

SICK = 1 if the respondent indicated he was limited in the kind or amount of work he could do, 0 otherwise,

MARST = 1 if married, spouse present, 0 otherwise,

MSPABS = 1 if married, spouse absent, 0 otherwise,

RURE = 1 if lived on a farm or in the country, 0 otherwise,

SPINC = spouse's income,

NDEPC = number of dependent children,

INCFA = income from assets,

PUBTR = public transfer payments,

PRVTR = private transfer payments,

LFP = 1 if the respondent worked in 1971, 0 otherwise.

The probit equation gives us an estimation of the probability that people work. People work only if the wage offer they receive is greater than or equal to their reservation wage. Thus the coefficients of the independent variables are expressed to reflect this relationship.[1] Given this, the expected signs of the coefficients depend on the sign

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[1] The β_i refer to coefficients which appear in the wage offer equation and the α_i refer to coefficients which appear in the reservation wage equation. σ is $(\sigma_{22})^{1/2}$.

of σ, the expected sign of the coefficients in the reservation wage equation, and the expected sign of the coefficients in the wage offer equation. Previous labor force participation estimates give us, however, some expectations regarding the relationship between the dependent and independent variables.

The EX1-EX4 variables are included to measure the pure effect of age on labor force participation. (Education is subtracted because we include it as a separate independent variable.) In general we expect a strong positive relationship between labor force participation and the variables EX1 and EX2 because these variables include younger men who have been shown to have a strong labor force attachment [11]. The sign of EX3 and EX4 is ambiguous because these variables represent older men (55-64 years of age) whose labor force attachment is weaker [11].[1]

Education is expected to have a positive effect on labor force participation because the opportunity cost of nonparticipation is larger for those people with more years of schooling. Previous research has shown that labor force participation rates for males steadily increases as education levels increase [11].

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[1]The ages represented by the EX variables overlap because years of education are subtracted. The maximum and minimum ages are as follows:

Variable	Minimum	Maximum
EX1	25 years	38 years
EX2	25 years	49 years
EX3	31 years	60 years
EX4	42 years	64 years

The health dummy is expected to have a negative effect on labor force participation because ill health reduces the opportunity cost of not working or conversely increases the costs of working in the form of difficulty of performing certain tasks, discomfort, etc. Not only does ill health increase the costs of working in the form of discomfort but it may increase out-of-pocket costs as well. Transportation costs, for example, may be higher for handicapped people if they must rely on special buses which have fork lifts to get them in and out.

The single best predictor of labor force participation for males is marital status. Bowen and Finegan [11] have reported participation rates for prime age males who were married with wife present compared to those who were separated from their wives. The latter group had a participation rate 18.5 percentage points lower than the former. The importance of marital status as an indicator of labor force behavior may be explained in two ways. First, marriage implies a greater necessity for earning money income because of larger financial responsibilities. Second, marriage may serve as a proxy for "normalcy." Married men seem better able to find and keep a job than those who are not. For these reasons, we expect a strong, positive relationship between the married, spouse present variable and labor force participation and a negative relationship between the married, spouse absent variable and labor force participation.

We include a dummy variable for rural environment for two reasons. First, living in a nonurban setting may reduce job opportunities and therefore participation. Second, living in a rural environment may

increase the opportunities for home production (gardening) which would also reduce labor force participation.

The number of dependent children is expected to have a positive effect on labor force participation by increasing a male's taste for money income because of increased financial responsibilities.

In general, we expect a negative relationship between the other income variables (spouse's income, asset income, public and private transfers) and labor force participation. The larger the amount of other income an individual has, the smaller is the necessity of working (assuming leisure is a normal good). Asset income, however, may serve as a proxy for a person's taste for work. People who are highly motivated to work may acquire more assets and thus have more asset income than those people less motivated to work. In this case, the relationship between the two variables is positive.

In the case of public and private transfers, the interpretation of the relationship may pose a problem. The direction of causality is not obvious. Is labor force participation reduced because of the availability of transfer income.[1]

The wage offer equation is:

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[1]Respondents who received disability insurance benefits or Aid to the Blind or Aid to the Permanently and Totally Disabled (DIABAPTD) were excluded from the sample for this reason. Also see Berkowitz, Johnson and Murphy [9].

$$WAGES = \beta_0 + \beta_1 EX1 + \beta_2 EX2 + \beta_3 EX3 + \beta_4 EX4 + \beta_5 EDUC + \beta_6 SICK + \beta_7 MARST + \beta_8 MSPABS + \beta_9 RURE + \gamma\lambda \quad [1]$$

where the independent variables have been defined above and the dependent variable is the hourly wage rate for labor force participants in 1971.

In general, we expect that the independent variables in the wage offer equation reflect the marginal productivity of the person who receives the wage. As noted above, the EX1-EX4 variables reflect the age of the respondent. The effect of increasing age on wage offers is ambiguous. Increases in age may indicate increases in experience thus increasing the person's marginal productivity and wage offers. On the other hand, depending on the individual's occupation, increasing age may signal increasing infirmity and thus a decrease in marginal productivity and wage offers.

The more years of education a person has, the higher is his marginal productivity and wage offer. If an individual is limited in the kind and amount of work he can do because of health, we expect wage offers to be lower. As noted above, the marital status variable can be thought of as an indicator of the psychological factors which

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[1] λ is the bias correction variable which is obtained from the probit estimates. It is the ratio of the distribution function to the density function of the standard normal random variable from $\phi = \frac{X_{2_i}\beta - X_{1_i}\alpha}{\sigma}$ to infinity for the ith observation. γ is the estimated coefficient of λ and is equal to $\frac{\sigma_{12} - \sigma_{22}}{\sigma_{22}^{1/2}}$.

may be viewed by the employer as evidence of stability, thereby increasing marginal productivity and wage offers. We expect wage offers in a rural environment to be lower than in urban areas reflecting labor demand conditions.

The reservation wage equation is:

$$\begin{aligned} RESW = {} & \alpha_0 + \alpha_1 \, EX1 + \alpha_2 \, EX2 + \alpha_3 \, EX3 + \alpha_4 \, EX4 + \alpha_6 \, SICK \\ & + \alpha_7 \, MARST + \alpha_8 \, MSPABS + \alpha_9 \, RURE + \alpha_{10} \, SPINC + \alpha_{11} \, NDEPC \\ & + \alpha_{12} \, INCFA + \alpha_{13} \, PUBTR + \alpha_{14} \, PRVTR \end{aligned}$$

where the independent variables are as defined above and RESW is the hourly reservation wage.

Note that the reservation wage equation is <u>derived</u> from the probit equation and the wage offer equation. That is, estimates of coefficients in these two equations (along with estimates of σ) are combined to get estimates of the alphas.

An individual has various alternatives to working available to him or her and the reservation wage depends on the value of the person's time when involved in these other activities as well as alternative sources of income and the costs of working.

The older a person is, the greater the reservation wage is expected to be because as age increases, the disutility of working increases. Similarly, if a person has health problems, the more distasteful working is likely to be resulting in a higher reservation wage. In addition, as noted above, health problems may increase the explicit costs of working which also results in a higher reservation wage. Marital status is expected to be negatively related to the

reservation wage for males because they have traditionally shouldered the income earning responsibilities of a family. Thus in order to meet this responsibility, they accept lower wages. On the other hand, if the spouse is absent, we expect the reservation wage to be higher because the income-earning responsibility is lessened. If a person lives on a farm or in the country we expect his reservation wages to be higher because the opportunities for valuable home-time would be greater than in an urban environment. We expect the availability of other income such as asset income to increase the reservation wage because other sources of income are substitutes for labor income. As the number of dependent children increases, the reservation wages are expected to go down because the larger the family size, the larger are income requirements.

The Results

The probit equation

The probit equation was estimated using a 20 percent subsample from the 1972 Survey of Nondisabled and Disabled Adults. The 20 percent subsample consisted of 1268 white males and 353 black males who were between 25 and 64 years of age. The sample was divided into black and white cohorts because of the suspicion that these two groups come from different populations. Bowen and Finegan note that the participation rates for prime-age black are lower than for their white counterparts [11]. Hall [18] and Boskin [10] also report racial differences

when analyzing labor force participation and hours worked.

The age limits were chosen because we wanted to eliminate those people who do not work because they are still in school (ages 18-24) and those people who have retired (ages 65 and over).

Table 1 presents the results of this estimation. Of the fourteen independent variables, eight were significant at the 5 percent level for white males and four were significant at the 5 percent level for black males.

Given the minimum and maximum years of education[1] the variables EX1-EX4 represent the following ages:

Variable	Minimum age	Maximum age
EX1	25 years	38 years
EX2	25 years	49 years
EX3	31 years	60 years
EX4	42 years	64 years

The coefficients of all these variables, for white males, is positive, as expected, and EX1, EX2, and EX3 are significant. For white males, being aged 25-60 significantly increases the probability of labor force participation. The coefficients of EX1-EX4 are much smaller for black males than for white males (EX4 is negative) and none is significant. This suggests that being a member of the prime-age group (25-54) does not have the same effect on labor force participation for black males as it does for white males and supports our hypothesis

[1]For males the maximum years of education reported in the sample is nineteen years for whites and eighteen years for blacks. The minimum for both groups is zero.

Table 1. Probit equation[a,b]

Independent variables	White males		Black males	
	Coefficient	t ratio	Coefficient	t ratio
Experience/age				
2-14 years (EX1)	.6021	2.5*	.0839	.2
15-25 years (EX2)	.4409	2.1*	.0997	.3
26-36 years (EX3)	.5377	3.0*	.1914	.6
37-47 years (EX4)	.2626	1.6	-.2768	-1.1
Education (EDUC)	.0833	4.9*	-.0017	.1
Health dummy (SICK)	-.9800	-7.4*	-1.8296	-7.0*
Married, spouse present (MARST)	.5612	4.0*	.6555	2.9*
Married, spouse absent (MSPABS)	-.0567	-1.0	.3461	1.1
Rural residence (RURE)	.1655	1.2	.2205	.8
Spouse's income (SPINC)	.000003	.1	.00005	1.0
No. of dependent children (NDEPC)	.0179	.4	.0571	.8
Asset income (INCFA)	-.000007	-.2	.0001	.4
Public transfers (PUBTR)	-.0003	-9.9*	-.0004	-5.8*
Private transfers (PRVTR	-.0002	-3.8*	-.0002	-1.2
Constant	.2470	1.1	1.5241	4.3*
N	1268		353	

[a]The dependent variable is labor force participation.

[b]Computed using data from [29].

*Significant at the 5% level.

that black and white men come from different populations.

The education variable has a positive, significant coefficient for white males which agrees with our expectation that more years of schooling increases the opportunity cost of nonparticipation. For black males, the coefficient of the education variable is negative, very small, and nonsignificant indicating that schooling has little effect on participation. This result is consistent with work done by Bowen and Finegan [11]. First, they report that participation rates of blacks are less sensitive to changes in educational attainment levels than for all prime-age males which agrees with our small, insignificant coefficient. Second, the percentage of the black male population in lower education categories is higher than for prime-age males as a whole. The negative relationship we get may be explained by the fact that blacks with less education "...because of a more random selection procedure, this group contains a relatively large proportion of individuals with considerable innate ability, drive, and so on" [11, p. 57].

The health dummy coefficient is negative and significant for both groups as expected, although it is almost twice as large for the black sample. If blacks are over-represented in unskilled occupations, then ill health would be expected to have a larger negative effect on participation.

The coefficient of the variable indicating the respondent is married is positive and significant for both groups. The dummy

variable representing married, spouse absent is negative and non-significant for white males. The coefficient for black males, while not significant, is large and positive. An explanation for this result may be that a larger percentage of black males fall into the category of married, spouse absent. As a result, other characteristics, leading to higher participation for this group, dominate financial responsibilities (the lack thereof) which suggests lower participation.

Two of the four other income variables are negative and significant as expected for white males, although for both public and private transfers the coefficients are small. Both the coefficients for asset income (which is negative) and spouse's income (which is positive) are small and insignificant. For black males, only the coefficient of public transfers is significant. The remaining independent variables, rural environment, and number of dependent children are insignificant for both groups.

The correlation coefficients among the independent variables for both groups show little evidence of multicollinearity[1]. The largest correlation coefficient in the matrix for black males is .53 between EX1 and EX2. For whites, it is .58 between EX2 and EX3 and between public and private transfers. The only real difference between the correlation matrices of the two groups is the correlation between public and private transfers. As noted above, for whites it is .58. For

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[1]See Appendix A for the correlation matrices of the independent variables in the probit equations.

blacks, it is .05. Public transfers include items such as unemployment compensation, Veterans' payments, etc. Private transfers include contributions from family outside the household plus things such as private disability pensions. Whites are more likely to receive both than are blacks possibly because fewer blacks have private disability insurance. Having a private disability/pension plan might indicate prior labor force attachment and perhaps a "better" job. These results are consistent with the importance of the private transfer payment variable for white males in labor force behavior and its nonimportance for blacks.

The wage offer equation

The wage offer equation was estimated using the same subsample used to estimate the probit equation except that those respondents who did not work in 1971 (LFP = 0) were excluded. The white male sample consisted of 1051 men aged 25-64. The black sample had 224 observations. The R^2 was .43 for the white group and .51 for the black group. Of the ten independent variables, five were significant at the 5 percent level for the white group. For black males, none was significant. The wage offer regressions include the estimated lambda coefficient obtained from the probit and therefore, the bias introduced when using truncated samples is avoided. Table 2 presents the results.

The coefficients of the EX1-EX4 independent variables are negative and only the first is significant for white males. If these variables

Table 2. Wage offer equation with lambda[a,b]

Independent variables	White males		Black males	
	Coefficient	t ratio	Coefficient	t ratio
Experience/age				
2-14 years (EX1)	-1.3062	-2.6*	.9546	.9
15-25 years (EX2)	-.3092	-.7	.6447	.7
26-36 years (EX3)	-.2155	-.5	.1956	.2
37-47 years (EX4)	-.4874	-1.2	.7543	1.0
Education (EDUC)	.3581	8.9*	.0735	.9
Health dummy (SICK)	-1.1686	-4.3*	-.0397	-.4
Married, spouse present (MARST)	1.3603	4.2*	-.0170	-.1
Married, spouse absent (MSPABS)	.3607	.2	-.0878	-.1
Rural residence (RURE)	-.0035	-.1	-1.2028	1.5
Lambda	1.1764	5.1*	-.5443	-.5
Constant	.5062	.8	3.0233	3.1*
R^2	.4336		.5139	
N	1051		224	

[a]The dependent variable is actual hourly wages in 1971.

[b]Computed using data from [29].

*Significant at the 5% level.

represent experience, then the estimates for white males suggests that having only 2-14 years of experience reduces wage offers by $1.31 per hour, other things being equal. That is, the lack of experience is associated with less marginal productivity. The pattern for white males suggests that being older decreases the reduction in wages until the oldest group is reached. Then, being older increases the reduction in wage offers. This lends support for interpreting the first three age group variables as proxies for experience. The fourth may be interpreted as a proxy for decreased marginal productivity due to advancing age, closeness to retirement, etc.

The coefficients of these variables for black males are positive and insignificant. The pattern for black males moving from younger to older age groups is opposite that of the white males until the oldest group is reached (EX4). The youngest black males have higher wage offers than do black males in the next two age groups. To interpret age as a proxy for experience in this case would seem inappropriate. Perhaps, for black males, increasing age represents decreasing marginal productivity due to infirmity. If blacks are under-represented in occupations where experience is perceived as being more important, such as white-collar jobs, and over-represented in jobs which require more physical capability, then the differences between the two groups can be explained.

The education coefficient is positive and significant at the one percent level for white males as expected. It is positive, insignificant and small for the black group. If relatively more blacks

are concentrated in lower education attainment levels as reported by Bowen and Finegan [11] and relatively more blacks are in unskilled jobs, then the latter result is not surprising. Increases in years of education may not represent increases in marginal productivity for this group. That is, a person with a grade school education may be as well equipped to drive a taxi as a person with a college education.

The health dummy has a large, negative coefficient for white males as expected. For the black group, the coefficient is quite small and insignificant. We would expect that ill health would be an important explanation of wage offers for black males because of their representation in unskilled jobs which require good health. Perhaps the variable we are using (response to whether health limited kind and amount of work one could do) does not measure what we want to measure for this group. The perception of ill health on the part of the respondent may not be the same as that of the employer.

Again, for the black group, the coefficient of the married, spouse present variable is small and has the wrong sign but conforms to our expectation for white males. For white males the assumption is that marital status is a proxy for stability or desireable psychological traits which are perceived to increase marginal productivity. For black males this may not be true. As Bowen and Finegan point out, "...a disproportionately large fraction of prime-age Negro males were not married with wife present" [11, p. 52]. If married, spouse present is not the

norm for black males, that status can hardly be judged as representing "normal" characteristics.

The married, spouse absent variable is insignificant for both groups. The rural environment dummy has negative coefficients for both as expected but is much larger for black males indicating that living in a rural environment has a disproportionately large effect on black wage offers.

The reservation wage equation

The reservation wage equation is calculated from the wage offer equation and the probit equation. The first step is to calculate $\hat{\sigma}$. Recall that the wage offer equation has one independent variable that does not appear in the reservation wage equation. In our model, that variable is the education variable. We have an estimate of the coefficient for education from the probit which is interpreted as $\frac{\hat{\beta}_5}{\hat{\sigma}}$. From the wage offer equation we have an unbiased estimate of $\hat{\beta}_5$. Given both of these, we can derive $\hat{\sigma}$. From our estimates:

$\hat{\beta}_5 = .3581$ for white males,

$\hat{\beta}_5 = .0735$ for black males

and

$\frac{\hat{\beta}_5}{\hat{\sigma}} = .0833$ for white males,

$\frac{\hat{\beta}_5}{\hat{\sigma}} = -.0017$ for black males.[1]

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[1] See Tables 1 and 2.

Therefore

$$\frac{.3581}{\hat{\sigma}} = .0833 \text{ and } \hat{\sigma} = 4.2989 \text{ for white males,}$$

$$\frac{.0735}{\hat{\sigma}} = -.0017 \text{ and } \hat{\sigma} = -43.2353 \text{ for black males.}$$

To calculate the alpha coefficients of the reservation wage equation, we use the estimates of $\hat{\sigma}$ and estimates of the coefficients from the probit and wage offer equations. For example, from probit we have estimates of $\frac{\hat{\beta}_1 - \hat{\alpha}_1}{\hat{\sigma}}$ and from the wage offer equation, we have estimates of $\hat{\beta}_1$.

$$\frac{\hat{\beta}_1 - \hat{\alpha}_1}{\hat{\sigma}} = .6021 \text{ for white males,}$$

$$\frac{\hat{\beta}_1 - \hat{\alpha}_1}{\hat{\sigma}} = .0839 \text{ for black males}$$

and

$$\hat{\beta}_1 = -1.3062 \text{ for white males,}$$

$$\hat{\beta}_1 = .9546 \text{ for black males.}^{1}$$

Therefore

$$\frac{-1.3062 - \hat{\alpha}_1}{4.2989} = .6021 \text{ for white males,}$$

$$\frac{9546 - \hat{\alpha}_1}{-43.2353} = .0839 \text{ for black males}$$

and

$$\hat{\alpha}_1 = -3.8946 \text{ for white males,}$$

$$\hat{\alpha}_1 = 4.5820 \text{ for black males.}$$

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[1] See Tables 1 and 2.

The reservation wage coefficients are presented in Table 3. For white males, the coefficients of the EX1-EX4 are all negative; for black males, they are positive except for the coefficient of EX4. The negative sign for white males may be due to the fact that working is the norm for this group regardless of age until age 65. Reservation wages increase over age groups, however, indicating that as one gets older, the opportunity cost of working increases. The positive signs of the coefficients for the first three age groups may be because black males in these age groups perceive more alternatives to working or value leisure more. These alternatives may disappear with advancing age or older black males have reduced expectations about wages they can hope to receive.

