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THE SOCIAL SECURITY EARNINGS TEST, LABOR SUPPLY DISTORTIONS, AND FOREGONE PAYROLL TAX REVENUE

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SUMMARY

In this study the social security earnings test is shown to have a significant effect empirically on the labor supply of retirement aged men. A rich data file from the Social Security Administration containing accurate benefit information provides a cross-section sample of 65-70 year old married men who worked some amount for emperical investigation. The data pertain to 1972. The results indicate that eliminating the earnings test would increase labor supply by 151 annual hours and payroll tax revenue by $31 per individual in the sample. The way in which the earnings test is relaxed is important also. Raising the exempt amount increased labor supply while lowering the tax rate did not. This follows from analyzing labor supply decisions over a nonlinear earnings-tested budget constraint. An econometric technique was developed for consistently estimating labor supply over nonlinear budget constraints. This technique conveniently summarized the budget constraint in an expected value calculation.

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The Social Security Earnings Test, Labor Supply Distortions, and Foregone Payroll Tax Revenue*

An important provision in the social security program is the retirement or earnings test which reduces social security retirement benefit payments when earned income exceeds a certain amount.[1] The earnings test was intended to direct benefits to individuals whose retirement had reduced their income and was outside their control. However, this provision imposes a high implicit tax rate on earnings above the exempt amount which 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 this regulation. The earnings test is an unpopular provision and recent attention has been focused on its potential work disincentive effects.[2]

The purpose of this study is to examine empirically whether the earnings test distorts labor supply and, if so, to measure this distortion. A brief review of recent literature on the earnings test will be given in Section II. A labor supply model based on comparing market wage and shadow price is constructed in Section III. Also, econometric methodology for estimating labor supply over a nonlinear budget constraint is developed. In Section IV the data and sample are described and the variables used in specifying the model are defined. The application of Section III's econometric methodology and discussion of empirical results comprise Section V. A summary and conclusion follow in Section VI.

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II. Review of Recent Literature

The Social Security Administration has been aware that the earnings test is unpopular because it can discourage work by persons who need to earn income in addition to their benefits. In defense of the earnings test, Myers (1964) stresses the insurance objectives of social security and points out that the program was not designed as an annuity. He also points out that the earnings test helps to improve social security finances. This issue is raised again by Ball (1976) but with attention paid to potential labor supply distortions:

> The issue is whether the present test strikes a reasonable balance between two desirable but conflicting goals. One goal is to conserve Social Security funds and keep down contribution rates by limiting payments to those people who have suffered a loss of earned income because of retirement. The other goal is to design a system so that it interferes as little as possible with incentives to perform useful work. The sort of test now in the law may well be about as good a one as we can devise in balancing these objectives.

Additional issues are reviewed and discussed by Schulz (1977). It is unfortunate that estimates of the cost of liberalizing the earnings test assume labor supply will not respond to proposed changes. This overestimates the cost by leaving out payroll tax revenue that would be collected on additional earnings generated by providing greater work incentives.

In a theoretical study, Hanoch and Honig (1976) examine the earnings test's effect on labor supply. The income effect of benefits and the tax effect of the earnings test are carefully analyzed through their impact on the labor supply curve. Labor supply (K) just becomes positive at a reservation wage which is raised by full potential benefits. At low wages (w) even full-time earnings would be close to the earnings test's exempt amount (M), so that the slope of the budget line, w, is unaffected by the earnings test's implicit tax rate. In other words, benefits will not be reduced and therefore there is no tax effect on substantially low wages. Hanoch and Honig go on to show that labor supply is backward bending in an intermediate range of w. As w increases, K increases up the point where earnings, wK, equal M and the earnings test will begin to reduce benefit payments for additional earnings. Individuals avoid any reduction in benefits by holding down K at higher w so that wK = M. Thus, the backward-bending portion of the labor supply curve comes from holding earnings equal to the exempt amount and is described by the rectangular hyperbola wK = M. If w increases further, benefit payments become a small enough share of total income so that the full benefit is foregone. At this point individuals leave the social security retirement system altogether and labor supply shifts back to the curve that is unaffected by benefits and the tax rate. Lowering the tax rate can bring people who had left the system back in. Also, Hanoch and Honig define a critical tax rate which just produces the result that people either earn no more than the exempt amount or leave the system. If lowering the tax rate still left it higher than this critical rate, then there would be no change in behavior. For these reasons, changes in the tax rate can have ambiguous effects on labor supply as well as no effect. The difficulties in describing economic behavior when the convexity assumption does not hold--usual economic relationships cannot be derived from first-order conditions and are not necessarily well defined--are born out by the above results. Also, the importance of distinguishing between responses to the exempt amount and the tax rate when analyzing the earnings test is made clear. Hanoch and Honig significantly advance the analysis of how social security can affect labor supply in their careful theoretical study.

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. To do this, he assumes that individuals react to the earnings test through its effect on net earnings. Based on this assumption, the reduction in benefits due to the earnings test is subtracted from gross earnings as are other taxes to define net earnings; this is done at some standard level of labor supply. The budget set would probably not be adequately represented by computing the net wage at a fixed number of hours of work because it has a pronounced nonconvex shape due to the exempt amount and implicit tax rate of 50 percent in the earnings test. This method for summarizing the effect of the earnings test ignores separate responses to these two parameters of the earnings test which Hanoch and Honig

(1976) have shown to be important. Accepting Boskin's specification and entering gross earnings and benefit reductions due to the earnings test as separate variables in his model, the hypothesis that their coefficients have the same magnitude and opposite sign (which is what he assumes) can be tested. Nonetheless, Boskin makes a contribution by analyzing retirement in the context of states of labor market activity and offering a specification for examining this dynamic process.

Boskin and Hurd (1977) discuss the methodology based on specifying a utility function for estimating labor supply in the presence of the earnings test. Rather than pursue this in their empirical analysis, they adopt a logit specification for estimating the probability of retiring, semi-retiring, and working. A good reason for not specifying utility is that empirical results based on it may depend strongly, if not entirely, on the particular functional form chosen. Nonetheless, Boskin and Hurd's results must be interpreted as reduced-form estimates because they have not considered the probability of choosing other portions of the nonconvex earnings-tested budget constraint. In addition, the identification of important coefficients in the Boskin-Hurd model depends critically on their linear specification.

The effect of the earnings test on the earnings distribution of persons eligible for benefits is a source of evidence that retirement may be induced by this test for retirement. A clustering of earned income around the exempt amount 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. The evidence gives a clear indication that there is some distortion.

Campbell and Campbell (1976) discuss potential reasons for conflicting results between SSA and other researchers on social security's impact on retirement. However, attention appears to be converging on the same issues as open empirical questions. In her review of the research and policy issues on retirement, Bixby (1976) remarks:

> Much more analysis is needed to throw light on changes in the likelihood of complete or partial retirement at different ages if the retirement test were modified to reduce its work disincentive effects....

