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THE EFFECT OF SOCIAL SECURITY ON RETIREMENT

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SUMMARY

This study examines the impact of social security on the retirement of married men aged 60-70 years. The empirical results are based on a rich file of data from the Social Security Administration (1973 CPS-IRS-SSA Exact Match File). The data permit precise calculation of social security wealth (the actuarial present value of benefits that a person would receive by retiring) denoted SSW. This variable measures social security's effect on retirement. The estimated effects are significant and considerable. When SSW increases from $35,000 to $55,000 the probability of retirement rises by .15 for 62-64 year olds relative to a .41 retirement rate. For 65-70 year olds this increase is .22 relative to .78. For 60-61 year olds who are entitled to SSW but not old enough to receive benefits the estimated effect was small and insignificant. This supports the conclusion that the observed effect on men eligible for benefits is a causal relationship.

The traditional method of comparing market and reservation wages for analyzing the decision to work provides the basic econometric model. SSW is added to construct a retirement model. A two-step probit analysis is developed to identify structural parameters in the retirement model.

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The Effect of Social Security on Retirement*

The social security program is the major source of income support for retired workers.[1] The basic idea of this program is to direct benefits to individuals whose retirement decreased their income and was outside their control. A provision consistent with this idea is the retirement test which reduces social security benefits when earned income exceeds a certain amount.[2] However, the variation in benefit levels for individuals who otherwise face the same economic opportunities in terms of their market wage, capital income, and other resources may influence the decision to retire. Also, the high implicit tax rate on earnings above an exempt amount can change the labor supply of persons who are eligible for retirement benefits subject to the earnings test. Therefore, rather than being outside individual control, retirement may be induced by social security. The net effect of social security on total income which is the sum of labor, benefit, and capital income is an unanswered empirical question because we do not know enough about its impact on retirement.[3]

This paper examines how social security affects retirement in a cross-section sample of men aged 60-70 years. The data source comes from the Social Security Administration and contains accurate information on the retirement benefits which each person is eligible to receive, regardless of whether he claims these benefits as a retiree. The foundation of this analysis is the standard theory of labor-leisure choice. Section II will briefly review recent liter-

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ature on social security and retirement behavior. The retirement model based on a market wage equation and shadow price equation is introduced in Section III. These two equations are part of a simultaneous equations model of labor supply which will be discussed briefly. The data source and specification of the model are presented in Section IV. Empirical results based on estimating the participation model over subsamples of 60-70 year old men constitute Section V. Section VI briefly summarizes and concludes this paper.

II. Review of Recent Literature

The Social Security Administration has conducted several surveys of beneficiaries almost since benefits were first paid in 1940.[4] Early survey results seemed to indicate that poor health and lack of employment opportunities were major reasons for the retirement of respondents. As Quinn (1975) points out, health may be a more convenient or socially acceptable explanation for departure from full-time work than personal economic gain. He shows that health, labor market conditions, and job characteristics do influence retirement, but economic factors have additional explanatory power in his retirement model. The main economic determinants are eligibility for social security and private pension retirement benefits and interaction between the two. The insignificant wage effect found by Quinn may be caused by his not having the full benefit amount which an individual is entitled to receive. Since this amount is expected to have a negative income effect on participation and be positively correlated with the wage, the wage effect which should be positive may be estimated as small and insignificant due to left-out variable bias. Another difficulty with these results is not being able to distinguish between the effect of eligibility for benefits and declining participation due to age. Although there are problems, Quinn's results provide empirical support for viewing retirement as an economic decision.

Boskin (1977) constructs a model which enables him to estimate responses to both social security benefits and the earnings test in the transition to retirement status. Since his results are based on defining retirement as working less than quarter time, it is not clear how much of the effect he measures is just due to whether or not a person works at all. Analyzing labor force participation separately from the amount of labor supplied after a person decides to work is important for two reasons: (1) it indicates whether the information in labor supply estimates comes from participation or variation in positive amounts of work; (2) participation analysis is not complicated by the earnings test which makes the budget line kinked and non-convex (discussed in Section III). A better understanding of how social security affects retirement is obtained by separating the benefit effect on participation and the combined effect of benefits and the earnings test on labor supply. Boskin also does not have data on individuals' full retirement benefits and is forced to use imputed benefits based on an earnings regression and the benefits formula or actual benefits received if present. Withstanding these problems, Boskin makes a significant contribution by analyzing retirement in the context of states of labor market activity and offering a specification for examining this dynamic process.

The earnings distribution of persons eligible for benefits is a source of evidence that retirement may be induced by social security. A clustering of earned income around the amount above which benefits are reduced for increases in earnings would indicate some distortion of labor supply. Evidence of this clustering effect has been presented by Social Security Administration (SSA) researchers Sander (1968) and Vroman (1971). They conclude that retirees do control their earnings so that benefits are not withheld by the earnings test. This is evidence that social security has an effect on labor supply conditional on participation but it does not indicate whether participation is itself affected by benefits. There have been differences in the retirement research done by the SSA and economists outside the SSA as discussed by Campbell and Campbell (1976), but recent results by both reveal some aspects of induced retirement. SSA researchers (e.g., Bixby, 1976) stress, as do Campbell and Campbell, the importance of finding and estimating work disincentives that operate against social security's objective of income maintenance for the aged.

Estimating the effect of social security on the probability of retirement is the focus of this study. Having an accurate measure of the potential benefit a person is entitled to receive is the main advantage of the data used here. The decision to work, the first step in the labor supply process, of potential retirees covered by social security comes under investigation as a useful empirical study on its own and as part of the important study of life-cycle labor supply.

III. The Retirement Model

A person decides to work based on the opportunities available inside and outside the market. This decision is embedded in the process of personal welfare maximization which can include human capital accumulation and bequest motives. This study analyzes labor force participation in a given year of retirement-aged men whose education and training are, for practical purposes, completed. In this context, a person's wage is a fixed market valuation of his working time. Whether a person works depends on the value of time spent in nonmarket activity as well. The value of time for nonworkers, their reservation wage, is larger than their market wage. When a person's reservation wage is less than the market wage and he can work any desired amount, then he supplies labor at a level which equates his shadow price of time and the market wage. The comparison of a market wage and reservation wage is the foundation of the retirement model used here. This approach is developed in the literature by Gronau (1973), Hall (1973, 1975), Hanoch (1976a, b), and Heckman (1974, 1977).

The market wage (w) that an individual faces will depend on a set of observed variables (X) and an error term (e_1) which includes unobserved and unobservable determinants of wage opportunities, other left-out variables, and a random disturbance. The market wage relationship is specified in the following semi-log form:

$$(1) \qquad \ln w = X\alpha + e_1 .$$

This form of the wage equation is widely accepted in the econometrics literature.[5]

Labor market activity also depends on the shadow price (s) of a person's time, which will be influenced by a set of variables (Y) and the amount of time spent working (K). Unobserved labor supply determinants and a random disturbance will be combined in an error term (e_2). The form of the shadow price equation is the same as eq. (1):

$$(2) \qquad \ln s = Y\beta + \gamma K + e_2 .$$

In the static labor force participation model, when market wage is less than shadow price at zero labor supply, i.e., $s(K=0) > w$, the individual will not participate in labor market activity; if $s(K=0) < w$, then the individual will participate.