The coefficient of the health dummy is positive for both groups and very large for blacks. If blacks are more likely to be in physically demanding occupations, the cost of working may be extremely high if one has a disability. The coefficient of the married, spouse present variable is negative as expected for white males, large and positive for black males. Black males may have a large response to alternative sources of income such as a wife's potential salary. That is, the increased financial responsibility associated with marriage may be supplanted by the possibility of substitute income that a spouse may generate. The rural environment variable has a positive coefficient as expected for blacks but a negative one for whites. If labor force participation is the norm for white males, living where job opportunities

Table 3. Reservation wage equation[a]

Independent variables	White males	Black males
	Coefficient	Coefficient
Experience/age		
2-14 years (EX1)	-3.8946	4.5820
15-25 years (EX2)	-2.2046	4.9553
26-36 years (EX3)	-2.5270	8.4708
37-47 years (EX4)	-1.6163	-11.2132
Health dummy (SICK)	3.0443	79.1430
Married, spouse present (MARST)	-1.0522	28.3237
Married, spouse absent (MSPABS)	.6044	14.8759
Rural residence (RURE)	-.7150	8.3306
Spouse's income (SPINC)	-.00001	.0022
No. of dependent children (NDEPC)	-.0770	2.4687
Asset income (INCFA)	.00003	.0043
Public transfers (PUBTR)	.0013	-.0173
Private transfers (PRVTR)	.0009	-.0086
Constant	-.5556	68.9182
$\hat{\sigma}$	4.2989	-43.2353

[a]Calculated from estimates of the coefficients in Table 1 and Table 2.

are fewer may reduce reservation wages for that group. The sign of the coefficient for the number of dependent children variable is positive for black males and negative for white males but quite small.

The coefficients of the other income variables are expected to be positive and are, with the exception of spouse's income, for white males although all are very small. The coefficients of public and private transfers are negative for the black group.

Summary and Conclusion

For white males, we are satisfied with the wage estimation results. More than half of the independent variables are significant at the 5 percent level in the probit equation. With the exception of spouse's income (which is very small) and the rural environment dummy, all of the variables have the expected sign. The wage offer equation has a reasonable R^2 for cross-sectional data and four of the nine independent variables are significant. The resulting coefficients of the reservation wage equation seem reasonable.

The results for black males are less satisfying. For the probit, only three of the fourteen variables are significant. For the wage offer equation, none of the independent variables is significant, although the R^2 is reasonable. The reservation wage equation for blacks strains credibility. The size of the estimated standard deviation indicates that the model for black males needs to be respecified. Recall the $\hat{\sigma}$ is estimated by having at least one

independent variable in the wage offer equation that is not in the reservation wage equation. In our model, that variable is education. We chose education because reservation wages depend on the value of alternative uses of time. Education, while obviously important in wage offers, would seem to have little effect on the former. Perhaps for black males, education is the inappropriate variable to omit. Respecification of the model for this group should include variables which measure discrimination, for example, in the wage offer equation and variables which measure motivational factors, such as whether the respondent attended segregated schools in the reservation wage equation.

Because the estimates of reservation wages are unbiased for both groups, and because our budget constraint precluded further efforts to come up with more satisfactory results for blacks, we use these results in our labor supply equations.

CHAPTER III. LABOR SUPPLY AND HEALTH

Introduction

The major objective of this chapter is to investigate the effect of poor health on labor force behavior. Specifically we compare models of labor supply which do not include health variables to models which do to see if the addition of health variables increases the explanatory power of the model in terms of $\bar{R}^2$. We expect that functional limitations by themselves do not explain the disability status of impaired persons. A person becomes disabled (reduces labor supply) because of the interaction between ill health and other economic and social characteristics. If this hypothesis is supported by our results then it would suggest that income replacement for disabled persons based on medical grounds is inappropriate and policies of preventive health care would not be expected to reduce the cost of the DI program.

Berkowitz, Johnson and Murphy (BJM) [9] conducted similar research using 1965 data. A second objective is to compare our results, using 1971 data, to their results. If the results are consistent, our research strengthens the conclusions drawn by BJM.

In addition, we want to examine which types of functional limitations are important in causing reduced labor supply. Information of this sort might provide guidelines for preventive or remedial health policies. If, for example, a person who has difficulty seeing reduces his labor supply, then a program designed to make glasses readily available to him might induce him to return to work.

Finally, we wish to see if we can gain some insights into the relationship between health and other determinants of labor supply. Bowen and Finegan [11, p. 65] have noted that much of the observed relationship between education and labor force participation rates may be due to health. BJM [9, p. 91] point out that some of the effect of marital status on labor supply may be caused by the relationship between marital status and mental or nervous disorders.

First we provide a brief theoretical framework from which we derive our models of labor supply. Next we specify our statistical model and present our results. Finally we summarize our results and draw conclusions.

Theoretical Framework[1]

The theory of labor supply assumes that the individual maximizes a concave utility function subject to a resource constraint. The major resource owned by consumers is time which may be used in two ways. The person may spend his time working, for which he receives a wage or he may use his time in nonmarket activities called leisure, the opportunity cost of which is the wage rate. The money earned by working may be spent on goods and services which can be aggregated into a composite good. The individual also may have nonlabor income.

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[1]The following discussion is based on Ashenfelter and Heckman [2].

The individual maximizes:

$$U = U(L, X) \tag{5}$$

where L = hours spent on nonmarket activities (leisure),

X = the composite good.

The resource constraint is as follows:

$$PX = W(T - L) + Y = WH + Y \tag{6}$$

where $H \equiv T - L$,

and P = the price of the composite good,

W = the hourly wage rate,

T = total time available,

Y = nonlabor income, and

H = hours spent working.

Equation (6) can be written as

$$\overline{PX} + \overline{WL} = \overline{WT} + \overline{Y} \tag{7}$$

to point out the concept of "full income" [7] which consists of the amount spent on goods and services, and on leisure.

Equations (5) and (7) can be combined to yield the following constrained utility maximizing equation:

$$\Phi = U(L, X) + \lambda(PX + WL - WT - Y).$$

The first order conditions for utility maximization are:

$$\frac{\partial \Phi}{\partial L} = \frac{\partial U}{\partial L} + \lambda W = 0 \tag{8}$$

$$\frac{\partial \Phi}{\partial X} = \frac{\partial U}{\partial X} + \lambda P = 0 \tag{9}$$

$$\frac{\partial \Phi}{\partial \lambda} = PX + WL - WT - Y = 0 \tag{10}$$

for given values of P, W, and Y.

These first order conditions require that the marginal utility of leisure equal the marginal utility of income times the wage rate; that the marginal utility from consuming the composite commodity equals the marginal utility of income times the price of the commodity; and that the budget constraint be fulfilled. Equations (8), (9), and (10) are a system of three equations in three unknowns (L, X, and λ) and three parameters (P, W, and Y). The solution of this system of equations results in three equations, one of which is the demand for leisure:

$$L = L(W, P, Y).$$

Since there are only two uses of time in the model, leisure and working, any change in the amount of time allocated to leisure must result in an equal and opposite change in the amount of time allocated to work. Thus, the supply of labor can be expressed as follows:

$$H = H(W, P, Y). \tag{11}$$

A standard way of estimating labor supply is to hypothesize a linear

approximation of equation (11) [2]. A linear model might take the following form:

$$H = \beta_0 + \beta_1 W + \beta_2 Y + \varepsilon \tag{12}$$

The models we estimate use equation (12) as a basis.[1]

The focus thus far has been on the theory of labor supply in terms of the determinants of the number of hours worked. For primary workers, the number of hours worked may not be a choice variable. Institutional constraints may only allow an all-or-nothing decision about working or not working. For this reason we are interested in the determinants of labor supply in the form of participation rates as well. The major theoretical difference between hours worked models and participation models is that there is no income effect associated

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[1] There is a problem in using the linear model in that the substitution effect of a change in wages may be negative under certain conditions. The change in hours resulting from a change in the wage rate is equal to a substitution effect and an income effect. Referring to equation (12):

$$\frac{\partial H}{\partial W} = \beta_1 = S + \frac{\partial H}{\partial Y} H$$

where S is the substitution effect and is positive, and $\frac{\partial H}{\partial Y}$ is the income effect and is negative.

Rewriting the above equation:

$$S = \beta_1 - \frac{\partial H}{\partial Y} H.$$

Empirically β_1 and $\frac{\partial H}{\partial Y}$ have been shown to be less than zero [3]. If H is small, then it is possible for S to be negative. Given "well behaved" utility functions, utility maximization requires a positive substitution effect. Since the dependent variable in our hours worked models is annual hours worked, we do not expect this to occur.

with wage rate changes in the latter. When wage rates increase, more people start to work. There is no income effect because there was no income (from own wages) prior to the decision to become a labor force participant.

The following section discusses the specific form of the labor supply models we used.

The Model

Our objective is to investigate the effects of a number of different independent variables on labor supply. These variables can be loosely classified into three groups; demographic variables, economic variables, and health variables. In general form the model we use is the following:

$$\begin{aligned}\text{Labor supply} = {} & \beta_0 + \beta_1 \text{ Age} + \beta_2 \text{ Marital status} + \beta_3 \text{ Race} \\ & + \beta_4 \text{ Education} + \beta_5 \text{ Public transfers} + \beta_6 \text{ Wages} \\ & + \beta_7 \text{ Asset income} + \beta_8 \text{ Family transfers} \\ & + \beta_9 \text{ Nonrespondent income} + \beta_{10} \text{ Rural residence} \\ & + \beta_{11} \ldots \beta_{18} \text{ Health variables.}\end{aligned}$$

The demographic variables in the model are age, race and marital status.[1] In other works [9, 11] age has been found to be negatively related to labor supply. Reasons for this may be related to declines in productivity due to increases in age and/or the increasing incidence

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[1] We classify education and rural residence as economic variables for reasons discussed below.

of ill health as one ages. Conversely, increasing age, up to some point, may represent increasing marginal productivity due to more years of experience. If wages are related to marginal productivity, an increase in the latter would cause an increase in the opportunity cost of not working. This suggests a positive relationship between age and labor supply, particularly for younger workers. Bowen and Finegan argue, however, that the relationship between age and labor force behavior "...certainly cannot be regarded as powerful..." [11, p. 72]. In spite of this uncertainty about the effect of age on labor supply, we include it as a continuous variable in our model because BJM [9] do. We also follow BJM [9] and divide the sample into "prime-age" subgroups (ages 25-54) and older subgroups (ages 55-64) to control for possible interaction between age and other independent variables in the model.

Race is taken into account in the model by subsampling. The sample was divided into racial subsamples because of observed differences in the labor force behavior of blacks and whites [9, 11].

The marital status variable is included for two reasons. First, marriage may represent obligatory labor force activity for males because of the traditional attitude that husbands support their families. Second, there may be a relationship between marriage and personality disorders. That is, marital status may be a proxy for normal behavior which, for males, implies labor force participation [9, 11, p. 74]. For both these reasons, we expect a strong positive relationship between marital status and labor supply.

Economic variables include education, wages, other income variables and rural residence. Years of education is included as an economic variable because it represents a measure of the opportunity cost of not working [11, p. 58]. Presumably, the better educated a person is, the more skills he possesses and therefore the higher is the wage he can earn if he works. Also education may serve as a proxy for motivation and talent [20]. For both of these reasons we expect a positive relationship between education and labor force behavior.

We tested the model using two different wage variables; actual wages reported by the respondent, and reservation wages.[1] Actual wages are expected to have a positive effect on labor force participation. The effect of wage offers on hours worked is uncertain. If the income effect of a change in wages dominates then hours worked changes in the opposite direction. If the substitution effect is strong, wage changes have a positive effect on hours worked.[2]

The reservation wage is the wage necessary to induce labor force participation. As such, increases in reservation wages are expected to have a negative effect on participation. The effect of a change in reservation wages on hours worked is ambiguous. If the actual wage is greater than the reservation wage and the latter increases, the change in the hours worked depends on the extent of the increase in reservation wages. As long as the actual wage is greater than the reservation wage,

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[1] See Chapter two for the derivation of reservation wages.

[2] Ashenfelter and Heckman [3] find that for primary workers, the wage effects are small and insignificant.

we expect no change in hours worked. In addition, institutional constraints (particularly for primary workers) may not permit adjustment in labor force behavior by varying the number of hours worked.[1]

The other income variables are asset income, public transfer payments, nonrespondent income (income earned by the spouse and by other household members), and family transfers which includes items such as alimony and regular contributions from nonhousehold members. These variables are expected to have a negative effect on labor force behavior because these sources of income can serve as substitutes for labor income. The inclusion of public transfers presents a problem in that often public transfers are forthcoming only if the recipient limits labor supply. Therefore the receipt of such transfers and the concomitant reduction in labor supply is a tautology. To control for this we follow BJM [9, p. 77] in eliminating from the sample those respondents who received (in 1971) Disability Insurance payments, Aid to the Blind, and Aid to the Permanently and Totally Disabled (DIABAPTD) because beneficiaries of these programs must severely restrict labor supply. To control for the endogeneity which may be inherent in the receipt of any public transfers, a second sample was also created which excluded recipients of any transfer payments.

The rural residence variable is included as an economic variable because we view it as a proxy for labor market conditions. Regional information was unavailable in our data so we were unable to use

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[1]This point applys to the relationship between actual wages and hours worked as well.

regional unemployment rates as BJM [9] did. Living in a rural environment may provide greater opportunities for home production and/or may represent limited employment opportunities. For these reasons we expect a negative coefficient for the rural variable.

The Survey of Health and Work Characteristics questionnaire [34] asked respondents whether they had difficulty in performing a variety of functions. If they had difficulty in performing these functions, they were asked if they could perform them at all. The functions include reaching, walking, using stairs, stooping, lifting, speaking, hearing, and seeing. In addition, respondents were asked if they experienced mental or nervous disorders. For each of the first five functions listed above, two dummy variables were created. The first dummy has a value of 1 if the respondent reported difficulty performing the function, and 0 otherwise. The second dummy has a value of 1 if the respondent said he could not perform the function at all, and 0 otherwise. The abilities to hear and speak were determined by interviewer observation. The respondent was asked if he had difficulty seeing. If he responded affirmatively the seeing dummy was given a value of 1 and he was then asked if he had trouble seeing even with glasses. If the answer was yes, the seeing with glasses dummy was given a value of 1. The existence of mental and nervous disorders was ascertained by using a flash card listing various conditions and asking the respondent which conditions were a problem to him.

We combined the health dummies listed above for use in the basic model in the following way. The dummy variables indicating difficulty

in or inability to reach were combined into one variable. The stooping, walking, using stairs variables were combined into one dummy as were the variables indicating difficulty seeing and difficulty seeing even with glasses. The other health variables were included as described above.

There are several things to note about the health variables. First, the responses to the health variables were not medically verified. In the BJM discussion of the health variables, they note that a pretest sample with medical examinations indicate that people underestimate the existence and degree of severity of the reported limitation [9, p. 79]. Second, the limitations were not related to occupational requirements or to whether these limitations have an effect on the kind and amount of work the respondent can do. Thus there is not a tautological relationship between health and work effort. We expect a negative relationship between the health dummies and labor force behavior.

Results

The data

The data used for the analysis are from the 1972 Survey of Disabled and Nondisabled Adults [29] and includes responses from 17,997 persons, aged 20-64, 8633 of whom considered themselves disabled and 9364 who did not. The disabled represent a population of 15.5 million persons and the nondisabled represent a population of 90.7 million persons [1]. From the total, we selected a number of cohorts to

conform to the BJM study [9]. We used a 20 percent subsample of males, aged 25-64. This sample was divided into race subsamples and further divided into age groups 25-54 and 55-64. From each of these age-race groups, persons who received transfers from Disability Insurance, Aid to the Blind, or Aid to the Permanently and Totally Disabled (DIABAPTD) were excluded for one set of regressions and persons receiving any public transfers were excluded for a second set. For each sample, we estimated both labor force participation and hours worked equations.

We tested four different models. First we used only the variables used in the BJM study [9]. Next we substituted reservation wages for actual wages. Then we tested an extended model using reservation wages, a larger number of health variables, more demographic variables, and more economic variables. Last, we tested the extended model using actual wages. The results for the first two models are presented in the next section.[1]

The basic model

Our hypothesis that the inclusion of health variables will not improve the explanatory power of labor supply models can be tested by comparing the $\bar{R}^2$ of models without variables representing functional limitations to the $\bar{R}^2$ of models including these variables. In general our results support this hypothesis.[2] For white males, in all

[1] A brief discussion of the results of the extended model is presented in Appendix C.

[2] See Table 4.

Table 4. $\bar{R}^2$ of labor supply equations

Cohort	Labor force participation						Hours worked					
	No health			Health			No health			Health		
	1966[a]	1972[b]	1972[c]	1966[a]	1972[b]	1972[c]	1966[a]	1972[b]	1972[c]	1966[a]	1972[b]	1972[c]
White males, aged 25-54, no DIABAPTD	.24	.10	.10	.29	.09	.11	.20	.16	.08	.23	.18	.11
White males, aged 25-54, no transfers	.14	.10	.16	.17	.10	.18	-	.13	.10	-	.19	.14
White males, aged 55-64, no DIABAPTD	.32	.20	.09	.34	.19	.10	.38	.28	.07	.42	.30	.08
White males, aged 55-64, no transfers	.44	.17	.15	.51	.20	.15	-	.27	.13	-	.28	.14
Black males, aged 25-54, no DIABAPTD	.13	.31	.11	.33	.20	.03	.13	.08	.04	.19	.28	.17
Black males, aged 25-54, no transfers	.35	.24	.05	.45	.13	-.04	-	.13	.17	-	.24	.30
Black males, aged 55-64, no DIABAPTD	.40	.17	-.09	.51	.37	.25	.18	.07	.10	.40	.29	.22
Black males, aged 55-64, no transfers	.78	.10	-.06	.74	.19	.30	-	.18	.18	-	.26	.25

[a] [9, pp. 101-106].

[b] [29] regressions were run using actual wages.

[c] [29] regressions were run using the same data base as in b but using reservation wages.

age-transfer payment subsamples, the addition of health variables improved the $\bar{R}^2$ only by a small amount and even caused a decrease in $\bar{R}^2$ for two samples.[1] Our results concur with the results obtained by BJM [9] for white males.

BJM [9] found that in the labor force participation equation for young black males, who received no DIABAPTD and in the hours worked equation for old black males who received no transfers the addition of health variables caused the $\bar{R}^2$ to more than double. All four models we tested had similar results for the latter group. For the former group, however, three of the four models we tested resulted in a decrease in $\bar{R}^2$ when health variables were included. Our models show a large increase in the $\bar{R}^2$ in the hours worked equations for both age groups of black males who received no DIABAPTD and in the labor force participation equation of the older group. The no-transfer-payment subsample shows a similar pattern. For the older black males in both the no-transfers and no DIABAPTD subsamples and for both labor force participation and hours worked equations, and for young blacks in the hours worked equation, the hypothesis of no effect of health variables cannot be accepted. In the remainder of this section we discuss the impact of the independent variables on labor supply behavior.[2]

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[1] The two samples are both age groups of white males who received no DIABAPTD.

[2] See Tables 6-21 at the end of the chapter for the estimates of the coefficients of the independent variables.

Demographic variables

The basic model contains three demographic variables, marital status, age and race. Race is taken into account by subsampling and racial differences, where they exist, will be noted throughout the discussion. The marital status variable is expected to have a significant positive effect on labor supply, especially for the participation decision. BJM [9, pp. 90-91] hypothesize that the importance of the marital status variable may be associated with its relationship to health variables when analyzing the labor force behavior of persons who consider themselves disabled. In four of the eight labor force participation equations the marital status coefficient is significant and positive in the BJM analysis. In addition, for these four cohorts, the size of the coefficient decreases when health variables are included in the model, which supports their hypothesis. For the hours worked equations, however, this pattern is not repeated, although the marital status coefficient is positive and significant for two of the four cohorts for which BJM present results [9, pp. 101-106].