This study will attempt to develop a consistent analysis of labor supply responses to the earnings test.

III. A Simultaneous Equations Model of Labor Supply

A person decides to work based on opportunities inside and outside the market. Therefore, a comparison of market wage and shadow price is the analytic foundation for the labor supply model used here. This approach to studying labor supply was developed by Gronau (1973, 1977), Hall (1973, 1975), Hanoch (1976a, b), and Heckman (1974, 1977).

The market wage, w, and shadow price, s, equations are specified as:

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

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

The market wage depends on a set of variables, X, and an error term, e_1, which includes unobserved and left-out determinants of wage opportunities and a random component. The semi-log specification is widely accepted in the econometrics literature.[3] Shadow price is influenced by a set of variables, Y, and the amount of time spent working, K. Left-out variables and a random disturbance are combined in an error term, e_2. Assuming that labor supply is generated strictly from these equations, the following labor supply equation is obtained:

$$(3) \qquad K = \begin{cases} (X\alpha - Y\beta - e_3)/\gamma & \text{when } w > s \text{ at } K = 0 \\ 0 & \text{when } w < s \text{ at } K = 0 \end{cases}$$

where $e_3 = e_2 - e_1$. Only the coefficients in eqs. (1) and (2) relative to γ can be estimated. If a variable influences both market wage and shadow price, i.e., is in both X and Y, only the difference between its coefficients in the two equations relative to γ can be identified.

This derivation assumes that the same variables which influence participation (or the choice of a budget line segment on which to work) also determine the amount of work (within the chosen segment). In fact, labor supply is a linear multiple of the gap between market and reservation wage. However, the labor supply decision may be a two-step process. In the first step, given the variables in eqs. (1) and

(2), it is decided whether or not to work. 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.

Another criticism of eq. (3) is that it is based on the assumption that workers can achieve any interior solution. Individuals may not be free to work any amount they might prefer because employers supply jobs at specific amounts of work. Also, there may be minimum supply conditions based on travel costs or hiring costs (Gronau, 1973, 1977; Hanoch, 1976a) or, in general, variable threshold levels of labor supply due to individual characteristics or market conditions (Maddala, 1976). This poses the problem that interior solutions do not generally describe labor supply. This problem is accentuated when the budget constraint is nonlinear.

For the above reasons, the labor supply equation is specified in the following general form:

$$(4) \qquad K = Wd + e_4 \ .$$

W may contain some or all of the X and Y variables and can also include other variables relevant to labor supply that do not appear in eqs. (1) and (2). The coefficients, d, may or may not equal the coefficients in eqs. (1) and (2) relative to γ. The disturbance, e_4, can be correlated with e_1 and e_2 or, from the strict derivation, equal

$e_2 - e_1$. Furthermore, the strict specification can be tested by examining whether the estimate of eq. (4) is statistically different from the estimate of eq. (3) (see Hanoch, 1976b, p. 13). A technique for consistently estimating eq. (4) over a nonlinear budget constraint will be developed and applied here to estimate labor supply decisions of persons eligible to receive social security benefits subject to the earnings test.

The earnings test that will be considered here operates as follows: there is no loss in benefits for earnings up to an exempt amount of $\$M_1$; the benefit payment is reduced by \$t for every \$1 of earnings up to $\$M_2$; benefits are reduced 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 social security program. The number of hours of work, K_3, that it takes to reach this point naturally depends on an individual's wage and benefit. Some individuals may be able to work full-time and not lose their entire benefit; their budget constraint is convex and this fact will be used in estimating the model. The amounts of market time, K_1 and K_2, required to earn M_1 and M_2, respectively, depend on a person's wage only. The earnings-tested budget constraint for a person with wage w who could receive a full benefit payment of BEN is illustrated in Figure 1.

Labor supply estimation over nonlinear budget sets can be developed from the market wage and shadow price equations. For the purpose of estimating all the structural parameters in eqs. (1), (2), and