As discussed by Pellechio (1978), full retirement is a dynamic life-cycle decision. The analysis of this decision requires adding the present value of future retirement benefits assuming full retirement to the set of explanatory variables in the static labor force participation model. In this study, social security wealth, SSW, as defined by Feldstein (1976) and Feldstein and Pellechio (1977a, b), is the relevant present value. Consequently, using eqs. (1) and (2) in the usual static sense and adding SSW,[6] a person decides to work when:

$$Y\beta + e_2 < \delta SSW + X\alpha + e_1$$

(3)

$$e_2 - e_1 < \delta SSW + X\alpha - Y\beta \ .$$

Let $e_0 = e_2 - e_1$, $I_0 = \delta SSW + X\alpha - Y\beta$, and DP be a qualitative variable indicating participation (DP = 1) or retirement (DP = 0). From eq. (3) the probability of participation, P(DP = 1), can be written as:

$$P(DP = 1) = P(e_0 < I_0) \ .$$

If e_1 and e_2 are normally distributed with variance σ_1^2 and σ_2^2, respectively, and covariance σ_{12}, e_0 is normally distributed with variance $\sigma_0^2 = \sigma_1^2 - 2\sigma_{12} + \sigma_2^2$. Given this specification, the participation probability becomes:

(4) $$P(DP = 1) = F(J_0)$$

where F is the standard normal distribution function and $J_0 = I_0/\sigma_0$, the participation index. Since the variables that are used to determine wage and shadow price appear in J_0, estimates of the coefficients in eqs. (1) and (2) and δ up to scale factor σ_0 may be obtained from a probit analysis of DP. If a variable is in both X and Y, i.e., it influences both market wage and shadow price, only the difference between its coefficients in eqs. (1) and (2) relative to σ_0 can be identified. Thus, a probit analysis of DP based on eqs. (1) and (2) estimates the net effect on participation of the variables in these equations.

Having the true wage, w*, that each person faces in the market would permit estimating coefficients in the shadow price equation. In this case, individuals work when:

$$e_2 < \delta SSW + \ln w^* - Y\beta$$

so that

$$P(DP = 1) = F[(\delta SSW + \ln w^* - Y\beta)/\sigma_2] .$$

The inverse of the estimated coefficient on ln w* yields an estimate of σ_2, $\hat{\sigma}_2$. The estimated coefficients for the Y variables and SSW are multiplied by $\hat{\sigma}_2$ to obtain maximum likelihood estimates of the β's and δ.

In this study, estimates of the α's, β's, and δ are obtained by estimating the wage equation over the sample of working persons and using imputed wages, w, in a second probit step. It may be desirable to use imputed wages rather than observed wages due to transitory disturbance or measurement error in reported earnings and labor supply of workers (Hall, 1973). Since participation defines the sample for market wage estimation, e_1 can be related to the X's through eq. (3) so that OLS estimates of α may be biased. Hanoch (1976b) and Heckman (1977) show that an additional variable must be included to correct for sample selection bias. This can be seen by taking the expectation of ln w conditional on participation:

$$(5) \qquad E(\ln w|X,\ DP = 1) = X + E(e_1|X,\ DP = 1)\ .$$

From the participation analysis the conditional mean of e_1 is:

$$(6) \qquad E(e_1|X,\ DP = 1) = E(e_1|e_0 < I_0)\ .$$

Evaluating this expression yields the following:

$$(7) \qquad E(e_1|X,\ DP = 1) = -\frac{\sigma_{10}}{\sigma_0}\,\frac{f(J_0)}{F(J_0)}$$

where $\sigma_{10} = E(e_1 e_0) = \sigma_{12} - \sigma_1^2$ and f is the standard normal density function. Thus, the wage regression function conditional on participation is:

$$(8) \qquad E(\ln w|X,\ DP = 1) = X\alpha + \left[\frac{\sigma_1 - \sigma_{12}}{\sigma_0}\right]\frac{f(J_0)}{F(J_0)}\ .$$

The additional variable that corrects for sample selection bias is $f(J_0)/F(J_0)$ which is the inverse of Mill's ratio and is abbreviated $M(J_0)$. Using the estimates of α/σ_0, β/σ_0, and δ/σ_0 from the probit analysis of DP [eq. (4)], an estimate of $M(J_0)$ is constructed for each individual. The wage equation is estimated over the sample of workers where wages are observed with the estimate of $M(J_0)$ added to the right-hand side. It is important to note that the Y variables which are not in X are nonetheless included in the wage regression to avoid inducing bias in their coefficient estimates in the second probit step. Using the coefficient estimates, a wage is imputed to workers and nonworkers.

The error (e_1') in using imputed rather than true wages enters the analysis as did e_1 [in eq. (3)] when using the market wage equation. Therefore, people work when:

$$e_2 - e_1' < \delta SSW + \ln \hat{w} - Y\beta \; .$$

Letting $\sigma_0'^2 = \sigma_1'^2 - 2\sigma_1'\sigma_2 + \sigma_2^2$, the participation probability becomes:

$$(9) \qquad P(DP = 1) \;=\; F[(\delta SSW + \ln \hat{w} - Y\beta)/ \,'_0] \; .$$

The estimates of coefficients for $\ln \hat{w}$, Y, and SSW can be used as in the case when true wages are known to estimate β and δ.[7]

A labor supply equation follows from eqs. (1) and (2) by setting $\ln w = \ln s$ and solving for K conditional on participation.[8] If this strict derivation is not assumed an independent equation for K can be added to eqs. (1) and (2) which would complete the labor supply model. In this way the variables which determine participation do not also strictly determine the amount of work. Consequently, the labor supply decision is viewed as a two-step process. In the first step, given a set of variables describing opportunities for market and nonmarket activity, it is decided whether or not to participate in the labor market. If the decision is for nonparticipation, then labor supply is naturally zero. However, conditional on deciding to work, the same variables with different coefficients or additional variables may determine how much to work in the second step of the supply decision. This study examines empirically the participation decision, the first step in the labor supply process, for retirement-aged men.

Up to this point, the model assumes that the wage rate is not changed by the earnings test. The earnings test that will be considered operates as follows: there is no loss in benefits for earnings up to an exempt amount of $\$M_1$; \$1 in benefits is lost for every \$2 of earnings up to $\$M_2$; benefits are lost dollar-for-dollar with earnings up to the point where the person receives no benefit income and the budget line returns to what it would be outside the retirement program. The earnings-tested budget line of a person with wage w who could receive full benefit amount FB is illustrated in Figure 1.

A crucial feature of this budget set for participation analysis is that the extension of its initial segment BC (shown as the dashed line CG) lies above the budget constraint. Although the earnings-tested budget constraint is nonlinear and nonconvex, it never cuts the extension of BC from below. If this were not the case, the market