In general, our results agree with the BJM [9] results although more weakly. In the labor force participation equations, the marital status coefficient was significant and positive for two of the eight cohorts when we used actual wages and three when we used reservation wages. For young black males who received no transfers, the inclusion of health variables caused the marital status coefficient to decrease and become insignificant. For young black males who received no DIABAPTD, however, the addition of health variables had no effect on

the significance of the marital status variable. These results occur when we use actual wages. When using reservation wages, the health model does not reduce the coefficient of marital status in two of the three samples where it was significant. For older white males, however, the coefficient becomes nonsignificant when the health model is used.

For the hours worked equations the marital status coefficient is nonsignificant for all cohorts, whether actual or reservation wages were used. When actual wages were used, the signs of the coefficient are positive except in the conventional model for old white males who received no transfers. There is no discernible pattern to the change in the marital status coefficient when health variables are added. When reservation wages are used, the signs of the coefficients for the white samples are negative and positive for black samples.

BJM suggest that much of the hypothesized association between health and marital status is due to the variable representing mental disorders [9, pp. 90-91]. Our results provide two pieces of evidence to support this. First, for young black males receiving no DIABAPTD in the hours worked equation using actual wages, the mental disorder dummy is large, negative and significant at the 5 percent level and the marital status coefficient falls from 622.1547 in the conventional model to 6.3109 in the health model. Second, in the labor force participation equation for old white males receiving no DIABAPTD when we use reservation wages, the mental disorder dummy again is significant, and when health variables are included the marital status variable becomes insignificant.

BJM argue that the existence of functional limitations affects blacks more than whites in terms of labor force behavior. The evidence they cite is that "...the explanatory power of the health models (relative to the conventional form) is from four to five times as great for the black cohorts" [9, p. 92]. If the comparison they are making is between black and white subsamples in terms of percentage changes in $\bar{R}^2$ after the health variables are added then in two of four cases for labor force participation and in both cases for hours worked then their results bear them out.[1] But in only two cases is there a particularly large change in $\bar{R}^2$ with the addition of measures of functional limitations. When we make the same comparisons using our results, a different pattern emerges.

In the participation equations the health models have more explanatory power for blacks than for whites only in the older black groups. For the younger groups, the inclusion of health variables causes $\bar{R}^2$ to decrease indicating that the addition of these variables has no value in explaining the variation among the respondents. In the hours worked equations, the health models explain black labor supply behavior better than for their white counterparts in three of four comparisons. The largest changes in $\bar{R}^2$ occur in the participation equations of older black males and the hours worked equations of blacks who do not receive DIABAPTD (both age groups). These results suggest the response of younger black males to ill health is in the form of a

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[1] See Table 5.

Table 5. Percentage change in $\bar{R}^2$ when health variables are added to a conventional model of labor supply

	1966[a]				1972[b]				1972[c]			
	LFP		HRS		LFP		HRS		LFP		HRS	
	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White
Males, aged 25-54, no DIABAPTD	138%	21%	46%	15%	-35%	-10%	250%	13%	-73%	10%	325%	38%
Males, aged 25-54, no transfers	29%	21%	-	-	-46%	0	85%	46%	-180%	13%	76%	40%
Males, aged 55-64, no DIABAPTD	28%	6%	122%	12.5%	118%	-5%	314%	7%	378%	11%	120%	14%
Males, aged 55-64, no transfers	-5%	17%	-	-	90%	18%	44%	4%	600%	0	39%	8%

[a]Calculated using results reported in [9, pp. 101-106].

[b][29]. Regressions were run using actual wages.

[c][29]. Regressions were run using reservation wages.

reduction in hours worked rather than in withdrawal from the labor force while older black males who receive no transfers respond by not working. The reasons for these differences in labor force response may be due to differences between blacks and whites caused by discrimination. We are somewhat suspicious of the large effect of health, particularly on older black males, because of the small and therefore less reliable samples.

Age is included in our models in two ways; the samples were divided into age groups, and age was included as a continuous variable in each of the samples. Labor force participation rates for males fall as age goes up [39]. For example, 1973 participation rates were:

Age	Rate
25-34	96%
35-44	96%
45-54	93%
55-64	78%

BJM get similar results from the data on impaired males in 1965 [9, p. 93].

Cohort did not receive DIABAPTD	Rate
White, 25-54	91%
White, 55-64	76%
Black, 25-54	88%
Black, 55-64	78%

They point out that participation rates for white males are more sensitive to being in the older age group than are blacks as evidenced by the change in sign from positive to negative and the significance of the constant term as one goes from the younger to the older age groups. The same result is not found for the hours worked models [9, p. 94].

Because of the decrease in participation rates as males age, BJM [9] expect a negative relationship between the continuous variable age and both participation decisions and number of hours worked. Their results bear them out with one glaring exception. They find that an additional year of age increases the probability of labor force participation in the older white samples [9, p. 94].[1]

The labor force participation rate for our impaired samples show a different pattern.

Cohort	Rate
White, 25-54	88.5
White, 55-64	90.9
Black, 25-54	75.6
Black, 55-64	68.4

These results may be due to the fact that we used a 20 percent subsample from the 1972 Survey of Disabled and Nondisabled Adults. The striking difference is between the black and white cohorts which is not observed in the population as a whole but which is consistent with the hypothesis that ill health has a larger effect on the black group.

Our results indicate more sensitivity to age in the participation equations for blacks than whites for both transfer payment subsamples

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[1]They offer an explanation of this result which hypothesizes that age is a proxy for survival for these groups. That is, the sample does not include institutionalized persons and older people are more likely to have illnesses which require institutionalization and thus not be included in the sample. In addition, the 55-64 age group (in 1965) may be smaller than normal because some of its members were killed in World War II. The sample, therefore, is subject to sample selection bias, the consequences of which are not known. These "survivors" may have more commitment to the labor force and/or less willingness to succumb to age [9, p. 95].

when actual wages are used. That is, the regressions for the younger age group of black males have significant positive coefficients on the constant term and the older black males have negative constant terms. This may be due to the different participation rates of our sample. In the BJM samples, participation decreases by 15 percentage points as white males age and 10 percentage points as black males age. In our sample, participation rates increase for whites but decrease for blacks.

The marginal effect of the continuous age variable is in most cases not significantly different from zero. There are, however, several pieces of evidence which support the hypothesis that the effect of age on labor force behavior is associated with impairments. In the hours worked equation for older white males who receive no transfers, the inclusion of health variables results in a more negative and now-significant coefficient of the age variable. This suggests that the existence of poor health exacerbates the reduction in hours worked as members of this group age. For young black males who receive no DIABAPTD, however, the addition of health variables causes the coefficient of the age variable to become less negative and now, nonsignificant in the labor force participation equation. For this group, the reduction in participation seemingly induced by aging may be due to ill health. In both cases, there is an apparent relationship between health and age.

Our results do not exhibit the positive relationship between age and participation for older white males. For older black males

who receive no DIABAPTD we do get this anomalous result. The addition of health variables in this model increases the coefficient of the age variable and causes it to become significant. We have no insights as to why we get this result but again, age and health are related.

Economic variables

The basic model includes wages, education, and other income variables as economic variables. We tested the model using two different measures of wages; reported wages and reservation wages calculated as described in Chapter 2. The reservation wage results were disappointing. In only two cases did they perform better (in terms of $\bar{R}^2$) than using actual wages. They did as well as actual wages in only four cases. The reason for this may be that some of the independent variables in the labor supply equation are also in the reservation wage equation. For example, the marital status variable is in both equations. Some of the effect of marital status on labor supply may be felt through the reservation wage variable, diluting the magnitude of the effect of both on labor supply. As was pointed out in the previous chapter, however, the use of reservation wages removes the bias that results from using truncated samples and therefore is statistically valid. In addition, reservation wage seems to be the theoretically more correct variable to use, particularly in the participation regressions.

BJM [9] find that wages have a significant positive effect on participation and a significant negative effect on hours worked for

all the white cohorts. Our results using actual wages are the same. These results are consistent with labor supply theory. The effect of an increase in wages on participation is positive because there is no income effect. The effect of a wage increase on hours worked depends on the relative strengths of the income and substitution effects. These results imply that the income effect dominates. However, these results do not agree with previous work on labor supply behavior of primary workers [3]. The response to changes in wages of both participation and hours worked for prime age males has been found to be insignificant and small. Secondary workers have been found to have large positive labor supply responses to changes in wages [3]. The implication of this is that white males who consider themselves disabled behave more like secondary workers instead of primary workers. As wages go up, more enter the labor force, and vice versa. This result suggests that disabled persons may respond to economic conditions and supports the hypothesis that it is the interaction of health with other characteristics that determines an individual's disability status.[1]

The positive effect of wages on participation and the negative effect on hours worked is repeated in the black cohorts when actual wages are used but less strongly. For black males who receive no

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[1]Bayo and Wilkin [5] point out that prevailing wage rates may have a strong influence on application rates for health related transfer payment programs such as DI.

transfer payments (both age groups), in the participation equations, the addition of health variables results in a loss of significance for the coefficient for wages. This suggests that there is some association between ill health and actual wages for these groups. Some of the variation in participation which appears to be explained by differences in actual wages, may be due to differences in impairments among respondents.

The reservation wage variable is significant and negative in the participation equation for older white males who receive no transfers and in the hours worked equations for both age groups. The only black group for which the variable is significant is in the health version of the participation equation for older black males who receive no transfer payments. The positive sign is puzzling because we expect an increase in reservation wages to reduce participation. The reason for this result may be that the reservation wage equation for black males is not very satisfying as we pointed out in Chapter 2. In addition, the small sample size makes the results less reliable.

BJM [9] expect the education variable to be positive and significant only when labor markets are imperfect; that is, when wages do not reflect the marginal productivity of workers. Their results for the participation equation support their expectations in that the education variable is insignificant except in the health model for younger black males who receive no DIABAPTD. They argue that for this group differences in education reflect differences in marginal

productivity that is not captured by wages and therefore has a significant effect on participation. They suggest the reason this applies to the black group is because of discrimination [9, pp. 97-98].

Our results are not consistent with the above hypothesis. The education variable is significant and positive for prime-age white males using both actual and reservation wages in the participation and hours worked equations and insignificant for all black groups. These results are consistent with Bowen and Finegan's 1969 research [11]. They expect a positive relationship between education and participation in general because "...the opportunity cost of staying out of the labor market is greater for a person with considerable education than for a person with relatively little education" [11, p. 53]. Bowen and Finegan [11] also find a relatively high participation rate for black males who have relatively fewer years of education. They explain this result by pointing out that "...because of a more random selection procedure, this group [who have fewer years of education and higher participation rates] contains a relatively large proportion of individuals with considerable innate ability, drive, and so on" [11, p. 57]. In other words, members of this group are labor force participants in spite of a lower educational attainment.[1]

Bowen and Finegan [11, pp. 63-64] also report a strong relationship between physical limitations and education and the effect of these

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[1]The sign and lack of significance of the education coefficient is consistent with results we obtained when we estimated reservation wages in Chapter 2.

characteristics on labor force participation. They show that if the sample is divided into two groups, one consisting of people who have no activity limitations and one of people who do, the observed increase in participation as years of education increase disappears for the former group. This may be because people with fewer years of education have fewer job opportunities available to them and thus are unable to adjust to health problems by changing jobs, so they drop out of the labor force. Ill health is a stronger deterrent to participation for the poorly educated. We would expect then, that the education variable would be significant for those people who considered themselves disabled. For younger white males, this is the case. For older white males and black males the education variable is insignificant. Perhaps by the time a white male reaches age 55, his opportunity set is not defined so much by the amount of education he has but by his experience, seniority, etc. For black males of all ages, the types of jobs available may be limited more by discrimination than lack of education.

The rationale for analyzing transfer payment subsamples is twofold. First, because the receipt of some types of transfer payments (e.g. DI) is conditioned on restricted labor supply, we want to exclude those respondents from the sample. Second, we want to see if the labor supply response of people who receive some types of transfer payments (e.g. veteran's benefits) is different (lower) than those respondents who receive no transfer payments. If the latter is true, then the concern over the disincentive effects of transfer payments is warranted.

BJM [9, pp. 98-99] find that for prime-age whites and older blacks, the participation rates of the no-transfer group is significantly higher. In addition, the public transfer variable is significant in the participation for all race-age subsamples and in all but the younger black sample for the hours worked equations.

Our results do not support the disincentive hypothesis so strongly.

	No DIABAPTD rate	No transfers rate
White, aged 25-54	86.7	88.5
Black, aged 25-54	70.5	75.6
White, aged 55-64	87.2	90.9
Black, aged 55-64	69.6	68.4

Although participation rates increase for all groups except for older black males, the increases are marginal. The coefficient of public transfers is insignificant for all black groups. It is significant only in the participation equation for older white males and in the hours worked equations for both age groups.

The relationship between other income variables and labor supply is hypothesized to be negative and BJM's results support this expectation. For all but two regressions, one or more of the three other income variables is significant and negative. Older white males' participation decisions are significantly related to all three other income variables. Our results are very different. In only one participation regression (older white males who receive no DIABAPTD) is another income variable significantly negative. Younger white males show a significant positive relationship between asset income

and hours worked. Apparently the asset income variable represents different things to different age groups. Older males appear to view it as a substitute for labor income while for younger males it represents a proxy for labor force commitment. An explanation for the latter result may be that asset income is a proxy for an individual's taste for work. People who are highly motivated to earn income may acquire more assets and thus have more asset income than those less motivated to work.[1]

Labor force participation is the norm for males, especially prime-age males. It may be that the availability of other income, especially in relatively small amounts, does not outweigh the social pressure to have a job.

Health variables

Although we have noted the relationship between health and the other independent variables where applicable in our discussion of the other independent variables, in this section we discuss specific results. In the participation regressions for white males, the types of limitations which have significant coefficients are mental in nature rather than physical. The opposite holds true for the black samples. The limitation variable which was most frequently significant for whites was the presence of nervous disorders while for blacks, it was stooping, walking, or using stairs limitations. If blacks typically

[1]This point is strengthened when the extended model, which also includes a variable representing net value of assets, is tested. The results show that the coefficient of the net value of assets is positive and significant. See Appendix C for further discussion of this point.

have more physically demanding jobs than do whites, this result is not surprising.

The hours worked equations for the younger age groups show a surprising result. The hearing limitation dummy has a significant positive coefficient. This may be a statistical artifact due to the way in which the variable was measured. The interviewer coded the respondent as having difficulty hearing by observation only. We have no way of knowing whether this meant that the respondent wore a hearing aid or whether the interview was conducted in sign language! On the other hand, people with a severe hearing loss are eligible for public programs which may provide them with training and/or motivation that they otherwise would not receive, resulting in a stronger labor force attachment than people with other functional limitations. In subsequent surveys we would like to see a better measure of "has difficulty hearing" in order to investigate its effect on labor supply.

Summary and Conclusions

The regression results using 1971 data are, in general, not as good as the results from 1965 data if goodness of fit is determined by the $\bar{R}^2$. In only one case in the labor force participation regressions is the $\bar{R}^2$ higher for 1971 data than for 1965 and in some cases the $\bar{R}^2$ is much lower. A similar pattern appears in the hours worked equations although the model does better overall. Perhaps the reason for the difference is a difference in the definition of disability used

in the two surveys. BJM [9, p. 8] defined disability as being unable to work or limited in the kind and/or amount of work one could do that lasted for six months or longer. The 1972 survey [29] defined disability as above except that the duration of the limitation lasted three months.[1] Our samples consisted of people who had been disabled (as defined above) for a shorter period of time than the BJM samples. This may mean that our samples contained people who were less severely disabled than the 1965 samples.[2]

Our results support the hypothesis that functional limitations, by themselves, do not explain a great deal of the variation in labor force behavior of impaired white males. The hypothesis is not supported for black males. The addition of health variables causes a large increase in $\bar{R}^2$ in all the hours worked regressions and in the participation regressions for older black males. In the participation equations for younger black males, the health model does a poorer job of explanation. These results suggest that younger black males are

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[1] BJM [9, p. 9] argue that there is some evidence that people who have been disabled for between four to six months and people who have been disabled seven months or longer are not very different groups.

[2] We tested the models described in this chapter using samples of males who did not consider themselves disabled. The regressions for labor force participation for the nondisabled had a much smaller $\bar{R}^2$. This suggests that the models are not very useful in predicting labor force participation of nondisabled people. The participation rates of these groups were quite high which indicates there was little variation in the sample.

more like their white counterparts. The participation decision is the more fundamental labor supply decision for prime-age males. The presence of limitations would seem to have less of an effect on this decision than on the number of hours worked. Younger black males adjust hours worked in response to health problems but not participation. This seems reasonable if blacks are over-represented in unskilled occupations where hours are more flexible.

The hypothesis that ill health interacts with other independent variables in explaining labor supply behavior is supported by our results. In particular, there is some evidence that there is a relationship between mental disorders and marital status. That is, the more likely a person is to have mental disorders, the less likely he is to be married and the less likely he is to be a labor force participant. The observed large positive relationship between marital status and participation is not due to marriage per se but to the mental health of the participant.

The effect of age on labor supply behavior also seems to be related to health. The observed negative effect of age on labor supply may be strengthened by the existence of impairments for older males. For younger males, the negative effect of age on labor supply may be due to health problems rather than aging itself.

The results support the hypothesis that some of the effect of education on participation is due to poor health for prime-age white males. Participation rates for disabled persons are expected to be more sensitive to differences in education than for the nondisabled.

The education variable is significant in the participation regressions for younger white males who considered themselves disabled. When the same model is tested using a sample of nondisabled white males, the education variable is not significantly different from zero.

The exclusion of recipients of transfer payments when the receipt of such payments requires a reduction in labor supply is justified. It appears, from our results, however, that the exclusion of recipients of all transfer payments provides little additional information. The participation rates of the two groups is only marginally different and the $\bar{R}^2$ and significant independent variables are similar for both samples. The cost of excluding transfer payment recipients is a reduction in sample size which may be quite high in the older black groups.

We were disappointed with the results when we tested the model using reservation wages. In general, the reservation wage models did no better and in some cases did a poorer job in explaining labor force behavior than models using the actual wage. The only exceptions were in the participation regression for younger white males who received no transfers and the health version of the hours worked model for older black males who received no transfers. The pattern differs between racial groups, however. The reservation wage models do just about as well as actual wage models in predicting participation of white males. For black males, actual wages do a better job. This may be because the estimate of reservation wages for white males is

more reasonable in terms of the size and sign of the coefficients than the estimate for black males. In future research we would like to improve the reservation wage model for black males.

Our results concur with the BJM [9] results and support the hypothesis that functional limitations alone do not result in a reduced labor supply but interact with other economic and demographic characteristics to determine labor force behavior.

Table 6. Labor force participation, white males aged 25-54, households receiving DIABAPTD excluded

Independent variable	1965 results[a]			
	No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	-.0370	3.29*	-.0038	3.03*
Education	-.0016	0.55	-.0029	1.00
Asset income	+.0006	8.71*	+.0004	.60
Family transfers	-.0189	0.83	-.0212	3.36
Public transfers	-.0077	3.06*	-.0063	7.11*
Nonrespondent income	+.0004	0.76	+.0003	0.68
Marital status	+.1616	5.98*	+.1232	4.54*
Rural residence/UE	-.0452	0.42	-.0377	0.35
Hourly wages	+.4524	8.66*	+.4148	8.10*
Stooping, walking limitations	-	-	-.0700	0.91
Reaching limitations	-	-	-.0156	1.17
Lifting limitations	-	-	-.0714	3.88*
Sensory limitations	-	-	+.0150	0.83
Speech	-	-	-.1972	3.31*
Hearing	-	-	+.0160	0.42
Mental disorders	-	-	-.1914	3.06*
Nervous disorders	-	-	-.7589	1.36
Constant	+.8697	11.10*	+.9568	11.83*
$\bar{R}^2$	.24	-	.29	-
N	751	-	751	-

[a] [9].