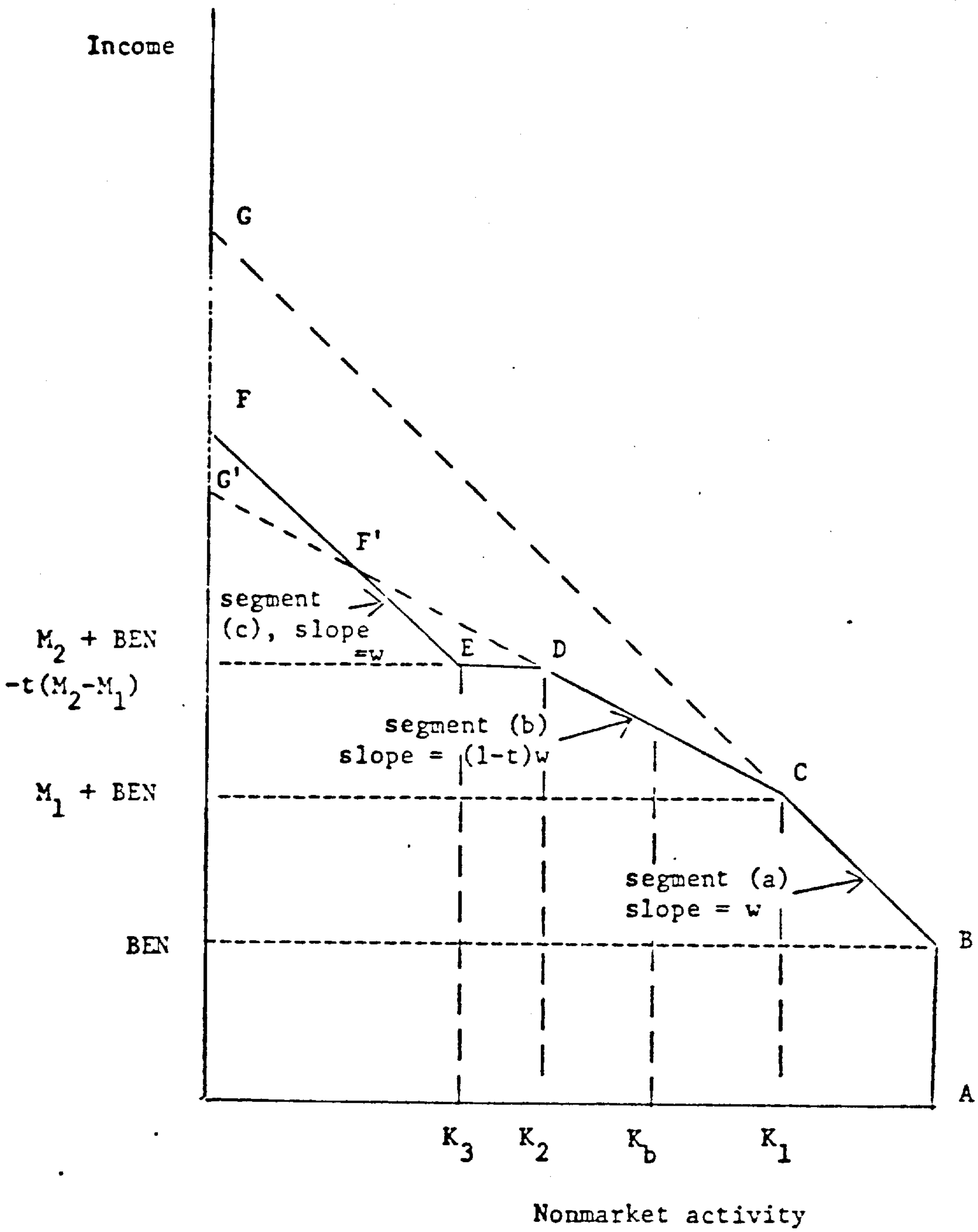

Fig. 1. The Earnings-Tested Budget Line

(4), the market wage equation can be estimated separately and used to construct an imputed wage which is, in turn, used in the labor supply equation. In this way, the wage effect which is dispersed through the X's is pulled together into one coefficient, i.e., the wage effect is measured by the single coefficient estimate for imputed wage. Having swept out the α's, the shadow price coefficients, the β's, are identified. Consequently eq.(1) is replaced by its estimate:

$$(5) \qquad \ln w = X\hat{\alpha} + e_1' = \hat{\ln w} + e_1'$$

where $\hat{\ln w}$ denotes imputed log of wage and e_1', the residual from the wage regression. Estimating labor supply over a nonlinear budget constraint will be based on eqs. (2) and (5). The basic idea is to use the distribution of the disturbances in these equations for computing the probability that an individual will choose to work on each segment and corner of his budget set.

When a person's reservation wage, s at K = 0, is greater than his market wage, he will not work. In terms of eqs. (2) and (5), this is expressed as:

$$(6) \qquad e_2 - e_1' > \hat{\ln w} - Y\beta \quad .$$

Letting $e_0' = e_2 - e_1'$, the probability of not working becomes:

$$(7) \qquad P(K = 0) = P(e_0' > \hat{\ln w} - Y\beta) \quad .$$

A person works when $e_0' < \ln \hat{w} - Y\beta$, but how much labor is supplied depends on other wage and shadow price comparisons. Working below K_1 implies that the shadow price of time at K_1 exceeds the market wage so that:

$$(8) \qquad e_0' > \ln \hat{w} - Y\beta - \gamma K_1 \quad .$$

Therefore the probability that a person works some positive amount less than K_1, i.e., along segment (a), is:

$$(9) \qquad P(0 < K < K_1) \;=\; P(\ln \hat{w} - Y\beta - \gamma K_1 < e_0' < \ln \hat{w} - Y\beta) \quad .$$

It is worthwhile to pause at this point and discuss estimating β and γ. Let e_0' be distributed normally with zero mean and variance σ_0^2 and denote the standard normal distribution by F and density by f. Under this specification, the probability of working less than K_1, following from eq. (8), is:

$$(10) \qquad P(K < K_1) \;=\; 1 - F[(\ln \hat{w} - Y\beta - \gamma K_1)/\sigma_0]$$

while the probability of working K_1 or more is:

$$(11) \qquad P(K \geq K_1) \;=\; F[(\ln \hat{w} - Y\beta - \gamma K_1)/\sigma_0] \quad .$$

Let DK be a binary variable indicating whether or not a person works less than K_1, where DK = 1 for individuals working K_1 or more in the sample and DK = 0 for those working below K_1. A probit analysis of DK maximizes the likelihood of observing the sample which is:

$$(12)\qquad L = \prod_{i\varepsilon\{DK=1\}} F[(\ln \hat{w}_i - Y_i\beta - \gamma K_{1i})/\sigma_0]$$

$$\cdot \prod_{i\varepsilon\{DK=0\}} \{1-F[(\ln \hat{w}_i - Y_i\beta - \gamma K_{1i})/\sigma_0]\} .$$

The inverse of the coefficient estimate for $\ln \hat{w}$ yields an estimate of σ_0. β and γ are estimated by dividing the coefficient estimates for variables in Y and K_1 by that for $\ln \hat{w}$. In this way, maximum likelihood estimates of σ_0, β, and γ are obtained. More importantly, as will be seen, the coefficient estimates from a probit analysis of working above K_1 can be used to estimate the probability of working on the segments and corners of a nonlinear budget constraint. The method for consistently estimating labor supply that will be used here requires calculating these probabilities. For this reason the first step in the empirical analysis will be a probit analysis of earning above the exempt amount, M_1, in Figure 1.

A crucial feature of the budget constraint for this analysis is that the extension of its initial segment BC shown as the dashed line CG in Figure 1 lies above the rest of the 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 wage and shadow price comparison that underlies the condition for working less than K_1 would not be valid. Fortunately this problem does not arise in the important first step of the empirical analysis because the earnings test is structured as it is in Figure 1.

Getting back to the choices made on a nonlinear budget constraint, the wage that an individual faces at K_1 is taxed at rate t. A person may be willing to work more than K_1 at his full wage but not at his taxed wage. In other words, the market wage may exceed his shadow price of time at K_1 but the taxed wage does not. For this reason, there is a non-zero probability that an individual works K_1 exactly. Working at least K_1 requires that:

$$(13) \qquad e_0' < \ln \hat{w} - Y\beta - \gamma K_1 \quad .$$

However, no more work than K_1 occurs when (1-t) w < s at K_1. Since it is the log of wage appearing in eq. (5), it follows that:

$$(14) \qquad e_0' > \ln(1-t) + \ln \hat{w} - Y\beta - \gamma K_1 \quad .$$

However, a problem arises due to the nonconvexity of the budget set. Equation (14) does not preclude working on segment (c) which, as drawn in Figure 1, cuts the extension of CD denoted by the dashed line DG' from below. As a result of this, the shadow price of time can equal the full wage at some labor supply greater than K_3. In other words, an indifference curve can pass through point C and also be tangent to segment (c) above F'. The same problem exists for examining choices along segment (b). Consider a person who chooses to work along segment (b) at K_b. Working on this segment implies that $S(K = K_1) < (1-t)w < S(K = K_2)$; if interior solutions are obtained then, in addition, $S(K = K_b) = (1-t)w$. However these conditions do not preclude working on segment (c). It is possible that $S(K = K_3) < w$ implying that this person would also work along segment (c). If γ is sufficiently large, then the full wage will not exceed shadow price at K_3. Nonetheless, in the case of two potential labor supply equilibria, the individual chooses the point yielding higher utility or is indifferent between two different amounts of work.

As a practical solution to the nonconvexity problem, the sample for estimation will be restricted to persons whose benefits are high relative to their wages so that K_3 is greater than full-time, full-year work (FT) as illustrated in Figure 2; FT equals 2080 annual hours of work. Because these individuals would have to work more than FT to get on segment (c), their earnings-tested budget constraints are effectively convex. For this reason, this subgroup of the population will be called the "convex" sample. Estimating the labor supply equation over the "convex" sample will be carried out here as a way around the nonconvexity problem.