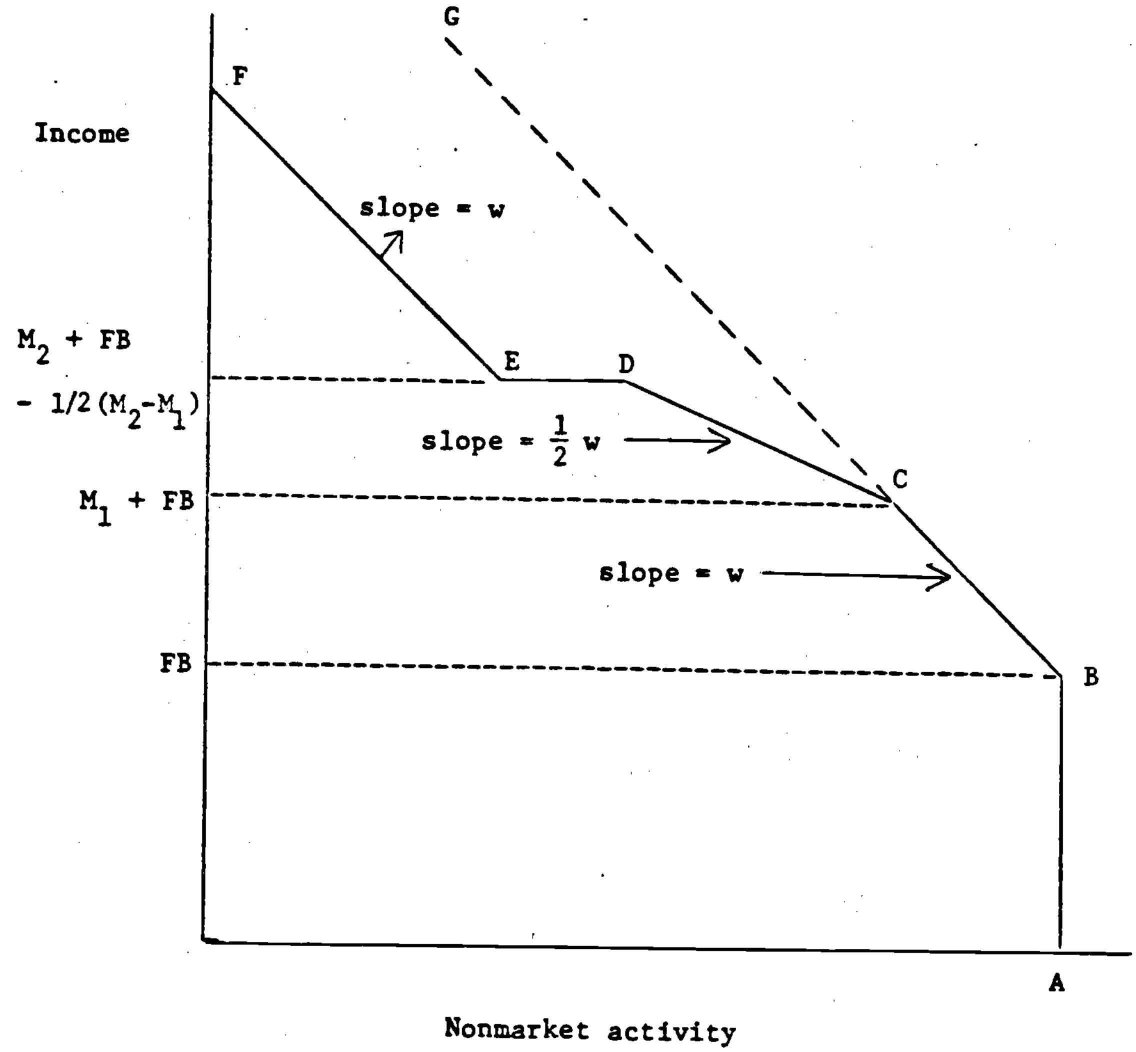

Fig. 1. The Earnings-Tested Budget Line

The earnings test provides that no benefits are withheld from workers earning less than M_1 a year, \$1 in annual benefits are withheld for each \$2 in annual earnings between M_1 and M_2, and \$1 was withheld for each \$1 in earnings above M_2.

wage and shadow price comparison at zero labor supply that underlies the participation analysis would not be valid. It would be possible for shadow price to be less than or equal to the slope along a segment which was above CG, indicating a potential positive amount of work, even though shadow price was greater than wage at zero labor supply. Fortunately no such problem arises with the earnings test.

The conventional assumption made here that individuals face a fixed wage may not describe how the market actually works. If wages rise with the amount of labor supplied, the resulting nonconvex budget line may cause problems. On the other hand, progressive income taxation diminishes the likelihood that a wage-hours locus will affect the analysis. There is the related issue that individuals may not be able to choose their amount of work freely and face discrete choices for part-time and full-time work. Thus, the work and nonwork dichotomy might be replaced by a trichotomy: full-time work, part-time work, and no work. Although the analysis can be extended to cover these and other descriptions of work choice, the approach taken here is less complicated than these others and is a good starting point.

IV. Data and Model Specification

The empirical analysis is based on a rich file of data from the Social Security Administration, the 1973 CPS-IRS-SSA Exact Match file.[9] This file starts with the March 1973 Current Population Survey (CPS) from which selected information on each individual has been taken. This information has been linked with extracts of Social Security Administration (SSA) records for each individual. The SSA data permit precise calculation of full social security retirement benefits. The amount of a monthly benefit award is related to past earnings. Benefits are determined by first computing an insured worker's average monthly earnings. This is done by summing a worker's covered earnings after 1950 omitting five years of lowest earnings and dividing the accumulated amount by the number of months during the same period; this average is denoted AME50. A formula stated in the law relates AME50 to the monthly benefit payable to an insured worker alone--this is the primary insurance amount, PIA. Benefits for a dependent spouse are 50 percent of the primary worker's PIA. A married couple will receive at least 150 percent of the primary worker's PIA. If the secondary worker's PIA is greater than 50 percent of the primary worker's, a retired couple will receive the sum of their separate PIA's. Actuarial reduction of full benefits payable to workers and spouses aged 62-64 years is applied according to the law. The potential benefit payable to a couple is denoted BHW.

Social security wealth, SSW, as defined in Feldstein (1976) and Feldstein and Pellechio (1977a, b), is based on the husband's and wife's respective PIA's. A couple's SSW is the actuarial present value of the husband's PIA and one of the following:

1) the dependent wife's allowance of 50 percent of her husband's PIA while he is alive and the survivor's benefits

of 82.5 percent contingent on his death when her PIA is less than 50 percent of his

2) the wife's PIA while the husband is alive and the survivor's benefit when her PIA is greater than 50 percent of his but less than 82.5 percent

3) the wife's PIA alone if it is greater than the survivor's benefit

The present value was calculated at several real discount rates. The SSW variable used here was based on a real discount rate of 3 percent. The size of the coefficient estimate for SSW varies directly with the discount rate, but other results do not change.

An individual's initial endowment of wealth and unexpected changes in wealth can influence life-cycle behavior. On the other hand, savings and realized capital income arise from an optimal plan that redistributes consumption and leisure over time. Therefore, capital income should have no independent influence on any one period's consumption or labor supply. Unfortunately the data contain no direct measure of endowed or accumulated wealth or capital gains or losses over time. The CPS income information reports property income as the sum of interest payments, dividends and rental income, and other income. The IRS data give the amount of total dividends and the taxable portion of interest received by an individual from bonds, debentures, notes, mortgages, personal loans, bank deposits, and savings accounts. The larger amount in capital income reported from the CPS and IRS is denoted KINC. Results will be presented including capital income in the model even though it should not have an independent effect on life-cycle labor supply. An argument can be made that capital income may capture the effect of initial endowments or unexpected capital gains or losses and therefore should be in the model. KINC enters the model through the shadow price equation. It is important to note that the results remain unchanged when KINC is excluded (as will be shown in Appendix B).

The SSA information also contains summary measures of a person's recent earnings experience. Average monthly earnings based on the five years of highest earnings serves as an indicator of a person's potential market wage. This is multiplied by 12 to yield average yearly earnings, AYE, which is used as an explanatory variable in the wage equation. This is done because the SSA uses nominal earnings in each year for computing the AME's without adjusting for wage growth or price inflation. Therefore, assuming that nominal earnings grow, AYE is an average of five recent yearly wages. A problem with AYE is that only annual amounts up to the maximum taxable earnings under the law in each year are used.[10] This truncation on earnings introduces a downward bias in AYE as a yearly wage estimate. However, the SSA describes a person's pattern of employment and from this description a binary variable, MAX, is set equal to 1 when a person always earned the maximum taxable amount and 0 otherwise. Putting MAX into the wage regression yields an estimate of the percentage increase in wages for persons who always earn the maximum or more. The equation used here to predict wages is not the traditional wage equation in the sense that wage is generated by schooling, experience, and background variables as developed by Griliches (1977), Gronau (1973), Mincer (1974), and Chamberlain (1975, 1977). Rather lagged wages measured by AYE and MAX serve as predictors of current wage along with other variables from the traditional model which will be used also.