[b] [29].

*Significant at the 5% level.

1971 results using actual wages[b]				1971 results using reservation wages[b]			
No health		Health		No health		Health	
$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
-.0021	1.01	-.0017	0.76	+.0018	0.66	+.0009	0.32
+.0131	2.36*	+.0137	2.42*	+.0246	4.36*	+.0225	3.90*
-.000005	0.37	-.000004	0.31	-.000004	0.24	-.000003	0.22
-.00008	0.62	-.0001	0.68	-.0001	0.77	-.0001	0.87
-.000004	0.26	+.000002	0.10	+.00004	1.14	+.00004	0.94
-.0000005	0.01	+.000002	0.39	-.000003	0.65	-	0.00
+.0504	1.01	+.0520	1.02	+.1279	2.11*	+.1355	2.23*
+.0349	0.81	+.0505	1.13	-.0058	0.12	+.0218	0.43
+.0200	4.90*	+.0193	4.64*	-.0405	1.39	-.0271	0.92
-	-	-.0499	1.27	-	-	-.0585	1.40
-	-	-.0290	0.61	-	-	-.0444	0.90
-	-	-.0067	0.17	-	-	-.0195	0.47
-	-	+.0119	0.31	-	-	+.0390	0.95
-	-	+.0203	0.17	-	-	-.1461	1.40
-	-	+.0186	0.24	-	-	+.0476	0.60
-	-	+.0562	0.84	-	-	+.0115	0.17
-	-	-.1807	2.10*	-	-	-.2014	2.25*
+.7128	6.22*	+.7148	6.08*	+.3986	3.15*	+.4950	3.68*
.10	-	.09	-	.10	-	.11	-
305	-	305	-	315	-	315	-

Table 7. Labor force participation, white males aged 55-64, households receiving DIABAPTD excluded

Independent variable	1965 results[a]			
	No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	+.0295	4.26*	+.0268	3.84*
Education	-.0026	0.54	-.0030	0.62
Asset income	-.0059	7.66*	-.0058	7.57*
Family transfers	-.0700	5.58*	-.0520	2.42*
Public transfers	-.0115	7.12*	-.0106	6.38*
Nonrespondent income	-.0049	4.75*	-.0046	4.51*
Marital status	+.0740	1.45	+.0775	1.49
Rural residence/UE	-.0964	0.46	-.1158	0.55
Hourly wages	+.4728	5.86*	+.4683	5.77*
Stooping, walking limitations	-	-	-.1648	1.05
Reaching limitations	-	-	-.0306	1.36
Lifting limitations	-	-	-.0393	1.24
Sensory limitations	-	-	-.0105	0.23
Speech	-	-	-	-
Hearing	-	-	-	-
Mental disorders	-	-	-.2223	0.90
Nervous disorders	-	-	-.1414	1.86
Constant	-.9431	2.19*	-.7029	-
$\bar{R}^2$	.32	-	.34	-
N	418	-	418	-

[a] [9].

[b] [29].

*Significant at the 5% level.

1971 results using actual wages[b]				1971 results using reservation wages[b]			
No health		Health		No health		Health	
$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
-.0114	1.22	-.0137	1.41	-.0137	1.12	-.0191	1.50
+.0078	0.81	+.0064	0.62	+.0168	1.42	+.0154	1.22
-.00004	2.30*	-.00003	2.20*	-.00002	1.39	-.00002	1.45
+.0001	0.66	+.0001	0.65	+.00006	0.62	+.00006	0.55
-.00004	2.88*	-.00004	2.73*	-.0001	1.49	-.0001	1.53
-.000001	0.11	+.000004	0.22	+.000002	0.25	+.000004	0.56
+.1212	1.64	+.0925	1.18	+.2125	2.25*	+.1873	1.88
+.0230	0.35	+.0114	0.17	+.0664	0.86	+.0499	0.64
+.0287	4.04*	+.0260	3.52*	+.0379	0.69	+.0456	0.80
-	-	+.0024	0.03	-	-	+.0301	0.44
-	-	+.0043	0.05	-	-	-.0253	0.33
-	-	+.0204	0.32	-	-	+.0003	0.01
-	-	-.0765	1.35	-	-	-.1093	1.86
-	-	-.0888	0.60	-	-	-.0955	0.61
-	-	-.0470	0.61	-	-	-.0696	0.87
-	-	-.1935	1.67	-	-	-.2410	2.00*
-	-	+.0195	0.17	-	-	+.0073	0.06
1.2994	2.31*	1.5271	2.58*	1.3582	2.02*	1.7720	2.54*
.20	-	.19	-	.09	-	.10	-
132	-	132	-	133	-	133	-

Table 8. Labor force participation, white males aged 25-54, households receiving any transfers excluded

Independent variable	1965 results[a]			
	No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	-.0025	2.31*	-.0031	2.51*
Education	+.0009	0.31	+.0006	0.18
Asset income	-.0004	0.16	-.0009	0.35
Family transfers	-.0194	3.54*	-.0210	3.87*
Nonrespondent income	+.0001	0.18	+.0037	0.08
Marital status	+.1361	4.86*	+.1066	3.75*
Rural residence/UE	-.0303	0.28	-.0513	0.48
Hourly wages	+.2324	3.97*	+.2061	3.52*
Stooping, walking limitations	-	-	.0191	0.23
Reaching limitations	-	-	-.0167	1.12
Lifting limitations	-	-	-.0421	2.05*
Sensory limitations	-	-	+.0208	1.16
Speech	-	-	-	-
Hearing	-	-	-	-
Mental disorders	-	-	-.2815	3.62
Nervous disorders	-	-	+.0015	0.04
Constant	+.8847	11.61*	+.9567	12.04*
$\bar{R}^2$	.14	-	.17	-
N	436	-	436	-

[a] [9].

[b] [29].

*Significant at the 5% level.

1971 results using actual wages[b]				1971 results using reservation wages[b]			
No health		Health		No health		Health	
$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
-.0039	1.78	-.0036	1.56	-.0021	0.78	-.0037	1.35
+.0098	1.70	+.0118	2.00*	+.0235	4.08*	+.0225	3.66*
-.00001	0.72	-.00001	0.77	-.00001	0.74	-.00001	0.83
-.00008	0.70	-.00009	0.78	-.0001	0.78	-.0001	1.06
-.00001	1.66	-.00001	1.11	-.00001	1.91	-.00001	1.04
+.0804	1.55	+.0722	1.36	+.2258	3.70*	+.2218	3.62*
+.0370	0.82	+.0432	0.93	+.0241	0.47	+.0459	0.88
+.0149	3.53*	+.0133	3.10*	-.0048	0.29	+.0112	0.67
-	-	+.0205	0.50	-	-	+.0023	0.05
-	-	-.0356	0.71	-	-	-.0619	1.13
-	-	+.0144	0.35	-	-	-.0014	0.03
-	-	+.0268	0.67	-	-	+.0591	1.35
-	-	+.0997	0.83	-	-	-.1557	1.39
-	-	-.0175	0.23	-	-	+.0350	0.42
-	-	+.0651	0.85	-	-	-.0087	0.11
-	-	-.2312	2.41*	-	-	-.2732	2.59*
+.8711	7.28*	+.8271	6.69*	+.5637	4.56*	.6565	4.84*
.10	-	.10	-	.16	-	.18	-
207	-	207	-	216	-	216	-

Table 9. Labor force participation, white males aged 55-64, households receiving any public transfers excluded

Independent variable	1965 results[a]			
	No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	+.0209	2.26*	+.0143	1.58
Education	-.0061	1.06	-.0074	1.33
Asset income	-.0066	7.97*	-.0061	8.32*
Family transfers	-.0864	5.76*	-.1643	3.75*
Nonrespondent income	-.0064	5.19*	-.0063	5.33*
Marital status	+.1913	2.79*	+.1807	2.73*
Rural residence/UE	-.1486	0.54	-.3114	1.17
Hourly wages	+.2373	2.50*	+.2275	2.50*
Stooping, walking limitations	-	-	-.2214	1.14
Reaching limitations	-	-	-.0915	2.29*
Lifting limitations	-	-	-.0171	0.40
Sensory limitations	-	-	+.0632	1.09
Speech	-	-	-	-
Hearing	-	-	-	-
Mental disorders	-	-	+.7746	1.74
Nervous disorders	-	-	-.0473	0.55
Constant	-.3843	0.68	+.1223	0.22
$\bar{R}^2$	.44	-	.51	-
N	187	-	187	-

[a] [9].

[b] [29].

*Significant at the 5% level.

1971 results using actual wages[b]				1971 results using reservation wages[b]			
No health		Health		No health		Health	
$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
-.0227	2.49*	-.0242	2.62*	-.0066	0.60	-.0099	0.97
+.0018	0.18	-.0066	0.62	-.0037	0.36	-.0082	0.75
-.00001	1.01	-.00002	1.23	+.000005	0.39	-	-
+.000005	0.60	+.00008	0.80	+.00004	0.42	+.00006	0.62
+.000001	0.24	+.000002	0.41	+.000001	0.23	+.000003	0.52
+.1557	1.92	+.1082	1.28	+.0928	1.05	+.0563	0.59
+.0286	0.44	+.0131	0.20	+.0111	0.16	-.0044	0.06
+.0264	3.27*	+.0276	3.37*	-.0731	2.92*	-.0677	2.58*
-	-	-.0458	0.70	-	-	+.0079	0.12
-	-	+.0964	1.32	-	-	+.0592	0.81
-	-	-.0495	0.76	-	-	-.0517	0.80
-	-	-.1287	2.22*	-	-	-.0994	1.64
-	-	-.1199	0.91	-	-	-.1077	0.81
-	-	+.1322	1.73	-	-	+.1146	1.47
-	-	-.1803	1.23	-	-	-.2583	1.74
-	-	-.0177	0.16	-	-	-.0612	0.55
1.9999	3.60*	2.2783	4.00*	1.2556	2.19*	1.6046	2.67
.17	-	.20	-	.15	-	.15	-
98	-	98	-	99	-	99	-

Table 10. Hours worked, white males aged 55-64, households receiving DIABAPTD excluded

Independent variable	1965 results[a]			
	No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	-.0034	2.46*	-.0031	2.25*
Education	+.0058	5.96*	+.0055	5.72*
Asset income	+.0009	1.54	+.0008	1.49
Family transfers	-.0512	3.07*	-.0628	3.81*
Public transfers	-.0030	8.00*	-.0026	7.00*
Nonrespondent income	-.0001	0.23	-.0001	0.08
Marital status	+.0263	2.48*	+.0338	3.11*
Rural residence/UE	-.0016	0.38	-.0239	0.92
Hourly wages	-.0052	3.30*	-.0049	3.21*
Stooping, walking limitations	-	-	-.0034	2.36*
Reaching limitations				
Lifting limitations	-	-	-.0069	1.15
Sensory limitations	-	-	-.0145	1.58
Speech	-	-	+.0085	0.41
Hearing	-	-	+.0252	2.14*
Mental disorders	-	-	-	-
Nervous disorders	-	-	+.0102	0.66
Constant	+.3207	3.73*	+.3305	3.91*
$\bar{R}^2$	.38	-	.42	-
N	240	-	240	-

[a] [9].

[b] [29].

*Significant at the 5% level.

1971 results using actual wages[b]				1971 results using reservation wages[b]			
No health		Health		No health		Health	
$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
-41.4548	2.09*	-41.0696	2.05*	-42.4318	1.39	-25.2256	0.78
+34.5822	1.61	+21.7308	0.98	+14.6830	0.51	-9.3432	0.30
+.0429	1.13	+.0566	1.48	-.0051	0.12	-.0041	0.10
-.1700	0.80	-.2453	1.06	-.1552	0.64	-.1862	0.70
-.1153	2.39*	-.1126	2.34*	-.0304	0.16	+.0726	0.36
-.0193	1.46	-.0124	0.91	-.0264	1.75	-.0196	1.26
+176.2551	1.02	+191.8281	1.06	-40.3066	0.16	-162.1517	0.62
+256.1379	1.89	+228.1471	1.66	+174.2759	0.98	+121.6638	0.67
-82.6833	5.42*	-85.2878	5.53*	-57.7273	0.41	-137.2642	0.90
-	-	-287.9083	2.13*	-	-	-407.8812	2.58*
-	-	-192.9455	1.23	-	-	-39.8471	0.22
-	-	-26.5257	0.20	-	-	+35.9035	0.24
-	-	-55.5874	0.45	-	-	+.9982	0.01
-	-	+186.7053	0.59	-	-	+116.0213	0.32
-	-	+49.7818	0.30	-	-	+135.0202	0.71
-	-	-4.5291	0.02	-	-	+45.9456	0.15
-	-	+21.0946	0.09	-	-	+97.0630	0.34
+4236.2597	3.59*	+4556.0642	3.77*	+4377.0533	2.72*	+3912.5382	2.30*
.28	-	.30	-	.07	-	.08	-
112	-	112	-	112	-	112	-

Table 11. Hours worked, white males aged 25-54, households receiving DIABAPTD excluded

Independent variable	1965 results[a]			
	No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	-.0001	0.31	+.0001	0.16
Education	+.0051	7.26*	+.0053	7.51*
Asset income	+.0002	1.45	+.0002	1.13
Family transfers	-.0059	2.52*	-.0059	2.47*
Public transfers	-.0016	6.54*	-.0015	6.35*
Nonrespondent income	-.0005	4.00*	-.0005	3.82*
Marital status	+.0417	5.62*	+.0466	6.24*
Rural residence/UE	-.0048	1.83	-.0045	1.73
Hourly wages	-.0029	2.19*	-.0033	2.44*
Stooping, walking limitations	-	-	-.0565	2.94
Reaching limitations	-	-	+.0037	0.97
Lifting limitations	-	-	-.0036	0.74
Sensory limitations	-	-	+.0017	0.38
Speech	-	-	+.0623	3.55*
Hearing	-	-	-.0022	0.24
Mental disorders	-	-	-	-
Nervous disorders	-	-	-.0211	1.82
Constant	+.1295	6.71*	+.1216	6.08*
$\bar{R}^2$	.20	-	.23	-
N	-	-	-	-

[a] [9].

[b] [29].

*Significant at the 5% level.

1971 results using actual wages[b]				1971 results using reservation wages[b]			
No health		Health		No health		Health	
$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
+2.1925	0.42	+3.367	0.62	+3.4603	0.50	+4.8260	0.68
+70.1256	4.88*	+75.4252	5.25*	+55.3911	3.70*	+60.9115	4.06*
+.0824	2.24*	+.0802	2.18*	+.0967	2.48*	+.0892	2.30*
-.0227	0.07	-.1338	0.43	-.1221	0.38	-.2672	0.81
-.1077	2.67*	-.1057	2.62*	+.0015	0.02	-.0099	0.10
-.0147	1.23	-.0100	0.82	-.0105	0.84	-.0060	0.48
+146.2605	1.12	+98.1414	0.75	-18.8435	0.12	-59.8203	0.37
+173.3518	1.60	+249.8020	2.26*	+116.9741	0.96	+220.7972	1.76
-51.9485	5.13*	-50.4184	4.98*	-92.8070	1.29	-82.1137	1.13
-	-	-159.3471	1.66	-	-	-158.3524	1.58
-	-	-174.7324	1.49	-	-	-156.0634	1.27
-	-	+165.7142	1.66	-	-	+134.3733	1.29
-	-	-56.3019	0.59	-	-	-140.4555	1.40
-	-	-190.1783	0.66	-	-	-208.8743	0.70
-	-	394.9546	2.00*	-	-	+480.2338	2.34*
-	-	-55.1962	0.31	-	-	-79.4224	0.44
-	-	-491.4930	2.21*	-	-	-469.0948	2.01*
+1234.4066	4.28*	+1227.3094	4.22*	+1143.3801	3.36*	+1164.5008	3.39*
.16	-	.18	-	.08	-	.11	-
267	-	267	-	267	-	267	-

Table 12. Hours worked, white males aged 25-54, households receiving public transfers excluded

Independent variable	1971 results using actual wages[a]				1971 results using reservation wages[a]			
	No health	Health	No health	Health	No health	Health	No health	Health
	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	+.4305	0.07	+3.1554	0.49	+9.0974	1.25	+9.8963	1.33
Education	+50.4830	2.95*	+65.1496	3.78*	+36.4153	2.13*	+47.5969	2.73*
Asset income	+.0916	2.34*	+.0897	2.32*	+.1181	2.96*	+.1120	2.81*
Family transfers	+.0716	0.23	-.1077	0.33	-.0972	0.30	-.2199	0.66
Nonrespondent income	-.0023	0.17	-.0007	0.05	-.0029	0.20	-.0011	0.08
Marital status	+133.2657	0.86	+76.4087	0.49	-235.0070	1.30	-246.2483	1.37
Rural residence/UE	+102.2259	0.78	+194.3866	1.49	-8.4243	0.06	+98.2100	0.72
Hourly wages	-54.2805	4.47*	-56.0381	4.71*	-173.4106	3.71*	-152.3482	3.25*
Stooping, walking limitations	-	-	-238.0912	2.08*	-	-	-221.0801	1.87
Reaching limitations	-	-	-304.4157	2.20*	-	-	-211.6411	1.48
Lifting limitations	-	-	+244.9972	2.10*	-	-	+202.2027	1.69
Sensory limitations	-	-	-47.3513	0.43	-	-	-146.7538	1.29
Speech	-	-	-263.7146	0.81	-	-	-329.6382	0.98
Hearing	-	-	+376.8904	1.70	-	-	+399.7858	1.75
Mental disorders	-	-	+52.3805	0.23	-	-	+46.5573	0.20
Nervous disorders	-	-	-653.5419	2.17*	-	-	-486.6500	1.55
Constant	1534.5210	4.43*	+1418.6251	4.08*	+1264.6665	3.45*	+1253.6712	3.38*
$\bar{R}^2$	.13	-	.19	-	.10	-	.14	-
N	189	-	189	-	189	-	189	-

[a] [29].

*Significant at the 5% level.

Table 13. Hours worked, white males aged 55-64, households receiving public transfers excluded

Independent variable	1971 results using actual wages[a]				1971 results using reservation wages[a]			
	No health		Health		No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	-40.9035	1.72	-49.7816	2.04*	-39.4630	1.41	-47.5496	1.63
Education	+48.2976	1.79	+36.3678	1.29	+9.0172	0.29	-6.5225	0.20
Asset income	+.0511	1.20	+.0654	1.49	-.0106	0.24	+.0001	0.01
Family transfers	-.1113	0.48	-.2055	0.80	-.1481	0.58	+.1595	0.57
Nonrespondent income	-.0133	0.81	-.0133	0.78	-.0364	1.99*	-.0322	1.70
Marital status	-46.6565	0.20	+104.4460	0.43	-344.8852	1.30	-222.0853	0.80
Rural residence/UE	+312.0417	1.91	+284.0115	1.69	+28.7999	0.15	+34.8033	0.18
Hourly wages	-92.9434	4.49*	-90.0376	4.15*	-197.3941	2.16*	-169.1406	1.77
Stooping, walking limitations	-	-	-274.2521	1.62	-	-	-438.3079	2.43*
Reaching limitations	-	-	-202.9689	1.06	-	-	+49.4683	0.24
Lifting limitations	-	-	-64.3392	0.38	-	-	-60.5236	0.33
Sensory limitations	-	-	-151.1543	0.97	-	-	-176.4263	1.03
Speech	-	-	+236.8700	0.68	-	-	+56.2744	0.15
Hearing	-	-	+21.9807	0.12	-	-	+68.8561	0.33
Mental disorders	-	-	+190.8550	0.47	-	-	+281.7768	0.63
Nervous disorders	-	-	+27.7922	0.10	-	-	+55.5632	0.18
Constant	+4270.7463	3.02*	+5039.4716	3.42*	+4679.8879	2.97*	+5486.5804	3.31*
$\overline{R}^2$	.27	-	.28	-	.13	-	.14	-
N	87	-	87	-	87	-	87	-

[a] [29].