The net wage and shadow price comparisons used to determine labor supply over the budget constraint in Figure 2 can be conveniently expressed using the following notation:

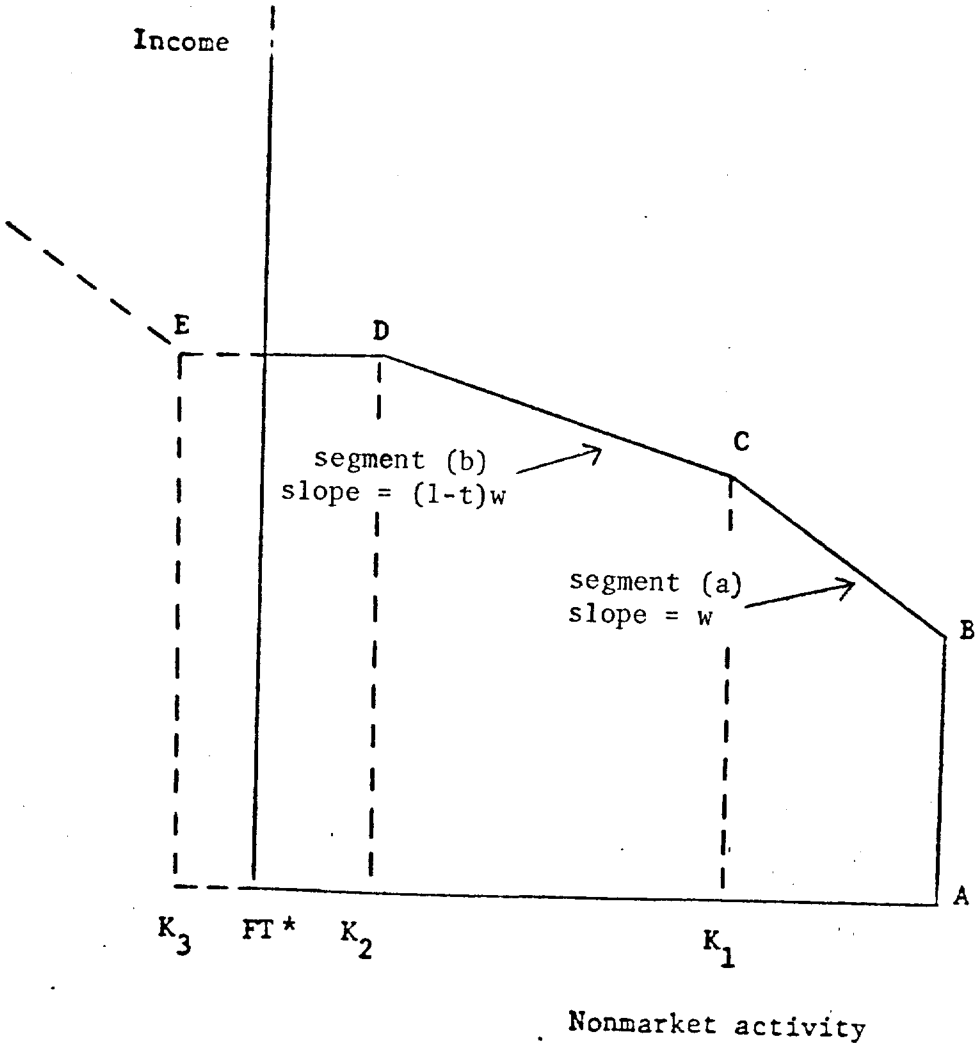

Fig. 2. The Earnings-Tested Budget Line in the "Convex" Sample

*FT = 2,080 annual hours of work.

$J_0 = (\ln \hat{w} - Y\beta)/\sigma_0$, the work participation index

$J_1 = (\ln \hat{w} - Y\beta - \gamma K_1)/\sigma_0$, the index for working up to K_1

$J_{1t} = [\ln(1-t) + \ln \hat{w} - Y\beta - \gamma K_1]/\sigma_0$, the index for working beyond K_1

Continuing with the normal specification where F denotes the distribution function, the possible labor supply choices on the earnings-tested budget constraint in Figure 2 and the probability for making each choice are:

Labor Supply Choice	Probability of Choice
Zero labor supply	$1 - F(J_0)$
Along segment (a)	$F(J_0) - F(J_1)$
At K_1	$F(J_1) - F(J_{1t})$
Along segment (b)	$F(J_{1t})$

Calculating the expected value of K given W from eq. (4) over the budget constraint, i.e., over the possible labor supply choices, yields the specification for consistently estimating the model. Let q index the types of choices where q = 1 for zero labor supply, 2 for working along segment (a), 3 for working at K_1 and 4 for working along segment (b). The expected value of K conditional on W is:

$$(15)\qquad E(K|W) = \sum_{i=1}^{4} P(q=i)[W_q d + E(e_4|W,q)]$$

where P(q=i) denotes the probability of making choice i and the subscript on W indicates that the value of some variables in W, in particular net wage, depend on q. Certainly, using the actual choice made to define the values of these variables in specifying the model induces bias in the estimate of the model. This occurs because, as shown throughout this section, the error term, e_0', depends on this choice and the potential correlation between e_0' and e_4 may induce simultaneity bias between e_4 and the variables depending on q. However, by ignoring the information in the choice actually made in the conditional expectation of K, this problem does not arise. This can be seen by carrying out the calculation further using the choice selection probabilities and calculating the expected values of e_4:

$$(16)\qquad E(K|W) = \left[1 - F(J_0)\right]\left[W_1 d - \frac{\sigma_{40}}{\sigma_0}\,\frac{-f(J_0)}{1-F(J_0)}\right]$$

$$+ \left[F(J_0) - F(J_1)\right]\left[W_2 d - \frac{\sigma_{40}}{\sigma_0}\,\frac{f(J_0) - f(J_1)}{F(J_0) - F(J_1)}\right]$$

$$+ \left[F(J_1) - F(J_{1t})\right]\left[W_3 d - \frac{\sigma_{40}}{\sigma_0}\,\frac{f(J_1) - f(J_{1t})}{F(J_1) - F(J_{1t})}\right]$$

$$+ \left[\quad F(J_{1t}) \quad\right]\left[W_4 d - \frac{\sigma_{40}}{\sigma_0}\,\frac{f(J_{1t})}{F(J_{1t})}\right]$$

$$= \left[\sum_{i=1}^{4} P(q=i) W_q\right] d$$

where $\sigma_{40} = E(e_0' e_4)$ and f denotes the normal density function. Equation (16) summarizes the budget constraint through an expected value calculation. The probability-weighted average of the expected value of e_4 on the segments and corners of the budget constraint equals 0. This says there is no problem with choice selection since information on the values of right-hand side variables given by this choice is not used in the conditional statement.