Variables that influence both market wage and shadow price are the number of years of schooling (SCHOOL) and binary variables for race (RACE = 1 for whites), residence in a rural area (RURAL), and age (DAGE = 1 for persons whose age equals AGE). Residence in the South (SOUTH) is an additional binary variable in the wage equation.

The age that a person attains in 1972 is used as his observed age. Month of birth is given in the data. The number of weeks that a person works is given in categories which are 1-13, 14-26, 27-39, 40-48, 49-52 weeks. The number of weeks worked is approximated by the midpoint of the category in which a person falls. Most people who work are in the 49-52 weeks category (see Appendix C) so the midpoint approximation does not pose any significant problem. A person is said to have retired when weeks worked in 1972 end before his month of birth. In other words, retirement status is defined by stopping work before reaching one's next year of age in 1972. A fortiori, this includes persons who retired before 1972. The natural assumption is that retirement is planned around the time a specific age is attained. Therefore, the participation model discussed in Section III becomes a retirement model when DP = 1 for working into or beyond one's month of birth.

Actuarial reduction of benefits is computed to the month of retirement. If a person under age 65 worked, actuarial reduction is based on the number of months between the last month of work and the month and year in which a person attains age 65.

The actual number of hours a person worked during the week before the March 1973 CPS is given. This observation on hours per week is multiplied by weeks worked in 1972 to yield an estimate of annual hours worked in 1972 for the sample of full-time workers. Observed wages are obtained for this sample when their 1972 earnings are divided by annual hours. The wage equation is estimated over the sample of full-time workers and the log of wage, LWAGE, is the left-hand side variable. If a person worked on a full-time basis in 1972 but hours worked were not reported for the survey week, the value for hours per week was set at 40. This attempts to avoid survey-week selectivity bias as defined and discussed by Hanoch (1976b).

The entire sample under study consists of married men aged 60-70 years whose CPS, SSA, and IRS records are properly matched. These men are insured under OASI, not covered by the railroad retirement system, and not employed by the federal or a state government. This was done so that responses to social security would not be confused with the effects of other pension programs. Also, the persons in the sample did not receive welfare income, unemployment compensation, or disability payments. In this way, income maintenance programs other than social security do not influence the behavior under study.

Wage, schooling, and age of wives may influence husbands' shadow price of time. These variables are added to the shadow price equation and are denoted LWAGEW, SCHOOLW, and AGEW, respectively.

Given the variables defined in this section, the equations discussed generally in Section III can be specified. The market wage equation is:

$$(1') \quad LWAGE = \alpha_0 + \alpha_1 AYE + \alpha_2 MAX + \alpha_3 SCHOOL + \alpha_4 SOUTH + \alpha_5 RURAL + \alpha_6 RACE + aDAGE + e_1 .$$

The shadow price equation is:

$$(2') \quad \ln s = \beta_0 + \beta_1 KINC + \beta_3 SCHOOL + \beta_5 RURAL + \beta_6 RACE + \beta_7 AGEW + \beta_8 LWAGEW + \beta_9 SCHOOLW + bDAGE + e_2 .$$

Since shadow price is not observed, eq. (2') cannot be estimated directly. The two-step probit analysis presented in Section III provides an indirect method for estimating the β's.

Although SSW is not an explanatory variable in the wage or shadow price equations, it enters the model through its influence on lifetime resources and net wage, as discussed in Pellechio

(1978). Letting k be the rate of accumulating SSW and t be the tax rate implicit in the earnings test at the margin of just working and earning some income, the shadow price and net wage comparison underlying the retirement decision can be expressed as:

$$s > w[1 + SSW (k + t)] .$$

By taking the log of this equation, SSW can enter the model separately. Even though a more precise specification for including SSW can be derived, simply adding SSW as a separate variable in the participation index [see Section III, eqs. (3) and (4)] is in the spirit of using a linear specification as a first approximation to the model's functional form.

The variables used in the retirement model are listed and summarized in Table 1. The effect of SSW on retirement is the main focus of study.

TABLE 1

LIST AND SUMMARY DESCRIPTION OF VARIABLES

Abbreviation	Description
DP	equals 0 for having retired when retirement is defined by stopping work before reaching one's next year of age in 1972; equals 1 for not having retired
AYE	average yearly earnings based on five years of highest earnings
MAX	equals 1 for persons always earning the maximum taxable amount under social security law; 0 otherwise
BHW	full potential social security benefit payable to a married couple
SSW	actuarial present value of benefits (including wives' survivors benefits) assuming full retirement
KINC	capital income
SCHOOL	years of schooling
SOUTH	equals 1 for residence in the South; 0 otherwise
RURAL	equals 1 for residence in a rural area; 0 otherwise
RACE	equals 1 for whites; 0 otherwise
LWAGE	log of observed wage for workers
AGEW	age of wife
LWAGEW	log of observed wage for working wives
SCHOOLW	wife's years of schooling
DAGE	binary variables for age: D60 = 1 for 61 year olds in the 60-61 age group D63 " 63 " 62-64 " D64 " 64 " " D66 " 66 " 65-70 " D67 " 67 " " D68 " 68 " " D69 " 69 " " D70 " 70 " "

V. Empirical Results

This section presents estimated retirement models for various age groups in the full sample of married men aged 60-70 years. The sample is divided into age groups based on prior considerations for which support can be found in the empirical results. To begin, there is a technical reason for estimating the model in separate age groups when the observed proportion of those who retire rises with age. A "different" equation may be required to approximate these changing retirement probabilities; the equation is "different" in the sense that its coefficients change in different age groups.

The first step in estimating the model is a probit analysis of retirement based on the variables in eqs. (1') and (2') and SSW. SSW is included because retirement is a dynamic decision in the life-cycle model. This requires adding the capital value of social security benefits that will be received during full retirement. The behavior of individuals in the 62-64 year old age group can illustrate the importance of the life-cycle approach. These individuals are eligible for benefits subject to actuarial reduction for early retirement. If this reduction is fair to an individual, there is no incentive to retire early and accept a reduced benefit if retirement is financed from private assets and social security. If a person wants to retire early, he can wait for his full benefit and finance early retirement from private assets with no loss in capital value of total resources. Therefore, there is no incentive to collect benefits early in a life-cycle model of behavior.

Social security can raise lifetime resources by yielding a higher-than-market rate of return and the resulting wealth effect could induce early retirement. Higher SSW may obviate private financing of this retirement. For men age 60-70 in 1972 who did not pay social security taxes over their whole working lives, their lifetime resources are likely to have been increased by the institution and gradual growth of social security. Thus, actuarial reduction would only mitigate the overall wealth effect in the sample under study here. This wealth effect could lower labor supply in all periods of life. However, due to institutional constraints, it may be difficult to lower hours worked per week or weeks worked per year during full-time working years. If this is the case, the relevant margin for reducing lifetime labor supply is the timing of retirement. Consequently, social security may induce early retirement through a constrained wealth effect. The coefficient for SSW in the retirement model measures a partial or full wealth effect on labor supply working through the retirement decision.