*Significant at the 5% level.

Table 14. Labor force participation, black males aged 25-54, household receiving DIABAPTD excluded

Independent variable	1965 results[a]			
	No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	+.0019	0.54	+.0038	0.12
Education	+.0133	1.79	+.0157	2.27*
Asset income	-.0370	2.98*	-.0351	3.15*
Family transfers	+.0018	0.06	-.0108	0.42
Public transfers	-.0144	3.76*	-.0122	3.29*
Nonrespondent income	-.0049	2.26*	-.0043	2.03*
Marital status	+.0710	1.26	+.0101	0.19
Rural residence/UE	-.4093	1.05	-.2314	0.63
Hourly wages	+.0384	1.49	+.0042	0.17
Stooping, walking limitations	-	-	+.4386	1.99
Reaching limitations	-	-	-.0725	1.83
Lifting limitations	-	-	-.0698	1.78
Sensory limitations	-	-	-.0660	1.75
Speech	-	-	-.3090	1.16
Hearing	-	-	-.2689	3.25*
Mental disorders	-	-	-.2905	2.63*
Nervous disorders	-	-	-.2999	3.16*
Constant	+.9150	3.80*	+.9841	4.42*
$\overline{R}^2$	.13	-	.33	-
N	145	-	145	-

[a] [9].

[b] [29].

*Significant at the 5% level.

1971 results using actual wages[b]				1971 results using reservation wages[b]			
No health		Health		No health		Health	
$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
-.0120	1.94	-.0095	1.06	-.0144	2.04*	-.0092	1.02
-.0207	1.52	-.0160	0.89	-.0198	1.30	-.0168	1.00
-.0002	1.51	-.0002	1.34	-.0001	0.57	-.0002	0.83
-	-	-	-	-	-	-	-
+.00001	0.14	-.000001	0.01	+.00003	0.34	+.0001	0.87
+.000001	0.07	+.000006	0.24	+.000008	0.36	+.000004	0.17
+.3028	2.68*	+.2801	2.00*	+.2164	1.01	+.0637	0.24
+.1274	0.98	+.1681	1.12	+.0906	0.62	+.1162	0.70
+.0467	3.15*	+.0421	2.26*	+.0029	0.51	+.0072	0.99
-	-	+.0441	0.30	-	-	+.0668	0.43
-	-	-.0558	0.29	-	-	-.0267	0.13
-	-	-.0646	0.40	-	-	+.0006	0.00
-	-	-.0357	0.28	-	-	+.0816	0.61
-	-	+.1849	0.71	-	-	+.2910	1.14
-	-	-.1719	0.39	-	-	-.5553	1.50
-	-	+.1302	0.60	-	-	+.0983	0.46
-	-	+.0898	0.34	-	-	+.1514	0.51
+1.0898	3.21*	+.9518	1.98	+.0855	0.81	-.1116	0.08
.31	-	.20	-	.11	-	.03	-
55	-	55	-	61	-	61	-

Table 15. Labor force participation, black males aged 55-64, households receiving DIABAPTD excluded

Independent variable	1965 results[a]			
	No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	-.0501	2.43*	-.0189	0.84
Education	-.0152	1.23	-.0110	0.85
Asset income	-.0304	4.03*	-.0388	5.38*
Family transfers	-.0347	0.17	+.0768	0.31
Public transfers	-.0166	2.25*	-.0109	1.32
Nonrespondent income	+.0015	0.34	+.0047	0.79
Marital status	+.2895	2.39*	+.1353	1.11
Rural residence/UE	-.3230	0.50	+.0780	0.11
Hourly wages	+.1222	0.24	+.2175	0.37
Stooping, walking limitations	-	-	-.8266	1.90
Reaching limitations	-	-	+.0434	0.55
Lifting limitations	-	-	-.1447	1.33
Sensory limitations	-	-	+.1246	1.22
Speech	-	-	-	-
Hearing	-	-	-	-
Mental disorders	-	-	-.6016	0.06
Nervous disorders	-	-	-	-
Constant	3.9407	3.07*	2.0678	1.52
$\bar{R}^2$	.40	-	.51	-
N	66	-	66	-

[a] [9].

[b] [29].

*Significant at the 5% level.

1971 results using actual wages[b]				1971 results using reservation wages[b]			
No health		Health		No health		Health	
$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
+.0349	1.48	+.0465	2.06*	+.0204	0.64	+.0316	1.16
-.0033	0.17	-.0071	0.37	-.0051	0.21	-.0039	0.18
+.00009	0.47	+.0001	0.79	+.0003	0.92	+.0002	0.74
+.0025	0.54	+.0056	1.14	+.0025	0.44	+.0081	1.49
-.0001	1.13	-.0002	1.85	-.0001	0.65	-.0001	0.84
+.00003	0.82	+.00003	1.10	-.00001	0.48	+.00001	0.30
+.1282	0.75	+.1260	0.80	+.2510	0.65	-.0053	0.01
+.1439	0.64	+.1016	0.47	+.0851	0.28	-.0080	0.03
+.0907	3.58*	+.0613	2.27*	-.0021	0.18	+.0031	0.29
-	-	-.3573	2.17*	-	-	-.5330	3.17*
-	-	-.0410	0.29	-	-	-.1445	0.94
-	-	+.1198	0.77	-	-	+.2397	1.49
-	-	-.1313	0.95	-	-	-.2132	1.36
-	-	-	-	-	-	-.1255	0.19
-	-	-.6839	1.73	-	-	-.6622	1.49
-	-	-.1682	0.87	-	-	-.2884	1.27
-	-	+.5442	1.78	-	-	+.4348	1.28
-1.6454	1.12	-1.9302	1.32	-.2856	0.16	-1.1375	0.68
.17	-	.37	-	-.09	-	.25	-
42	-	42	-	46	-	46	-

Table 16. Labor force participation, black males aged 55-64, households receiving any public transfers excluded

Independent variable	1965 results[a]			
	No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	+.0052	0.50	-.0040	0.26
Education	+.0078	1.11	+.0123	1.11
Asset income	-.0306	6.89*	-.0290	5.44*
Family transfers	+.0378	0.41	-.0600	0.18
Nonrespondent income	+.0015	0.60	+.0039	0.70
Marital status	+.0025	0.03	-.0443	0.44
Rural residence/UE	+.0891	0.18	+.1349	0.19
Hourly wages	+.2497	0.85	+.1557	0.33
Stooping, walking limitations	-	-	-.0623	0.19
Reaching limitations	-	-	-.0318	0.45
Lifting limitations	-	-	-.0566	0.62
Sensory limitations	-	-	-.0973	1.01
Speech	-	-	-	-
Hearing	-	-	-	-
Mental disorders	-	-	-	-
Nervous disorders	-	-	-	-
Constant	+.5676	0.84	1.1909	1.33
$\bar{R}^2$	.78	-	.74	-
N	29	-	29	-

[a] [9].

[b] [29].

*Significant at the 5% level.

1971 results using actual wages[b]				1971 results using reservation wages[b]			
No health		Health		No health		Health	
$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
+.0233	0.86	+.0464	1.57	-.0011	0.04	+.0297	1.11
-.0025	0.10	-.0125	0.48	+.0089	0.33	-.0046	0.20
-.00005	0.05	-.0008	0.75	+.0007	0.68	-.0007	0.70
+.0032	0.63	+.0054	0.94	.0030	0.51	+.0070	1.27
+.00002	0.68	+.00006	1.22	-.00003	1.04	+.000008	0.18
+.1918	0.96	+.1168	0.57	+.1638	0.63	-.3668	1.46
+.1584	0.66	+.1564	0.63	+.0198	0.07	-.3095	1.11
+.0823	2.99*	+.0608	1.80	+.0032	0.44	+.0184	2.41*
-	-	-.3067	1.37	-	-	-.6687	3.22*
-	-	+.0044	0.02	-	-	-.1493	0.91
-	-	+.1200	0.58	-	-	+.2472	1.38
-	-	-.1230	0.66	-	-	-.3630	1.98
-	-	-	-	-	-	+.2492	0.34
-	-	-.6489	1.42	-	-	-.7974	1.79
-	-	-.2074	0.89	-	-	-.2916	1.54
-	-	+.6036	1.60	-	-	+.4822	1.37
-1.0189	0.61	-2.0142	1.06	+.1114	0.06	-3.0044	1.60
.10	-	.19	-	-.06	-	.30	-
34	-	34	-	38	-	38	-

Table 17. Labor force participation, black males aged 25-54, households receiving public transfers excluded

Independent variable	1965 results[a]			
	No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	-.0036	0.92	+.0049	1.20
Education	+.0070	0.78	+.0121	1.34
Asset income	-.0596	4.04*	-.0492	3.42*
Family transfers	-.1245	1.21	-.1168	1.23
Nonrespondent income	-.0147	4.30*	-.0095	3.32*
Marital status	+.0365	0.54	-.0126	0.19
Rural residence/UE	-.2944	0.59	+.1712	0.35
Hourly wages	+.7315	2.77*	+.6720	2.61*
Stooping, walking limitations	-	-	+.1170	0.38
Reaching limitations	-	-	-.0727	1.64
Lifting limitations	-	-	-.0822	1.63
Sensory limitations	-	-	-.1295	2.67*
Speech	-	-	-	-
Hearing	-	-	-	-
Mental disorders	-	-	-.1058	0.79
Nervous disorders	-	-	-.2063	1.80
Constant	+.7749	2.45*	+.6151	1.99
$\bar{R}^2$	.35	-	.45	-
N	81	-	81	-

[a] [9].

[b] [29].

*Significant at the 5% level.

1971 results using actual wages[b]				1971 results using reservation wages[b]			
No health		Health		No health		Health	
$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
-.0052	0.73	-.0072	0.64	-.0081	0.95	-.0058	0.46
+.0012	0.93	+.0050	0.22	-.0020	0.12	+.0107	0.52
-.0002	1.73	-.0003	1.53	-.0001	0.74	-.0002	1.13
-	-	-	-	-	-	-	-
+.000004	0.18	+.00003	0.95	+.000006	0.23	+.00002	0.86
+.3317	2.74*	+.2015	1.19	+.2003	0.90	+.1457	0.60
+.0994	0.74	+.0558	0.32	+.0651	0.42	+.0641	0.33
+.0343	2.41*	+.0175	0.89	+.0031	0.67	+.0022	0.43
-	-	+.0785	0.46	-	-	-.0533	0.31
-	-	-.1541	0.61	-	-	-.0854	0.35
-	-	+.3898	1.63	-	-	+.4958	2.03*
-	-	-.0244	0.16	-	-	-.0197	0.11
-	-	+.2143	0.70	-	-	+.1193	0.40
-	-	+.3458	0.58	-	-	-.0616	0.15
-	-	+.0088	0.03	-	-	-.0041	0.02
-	-	+.2795	0.77	-	-	+.2696	0.67
+.7041	1.86	+.7544	1.33	+.4299	0.56	+.3622	0.42
.24	-	.13	-	.05	-	-.04	-
40	-	40	-	45	-	45	-

Table 18. Hours worked, black males aged 25-54, households receiving DIABAPTD excluded

Independent variable	1965 results[a]			
	No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	+.0006	0.68	+.0009	1.04
Education	+.0010	0.55	+.0017	1.64
Asset income	-.0068	1.82	+.0070	1.94
Family transfers	-.0106	1.61	-.0075	1.16
Public transfers	-.0019	1.62	-.0001	0.51
Nonrespondent income	-.0005	0.80	-.0007	0.99
Marital status	+.0088	0.60	+.0124	0.85
Rural residence/UE	-	-	-	-
Hourly wages	-.0016	2.73*	-.0017	2.61*
Stooping, walking limitations	-	-	-.0818	1.32
Reaching limitations	-	-	+.0186	1.64
Lifting limitations	-	-	-.0251	2.08*
Sensory limitations	-	-	-.0012	0.12
Speech	-	-	-	-
Hearing	-	-	+.0358	1.23
Mental disorders	-	-	-	-
Nervous disorders	-	-	-.0200	0.64
Constant	+.0825	1.41	+.0475	0.80
$\overline{R}^2$	.13	-	.19	-
N	-	-	-	-

[a] [9].

[b] [29].

*Significant at the 5% level.

1971 results using actual wages[b]				1971 results using reservation wages[b]			
No health		Health		No health		Health	
$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
-18.1062	0.92	-19.1079	0.81	-7.3147	0.36	-4.1736	0.17
+15.5352	0.37	-42.6406	0.92	-1.2717	0.30	-36.7011	0.69
-.2380	0.42	-.2222	0.40	-.5387	1.00	-.4721	0.75
-	-	-	-	-	-	-	-
-.1810	1.00	-0.3258	1.78	.0696	0.23	-.2018	0.65
-.0176	0.28	+.0411	0.55	-.0243	0.36	-.0286	0.39
+622.1547	1.70	+6.3109	0.01	+258.6201	0.43	+401.2986	0.54
-97.3656	0.27	-51.2184	0.14	-167.2032	0.43	-44.7450	0.11
-68.1328	1.56	-95.4233	1.95	+16.4275	0.99	+3.9545	0.23
-	-	-235.5998	0.56	-	-	-589.7517	1.38
-	-	-1292.3796	1.52	-	-	-624.9922	0.74
-	-	+765.4072	1.11	-	-	+210.3500	0.31
-	-	-120.9307	0.37	-	-	-140.5541	0.39
-	-	+294.7506	0.42	-	-	-315.0078	0.46
-	-	+3566.1697	2.54*	-	-	+2557.6845	1.83
-	-	-1133.8055	2.13*	-	-	-1081.3473	1.89
-	-	+568.5774	0.67	-	-	6.5524	0.01
1953.1926	1.84	+3359.2736	2.68*	-1198.0523	0.42	+1763.8930	0.60
.08	-	.28	-	.04	-	.17	-
41	-	41	-	41	-	41	-

Table 19. Hours worked, black males aged 55-64, households receiving DIABAPTD excluded

Independent variable	1965 results[a]			
	No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	+.0035	0.63	-	-
Education	+.0075	2.10*	-	-
Asset income	-.0004	0.05	+.0083	1.53
Family transfers	+.0489	0.87	+.1303	2.22*
Public transfers	-.0051	2.76*	-.0040	2.28*
Nonrespondent income	-.0015	1.36	-.0036	0.35
Marital status	+.0516	1.52	-	-
Rural residence/UE	+.0051	0.26	-	-
Hourly wages	+.0104	0.61	+.0528	0.36
Stooping, walking limitations	-	-	-.0181	2.14*
Reaching limitations				
Lifting limitations	-	-	-.0361	1.69
Sensory limitations	-	-	-.0021	0.11
Speech	-	-	-	-
Hearing	-	-	-.0238	0.63
Mental disorders	-	-	-	-
Nervous disorders	-	-	-	-
Constant	-.1734	0.49	+.1802	8.00*
$\overline{R}^2$	.18	-	.40	-
N	40	-	40	-

[a] [9].

[b] [29].

*Significant at the 5% level.

1971 results using actual wages[b]				1971 results using reservation wages[b]			
No health		Health		No health		Health	
$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
+14.0021	0.28	+8.3584	0.16	+32.1861	0.68	+33.5200	0.62
+12.3144	0.32	+15.4589	0.42	+.1170	0.01	+30.3917	0.68
-.1644	0.44	+.0403	0.11	+.0616	0.14	-.0693	0.13
-4.7561	0.54	3.8095	0.34	-2.7096	0.31	+1.6132	0.13
-	-	-	-	-	-	-	-
+.1184	1.54	+.0377	0.48	+.1307	1.73	+.0523	0.64
+109.0571	0.29	+166.4915	0.47	+559.8601	1.01	+27.2571	0.03
-517.3691	1.09	-776.5650	1.62	-228.8347	0.48	-663.4530	1.20
-24.6716	0.44	-72.0961	1.26	-14.0878	0.98	+6.9887	0.29
-	-	-343.5244	0.91	-	-	-332.3727	0.83
-	-	+21.5152	0.06	-	-	+126.6186	0.33
-	-	+162.4155	0.44	-	-	+218.9698	0.56
-	-	-661.9654	2.19*	-	-	-712.3654	2.04
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-449.7970	0.79	-	-	-218.7918	0.35
-	-	-1034.3139	1.64	-	-	-828.2028	1.30
+293.8014	-	+1517.4728	0.44	+1136.4229	0.36	-1461.0058	0.38
.07	-	.29	-	.10	-	.22	-
31	-	31	-	31	-	31	-

Table 20. Hours worked, black males aged 25-54, households receiving public transfers excluded

Independent variables	1971 results using actual wages[a]				1971 results using reservation wages[a]			
	No health		Health		No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	-22.8689	1.02	-6.9282	0.23	-14.6322	0.68	-6.7975	0.24
Education	+26.4862	0.60	-22.1698	0.37	+19.2338	0.44	-32.544	0.57
Asset income	-.1499	0.26	-.3636	0.53	-.0453	0.85	-.3076	0.47
Family transfers	-	-	-	-	-	-	-	-
Nonrespondent income	+.0203	0.32	-.0127	0.14	-.0468	0.69	-.1116	1.47
Marital status	+736.2324	1.87	+389.6872	0.68	+101.9638	0.18	+46.8144	0.07
Rural residence/UE	+102.8221	0.26	-235.3779	0.55	+80.9784	0.21	-202.8386	0.49
Hourly wages	-67.8457	1.55	-75.6126	1.38	+21.2182	1.86	+20.7645	1.85
Stooping, walking limitations	-	-	-374.0763	0.71	-	-	-797.1270	1.88
Reaching limitations	-	-	-596.9303	0.61	-	-	-40.5029	0.05
Lifting limitations	-	-	+446.0978	0.58	-	-	-30.5772	0.05
Sensory limitations	-	-	-643.8667	1.57	-	-	-392.7245	0.96
Speech	-	-	-7266.7167	0.28	-	-	-923.4799	1.20
Hearing	-	-	+2997.8057	1.82	-	-	2374.6366	1.61
Mental disorders	-	-	-1407.2779	1.87	-	-	-1344.1404	1.86
Nervous disorders	-	-	-53.7378	0.06	-	-	-307.4972	0.35
Constant	+1884.7226	1.63	+2737.0322	1.86	-1750.7896	0.89	-472.5450	0.23
$\overline{R}^2$	.13	-	.24	-	.17	-	.30	-
N	33	-	33	-	33	-	33	-

[a] [29].

*Significant at the 5% level.

Table 21. Hours worked, black males aged 55-64, households receiving public transfers excluded

Independent variable	1971 results using actual wages[a]				1971 results using reservation wages[a]			
	No health		Health		No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	+6.3302	0.12	+21.1058	0.29	+9.6534	0.19	+35.2913	0.57
Education	+15.3617	0.36	+20.7030	0.44	+12.4227	0.26	+21.6693	0.43
Asset income	-.0832	0.05	-.2185	0.11	-.0613	0.03	-.4364	0.19
Family transfers	-3.9241	0.46	+.5641	0.05	-3.4713	0.39	-.3582	0.03
Nonrespondent income	+.1016	1.14	+.0270	0.25	+.1045	1.17	-.0360	0.34
Marital status	+665.1910	1.63	+481.7981	1.14	+738.0148	1.26	+494.1366	0.52
Rural residence/UE	-410.8124	0.90	-587.5402	1.10	-353.4086	0.63	-514.0695	0.70
Hourly wages	-4.2557	0.08	-25.6325	0.38	-2.8847	0.15	.6923	0.02
Stooping, walking limitations	-	-	+51.2240	0.12	-	-	+68.0912	0.10
Reaching limitations	-	-	+193.9403	0.43	-	-	+250.5259	0.58
Lifting limitations	-	-	+151.1114	0.33	-	-	+170.1752	0.37
Sensory limitations	-	-	-393.8852	1.05	-	-	-407.1105	0.84
Speech	-	-	-	-	-	-	-	-
Hearing	-	-	-	-	-	-	-	-
Mental disorders	-	-	-391.9813	0.62	-	-	-317.2424	0.50
Nervous disorders	-	-	-1043.6636	1.38	-	-	-952.9761	1.24
Constant	+163.4945	0.05	-211.3150	0.05	+379.1295	0.10	-1331.0188	0.23
$\overline{R}^2$	.18	-	.26	-	.18	-	.25	-
N	25	-	25	-	25	-	25	-

[a] [29].