The way in which eq. (16) treats variables which change value on different portions of the budget constraint has some interesting implications. For example, given gross wage, the wage variable equals the probability-weighted average of net wage rates on all segments of the budget constraint. The weights vary over individuals according to their values for the variables that go into the J-indexes. The coefficients for these variables in the indexes are estimated through a probit analysis of working above K_1 which has been discussed. The weights also depend on the parameters of the income maintenance or tax program under study; the program's breakpoints and tax rates are used in evaluating the J-indexes. For this reason, it is possible to use regression estimates of the labor supply equation for predicting labor supply responses to changes in the program. In addition, since gross wage, w, is assumed to be constant and the log of net wage is specified as the wage variable in eq. (4) and tax rates, t_q, vary over the labor supply choices, eq. (16) implies the following:

$$(17) \quad E(K|W) = \sum_{i=1}^{4} P(q=i) \ln(1-t_q)w \, d_1 + \ldots$$

$$= [\sum_{i=1}^{4} P(q=i)]w \, d_1 + [\sum_{i=1}^{4} P(q=i) \ln(1-t_q)] \, d_1 + \ldots$$

$$= [\ln w]d_1 + [\sum_{i=1}^{4} P(q=i) \ln (1-t_q)] \, d_1 + \ldots$$

where d_1 is the coefficient for the wage variable. Consequently, the effect of a nonlinear tax or income maintenance program is summarized through an expected value of the tax rates faced along the entire budget constraint. Furthermore, the coefficient estimates for the gross wage and expected tax variables should be statistically the same. Any predicted responses to changes in the tax program under study come through changes in the expected tax variable.

Equation (16)'s specification of the labor supply regression yields a consistent estimate of the labor supply equation over convex budget constraints. This technique does not supplant knowledge of the utility function that would fundamentally solve the problems in the nonconvex case. However, this should be weighed against the method's merit as a tractable way of summarizing a nonlinear budget constraint. It is less restrictive than specifying a functional form for utility or requiring that the shadow price equation be integrable. The specification used here can be examined by testing the gross wage and expected tax coefficient estimates for equality.

IV. Data and Definition of Variables

The empirical analysis is based on a rich file of data from the Social Security Administration, the 1973 CPS-IRS-SSA Exact Match file.[4] This file starts with the March 1973 Current Population Survey (CPS). Each individual's CPS record is matched to extracts of their income tax return (IRS) and administrative records of the Social Security Administration (SSA). The labor supply of married men aged 65-70 years whose CPS, IRS and SSA records are properly matched in this file is studied here. These individuals are eligible for social security retirement and survivor benefits. They are not covered by the railroad retirement system and not employed by the federal or a state government. Also, they do not receive welfare income, unemployment compensation, or disability payments. In this way, government pension and income maintenance programs other than social security do not influence the behavior under study.

The sample consists of those 65-70 year olds who worked some amount of weeks in 1972. The econometric methodology developed in Section III produces consistent estimates of the labor supply model in this selected sample. The actual number of hours a person worked during the week before the March 1973 CPS is given in the Exact Match file. If a person worked in 1972 but hours worked were not reported for the survey week, hours per week was set a 40 for full-time workers and 20 for part-time workers. This was done to avoid survey-week selectivity bias as defined and discussed by Hanoch (1976b). The measure of hours per week is multiplied by weeks worked in 1972 to obtain an estimate of annual hours worked. Labor supply will be measured by this estimate of annual hours worked which is denoted HOURS.

Given 1972 earnings reported in the file and the estimate of annual hours of work, the number of hours that it would take to earn the exempt amount of $1,680 in the earnings test for 1972 can be calculated. This amount of working time, denoted K_1 here as in Section III, is important in the first step of the analysis. Assuming wages do not change much in 1973 for 65-70 year olds, K_1 can be computed for the exempt amount of $2,100 in 1973. Since earnings are reported in 1973 as well as in 1972, a binary variable, DK, for each year is set equal to 1 for earning the exempt amount or more. Thus for each person, two observations on earning the exempt amount or more are obtained. The probit analysis of working above K_1 described in Section III is carried out in the sample of pooled observations on DK for the same individuals in 1972 and 1973.

The change in the earnings test from 1972 to 1973, i.e., the increase in the exempt amount from \$1,680 to \$2,100, is important for measuring a response to the exempt amount. In only a cross-section sample where this amount is the same for all individuals, K_1 is just the inverse of observed wage. However, variation in the exempt amount permits estimating the valuation of time coefficient, γ, in the shadow price equation. With an estimate of $\hat{\gamma}$, changes in shadow price with respect to working time which, along with net wage changes, determine the probabilities for working on various portions of the budget constraint can be computed.

After computing an individual's probabilities for the labor supply choices his expected tax variable shown in eq. (17) of Section III can be calculated - it is denoted ETAX. As discussed in Section III an imputed wage is used in estimating the parameters of the labor supply model. The log of a person's wage imputed from a wage regression is denoted $L\hat{W}AGE$. The specification of the wage equation and its estimate are given in Appendix A.

The SSA data permit precise calculation of full social security retirement benefits for which a person is eligible whether or not any benefit payment is actually made. Social security wealth is defined to be the actuarial present value of future benefit payments which couples in the sample are eligible to receive; this is computed and denoted SSW. Although SSW is not an explanatory variable in the wage or shadow price equation it enters the model because it can change lifetime resources. As discussed in Pellechio (1978b) SSW measures social security's effect on labor supply in a life-cycle framework through the market wage-shadow price comparison.

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.

Other variables that influence 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). 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.

A summary description of the variables described in this section is given in Table 1.

TABLE 1

LIST AND SUMMARY DESCRIPTION OF VARIABLES

Abbreviation	Description
DK	equals 1 for earning the exempt amount or more in the earnings test; 0 otherwise. There are two observations on DK for earning the exempt amount or more in 1972 and 1973 for each individual
K_1	number of hours of work it takes to earn the exempt amount. There are two observations for each individual
HOURS	estimate of annual hours worked in 1972
LWAGE	log of wages imputed from wage equation estimate reported in Appendix A
ETAX	expected tax variable given in eq. (17)
SSW	actuarial present value of benefits (including wives' survivors benefits) assuming full retirement
KINC	capital income
SCHOOL	years of schooling
RURAL	equals 1 for residence in a rural area; 0 otherwise
RACE	equals 1 for whites; 0 otherwise
AGEW	age of wife
LWAGEW	log of observed wage for working wives
SCHOOLW	wife's years of schooling
DAGE	binary variables for age: D66 =1 for 66 year olds in the 65-66 age group D67 " 67 " D68 " 68 " D69 " 69 " D70 " 70 "

V. Econometric Specification and Empirical Results

As discussed in general in Section III, labor supply is generated by comparing shadow price with the log of wage imputed from an estimate of the wage equation. The wage regression results for 65-70 year olds are reported in Appendix A. In the probit analysis which is the first step in estimating the labor supply model, the shadow price specification is:

$$(2') \quad \ln s = \beta_0 + \gamma K_1 + \beta_1 KINC + \beta_2 SCHOOL + \beta_3 RURAL + \beta_4 RACE$$

$$+ \beta_5 AGEW + \beta_6 LWAGEW + \beta_7 SCHOOLW + bDAGE + e_2 \quad .$$

Social security's effect on earning above the exempt amount is measured through social security wealth, SSW, which is added to the model.