The opportunity to avoid actuarial reduction and accumulate additional benefit credits through earnings as discussed in Pellechio (1978) provides an argument for observing SSW act as an incentive not to retire between ages 62 and 64. Holding wage constant, higher social security wealth might imply a higher rate of return from social security. In this way, social security acts as a net wage subsidy. However it is not likely that significant increases in the present value of benefits can be gained for working between ages 62 and 65, especially since the 1972 legislation changed the computation of the benefits base (AME50, see Section IV) to cover earnings in years to age 62 back from age 65. It is important to add that the earnings test applied in the social security program reduces benefits only after earnings exceed a certain amount. Consequently, at zero labor supply the marginal tax rate of the earnings test is zero. Therefore, the reduction in benefits due to the earnings test should not be responsible for early retirement effects observed in the estimates of the retirement model.

Actuarial reduction was the main reason for estimating the model separately for 62-64 year olds. The estimated coefficient for SSW should be interpreted as measuring the net impact of the effects discussed above. Subsequent refinements in specifying the model and defining the variables may permit estimating the wealth, accumulation, and substitution effects separately (see Pellechio, 1978).

Persons aged 60-61 years are not eligible to receive benefits, but an accurate potential benefit can be computed from their average monthly earnings nonetheless and SSW can be calculated from these benefits. However there should be no explanatory power associated with benefits that cannot be received. Thus these ineligible persons serve as a control group--if social security does influence their labor force participation, then there is correlation without causality in the estimates.

Persons aged 65 and over are eligible to receive their full benefits. If they postpone retirement, benefits are increased by only 1 percent annually. Such a low benefit increase for working beyond age 65 would encourage retiring because delaying retirement lowers the present value of benefits at a market rate of interest greater than 1 percent. Therefore, at least in the over-65 age group, higher SSW should induce retirement since the higher is SSW, the greater the loss from postponing retirement.

Table 2 presents probit estimates of the retirement model based on eqs. (1') and (2') and SSW over the three age groups discussed above. For each variable in these equations and SSW, the estimated value of its coefficient in the participation index, J_0, discussed in Section III, is given.

For 60-61 year olds, the coefficient estimate for SSW is small and insignificant compared to those in the other age groups. Since 60-61 year olds are not eligible for retirement benefits, social security should not affect their retirement and the supporting empirical evidence is encouraging. The life-cycle model does suggest that raising lifetime resources through SSW could change desired labor supply in all periods. Thus, being ineligible to receive benefits does not entirely preclude SSW's having an effect on labor supply. However, as mentioned, institutional work arrangements may not allow individuals to adjust their labor supply in all periods to desired levels. The timing of retirement may be where changes in lifetime labor supply in response to social security occur. Since

TABLE 2

PROBIT ANALYSIS† OF RETIREMENT

(DP = 0 for having retired, 1 for working)

Variables	Not Eligible Ages 60–61	Actuarial Reduction Ages 62–64	Full Benefits Ages 65–70
	Coefficient Estimates (standard errors)		
MAX	0.614 (0.200)	0.641 (0.158)	0.159 (0.158)
$AYE/10^3$	0.027 (0.051)	0.230 (0.039)	0.394 (0.039)
$SSW/10^4$	0.014 (0.068)	-0.174 (0.056)	-0.255 (0.054)
$KINC/10^4$	-0.261 (0.216)	-0.216 (0.136)	-0.002 (0.081)
SCHOOL	-0.005 (0.025)	0.012 (0.020)	0.016 (0.017)
SOUTH	-0.185 (0.149)	0.033 (0.020)	-0.056 (0.099)
RURAL	-0.020 (0.140)	0.155 (0.118)	-0.183 (0.104)
RACE	-0.312 (0.311)	-0.446 (0.224)	-0.105 (0.198)
AGEW	-0.004 (0.012)	-0.011 (0.009)	0.003 (0.009)
LWAGEW	-0.048 (0.066)	0.217 (0.054)	0.162 (0.049)

†These results were obtained from the Maximum Likelihood Probit Estimation Program written by Forrest Nelson and Richard Rosett, University of Rochester, and modified by Bronwyn H. Hall, Harvard University.

TABLE 2--Continued

Variables	Coefficient Estimates (standard errors) Not Eligible Ages 60-61	Actuarial Reduction Ages 62-64	Full Benefits Ages 65-70
SCHOOLW	-0.009 (0.029)	-0.002 (0.021)	0.012 (0.019)
CONSTANT	1.29 (0.81)	0.584 (0.596)	-1.99 (0.62)
DAGE*			
Retired	103	288	918
Working	468	418	255
-2 × Log Likelihood Ratio	19.8	105	213

*DAGE Coefficient Estimates (Standard Errors):

Ages 60-61:	D61	0.078 (0.127)		
Ages 62-64:	D63	-0.124 (0.126)	D64	-0.213 (0.126)
Ages 65-70:	D66	-0.085 (0.139)	D67	-0.101 (0.146)
	D68	-0.208 (0.155)	D69	-0.058 (0.159)
	D70	-0.018 (0.170)		

it is still a period of accumulating SSW for 60-61 year olds, an insignificant, small coefficient estimate for SSW could result from the wealth effect being offset by the incentive to work and gain credit for higher future benefits. However the wealth effect should be dominant for 61-61 year olds who paid nothing into the social security program before it was established and little during its early stages, but obtained full coverage. Evidence that social security has no effect on the labor force participation of persons ineligible to receive benefits indicates that its observed significant effect on the retirement behavior of eligible persons is a causal relationship.

In the 60-61 year old sample, the only variable having a significant effect on work is MAX, indicating that a person who always worked and earned the maximum taxable amount is likely to continue working. Permanent unobserved determinants of labor supply may induce a positive correlation between labor force participation before and after the observed period [Hall (1975) discusses this in the context of the negative income tax experiments]. In addition to measuring a wage effect, MAX may also be serving as a serial correlation variable controlling for unobserved labor supply determinants.

The transition from actuarially reduced to full benefits increases social security's effect on retirement. The rate of accumulating SSW is reduced by moving out of the range in which benefits are actuarially increased for later retirement and into the period for receiving full benefits where delaying retirement increases benefits by an insignificant amount. Consequently, postponing retirement decreases SSW and the larger is SSW, the greater is the capital loss. Such losses are avoided by retiring.

The quantitative impact of the variables in Table 2 on retirement is not immediately apparent from the coefficient estimates reported there. The estimated probability of labor force participation, or, in other words, of not being retired, is:

$$(10) \qquad P(DP = 1) = \int_{-\infty}^{\hat{J}_0} f(t)dt$$

where $\hat{J}_0$ is the participation index discussed in Section III and estimated in Table 2, and f is the standard normal density function. It follows that:

$$(11) \qquad \frac{\partial P}{\partial x} = f(\hat{J}_0)b_x$$

where x is any variable in J_0 and b_x is x's coefficient estimate in J_0 (these coefficient estimates are given in Table 2). For example, when x is SCHOOL, b_{SCHOOL} is the estimate of $(\alpha_3 - \alpha_3)/\sigma_0$. As can be seen, the effect of one variable depends on the net result of its influence on market wage and shadow price and the values for all the other variables through $f(\hat{J}_0)$. Using the example of a white married male aged 62 years with twelve years of schooling who resides neither in the South nor a rural area with a nonworking wife of the same age and education and has values of AYE and KINC equal to their mean values for 62-64 year olds, the point estimate of -0.174 for SSW indicates that a \$10,000 increase in social security wealth centered on its mean value of \$46,016 raises the probability of retirement by 0.05. For the same male aged 65 years, SSW's point estimate of -0.255 raises the retirement probability by 0.08 for the same \$10,000 increase around a mean value of \$46,115. This provides some quantitative reference point for the estimates in Table 2.