*Significant at the 5% level.

CHAPTER IV. THE SUPPLY OF AND THE DEMAND FOR DISABILITY INSURANCE

Introduction

In this chapter our objective is to update and expand the BJM [9] analysis in order to explain the size of the Social Security Disability Insurance Program (DI). We do this by identifying and analyzing the importance of variables which influence an individual's decision to apply for DI and those which reflect the outcome of the application process.

In estimating the demand for DI benefits, our interest is to understand the application process. Specifically, we want to look at the effects of health and of benefit levels on the probability of application.

There has been some speculation that increased benefit levels for DI recipients are a major cause of recent increases in the disability incidence rate. The disability incidence rate is the fraction of insured workers who are granted DI benefits each year [5]. Increases in the disability incidence rate result in increased costs of the DI program. If benefit levels are an important determinant of the probability of applying for DI benefits, then they may well be an important explanation for increases in the disability incidence rate and the increasing cost of the DI program.

We continue our investigation of the effect of functional limitations on labor supply by including health variables in our model of

the probability of application for DI benefits. We expect that ill health is an important factor in an individual's decision to apply for DI but that it is not the only reason. Other economic and demographic characteristics are expected to play an important part in the application decision.

The awards procedure for determining disability status involves three steps. First the applicant is evaluated on the basis of criteria contained in the Social Security Administration medical listings. If the applicant fails to qualify under the first test, he may qualify if his impairments are such that they are considered to be the equivalent of those contained in the listings. If the applicant is not accepted under the first two tests, he is evaluated under a third which includes consideration of his education, work experience, and age in conjunction with his health. People who have few years of education, have worked for a long time in unskilled jobs, are elderly, are unable to qualify for jobs which are available in some areas of the country, and are in poor health may be judged eligible for DI benefits even if ill health alone would not qualify them [15].

To determine the importance of factors involved in the award procedure we estimate the "supply" of DI benefits. We expect health to be an important determinant of acceptance. Given the third test, we also expect demographic variables such as age and education to be important in the acceptance equation.

Theoretical Considerations

Any economic model of behavior embodies the notion of choice. In the model specifying the demand for DI benefits, we are assuming that the choice facing the individual is between applying for DI benefits or not. Subsumed in the above is that the individual does have a choice. That is, his impairments are not so severe that he cannot participate in the labor force at all, nor so spurious that he perceives that there is no possibility of being granted DI benefits.

The would-be applicant is assumed to know that the DI program has a means test such that if he earns more than a maximum amount per month[1] he will lose his benefits (after a grace period). The comparison the individual is expected to make is between the income he could earn without DI benefits and the income he would receive if accepted which consists of benefits plus any amount he earns himself up to the maximum allowed. In addition, the individual must weigh the tradeoff between changes in his income, if accepted, and his preferences for leisure. That is, the potential applicant maximizes utility, not income.

The model is illustrated in Figure 1.[2] The income-leisure constraint is represented by LD, the slope of which is the wage rate. Dealing only with market choices for the moment, the individual maximizes utility at a point such as E, where one of a set of strictly

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[1]The amount was $140 in 1971 and is $280 in 1979.

[2]The following discussion is based on BJM [9, pp. 112-113].

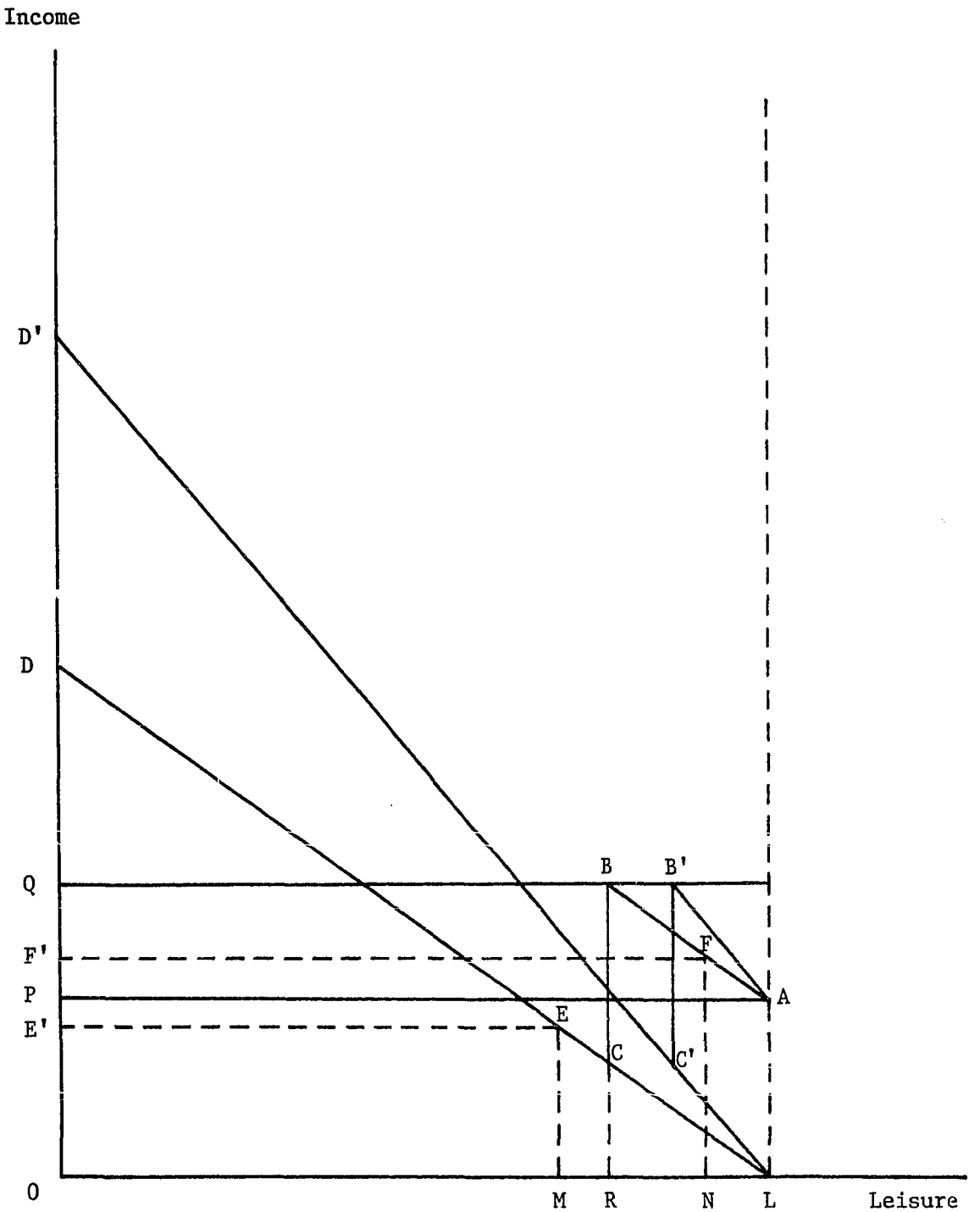

Figure 1. The demand for leisure

convex indifference curves (not shown) is tangent to the income-leisure constraint. The income he earns is OE' and he consumes OM amount of leisure. If the individual were accepted for DI, assume he would receive a benefit equal to OP and that the maximum amount of income he may earn without losing benefits is PQ. The line AB represents DI benefits (OP) plus any amount he can earn up to the maximum. That is, if he works LR amount of time he will earn the maximum allowable earnings given his wage rate. If he works more than LR, he will lose DI benefits and the relevant constraint becomes CED. The total constraint facing the individual after introducing the possibility of receiving DI benefits is ABCED. The individual maximizes utility at a point such as F where he is on a higher indifference curve than at point E.

If the wage rate goes up so that the individual's opportunities are reflected by the income-leisure constraint AB'C'D' and the individual was initially at a point such as F, he may work more or less, depending on the relative sizes of the income and substitution effects. If he is at point B, he may reduce the amount of time he spends working. He may do this because if he continues to work LR amount of time, he will lose DI benefits. Only if there is an indifference curve that passes through point B' and cuts the income-leisure constraint LC'D' from above will he increase the amount of time he spends on work.

The "supply" of DI benefits is not a supply curve in an economic sense because there is no price variable involved. We estimate the

probability of being accepted as a DI beneficiary because our interest is in the scope of the DI program and not all applicants are awarded benefits.

The Application Model

The statistical model

The model we tested to identify the independent variables which are important in the application process is as follows:

$$\text{Probability of application} = \beta_0 + \beta_1 \text{ Opportunity cost} + \beta_2 \text{ Transfer income} + \beta_3 \text{ Asset income} + \beta_4 \text{ Net value of assets} + \beta_5 \text{ Spouse's income} + \beta_6 \text{ Family transfers} + \beta_7 \text{ Age} + \beta_8 \text{ Education} + \beta_9 \text{ Number of dependent children} + \beta_{10} \text{ Rural residence} + \beta_{11} \text{ Race} + \beta_{12} \ldots . \beta_{26} \text{ Health limitations.}$$

The independent variables fall into three categories; economic variables, demographic variables often used in labor supply models, and health variables.

To test the hypothesis that higher benefit levels in relation to a person's market wage increase the probability of application, we followed BJM [9] in using the ratio of average monthly wages to expected benefits if accepted. This variable is an attempt to measure the opportunity cost facing the individual when making the application decision. We expect that the higher the opportunity cost of receiving

DI benefits as compared to the return he could receive from working, the smaller is the likelihood of application.

The health variables are dummy variables which indicate the respondent's answers to questions about functional limitations. Examples are, "Do you have difficulty using stairs or inclines?" and "Can you use stairs or inclines at all?" [34, p. 5]. If the respondent answered yes to the first question, the health variable representing difficulty using stairs would equal one, and would equal zero otherwise. If the respondent answered no to the second question, the health variable representing inability to use stairs at all would equal one, and would equal zero otherwise. The health variables are independent of labor supply in that positive responses to the functional limitation questions are not associated with whether or not the respondent worked.

We expect the presence of functional limitation to be positively related to the decision to apply for DI benefits because the more limitations a person has and the more severe the limitations, the greater the probability of being accepted if one applies for benefits.

The model of the probability of applying for DI benefits is a labor supply model in that the higher the probability of applying, the lower the probability of labor force participation. Because of this we also include economic and demographic variables which are often used in labor supply models. These variables are education, family transfers, spouse's income, age, rural environment, transfer income (excluding DI), asset income, race, net value of assets, and the number of dependent children.

Education represents an investment in human capital and, as such, opens up broader work opportunities. The expected sign is negative.

We expect the signs of the other income variables to be positive. The amount one receives from other sources of income reduces the proportionate loss of income if accepted for DI benefits. For example, if one family has asset income equal to $10,000 per year, wages equal to $10,000 per year and expects a benefit amount equal to $5,000 per year, the reduction in income equals 25 percent. Another family, with the same yearly wage and expected benefit amount but no asset income, would have a reduction in income equal to 50 percent. We expect the former to be more likely to apply.

The transfer income variable includes transfers from such sources as private pensions, Veteran's benefits, railroad retirement, etc., which may be predicated on reduced labor supply. As BJM [9] point out, however, these transfers are not necessarily dependent on DI beneficiary status and therefore inclusion in the model seems warranted.

We also expect the sign of the net value of assets to be positive. This variable represents, in a sense, a form of "security." The larger it is, the better able one is to cope with a reduced income if accepted.

The effect of rural residence on the application rate is somewhat ambiguous. Lower wages and fewer job opportunities might encourage application. On the other hand, lack of knowledge about the program or a greater social stigma associated with not working could have the opposite effect.

Race is included because evidence from other labor market studies indicate that labor market behavior differs between races. This variable is entered as a dummy (black = 1, white = 0). Owing to the more restricted labor market opportunities for many black males, our expectation is that the coefficient will be positive.

Age is included because of the tendency for disability to increase as workers grow older, both because of the higher incidence of physical and mental impairments and because of the tendency for chronic ailments to worsen over time. Therefore, we expect the sign of the age variable to be positive.

Number of dependent children is included as a measure of a worker's obligation. Because a worker with a large number of children has a greater need for income, he is less likely to apply.

Results

The application regression was estimated using a sample from the 1972 Social Security Survey of Disabled and Nondisabled Adults. Observations were limited to insured males aged 25-64 who reported some form of physical or mental impairment that limited their ability to work.[1]

In general, the model supports the hypothesis that increasing benefit levels (reducing opportunity costs) increases the probability of application for DI. Eleven of the fifteen health variables had coefficients which were significant at the 5 percent level or better and

[1] See Table 22 for the estimated coefficients.

Table 22. Probability of applying for disability insurance benefits, insured males aged 25-64

Independent variables	Coefficient[a]	t ratio
Constant	.0167	0.3
Economic variables		
Opportunity cost	-.0518	5.2*
Transfer income	.00003	7.6*
Income from assets	.000018	3.2*
Net value of assets	-.0000004	2.7*
Spouse's income	-.00001	0.6
Intrafamily transfers	-.00002	0.8
Other labor supply variables		
Age (25-64)	.0027	3.3*
Education (0-19)	-.0104	4.1*
No. of dependent children	-.0065	1.1
Rural residence	-.0036	0.2
Race (black = 1, white = 0)	.0833	3.0*
Health variables		
Limitations in reaching		
Difficulty reaching	.0928	4.1*
Cannot reach at all	.0925	2.3*
Limitations in mobility		
Difficulty walking	.1269	5.8*
Cannot walk	=.1678	2.5*
Difficulty using stairs	.0957	4.4*
Cannot use stairs	.1835	4.1*
Difficulty stooping	.0402	2.0*
Cannot stoop	.1705	5.2*
Cannot lift heavy weights	.0385	2.0*
Speech impairment	.0583	1.4
Mental disorder	.0791	2.8*
Nervous disorder	.0454	1.2
Sensory disorders		
Hearing	-.0434	1.6
Trouble seeing	-.0031	0.2
Trouble seeing with glasses	.1214	4.6*
R^2 = .278		

[a] [29].

*Significant at the 5 percent level.

have the correct sign. Six of ten labor supply variables are also significant at the 5 percent level. The percentage of the variance explained by the model is .278 which seems reasonable for cross-sectional data.

Our results are not strictly comparable with the BJM [9] results because we had insufficient information about how some of their variables were calculated. We will, however, note the similarities and differences between their results and ours and speculate on reasons for the differences.

The opportunity cost variable is defined as average monthly wages divided by monthly benefits to be received if the respondent is awarded DI status.[1] The estimated coefficient has a negative sign and is significant as expected. If benefit levels increase from $100 to $200 per month when a person's market wages are $400 per month, the increase in the probability of application is 10.36 percent. This result is about twice the BJM [9, p. 129] figure of 5.327 percent, reinforcing their conclusion that increasing benefit levels results in an increasing number of applications for DI.

All except four of the coefficients of the health dummies were significant and all but three had the correct sign. The inability to use stairs or inclines causes an increase in the probability of application of 18 percent, and the inability to stoop causes an increase of 17 percent. Two of the variables which had negative signs were not

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[1] See Appendix D for a discussion of how the opportunity cost variable was derived.

significantly different from zero. The coefficient of the variable, has difficulty walking, is positive and significant but the coefficient of the variable, cannot walk at all, has a negative sign and is significant at the 5 percent level. There is no obvious intuitive or theoretical explanation for this. One might hypothesize that someone who is so seriously impaired as to be unable to walk and has enough work experience to qualify for DI benefits, has an extremely strong commitment to the labor force; that his disability becomes a challenge to overcome.

Although we do not have information on how BJM [9] constructed their health variables, in general our results agree with theirs. One exception is the coefficient of nervous disorders. BJM [9] find the coefficient significant at the one percent level while we find it insignificant. In the 1972 survey, the condition categories included in the nervous disorder variable were rather vague. For example, the respondent was asked if he had "chronic nervous disorders" and "other nervous disorders" [34]. Perhaps BJM [9] had a more well-defined variable.

The coefficients of the labor supply variables generally had the correct sign and were significant. Age, as expected, has a positive sign and is significant. The coefficient of education is negative, as expected, and significant. Two of the other income variables (transfer income and income from assets) have the correct sign and are significant. Two others (spouse's income and family transfers) have the incorrect

sign and are not significant. This is consistent with work done by others [3] who have found that spouse's income has little effect on the participation of married men.

The BJM [9] coefficient for spouse's wage is also negative but significant at the one percent level. Our measure of spouse's income is 1971 income while BJM's measure is spouse's average monthly earnings on her last job. Our choice of this variable was made because of lack of data, not theoretical conviction, but we feel more comfortable with a negative sign if the results are insignificant.

The coefficient for net value of assets also has a negative sign and is significant. This is unexpected in view of our hypothesis that the more wealth one has, the more likely is he to apply for DI benefits, other things equal, because the wealthier one is, the less does one need to use income to acquire assets and/or pay off debts. The consequences of a reduced income stream, if accepted for DI, are mitigated. BJM results are similar to ours and they argue that the net value of assets may serve as a proxy for a person's inclination to work [9, p. 127].

The sign of the race dummy is significant and positive as expected. This may be due to the fact that discrimination has resulted in a smaller set of job opportunities for many blacks or that blacks are more likely to hold physically demanding jobs which they no longer can perform if they have limitations.

The Awards Model

The statistical model

The regression equation we used to estimate the probability of acceptance as a DI beneficiary after application is as follows:

$$\text{Probability of acceptance} = \beta_0 + \beta_1 \ldots \beta_{16} \text{ Health variables} + \beta_{17} \text{ Severity of disability} + \beta_{18} \text{ Age} + \beta_{19} \text{ Rural residence} + \beta_{20} \text{ Education} + \beta_{21} \text{ Number of dependent children} + \beta_{22} \text{ Race.}$$

The awards model includes all the health variables included in the application model. We expect a positive relationship between the probability of acceptance and the existence of functional limitations in light of the medical impairments requirements of the first test an applicant must pass in order to be accepted.

The remaining variables are demographic. The age variable was included because ill health is more likely to occur among older persons and chronic health problems may worsen with age. In addition, the Social Security Administration regulations are more permissive in allowing benefits for older workers. We expect the sign to be positive.

The race variable was included for two reasons. First, if more blacks apply for disability benefits, it may be that more claims are questionable and therefore blacks have a higher denial rate. In this case, we expect a positive relationship between race (white = 1,

black = 0) and probability of acceptance. On the other hand, blacks may be more poorly educated and/or more likely to have a history of work in unskilled occupations, therefore qualifying them for acceptance under the third test. In this case, we expect a negative relationship.

If persons who live in a rural environment and persons who have dependent children are less likely to apply for DI benefits, we expect the probability of acceptance to be higher because fewer claims would be suspect. Therefore, we expect a positive relationship between rural residence (rural = 1, nonrural = 0) and/or the number of dependent children and the probability of acceptance.

The sign of the education variable is ambiguous. As indicated previously, people with more education are less likely to apply for DI benefits and therefore (following the same reasoning as above) more likely to be awarded disability status. On the other hand, the more education a person has, the more likely it is he will be able to find alternative job opportunities if he becomes impaired.