Table 2 presents an estimate of the index for working up to K_1, J_1, as discussed in Section III from a probit analysis of earning the exempt amount or more in 1972 and 1973 based on $\hat{LWAGE}$, eq. (2') and SSW. The cross-section sample is made up of 593 persons who provide two observations on earning the exempt amount or more for 1972 and 1973. The probit analysis is carried out for the pooled observations on 593 working men aged 65-70 years. The nonconvexity of the earnings-tested budget constraint does not affect the analysis (see Section III, Figure 1).

TABLE 2

PROBIT ANALYSIS[†] OF EARNING ABOVE THE EXEMPT AMOUNT IN THE EARNINGS TEST FOR MARRIED MEN AGES 65-70[‡]

(DK = 1 for earning above the exempt amount, 0 for below)

Variables	Coefficient Estimates (Standard errors)	Variables	Coefficient Estimates (Standard errors)
$\hat{LWAGE}$*	1.40 (0.14)	AGEW	-0.017 (0.008)
$K_1/10^3$	-0.532 (0.089)	LWAGEW	0.101 (0.043)
$SSW/10^4$	-0.259 (0.050)	SCHOOLW	0.037 (0.018)
$KINC/10^4$	-0.209 (0.086)	D66	-0.189 (0.122)
SCHOOL	-0.038 (0.017)	D67	-0.181 (0.134)
RURAL	0.313 (0.100)	D68	-0.139 (0.146)
RACE	-0.733 (0.180)	D69	-0.279 (0.147)
CONSTANT	1.61 (0.539)	D70	-0.336 (0.164)
Earning above exempt amount	522		
Earning below exempt amount	664		
-2 x Log Likelihood Ratio	401.		

[†]These results were obtained from the Maximum Likelihood Probit

TABLE 2--Continued

Estimation Program written by Forrest Nelson and Richard Rosett, University of Rochester, and modified by Bronwyn H. Hall, Harvard University.

‡For each individual there are two observations on earning the exempt amount or more based on reported earnings in 1972 and 1973. The probit analysis is carried out in the sample of pooled observations on DK for these individuals.

*The log of market wages was imputed using the wage regression reported in Appendix A.

The wage effect is significantly positive as expected from examining Figure 1. At higher wages, segment (c) is reached more quickly and foregone benefits are a smaller share of total earnings at optimum labor supply. The estimated probability of earning the exempt amount or more is:

$$(18) \qquad P(DK=1) = \int_{-\infty}^{\hat{J}_1} f(t)dt$$

where $\hat{J}_1$ is the index for working up to K_1 discussed in Section III and estimated in Table 2 and f is the standard normal density function. It follows that:

$$(19) \qquad \frac{\partial P}{\partial x} = f(\hat{J}_1)b_x$$

where x is any variable in J_1 and b_x is x's coefficient estimate in J_1 (these coefficient estimates are what is given in Table 2). The effect of one variable depends on the values for the other variables through $f(\hat{J}_1)$. Using the example of a white married male aged 65 years with 12 years of schooling who does not reside in a rural area with a nonworking wife of the same age and education and has KINC equal to its mean value for 65-70 year olds, the point estimate of 1.40 for LWAGE indicates that an increase in wages from \$3 to \$4 per hour raises the probability of earning above the exempt amount by 0.13 approximately. This provides some quantitative reference point for the estimates in Table 2.

The coefficient estimate for K_1 is significantly negative, indicating that shadow price is raised by increases in working time. Using the above example with $\hat{LWAGE}$ set at its mean value, the increase in the exempt amount from \$1,680 to \$2,100 lowers the probability of earning above the exempt amount by 0.03. Since K_1's coefficient is $-\gamma/\sigma_0$ and $\hat{LWAGE}$'s, $1/\sigma_0$, then dividing K_1's coefficient estimate by $\hat{LWAGE}$'s yields an estimate of γ of 0.38×10^{-3}. This corresponds to an elasticity of shadow price with respect to hours of work of 0.26 at K_1's mean value of 681 hours.

SSW lowers the probability of working above K_1 and the coefficient estimate and standard error are close to the values obtained in my retirement study.[5] This indicates that SSW shifts the labor supply curve leftward as Hanoch and Honig (1976) demonstrate should be the case.

Capital income and schooling are expected to raise shadow price and their significant negative coefficients support this hypothesis. The positive coefficient estimate for RURAL indicates that persons who work in rural areas are likely to earn more than the exempt amount. Whites have a significantly higher probability of earning below the exempt amount. The higher is a wife's wage, the greater is the chance that the husband works more than K_1, indicating that husband's and wife's time are complements. A pattern of increasing likelihood for working less than K_1 with advancing age is given by the DAGE coefficient estimates.

The coefficient estimates for variables in J_1 given in Table 2 are used to compute estimates of all the J-indexes defined in Section III. Continuing with the normal specification, the probabilities for working on different portions of the budget constraint are calculated from the J-indexes for each individual. For persons with convex budget sets, the "convex" sample, as shown in Figure 2, the probability of working on segment (c) is zero and there are no nonconvexity problems in the analysis.

With an individual's probabilities for the labor supply choices ETAX is calculated. Along with the implicit tax rate of the earnings test, income and payroll tax rates are also added in the calculation.[6] The labor supply equation is specified as:

$$(4') \quad HOURS = d_0 + d_1\hat{LWAGE} + d_1ETAX + d_2SSW + d_3KINC + d_4SCHOOL + d_5RURAL + d_6RACE + d_7AGEW + d_8LWAGEW + D_9SCHOOLW + \delta DAGE + e_4 \; .$$

Estimates of the HOURS equation are presented in Table 3 for the "convex" sample. Consistent estimates of this labor supply model over the nonlinear convex budget constraint are obtained using ordinary least squares. The unconstrained regression yields separate coeffi-

TABLE 3

HOURS EQUATION ESTIMATES IN THE "CONVEX" SAMPLE BASED ON METHOD FOR CONSISTENT ESTIMATION OVER NONLINEAR BUDGET CONSTRAINTS USING OLS