By estimating the wage equation and using imputed wages in the second probit step, the wage effect is summarized in a single coefficient. When this is done, estimated probabilities of retirement by wage and benefit amounts can be calculated. Regressing observed wages in the sample of full-time workers on all variables in the retirement model is the intermediate step in the analysis. The coefficient estimates in Table 2 are used to construct $M(\hat{J}_0)$, an estimate of the inverse of Mill's ratio discussed in Section III. This variable is added to the wage regression to correct potential bias in coefficient estimates induced by selecting the sample of full-time workers. This does not imply that the first probit analysis produced biased estimates; it was carried out over the full sample so there is no selectivity problem. Since the intermediate step is not the focus of study, estimated wage equations for the three age groups are presented and discussed in Appendix A.

In the first probit step, the wage effect is dispersed through the variables in eq. (1'). By using imputed wages in the second probit step, three things are accomplished:

1) the wage effect is measured by the coefficient estimate for imputed wage, or, in other words, the dispersed wage effect in the reduced form is pulled together into one coefficient;
2) having swept out the α's, the shadow price coefficients, the β's, are identified;
3) the variation in SSW in the second step is net of its correlation with wage. Even though SSW does not appear in the wage equation, it is included in the wage regression to avoid inducing bias in its second step coefficient estimate.

The first probit step consistently estimates the reduced form effects of variables in the model on the probability of retirement. These results shown in Table 2 provide strong evidence that social security influences retirement behavior through SSW. The wealth effect and the associated losses in SSW from continuing work induce retirement. The main empirical results are obtained from the first probit step on which this study could conclude. However, as described in Section III and provided consistent estimates are still obtained,[11] the second step identifies the structural parameters in the model.

Estimates of the retirement model using imputed wages are presented in Table 3. Higher wages significantly raise the probability of working for persons eligible to receive benefits aged 62 and over. This contrasts with Quinn's (1975) result that there is

TABLE 3

PROBIT ANALYSIS OF RETIREMENT USING IMPUTED WAGES† ($\widehat{LWAGE}$)

Variables	Coefficient Estimates (standard errors) Not Eligible Ages 60-61	Actuarial Reduction Ages 62-64	Full Benefits Ages 65-70
$\widehat{LWAGE}$	0.513 (0.231)	1.27 (0.16)	1.58 (0.15)
$SSW/10^4$	-0.037 (0.070)	-0.192 (0.055)	-0.293 (0.056)
$KINC/10^4$	-0.346 (0.220)	-0.613 (0.144)	-0.215 (0.084)
SCHOOL	-0.002 (0.025)	0.001 (0.020)	-0.027 (0.018)
RURAL	-0.026 (0.141)	0.302 (0.124)	0.042 (0.108)
RACE	-0.352 (0.316)	-0.466 (0.222)	-0.208 (0.196)
AGEW	-0.002 (0.011)	-0.008 (0.009)	-0.002 (0.009)
LWAGEW	-0.011 (0.070)	0.292 (0.057)	0.216 (0.050)
SCHOOLW	-0.014 (0.030)	-0.011 (0.021)	0.013 (0.019)
CONSTANT	0.924 (0.774)	0.462 (0.572)	-0.980 (0.594)

†The log of market wages was imputed using the estimate of the wage equation in each age group presented in Appendix A.

TABLE 3--Continued

Variables	Coefficient Estimates (standard errors) Not Eligible Ages 60-61	Actuarial Reduction Ages 62-64	Full Benefits Ages 65-70
DAGE*			
Retired	103	288	918
Working	468	418	255
-2 × Log Likelihood Ratio	10.9	98	206

*DAGE Coefficient Estimates (standard errors):

Ages 60-61:	D61	0.064 (0.125)		
Ages 62-64:	D63	-0.076 (0.126)	D64	-0.123 (0.126)
Ages 65-70:	D66	-0.066 (0.159)	D67	0.049 (0.148)
	D68	0.022 (0.160)	D69	-0.066 (0.159)
	D70	-0.191 (0.166)		

little wage effect. This can probably be explained by his not having the benefit amount in his model. The wage effect for 60-61 year olds is significantly positive but less than that for 62-70 year olds.

The same pattern of responses to social security wealth given in Table 2 is repeated in the second point analysis. It was specified that SSW does not appear in the wage equation so that its coefficient estimate should not change in the second step. However benefits are based on an average of a person's earnings which are the product of wage and labor supply. Since the benefit formula is progressive a negative coefficient on SSW could be obtained from a wage effect working through this formula. Having SSW in the wage regression as a statistical requirement also attempts to deal with this problem. Consequently obtaining the same strong impact of SSW again empirically supports the proposed life-cycle responses to social security. The insignificant small coefficient estimate for SSW for ineligible persons lends support to interpreting effects on eligible persons as a causal relationship. The SSW coefficient estimates are significantly negative for 62-70 year olds indicating again a wealth effect inducing retirement. SSW has a greater impact on the probability of retirement for 65-70 year olds. This is the correct dynamic life-cycle pattern when the rate of accumulating SSW decreases as it does going from actuarially reduced to full benefits.

The wage effect has been summarized in one significantly estimated coefficient and removed from other variables' influences on retirement. Therefore using the results in Table 3, estimated retirement probabilities can be calculated for different wage and benefit amounts. This was done for married males with twelve years of schooling residing outside the South or a rural area with a nonworking wife of the same age and education and having the mean value of KINC for their respective age groups. The top half of Table 4 presents the estimated retirement probabilities for a person aged 62 years at various wage and SSW levels. SSW has a mean value of $46,016 and a standard deviation of $11,536 in the 62-64 age group so with slight interpolation in Table 4, an increase in SSW from one standard deviation below to one standard deviation above the mean raises the probability of retirement by 0.12 to 0.16 for wages between $3 and $7 per hour.

In the bottom half of Table 4, retirement probabilities are calculated for a male aged 65. Increasing SSW from one standard deviation ($11,666) below the mean of $46,115 to one above raises the retirement probability by 0.14 to 0.25 for wages between $3 and $7 per hour. For both examples in Table 4, social security's effect on retirement is significant.

The coefficient for $\widehat{\text{LWAGE}}$ in the second probit step is the inverse of σ'_0, the standard error in eq. (9). The coefficient for SSW is its coefficient in the retirement model relative to this standard error, δ/σ'_0. Consequently, by dividing the coefficient estimate for

TABLE 4

ESTIMATED RETIREMENT PROBABILITIES

SSW (thousands of dollars)	WAGE (hourly) $1	$2	$3	$4	$5	$6	$7
Married Man aged 62 years							
$0	0.847	0.557	0.356	0.231	0.154	0.106	0.074
$15	0.905	0.667	0.467	0.328	0.233	0.169	0.124
$25	0.934	0.734	0.544	0.400	0.296	0.221	0.168
$35	0.955	0.793	0.619	0.475	0.365	0.283	0.220
$45	0.971	0.844	0.690	0.552	0.440	0.351	0.282
$55	0.981	0.885	0.754	0.627	0.516	0.424	0.359
$65	0.989	0.918	0.811	0.697	0.592	0.501	0.423
$75	0.993	0.944	0.858	0.761	0.665	0.577	0.500
Married Man aged 65 years							
$0	0.933	0.655	0.404	0.243	0.147	0.090	0.057
$15	0.973	0.799	0.578	0.398	0.270	0.184	0.126
$25	0.987	0.871	0.687	0.513	0.375	0.272	0.197
$35	0.994	0.923	0.783	0.628	0.489	0.376	0.288
$45	0.998	0.957	0.858	0.732	0.605	0.491	0.395
$55	0.999	0.978	0.914	0.819	0.712	0.606	0.510
$65	0.999	0.989	0.951	0.886	0.802	0.713	0.625
$75	0.999	0.995	0.975	0.934	0.873	0.804	0.729

SSW by that for $\widehat{\text{LWAGE}}$, an estimate of δ is obtained. This estimate is 0.15 for 62-64 year olds and 0.19 for 65-70 year olds. By the same calculation, coefficients for variables in the shadow price equation are identified. For example, the estimate of β_8, the LWAGEW coefficient, is 0.23 for 62-64 year olds and 0.14 for 65-70 year olds.