A dummy variable was included to capture the effects of "severe" disabilities on the probability of acceptance. If the respondent indicated he was unable to perform any one of the functions, such as reaching, etc., the variable was given a value of one, zero otherwise. We expect a positive relationship between this variable and the probability of acceptance.

The applicant is automatically turned down if he has earnings greater than $140 per month in 1971. Therefore, the values of the

independent variables are constrained to equal zero if the applicant earned more than $140 in the year when he applied.

The results

The regression was estimated using a subsample of the 1972 Social Security Survey of Disabled and Nondisabled Adults [29]. The respondents consisted of 618 insured males, aged 25-64, who had applied for DI benefits in 1968, 1969, 1970 or 1971.

The award model only explains 14 percent of the variance of the probability of application and only three of the independent variables were significant at the 5 percent level. Two of the health variables were significant and positive as expected. These are the "difficulty reaching" dummy and the "difficulty using stairs" dummy. Five of the health dummies had negative signs indicating reduced probability of acceptance but none were significantly different from zero.

Age was the only significant demographic variable. The education variable, although insignificant, had a negative sign suggesting that people with more education are more likely to have residual capacity when they become impaired. The sign of the race dummy was positive, supporting the hypothesis that blacks are more likely to be turned down when they apply for disability benefits.

The model constructed and tested by BJM [9] explains 34 percent of the variance. All of the health variables they used were significant as were all of the demographic variables. BJM use data from 1965 and

Table 23. Probability of being awarded disability insurance benefits, insured male applicants aged 25-64

Independent variables	Coefficient[a]	t ratio
Constant	.2361	13.8*
Health variables		
Limitations in reaching		
Difficulty reaching	.1264	2.4*
Cannot reach at all	.0679	0.8
Limitations on mobility		
Difficulty walking	-.0242	0.4
Cannot walk	-.0158	0.1
Difficulty using stairs	.1744	2.9*
Cannot use stairs	.1679	1.9
Difficulty stooping	.0429	0.7
Cannot stoop	.0698	0.9
Cannot lift heavy weights	-.0457	0.9
Speech impairment	.0176	0.2
Mental disorder	.1159	1.9
Nervous disorder	.1079	1.0
Sensory disorders		
Hearing	.0649	0.9
Trouble seeing	-.0217	0.4
Trouble seeing with glasses	-.1183	1.6
Severity of disability	.0454	0.9
Demographic variables		
Age (25-64)	.0073	3.2*
Rural environment	-.0643	1.2
Education (0-19)	-.0215	1.8
No. of dependent children	.0217	1.4
Race	.0633	0.9
$R^2 = .14$		

[a] [29].

*Significant at the 5 percent level.

and use more aggregated measures of health than we do.[1] In addition, it is not clear how BJM constructed their health variables.

Conclusions

The results of the application model are reasonably good, both in terms of the R^2 and the number of significant variables. In addition, the results using 1971 data are consistent with the BJM [9] results using 1965 data. Both show a statistically significant inverse relationship between opportunity cost and application rate.

As noted in the introduction to this chapter, determination of disability status by the Social Security Administration follows a three-stage procedure which involves the interaction of health variables with age, education, type and length of work experience and employment opportunities. The BJM [9] model did not include the latter two variables, nor did we. The reasons we did not are: 1) because our desire to replicate the BJM [9] results for purposes of comparison, and 2) the data set we were using did not contain some of the information necessary to construct these variables.

To improve the fit of the acceptance equation, we suggest the following three approaches:

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[1] We tested the awards model using more aggregated measure of health. In particular we combined the reaching dummies into one variable, the walking, using stairs, and stooping dummies into one variable, and the mental and nervous disorders dummies into one variable. There was no change in the results.

1. To measure the length of work experience, use the quarters of coverage that are available on the 1972 Social Security Survey of Disabled and Nondisabled Adults [29]. Quarters of coverage are available back to 1937. We would expect the larger the number of quarters of coverage, the higher the probability of acceptance.
2. Construct a dummy variable indicating whether the applicant had worked as an unskilled laborer according to the U.S. Department of Commerce's occupation classification. We would expect a positive relationship between this variable and the probability of acceptance.
3. Use a regional (preferably state) unemployment rate as a proxy for employment opportunities.

The higher the regional unemployment rate, the lower the probability of acceptance because unemployed people may be applying on spurious health grounds.

Our results suggest that the health effect on acceptance is much weaker than do the BJM [9] results. An explanation might be that more and more people are being accepted under the second and third tests rather than the first. The value of the constant term is large and significant. This reinforces the suspicion that other variables are needed in the regression to explain the probability of acceptance.

CHAPTER V. CONCLUSION

Summary

The prime focus of this analysis has been to estimate the labor supply response of persons who consider themselves to be disabled to various types of functional limitations. Labor supply was measured in terms of labor force participation, annual hours worked, and the decision to apply for Disability Insurance (DI). It is expected that people do not leave the labor force, reduce annual hours worked, or decide to apply for DI on the basis of functional limitations alone but on the interaction between functional limitations and other economic and social characteristics. To test this hypothesis, we compared models of labor force behavior which did not contain variables representing functional limitations to models which did.

Our results support the hypothesis that the addition of functional limitations does not contribute much to the explanation of labor force behavior for disabled white males. The $\bar{R}^2$ of the latter models is only marginally higher than the $\bar{R}^2$ of the former in most cases. The data do not, however, support the hypothesis for black males. For older black males, the addition of health variables caused the $\bar{R}^2$ to increase by more than 100 percent in the participation equations for all groups and by as much as 600 percent in one case. For the older group who received no DIABAPTD, the health model increased the $\bar{R}^2$ by as much as 314 percent in the hours worked equations. For younger black males who received no DIABAPTD, the health model increased the

$\bar{R}^2$ by more than 200 percent in the hours worked regressions. For the participation regression, however, the health version of the model resulted in a decrease in $\bar{R}^2$ for younger black males.

These results suggest that poor health does play an important role in the labor supply decisions of older black males, particularly in the participation choice. Younger black males, on the other hand, are not likely to drop out of the labor force because of poor health. Their response to poor health seems to be in the form of a reduction in hours worked. This group seems more like white males than older black males, at least in their labor force participation response to health variables.

Our results, using 1971 data, do a poorer job, in general, of explaining labor force behavior than the results using 1965 data, but the results we get are fairly consistent with those obtained by BJM [9]. The major difference between our results and the BJM results [9, pp. 101-106] is that they report a large increase (154 percent) in $\bar{R}^2$ with the addition of health variables in the participation regression of younger black males who receive no DIABAPTD. As noted above, we observe a decrease in $\bar{R}^2$ when health variables are added for this group. In the hours worked regression for this group, BJM [9] find a relatively small increase in $\bar{R}^2$ using the health model while we find a large increase. In 1971, this group seemed to adjust hours worked in response to ill health rather than by leaving the labor force. In 1965, the opposite behavior appeared to be the case. These comparisons

suggest that, for those blacks who choose to be members of the labor force, the existence of functional limitations does not deter their participation. It may be that these black males have a stronger labor force commitment than their counterparts questioned in 1965.

The independent variables which appear to be the most closely associated with health are marital status, age and education. In particular, our results support the suspicion that marital status derives some of its importance in determining labor supply from its relationship with mental and nervous disorders. Age and health also appear to be related. For younger males, much of the impact on labor supply presumed to be caused by aging may be due, rather, to poor health. For older males, aging may exacerbate existing functional limitations. There is some evidence that more years of education enables an individual to continue working in spite of limitations because, the more highly educated one is, the more job alternatives are available. In a sense, education can compensate for physical limitations, at least up to some point.

The estimates of reservation wages for white males seemed to be reasonable in that they conformed to our expectations. In the probit equation, eight of the fourteen independent variables were significant and most had the correct sign. In the wage offer equation, half of the independent variables were significant and the $\bar{R}^2$ was equal to .43 which is reasonable for cross-sectional data.

The results for black males leave a great deal to be desired. In the probit equation, only the health dummy, the marital status

dummy and the public transfer coefficient are significant and have the correct sign. The wage offer equation has no significant coefficients and they are all quite small. The derived reservation wage equation has coefficients which seem too large, for the most part, and often have unexpected signs. In addition, the estimated standard deviation is equal to -43.2 which is ten times the size of the standard deviation estimated for the white sample. All of these things lead us to suspect that the model is misspecified for black males.

Given the unsatisfying results for the reservation wages of black males, we were not surprised that actual wages did a better job in explaining the variation in the labor supply models for these samples in Chapter 3. We were disappointed, however, in the labor supply models when using the reservation wages for white males. In only one case (the participation regression for younger white males who received no transfers) did the use of reservation wages result in even a marginally higher $\bar{R}^2$ than using actual wages. In general, reservation wages did just about as well (in terms of $\bar{R}^2$) as actual wages in the participation equations for white males, but actual wages performed better in the hours worked equations. This may be because reservation wages conceptually are more closely related to the participation decision than the hours worked decision.

The probability that a disabled person will apply for DI seems to be fairly well explained by our model. Among the economic variables in the model, opportunity cost, transfer income, and asset income have

the predicted sign and are significant. The significant demographic variables are age, education and race and all have the expected sign. Eleven of the fifteen health variables are significant. Of these, only one has the incorrect sign. Overall, the results using 1971 data are consistent with the BJM [9] results.

The awards model we tested did a much poorer job of explaining the probability that an applicant will be granted DI benefits. Only one of the health variables, difficulty using stairs, is statistically significant. Of the demographic variables included in the model, only the age variable had a significant coefficient.

Problems and suggestions for future research

One major caveat we enter in interpreting our results is the small sample size of the black cohorts. The 1972 survey [29] contained 530 respondents who were disabled, male, and black. When persons aged 20-24, and records for which there were missing data were eliminated, the total black sample was reduced to 353 observations. Further reductions in the sample were caused by eliminating transfer payment recipients. In light of our results for black males, which concur with BJM's [9] results, we would suggest that future surveys increase the number of observations in this cohort. Larger samples would make us more confident of the results.

The specification of the model we used to estimate reservation wages for the black samples needs to be revised. First, we suggest experimentation to ascertain which independent variable should be eliminated from the reservation wage equation. Second, variables should be included in the wage offer equation which indicate the effect of attitudes or discrimination on the wage offers blacks receive. Finally, variables which represent motivational factors should be included in the probit equation.

Another issue which we feel requires further research is the measurement of the functional limitations. In our model we used dummy variables to indicate the presence or absence of a limitation. This method of representing the health variables has two drawbacks. First, it does not capture differences among persons with the same limitation. For example, a person may report he has difficulty walking. We do not know whether this person has lost a leg or whether a chronic case of the gout makes walking difficult. The former impairment may have a larger impact on labor supply than the latter. In addition, to represent all the various functional limitations requires a large number of dummy variables which can be cumbersome to use and may present statistical problems when samples are small. What is needed is some quantitative measures of health which reflect the loss of function as a continuous variable.[1]

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[1]Berkowitz [8] has constructed a number of health variables by weighting responses to questions about function limitations according to American Medical Association values of the loss of such functions. For example, the loss of both legs is assigned a value of 64 percent of the whole person. Berkowitz assigns this value to a person who says he is unable to walk at all. If a person has mutliple limitations, the weights are added up.

Finally, we would like to investigate the effects of health on the labor supply of women. As more women enter the labor force, more will become eligible for disability insurance benefits and more women will be receiving these benefits on the basis of their own work history. In order to evaluate the DI program and to perhaps modify it in the future, it is necessary to have an understanding of the labor supply response of women to functional limitations. Previous research [3, 12] has suggested that married women may respond differently to traditional labor supply determinants than men do. This may be true of health variables as well. Or it may be that women, married or not, respond in a way similar to their male counterparts. In either case, information about this group of workers is important as a guideline for policy making. In the 1972 Survey of Disabled and Nondisabled Adults, more than half (55 percent) of the respondents who considered themselves disabled were women [1, p. 1]. Any analysis of the determinants of disability is not complete if information from half the sample is neglected, particularly when women make up a significant proportion of the labor force.

Conclusions

It is intuitively obvious that persons who suffer from chronic functional limitations are likely, ceteris paribus, to reduce labor supply. But other things are seldom equal. One person who has difficulty walking may not be employable because he has only a grade school education while another, with the same limitation, who has a

Ph.D. in nuclear engineering may command a salary in five figures. Public policies designed to provide income replacement for impaired individuals on the basis of medical considerations alone, therefore, do not address the problem adequately. Although the intent of Congress seems to have been initially to make DI benefits available based on medical criteria, Social Security regulations, in response to judicial interpretation of the disability insurance system, permit the granting of benefits based on the interaction of medical conditions with the socioeconomic characteristics of the applicant [9, p. 59]. This study provides support for this adjudication process.

It also lends support to the hypothesis that increased benefit levels have a strong disincentive effect on labor force participation. Higher benefit levels increase application rates which may contribute to increased costs of the Disability Insurance Program.

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ACKNOWLEDGEMENTS

Many people have assisted me in the preparation of this dissertation. In particular, I would like to thank Charles Meyer who provided direction and focus for this thesis and shared his expertise on the Social Security Disability Insurance Program with me. I have depended on his advice and profited from his constructive criticism.

I would also like to acknowledge the contribution made by Bill Colclough in preparing the data and doing the programming necessary for the statistical analysis. This contribution was essential to the completion of this study. J. D. Adams, Ralph Schnelvar, and James Hoekstra also assisted Bill in adapting a probit program for use at Iowa State.

A word of thanks is due Peter Mattila who looked at the labor supply models and provided several valuable comments.

Diana McLaughlin not only provided clerical assistance in typing the manuscript but helped guide me through the rules and regulations surrounding the preparation and submission of a dissertation.

I owe a major debt to James A. Stephenson who nagged when I was not working, patted me on the back when I was, and in general provided the motivation I needed to complete this project.

APPENDIX A. CORRELATION COEFFICIENTS FOR THE PROBIT EQUATION

Table A.1. Correlation coefficients---white males--probit[a]

Independent variables	EX1	EX2	EX3	EX4	SICK	MARST	MSPABS	RURE	EDUC	SPINC	NDEPC	INCFA	PUBTR	PRVTR
EX1	1	.50	.52	.51	.08	.20	-.003	-.05	-.38	.02	-.14	.11	.07	.04
EX2	.50	1	.58	.57	.07	.16	.03	-.02	-.33	-.01	-.23	.06	.003	.05
EX3	.52	.58	1	.65	-.03	.10	-.02	-.03	-.27	-.03	-.16	.11	-.07	-.05
EX4	.51	.57	.65	1	-.09	-.002	.29	-.03	.24	.009	.02	.08	.02	-.01
SICK	.08	.07	.03	-.09	1	.07	-.02	-.09	.08	-.001	-.20	.01	-.16	.04
MARST	.20	.16	.10	-.002	.07	1	.15	-.02	-.09	-.32	-.32	.01	-.02	-.07
MSPABS	-.003	.03	-.02	.29	-.02	.15	1	.07	.01	-.004	.006	.03	-.02	-.07
RURE	-.05	-.02	-.03	-.03	-.09	-.02	.07	1	.18	.02	-.01	.001	-.10	.04
EDUC	-.38	-.33	-.27	.24	.08	-.09	.01	.18	1	-.09	.05	-.09	-.06	-.07
SPINC	.02	-.01	-.03	.009	-.001	-.32	-.004	.02	-.09	1	.09	.03	.02	.02
NDEPC	-.14	-.23	-.16	.02	-.20	-.32	.006	-.01	.05	.09	1	.03	.03	.04
INCFA	.11	.06	.11	.08	.01	.01	.03	.001	-.09	.03	.03	1	.003	.17
PUBTR	.07	.003	-.07	.02	-.16	-.02	-.02	-.10	-.06	.02	.03	.003	1	.58
PRVTR	.04	.05	-.05	-.01	.04	-.07	-.07	.04	-.07	.02	.04	.17	.58	1

[a][29].

Table A.2. Correlation coefficients---black males--probit[a]

Independent variables	EX1	EX2	EX3	EX4	SICK	MARST	MSPABS	RURE	EDUC	SPINC	NDEPC	INCFA	PUBTR	PRVTR
EX1	1	.48	.46	.49	.22	.19	-.04	.06	-.46	.04	-.21	.09	.02	.12
EX2	.48	1	.46	.52	.07	.06	-.07	.03	-.42	.04	-.30	-.05	.09	.14
EX3	.46	.46	1	.53	-.006	.07	-.08	.38	-.40	.006	-.13	-.12	.05	.07
EX4	.49	.52	.53	1	.03	.06	.001	.12	.29	.03	-.18	-.03	.13	.18
SICK	.22	.07	-.006	.03	1	-.06	-.09	-.05	.10	-.003	-.13	.12	-.05	-.09
MARST	.19	.06	-.07	.06	-.06	1	.40	-.08	-.11	.40	-.20	.03	-.21	-.06
MSPABS	-.04	-.07	-.08	.001	-.09	.40	1	.07	.01	-.08	-.09	.14	-.28	-.08
RURE	.06	.03	-.38	.12	-.05	-.08	.07	1	.11	.14	-.02	.01	-.02	.10
EDUC	-.46	-.42	-.40	.29	.10	-.11	.01	.11	1	-.14	.02	-.01	-.06	.08
SPINC	.04	.04	.006	.03	-.003	.40	-.08	.14	-.14	1	.05	.07	.17	-.02
NDEPC	-.21	-.30	-.13	-.18	-.13	-.20	-.09	-.02	.02	.05	1	.04	.006	.02
INCFA	.09	-.05	-.12	-.03	.12	.03	.14	.01	-.01	.07	.04	1	-.01	-.01
PUBTR	.02	.09	.05	.13	-.05	-.21	-.28	-.02	-.06	.17	.006	-.01	1	.05
PRVTR	.12	.14	.07	.18	-.09	-.06	-.08	.10	.08	-.02	.02	.01	.05	1

[a] [29].

APPENDIX B. LABOR SUPPLY RESULTS FROM COMBINED AGE-GROUP SAMPLES FOR BLACK MALES

Because of the small sample sizes of the black transfer-payment groups, we tested the models using combined age-group samples. By increasing the sample size, we increase the reliability of the estimates. The black samples showed the largest increases in $\bar{R}^2$ when health variables were added to the model. We wanted to see if this continues to be true in larger samples. Tables B.1 to B.4 present the results.

In most cases, the results are similar to the ones obtained in the age-group samples. The $\bar{R}^2$ in the combined samples are close to being averages of the two $\bar{R}^2$'s in the separate agegroup samples and the number of significant independent variables does not change much. In one case, however, the combined sample does a much better job in explaining labor force behavior than either of the two age-group samples. For black males who receive no transfers, in the hours worked regressions the combined sample has an $\bar{R}^2$ of .20 for the conventional model and an $\bar{R}^2$ of .35 for the health model; when using actual wages for the youner age group, the $\bar{R}^2$ were .13 and .24; and, for the older age group, they were .18 and .26. In addition, the number of significant variables increased from none in either of the age group samples to five in the combined sample.

The marital status variable is significant and positive for the no-transfer group in both models. The inclusion of health variables reduces the size of the coefficient of the marital status variable

712.5 to 618.4. This is consistent with results we discussed previously. The coefficient of wages is significant and negative in the health model, insignificant in the conventional model. It would appear the income effect of a change in wages is more pronounced when health variables are included. The health variables that are significant are sensory limitations, mental disorders, both of which have negative coefficients, and difficulty in hearing, which has a positive sign. The latter result also occurs in the no DIABAPTD subsample. A possible explanation is discussed in Chapter 3.

The reason for the better performance of the combined age-group sample in the hours worked equation for the no-transfer cohort may be a statistical one. In more aggregated samples, there is a greater probability that the residuals will tend to cancel each other out, resulting in a better fit.[1]

The results from the combined age-group sample bolster our confidence in the conclusions we drew from the smaller samples that there seems to be racial differences in the way individuals respond to functional limitations.