Variables	Coefficient Estimates (Standard errors) Unconstrained	Constrained
$\widehat{LWAGE}$	1161. (534.)	--
ETAX	1742. (890.)	--
$\widehat{LWAGE}$ + ETAX	--	813. (450.)
SSW	-0.020 (0.012)	-0.015 (0.011)
KINC	-0.001 (0.019)	-0.005 (0.019)
SCHOOL	-15.1 (27.7)	-5.9 (26.7)
RURAL	366. (172.)	328. (169.)
RACE	-652. (388.)	-365. (308.)
AGEW	-21.2 (12.4)	-16.7 (11.8)
LWAGEW	69.6 (75.8)	41.2 (72.2)
SCHOOLW	23.7 (28.9)	12.6 (27.4)

TABLE 3--Continued

Variables	Coefficient Estimates (Standard errors) Unconstrained	Constrained
CONSTANT	4201. (1197.)	3392. (994.)
DAGE*		
R^2	.101	.094
N	212	212
SSR/10^9	0.18025	0.18160

*DAGE Coefficient Estimates (standard errors):

	Unconstrained	Constrained
D66	-667. (229.)	-613. (225.)
D67	-765. (234.)	-689. (226.)
D68	-626. (246.)	-552. (239.)
D69	-836. (258.)	-741. (247.)
D70	-904. (283.)	-759 (257.)

cient estimates for LWAGE and $\hat{ETAX}$ and the constrained version requires the same coefficient estimates for these variables. As specified in Section III, the labor supply model implies that the wage and tax coefficients should be equal. The F-statistic for testing the hypothesis that LWAGE and $\hat{ETAX}$ have the same coefficient estimate is 1.48 which indicates that the hypothesis can be accepted at a high confidence level. This evidence provides some support for the method proposed and used here for consistently estimating labor supply over nonlinear budget sets. In addition, the wage and tax effects are large. An increase in wages from $3 to $4 per hour raises annual hours worked by 334.

The effects of changing the tax rate and exempt amount in the earnings test are not immediately apparent from the calculation of the tax variable in eq. (17). Because the J-indexes depend on these earnings test parameters, the probabilities of choosing the segments of the budget constraint change with the earnings test. Since the probabilities summarize the effect of the earnings test through the expected tax calculation, an earnings test change is ultimately expressed as a change in the expected tax variable. This change was computed for increases in the exempt amount to $5,000, $7,000, and $10,000 and a decrease in the tax rate from 50 to 25 percent and the elimination of the earnings test. In all hypothesized changes, the dollar-for-dollar reduction in benefits for earnings was eliminated. The predicted annual hours of work for the earnings test as it operated in 1972 and for the hypothetical alternatives are given in Table 4.

TABLE 4

PREDICTED ANNUAL HOURS OF WORK (IN MILLIONS) FOR

ACTUAL AND ALTERNATIVE EARNINGS TESTS IN 1972

Actual Earnings Test: 1,839

Alternative Earnings Tests:

Exempt Amounts	Tax Rates 50%	25%
$5,000	1,833	1,693
$7,000	1,860	1,720
$10,000	1,901	1,803

Elimination of Earnings Test: 2,002

The predicted annual hours of work in Table 4 are based on the constrained estimate of the HOURS equation in Table 3. Since it is a consistent estimate of the labor supply model, fitted hours were calculated for the full sample of 593 individuals facing both convex and nonconvex budget constraints. This sample corresponds to a group of 1.081 million married men in the 1972 population, an estimate obtained by adding up the CPS population weight for each individual. Each person's predicted hours were multiplied by his population weight to obtain predictions for this subgroup in the population. The sample includes only married working men satisfying selection criteria designed to eliminate potential effects of income maintenance and pension programs other than social security. Therefore, the predicted responses arise from a narrowly defined subgroup in the total population of persons whose labor supply might be affected by the earnings test.

Elimination of the earnings test increases predicted hours by 163 million. At an average wage of $4 per hour, total income in this population rises by $652 million and an additional $34 million in payroll tax revenue is collected. At a $10,000 exempt amount and 50 percent tax rate, payroll tax revenue is increased by $13 million. Even at a high exempt amount of $10,000, persons with high earnings are still likely to forego their entire benefit. Consequently, the opportunity to improve social security finances by easing the earnings test is a relevant policy consideration.

The decrease in hours worked for a reduction in the tax rate at each exempt amount can be explained by deciding to work less and receive benefits by persons who formerly earned enough to reduce their benefit payment to zero, i.e., the return to the retirement program of persons who had left by virtue of their earnings. This is illustrated in Figure 3 by the change in equilibrium from E_0 to E_1. Whereas before the person equated his untaxed wage to shadow price, after the reduction in the earnings test tax rate, he decides to accept his taxed wage at a lower labor supply and receive some benefit income. Computationally ETAX decreases even though the tax rate is