The estimates for capital income's effect on retirement change substantially for 62-64 and 65-70 year olds from Table 2 to Table 3. As can be seen in Appendix A, KINC has a significant positive coefficient in the wage regression even though KINC was not specified in the wage equation. There is no direct causal relationship between wages and capital income. However, unobserved personal characteristics such as ability, preferences for market work, and accumulation of private assets and other special aptitudes and traits that are common in having both high wages and assets can produce the observed relationship between KINC and wage. When this common effect is taken out by imputing wages from a regression on all the variables, KINC's coefficient is significantly negative for 60-61 year olds. This is an expected result and serves to illustrate the additional information gained from the two-step procedure.

Having KINC in the model raises a specification issue. If capital income should enter the model as exogenous nonlabor income, net worth or the change in net worth based on total accrued gains and losses is the appropriate variable. Actually, potential capital income based on Hick's (1946, p. 172) definition of income is the relevant variable. Whether or not a person realizes income from his assets may depend on his retirement decision. Thus, it can be argued that KINC is an endogenous variable that induces bias in other coefficient estimates. Also, as discussed in Section IV, the life-cycle model implies that capital income should have no independent influence on consumption or labor supply in any one period unless it is measuring the effect of initial endowments or unexpected changes in net worth. For these reasons the model was estimated excluding KINC and the results were unchanged (see Appendix B which presents reduced-form results obtained from repeating the first-step probit analysis of the model without KINC--these results should be compared with those in Table 2).

The only other variable having a significant effect on a married man's labor force participation is his wife's wage. The significant positive coefficient estimate for LWAGEW implies that husbands' and wives' time are complements in household utility. Even if LWAGEW just indicates that a wife has worked the same implication can be drawn. The other variables in the model show no significant pattern of retirement effects.

Private pension variables are an obvious omission in the model. However, holding the variables in the model--in particular, wages--constant, potential private pension benefits are likely to be uncorrelated with social security benefits and wealth. Thus, leaving out private pension variables would not affect the results. Private pension formulas for integrating benefits with social security suggest a possible negative correlation between the two. This implies that the results reported here underestimate social security's impact on retirement.

Since AYE is an average of past earnings, unobserved labor supply determinants may be measured in AYE also. Thus AYE could be included in the shadow price equation due to its possible correlation with shadow price through these determinants. For the same reason, MAX could also be included in the shadow price equation. This suggests including AYE and MAX along with $\widehat{\text{LWAGE}}$ in the second probit step. The reduced-form results in Table 2 from the first probit step remain unchanged. Again, the analysis of social security's effect on retirement could be based and concluded on the results in Table 2.

In this study benefits depend on a person's history of wages and labor supply for at least the last twenty years through the calculation of average monthly earnings as the benefit base. It can be argued that a person's labor supply also depends on his entire wage and employment experience. Consequently a person's benefit and complete labor market experience cannot vary independently. Benefits are only a complicated nonlinear transformation of the fully specified labor supply model. Any estimated effect of social security really only measures the effects of the variables in the full model working through the function used to define benefits. A social security effect cannot be identified in this idealized model of labor supply. A reasonable reply to this argument makes the point that labor supply in any one period depends on employment experience of a few years rather than twenty years or more. The assertion being made in this study is that because benefits vary independently of the employment experience that possibly influences labor supply, social security can have an independent impact on the decision to retire. This assertion is strengthened by the fact that people were covered by social security at different times in their employment histories as the program developed.

VI. Summary and Conclusion

This study examined the effect of social security on retirement decisions of married men aged 60-70 years. A life-cycle model of labor supply provided the framework for specifying the model for empirical study. Market wage and shadow price equations were the foundation of analysis. Added to this standard framework for labor supply study was social security wealth defined as the present value of benefit income that a person would receive in full retirement. This additional variable came from the life-cycle model's optimality conditions for labor supply and measures social security's influence on retirement.

A two-step probit analysis was developed in order to identify the structural parameters of the model. In this way, the coefficients in the shadow price equation could be estimated even though shadow price is not observed. In addition, this yielded a single coefficient estimate summarizing the effect of the market wage on retiring. The wage effect was also cleared from the coefficient estimates for other variables. The variables in the retirement model were defined from data containing accurate information on persons' full potential social security benefit whether or not any benefit payment was actually made.

The retirement model was estimated separately over three age groups in the 60-70 year old range of the full sample. In the 62-64 and 65-70 year old samples of men eligible for benefits, social security significantly raised the probability of retirement. A two standard deviation increase in social security wealth centered on its mean value raised the estimated retirement probability by 0.15 for 62-64 year olds and 0.22 for 65-70 year olds. As expected, actuarial reduction lessened the impact for 62-64 year olds. For 60-61 year olds covered by social security but ineligible for receiving benefits, the estimated effect of social security was small and insignificant. This supports the conclusion that the observed effect on the retirement of eligible persons is a causal relationship. It also suggests that institutional work arrangements may make retirement the relevant margin for altering lifetime labor supply in response to social security.

These results caution against assuming that retirement age is fixed when studying social security's or any other retirement program's effects on individual behavior or considering changes in these programs. Furthermore, being a large, important income maintenance program, social security should minimize work disincentives.

Notes

1. Social security benefit payments to retired workers and their dependents and survivors amounted to $37 billion in fiscal year 1972. Private pension programs paid out $10 billion in benefits in 1972. Financial statements on the social security program can be found in the annual reports of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance. A good presentation of the old age, survivors, and disability insurance (OASDI) program can be found in OASDI Digest (see U.S. Department of Health, Education, and Welfare, Social Security Administration, 1974). The principal source which describes changes in program definitions and provisions and presents annual data on covered workers, earnings, and benefit payments is the Annual Statistical Supplement of the Social Security Bulletin. Skolnik (1976) describes private pension programs and estimates coverage, contributions, number of beneficiaries, and benefit payments under these programs.

2. At present an individual can earn $3,000 in a year without losing any social security retirement benefit. Once the $3,000 exempt amount is exceeded, the retirement test is administered on a monthly basis where $1 in benefits is lost for every $2 of earned income over $250 in a given month. It is important to note that if earnings exceed $250 in some months but yearly earnings do not exceed $3,000, the retirement test is not applied in any month of the year. Since retirement is tested solely through earned income, this mechanism

will be called the "earnings test."

3. Income from accumulated private assets is another major source of retirement income. The effect of social security on private capital accumulation has been the subject of recent theoretical and empirical study by Feldstein (1974, 1977), Feldstein and Pellechio (1977a), Munnel (1974, 1976), Kotlikoff (1977a, b), and Barro (1977).

4. An excellent review of these surveys and findings can be found in Bixby (1976).

5. See Heckman (1974a, p. 85), Griliches (1977), and Chamberlain (1977).

6. A justification of this linear specification for adding SSW is given in Section IV.

7. Obtaining a single estimate of the wage effect by using imputed wages is also proposed by Gronau (1977). The method proposed here was developed independently.