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[1]This point was made to me in a discussion with James A. Stephenson.

Table B.1. Labor force participation, black males, households receiving DIABAPTD excluded[a]

Independent variables	1971 results using actual wages				1971 results using reservation wages			
	No health		Health		No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	-.0031	0.75	-.0007	0.15	-.0050	1.05	-.0017	0.33
Education	-.0104	0.94	-.00075	0.63	-.0098	0.83	-.0091	0.77
Asset income	-.00006	0.53	-.00006	0.53	+.000007	0.06	-.00001	0.10
Family transfers	+.0034	0.77	+.0038	0.77	+.0029	0.55	+.0056	1.03
Public transfers	-.00002	0.42	-.00002	0.35	+.00001	0.16	+.00004	0.44
Nonrespondent income	+.00002	1.16	+.00002	1.18	+.000005	0.30	+.000005	0.30
Marital status	+.1803	1.92	+.1946	1.93	+.1361	0.84	+.0943	0.55
Rural residence/UE	+.1348	1.18	+.1706	1.42	+.0712	0.55	+.1047	0.80
Hourly wages	+.0562	4.37*	+.0533	3.82*	+.0031	0.74	+.0040	0.87
Stooping, walking limitations	-	-	-.0737	0.73	-	-	-.1210	1.11
Reaching limitations	-	-	-.0557	0.48	-	-	-.1081	0.91
Lifting limitations	-	-	+.0145	0.13	-	-	+.0976	0.85
Sensory limitations	-	-	-.0562	0.62	-	-	-.1191	1.24
Speech	-	-	+.0426	0.18	-	-	+.0965	0.46
Hearing	-	-	-.3197	1.19	-	-	-.3858	1.48
Mental disorders	-	-	+.0392	0.29	-	-	-.0911	0.69
Nervous disorders	-	-	+.1562	0.81	-	-	+.1332	0.62
Constant	+.6631	2.49*	+.5968	2.04*	+.3817	0.50	+.2518	0.29
$\bar{R}^2$	.21	-	.18	-	.03	-	.06	-
N	97	-	97	-	107	-	107	-

[a] [29].

*Significant at the 5 percent level.

Table B.2. Hours worked, black males, households receiving DIABAPTD excluded[a]

Independent variables	1971 results using actual wages				1971 results using reservation wages			
	No health		Health		No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	-10.9603	1.11	-9.6702	1.00	-3.4310	0.31	-4.9562	0.44
Education	+15.4455	0.57	-.6362	0.02	+16.7987	0.60	+3.9637	0.14
Asset income	-.0831	0.31	+.0352	0.14	-.1794	0.64	-.0003	0.01
Family transfers	-4.6351	0.48	+11.0064	1.12	-3.9344	0.39	+10.6232	1.00
Public transfers	-.0810	0.59	-.1440	1.11	+.0035	0.02	-.1157	0.57
Nonrespondent income	+.0553	1.27	+.0248	0.61	+.0459	0.97	+.0186	0.41
Marital status	+436.5027	1.76	+454.9210	1.92	+351.3361	0.89	+604.0269	1.55
Rural residence/UE	-269.5247	1.00	-407.8252	1.59	-260.7451	0.89	-353.8278	1.23
Hourly wages	-62.5933	2.00*	-78.4214	2.68*	+6.0560	0.57	+.4351	0.04
Stooping, walking limitations	-	-	-391.7655	1.79	-	-	-403.7207	1.71
Reaching limitations	-	-	-297.1811	0.99	-	-	-238.6149	0.75
Lifting limitations	-	-	+189.6058	0.68	-	-	+171.7656	0.57
Sensory limitations	-	-	-536.4717	2.77*	-	-	-487.9469	2.35*
Speech	-	-	-288.2659	0.63	-	-	-618.6239	1.29
Hearing	-	-	+2440.6417	2.60*	-	-	+2201.9173	2.21*
Mental disorders	-	-	-938.3568	2.83*	-	-	-830.9660	2.36*
Nervous disorders	-	-	-550.1149	1.34	-	-	-520.8357	1.19
Constant	+1709.3326	2.59*	+2570.9479	4.00*	+141.5361	0.07	+1831.5128	0.95
$\bar{R}^2$	.10	-	.29	-	.04	-	.20	-
N	72	-	72	-	72	-	72	-

[a][29].

*Significant at the 5 percent level.

Table B.3. Labor force participation, black males, households receiving public transfers excluded[a]

Independent variables	1971 results using actual wages				1971 results using reservation wages			
	No health		Health		No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	-.0041	0.95	-.0041	0.83	-.0043	0.89	-.0025	0.48
Education	-.0026	0.21	-.0008	0.06	-.0003	0.02	+.0002	0.02
Asset income	-.0002	1.68	-.0003	1.74	-.0001	0.90	-.0002	1.35
Family transfers	+.0031	0.73	+.0049	1.03	+.0024	0.47	+.0065	1.25
Nonrespondent income	-.000007	0.40	+.00001	0.50	-.000008	0.45	-.000006	0.38
Marital status	+.2661	2.56*	+.2396	2.12*	+.1703	1.10	+.0549	0.35
Rural residence/UE	+.0998	0.84	+.1202	0.94	+.0303	0.23	+.0243	0.18
Hourly wages	+.0472	3.68*	+.0434	3.10*	+.0040	1.19	+.0053	1.49
Stooping, walking limitations	-	-	-.1095	0.98	-	-	-.2403	2.01*
Reaching limitations	-	-	-.0049	0.04	-	-	-.0616	0.50
Lifting limitations	-	-	+.1295	1.03	-	-	+.2580	2.00*
Sensory limitations	-	-	-.0167	0.16	-	-	-.1005	0.94
Speech	-	-	+.0325	0.12	-	-	+.0320	0.14
Hearing	-	-	-.1815	0.60	-	-	-.1704	0.63
Mental disorders	-	-	-.0783	0.54	-	-	-.1722	1.25
Nervous disorders	-	-	+.2213	1.07	-	-	+.1462	0.64
Constant	+.6734	2.43*	+.7266	2.38*	+.1702	0.28	+.1432	0.22
$\bar{R}^2$	.20	-	.16	-	.06	-	.13	-
N	74	-	74	-	83	-	83	-

[a] [29].

*Significant at the 5 percent level.

Table B.4. Hours worked, black males, households receiving public transfers excluded[a]

Independent variables	1971 results using actual wages				1971 results using reservation wages			
	No health		Health		No health		Health	
	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t	$\hat{\beta}$	t
Age	-16.8825	1.63	-13.0442	1.26	-9.4696	0.87	-5.6524	0.51
Education	+22.7938	0.79	-.8289	0.03	+24.1940	0.82	+9.8276	0.31
Asset income	-.1565	0.38	-.1615	0.33	-.3845	0.90	-.3021	0.61
Family transfers	-3.1827	0.34	+11.8716	1.20	-3.1881	0.34	+9.6913	0.94
Nonrespondent income	+.0485	1.10	+.0010	0.02	+.0257	0.54	-.0294	0.64
Marital status	+712.4808	2.62*	+618.4013	2.38*	+520.2591	1.42	+417.6879	1.20
Rural residence/UE	-119.5313	0.42	-447.2570	1.60	-163.0683	0.55	-504.7213	1.71
Hourly wages	-55.1218	1.76	-69.5769	2.35*	+10.2052	1.26	+12.9363	1.67
Stooping, walking limitations	-	-	-320.9058	1.38	-	-	-425.3694	1.72
Reaching limitations	-	-	-220.9946	0.71	-	-	-103.7169	0.33
Lifting limitations	-	-	+201.9683	0.69	-	-	+244.3841	0.80
Sensory limitations	-	-	-655.6095	2.97*	-	-	-608.1239	2.69*
Speech	-	-	-487.6480	0.82	-	-	-801.6474	1.34
Hearing	-	-	+2288.5136	2.34*	-	-	+2052.2371	2.04*
Mental disorders	-	-	-908.1377	2.34*	-	-	-735.1229	1.83
Nervous disorders	-	-	-481.5420	1.18	-	-	-499.1316	1.18
Constant	+1643.8837	2.43*	+2554.1630	3.78*	-460.0071	0.31	-117.7513	0.08
$\overline{R}^2$	.20	-	.35	-	.18	-	.31	-
N	58	-	58	-	58	-	58	-

[a][29].

*Significant at the 5 percent level.

APPENDIX C. LABOR SUPPLY RESULTS USING THE EXTENDED MODELS

In an attempt to increase the explanatory power of the models discussed in Chapter 3, we tested an extended version. Specifically, we tested the following model:

$$\text{Labor supply} = \beta_0 + \beta_1 \text{ Age} + \beta_2 \text{ Education} + \beta_3 \text{ Asset income} + \beta_4 \text{ Nonrespondent income} + \beta_5 \text{ Marital status} + \beta_6 \text{ Wages} + \beta_7 \text{ Family transfers} + \beta_8 \text{ Rural residence} + \beta_9 \text{ Public transfers} + \beta_{10} \text{ Private transfers} + \beta_{11} \text{ Net value of assets} + \beta_{12} \text{ Number of dependent children} + \beta_{13} \cdots \beta_{28} \text{ Health variables.}$$

We added private transfers, number of dependent children, net value of assets and disaggregated the health variables. Private transfers are sources of income such as insurance annuities and were added to see if the source of transfers made a difference. Net value of assets was included because the wealthier a person is, the less pressure may there be to work. A priori one would expect a negative relationship between the net value of assets and labor supply. Most estimates, however, are positive, suggesting that wealth may be a proxy for motivation. That is, people work harder in order to acquire wealth. The existence and number of children for males makes labor force activity more obligatory, other things equal. We expect a positive relationship. In this model we do not combine the health variables and we did in the models discussed in Chapter 3. We wish to see which specific limitations have an effect on labor force activity.

Table C.1 presents the $\bar{R}^2$ of both the extended and basic models. For all but one sample, the extended model does, at best, only marginally better and sometimes does not do as well. Only for the black males who receive no DIABAPTD in the hours worked equations does the extended model do better.

For younger white males, in the hours worked equations, the results using the extended model provide an insight into the effect of wealth on labor supply behavior. When the basic model is used, the asset income variable is significant and positive. When the extended model is used, the variable representing net value of assets is significant and positive but, the asset income variable becomes insignificant. This suggests that it is not the income received from assets which has a positive effect on labor supply so much as the wealth effect of owning assets which is consistent with the hypothesis noted above. The same result is not observed in other cohorts.

Table C.2 presents the regression results for the health version of the hours worked equations for black males. In the extended model, the rural residence dummy and the has difficulty walking dummy become significant when they were not in the basic model. Also, the mental disorder dummy becomes insignificant in this model. We expect the rural residence variable to have a negative effect on labor supply because the value of home time may be greater in the country and/or employment opportunities are fewer. Disaggregating the stooping, walking, using stairs variable into its various components indicates that having difficulty walking reduces labor supply.

Using the extended model does not change the conclusions we reached in Chapter 3 regarding the impact of health on labor supply behavior. In general, the pattern we observed using the basic model is duplicated using an extended model of labor supply.

Table C.1. $\bar{R}^2$ of the basic and extended labor supply equations

Cohort	Labor force participation				Hours worked			
	No health		Health		No health		Health	
	1971[a]	1971[b]	1971[a]	1971[b]	1971[a]	1971[b]	1971[a]	1971[b]
White males, aged 25-54, no DIABAPTD	.09[c] (.10)	.09 (.10)	.13 (.09)	.15 (.11)	.20 (.16)	.11 (.08)	.24 (.23)	.16 (.11)
White males, aged 25-54, no transfers	.09 (.10)	.15 (.16)	.10 (.10)	.16 (.18)	.17 (.13)	.11 (.10)	.23 (.19)	.17 (.14)
White males, aged 55-64, no DIABAPTD	.20 (.20)	.09 (.09)	.24 (.19)	.18 (.10)	.27 (.28)	.12 (.07)	.34 (.30)	.14 (.08)
White males, aged 55-64, no transfers	.16 (.17)	.15 (.15)	.18 (.20)	.16 (.15)	.25 (.27)	.15 (.13)	.30 (.28)	.14 (.14)
Black males, no DIABAPTD	.20 (.21)	.02 (.03)	.18 (.18)	.08 (.06)	.17 (.10)	.10 (.04)	.42 (.29)	.35 (.20)
Black males, no transfers	.19 (.20)	.04 (.06)	.24 (.16)	.17 (.13)	.23 (.20)	.20 (.18)	.39 (.35)	.41 (.31)

[a] [29].

[b] Regressions were run using the same data base but using reservation wages.

[c] The top row of figures refer to the $\bar{R}^2$ obtained when testing the extended model. The bottom row of figures refers to the $\bar{R}^2$ obtained when testing the basic model.

Table C.2. Hours worked by black males using the extended model

Independent variables	Households receiving no DIABAPTD			
	1971[a]		1971[b]	
	Coefficient	t ratio	Coefficient	t ratio
Age	-4.4531	0.39	-.7958	0.06
Education	-3.0857	0.12	+2.4439	0.09
Asset income	-.3950	1.27	-.5220	1.58
Private transfers	-	-	-.4992	1.77
Nonrespondent income	-.0034	0.08	-.0019	0.04
Marital status	+480.9453	1.83	+800.5361	1.92
Hourly wages	-64.2156	2.34*	-3.8055	0.32
Family transfers	+9.2178	0.91	+7.5222	0.71
Rural residence/UE	-707.3968	2.74*	-645.8338	2.15*
No. of dependent children	+131.2385	1.81	+127.8724	1.60
Net value of assets	+.0222	1.88	+.0239	1.91
Public transfers	-.2060	1.62	-.2204	0.85
Has dfficulty reaching	-296.4611	0.89	-193.1828	0.54
Cannot reach	+124.0492	0.19	+390.8269	0.54
Has difficulty walking	-792.7847	3.24*	-871.9910	3.39*
Has difficulty using stairs	-127.8500	0.47	-216.0504	0.76
Cannot use stairs	-52.9869	0.07	-204.8875	0.26
Has difficulty stooping	+232.3443	1.00	+245.7394	1.00
Cannot stoop	+478.3770	0.78	+657.3671	0.98
Has difficulty lifting	+62.9335	0.19	-58.2076	0.16
Speech problems	-158.9253	0.31	-468.4929	0.87
Hearing problems	+2794.7224	3.09*	+2642.2253	2.77*
Has difficulty seeing	-568.6837	2.74*	-606.9037	2.72*
Has difficulty seeing with glasses	-148.3279	0.44	+77.4567	0.20
Mental disorders	-633.5059	1.82	-636.8936	1.71
Nervous disorders	-634.5978	1.55	-637.1954	1.47
Constant	+2201.6490	2.96*	+2264.5443	1.07
N	72	-	72	-
$\bar{R}^2$	.42	-	.35	-

[a] [29]. Regressions were run using actual wages.

[b] [29]. Regressions were run using reservation wages.

*Significant at the 5 percent level.

Households receiving no transfers			
1971[a]		1971[b]	
Coefficient	t ratio	Coefficient	t ratio
-14.9289	1.09	-8.9282	0.65
-14.3274	0.43	-9.6397	0.29
-.9789	1.50	-1.5684	2.35*
-	-	-	-
-.0331	0.65	-.0621	1.19
+840.7346	2.34*	+899.1427	2.28*
-55.8531	1.81	+8.7730	1.12
+13.5601	1.17	+10.6554	0.93
-644.6745	2.01*	-715.8288	2.24*
+93.5734	1.17	+53.2962	0.66
+.0144	0.80	+.0182	0.99
-	-	-	-
-185.0847	0.49	-63.0344	0.17
+551.8959	0.66	+961.6108	1.20
-813.4897	2.59*	-989.4009	3.25*
+79.2942	0.24	-11.7751	0.04
+272.4301	0.31	+275.8675	0.32
+163.8476	0.64	+140.3759	0.55
+768.0884	1.09	+970.9567	1.40
-101.5375	0.26	-249.3170	0.66
-217.9608	0.30	-166.3748	0.22
+2570.8090	2.47*	+2420.7904	2.38*
-548.3411	2.23*	-635.2361	2.57*
-395.5628	0.86	-200.6842	0.44
-712.7172	1.60	-683.8794	1.55
-443.8063	0.98	-416.5567	0.94
+2493.6184	2.87*	+704.7936	0.48
58	-	58	-
.39	-	.41	-

APPENDIX D. CALCULATION OF THE OPPORTUNITY COST VARIABLE

The opportunity cost variable in the application equation is the ratio of actual monthly wages of the respondent to the amount he would receive if he were accepted as a DI beneficiary. First, we describe how the expected monthly benefit amount was calculated and then how the actual monthly wage was calculated.

Monthly Benefit Amount

This calculation proceeds in three steps. First, the average monthly wage (AME) is determined. Then, the primary insurance amount (PIA) is calculated. Finally, the monthly benefit amount (MBA) is derived, which depends on family size and composition and is subject to minimum and maximum benefit constraints.

1. AME calculation
    a. Eliminate earnings in the five years when earnings were the lowest from 1951 to date of application, if the respondent applied, or 1971 if he did not apply, and add the earnings in the remaining years.
    b. Eliminate quarters of coverage (QC) in the years eliminated in a, add up the remaining QC and multiply by 3.
    c. Divide a by b to get AME.
2. PIA and MBA calculation
    a. The AME is used to calculate the PIA. See table D.1 for the procedure.

b. The calculation of the MBA is presented in table D.2.

Actual Monthly Wage

If the respondent never applied or applied in 1971 and worked in 1971, the actual monthly wage in 1971 was used. If the respondent applied prior to 1971 (1968, 1969, or 1970), earnings in that year were used if they were greater than zero. If they were equal to zero, earnings in the year the respondent last worked were used, if that year was not before the year in which he was disabled. For example, if a respondent applied in 1970 and his earnings in that year were zero, and he became disabled in 1968, earnings in 1969 would be used if nonzero. If earnings in 1969 were zero, then earnings in 1968 were used if nonzero. If earnings in 1968 were zero, then the opportunity cost of applying for benefits was equal to zero. If the respondent applied in 1971 and had zero wages, the above procedure was used.[1]

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[1] If a person has a condition which is steadily deteriorating, then the procedure used to calculate actual wages does not reflect the true opportunity cost of applying for DI benefits. The amount he could earn prior to his impairment may not be what he could earn given the impairment.

Table D.1. PIA calculation[a]

Year	PIA
1968-1969	71.16% of first $110 of AME
	+ 25.88% of next $290 of AME
	+ 24.18% of next $150 of AME
	+ 28.43% of next $100 of AME
1970	81.83% of first $110 of AME
	+ 29.76% of next $290 of AME
	+ 27.81% of next $150 of AME
	+ 32.69% of next $100 of AME
1971	90.01% of first $110 of AME
	+ 32.74% of next $290 of AME
	+ 30.59% of next $150 of AME
	+ 35.96% of next $100 of AME
	+ 20.00% of next $100 of AME

[a][30, p. 19].

Table D.2. MBA calculation

MBA = 100% of PIA if no dependents
+ 50% of PIA for wife caring for dependent child
+ 50% of PIA for dependent child[a]

Year	Minimum benefit[b]			
1968	$55	1. AME = 0 - 150	150% of PIA	
		2. AME = 151 - 650	80% of first $436 of AME	
			+ 40% of next $214 of AME	
1969-1970	$64	1. AME = 0 - 200	150% of PIA	
		2. AME = 201 - 650	80% of first $436 of AME	
			+ 40% of next $214 of AME	
1971	$70.40	1. AME = 0 - 200	150% of PIA	
		2. AME = 201 - 628	88% of first $436 of AME	
			+ 44% of next $191 of AME	
		3. AME = 628 - 750	175% of PIA	

[a] [30, pp. 20-21].

[b] [30, p. 24].