8. This derivation is carried out by Heckman (1974a & b, 1977). Hanoch (1976a) points out the restrictive features of this model and presents a general formulation.

9. See Aziz, Kilss, and Scheuren (1978) for a description and documentation of the data.

10. As a result of this truncation, the maximum value of AYE is $8,040.

11. There is a problem in using imputed wages which is that the residual vector from ordinary least squares estimation of the wage equation is not homoscedastic in small samples. Therefore a probit specification can give inconsistent estimates. The sample size used here may be large enough so that the asymptotic normal distribution of the shadow price error minus the wage regression residual justifies the probit specification. Nonetheless the second probit step may be misspecified which should be noted.

APPENDIX A

WAGE EQUATION ESTIMATES

Results from estimating the wage equation over the three age groups with and without the correction for sample selection are presented in Table A. The dependent variable is the log of observed hourly wage. The regressions account for at least 40 percent of the variation in logged wages with AYE and MAX adding significantly to explanatory power. An average of lagged wages was expected to be a good predictor of current wages. The regressions were intended to predict individuals' potential market wages and not to serve as estimates of the traditional wage equation. SSW is present not for structural reasons, but to clear its coefficient estimate in the second step of a wage effect working through the benefits formula (see p. 34 in the text).

Even though $M(\hat{J}_0)$ is a nonlinear function of the other variables it caused problems in getting precise estimates. Since the main objective was prediction and not estimation of the traditional wage equation, the log of wages were imputed based on the regressions without $M(\hat{J}_0)$ as an explanatory variable.

TABLE A

WAGE EQUATION ESTIMATES OVER THE FULL-TIME WORKING SAMPLE

Variables	Coefficient Estimates (standard errors) Ages 60-61		Ages 62-64		Ages 65-70	
$M(\hat{J}_0)$	--	-1.37 (1.91)	--	0.507 (0.623)	--	-0.085 (1.02)
MAX	0.143 (0.058)	-0.131 (0.387)	0170 (0.067)	0.316 (0.194)	0.270 (0.115)	0.265 (0.131)
$AYE/10^3$	0.189 (0.019)	0.172 (0.030)	0.217 (01021)	0.285 (0.862)	0.227 (0.029)	0.202 (0.305)
$SSW/10^4$	0.036 (0.025)	0.029 (0.027)	-0.003 (0.028)	-0.051 (0.066)	0.043 (0.043)	0.058 (0.188)
$KINC/10^4$	0.236 (0.079)	0.380 (0.216)	0.309 (0.077)	0.247 (0.109)	0.125 (0.063)	0.126 (0.063)
SCHOOL	0.007 (0.009)	0.010 (0.010)	0.011 (0.010)	0.014 (0.011)	0.027 (0.013)	0.026 (0.017)
SOUTH	-0.058 (0.052)	0.043 (0.150)	-0.003 (0.057)	0.006 (0.058)	0.066 (0.081)	0.070 (0.094)
RURAL	-0.024 (0.049)	-0.015 (0.051)	-0.121 (0.060)	-0.078 (0.080)	-0.150 (0.087)	-0.138 (0.168)
RACE	0.121 (0.103)	0.283 (0.247)	0.001 0.109	-0.123 (0.188)	0.081 (0.150)	0.087 (0.167)
AGEW	-0.002 (0.004)	-0.001 (0.048)	-0.002 (0.004)	-0.004 (0.005)	0.001 0.007	0.001 0.008
LWAGEW	-0.045 (0.023)	-0.020 (0.042)	-0.058 (0.025)	-0.002 (0.074)	-0.035 0.036	-0.044 (0.118)
SCHOOLW	0.017 (0.010)	0.002 (0.012)	0.010 (0.011)	0.009 (0.011)	-0.003 (0.015)	-0.003 (0.018)

TABLE A--Continued

Variables	Coefficient Estimates (standard errors)					
	Ages 60-61		Ages 62-64		Ages 65-70	
CONSTANT	-0.171 (0.273)	0.098 (0.464)	-0.058 (0.287)	-0.346 (0.459)	-0.620 (0.485)	-0.420 (2.46)
DAGE*						
R^2	0.413	0.414	0.404	0.405	0.471	0.471
N	528		548		336	

*DAGE Coefficient Estimates (standard errors):

Ages 60-61:	D61	0.022 (0.043)		
with $M(\hat{J}_0)$:	D61	-0.021 (0.073)		
Ages 62-64:	D63	-0.033 (0.059)	D64	-0.059 (0.061)
with $M(\hat{J}_0)$:	D63	-0.068 (0.074)	D64	-0.117 (0.094)
Ages 65-70:	D66	-0.003 (0.101)	D67	-0.101 (0.112)
	D68	-0.154 (0.123)	D69	-0.005 (0.151
	D70	0.098 (0.161)		
with $M(\hat{J}_0)$:	D66	0.002 (0.115)	D67	-0.097 (0.129)
	D68	-0.141 (0.194)	D69	-0.002 (0.153)
	D70	0.098 (0.161)		

APPENDIX B

PROBIT ANALYSIS OF RETIREMENT EXCLUDING CAPITAL INCOME (KINC)

	Coefficient Estimates (standard errors)		
Variables	Not Eligible Ages 60-61	Actuarial Reduction Ages 62-64	Full Benefits Ages 65-70
MAX	0.594 (0.198)	0.645 (0.158)	0.159 (0.157)
AYE/10^3	0.025 (0.051)	0.230 (0.039)	0.394 (0.039)
SSW/10^4	0.002 (0.007)	-0.175 (0.056)	-0.252 (0.054)
SCHOOL	-0.009 (0.025)	0.007 (0.020)	0.016 (0.017)
SOUTH	-0.196 (0.148)	0.026 (0.115)	-0.056 (0.099)
RURAL	-0.022 (0.140)	0.170 (0.117)	-0.183 (0.104)
RACE	-0.329 (0.311)	-0.470 (0.224)	-0.106 (0.198)
AGEW	-0.004 (0.011)	-0.011 (0.009)	0.003 (0.009)
LWAGEW	-0.048 (0.066)	0.224 (0.054)	0.163 (0.049)
SCHOOLW	-0.012 (0.029)	-0.005 (0.021)	0.011 (0.019)
CONSTANT	1.36 (0.80)	0.662 (0.593)	-2.01 (0.62)

APPENDIX B—Continued

Variables	Coefficient Estimates (standard errors) Not Eligible Ages 60-61	Actuarial Reduction Ages 62-64	Full Benefits Ages 65-70
DAGE*			
Retired	103	288	918
Working	468	418	255
-2 × Log Likelihood Ratio	18.5	103	213

*DAGE Coefficient Estimates (standard errors):

Ages 60-61:	D61	0.083 (0.127)		
Ages 62-64:	D63	-0.118 (0.126)	D64	-0.219 (0.125)
Ages 65-70:	D66	-0.086 (0.139)	D67	-0.101 (0.146)
	D68	-0.209 (0.155)	D69	-0.058 (0.159)
	D70	-0.018 (0.170)		

APPENDIX C

NUMBER OF OBSERVATIONS IN WEEKS WORKED CATEGORIES FOR FULL-TIME WORKERS BY AGE

Age	Weeks Worked Categories 1-13	14-26	27-39	40-48	49-52
60	2	5	12	13	248
61	5	7	9	8	219
62	6	10	14	7	158
63	9	8	5	10	155
64	3	8	3	14	138
65	10	12	14	7	83
66	3	10	0	3	53
67	7	2	3	5	35
68	2	5	4	0	31
69	2	3	1	1	18
70	0	2	3	2	15

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