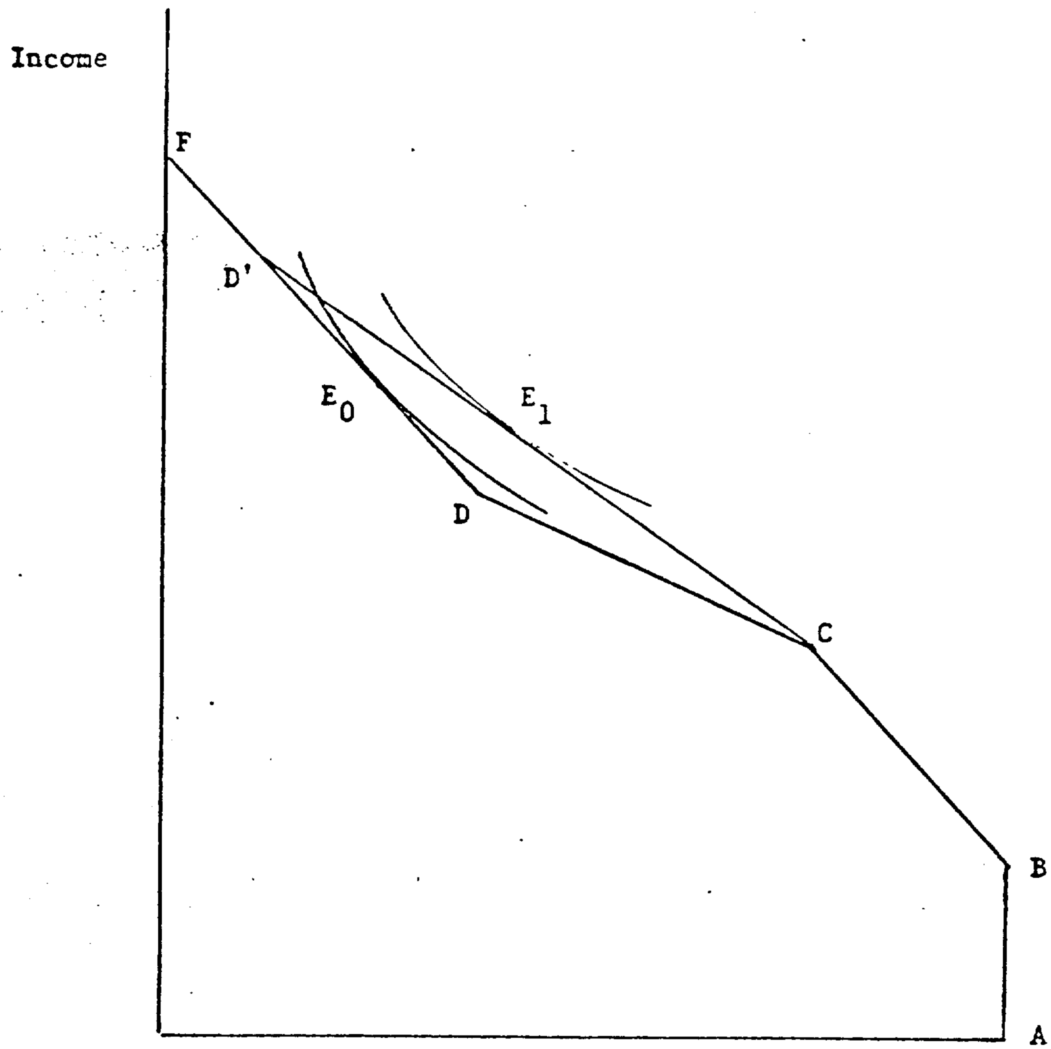

Fig. 3. Changing the Earnings Test Tax Rate

lower because it is applied over a larger segment of the budget line.

There is a slight drop in hours going from the actual earnings test to one with an exempt amount of $5,000. This can be explained by the balancing of increased hours of work from individuals who earn no more than the exempt amount with reduced hours by those returning to the retirement program.

Evidence of a labor supply shift induced by social security in which fewer hours are worked holding wages and tax rates constant is given by the negative coefficient estimate for SSW. A one standard deviation, $12,039, increase in SSW reduces annual hours worked by 180. The pattern of effects of other variables on labor supply obtained in the first step of the analysis is repeated when the HOURS equation is estimated.

In this section the effect of social security on labor supply of working men eligible for full retirement benefits was examined empirically. The results indicate that the earnings test does discourage work thereby reducing payroll tax revenue that would be collected on undistorted labor supply. Although the estimates support the specification and methodology developed for this analysis and measure reasonable economic responses to the earnings test, they are reported with due caution.

VI. Summary and Conclusion

The effect of the social security earnings test on labor supply in a sample of 65-70 year old working men was examined in this study.

This required implementing a technique for consistently estimating labor supply over the nonlinear earnings-tested budget constraint. The resulting specification summarized this constraint through an expected value calculation [equation (16)]. As a practical way of avoiding the problems posed by a nonconvex budget set, the sample was restricted to those persons whose wage and benefit levels were such that their budget constraints were convex. In the expected value expression for the budget constraint, the labor supply effects of the earnings test's exempt amount and tax rate were summarized in an expected tax variable. Furthermore, the specification of the labor supply model implied that the coefficients for the market wage and expected tax variable should be equal.

The empirical results indicated that wages and the earnings test have a significant effect on the number of annual hours worked. The estimates supported the hypothesis that the wage and tax coefficients are equal. Based on the estimate of the model, predicted responses to hypothetical changes in the earnings test in 1972 were computed. An increase in the exempt amount to $10,000 from the $1,680 actually applied in that year was predicted, in a population of 1.081 million, to increase labor supply by 61 million annual hours and payroll tax revenue by approximately $13 million. In per capita terms, these increases are 57 annual hours and $12 respectively. By eliminating the earnings test, an additional 151 annual hours of work and $31 in payroll tax revenue per person are obtained. Lowering the earnings test tax rate was predicted to decrease labor supply. This counterintuitive result is explained by the fact that as the tax rate decreases, wages are taxed over a larger segment of the nonconvex budget constraint.

The cautionary note on these results that concluded Section IV is repeated here. More work in estimating labor supply and testing the methodology in larger samples and other data files is required before firm conclusions can be drawn.

Appendix A

The econometric methodology and empirical results in the text are based on using an imputed wage obtained from an estimate of the wage equation. This equation is discussed here. Its specification uses variables described in Section IV and some additional variables described here.

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. 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 SSA information 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. 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.

A binary variable (SOUTH) equals for residence in the South. Given the variables described here and in Section IV, the wage equation is specified to be:

$$\text{(A1)} \quad LWAGE = \alpha_0 + \alpha_1 AYE + \alpha_2 MAX + \alpha_3 SCHOOL + \alpha_4 SOUTH + \alpha_5 RURAL + \alpha_6 RACE + aDAGE + e_1 .$$

The estimate of this equation used for imputing wages is given in Table A-1. SSW, KINC, AGEW, LWAGEW and SCHOOLW are present not for structural reasons but to avoid inducing bias in their coefficient estimates in the labor supply (HOURS) regression reported in Section V.

TABLE A-1

WAGE EQUATION ESTIMATE OVER THE FULL-TIME WORKING SAMPLE

Variables	Coefficient Estimates (Standard errors)	Variables	Coefficient Estimates (Standard errors)
MAX	0.270 (0.115)	AGEW	0.001 0.007
AYE/10^3	0.227 (0.029)	LWAGEW	-0.035 0.036
SSW/10^4	0.043 (0.043)	SCHOOLW	-0.003 (0.015)
KINC/10^4	0.125 (0.063)	D66	-0.003 (0.101)
SCHOOL	0.027 (0.013)	D67	-0.101 (0.112)
SOUTH	0.066 (0.081)	D68	-0.154 (0.123)
RURAL	-0.150 (0.087)	D69	-0.005 (0.151)
RACE	0.081 (0.150)	D70	0.098 (0.161)
R^2	0.471	CONSTANT	-0.620 (0.485)
N	336		

The wage regression accounts for 47% of the variation in logged wages with AYE and MAX adding significant explanatory power. An average of logged wages was expected to be a good predictor of current wages. The regression was used to impute individual market wage and was not intended to be an estimate of the traditional wage equation.

References

Aziz, Faye; Beth Kilss; and Frederick Scheuren. 1973 Current Population Survey--Administrative Record Exact Match File Codebook, Part I. Studies from Integrating Data Linkages, Report No. 8, U.S. Department of Health, Education, and Welfare, Social Security Administration, Office of Research and Statistics, 1978.

Ball, R.M. "Income Security in Retirement." Social Policy, Ethics, and the Aging Society, B.L. Neugarten and R.J. Havighurst (eds.). Washington D.C.: U.S. Government Printing Office, 1976.

Bixby, Lenore E. "Retirement Patterns in the United States: Research and Policy Interaction." Social Security Bulletin, August 1976, pp. 3-19.

Boskin, Michael J. "Social Security and Retirement Decisions." Economic Inquiry, vol. 15, no. 1, January 1977, pp. 1-25.

Boskin, Michael J. and Michael D. Hurd. "The Effect of Social Security on Early Retirement." Stanford University and National Bureau of Economic Research, July 1977.

Campbell, Colin D. and Rosemary G. Campbell. "Conflicting Views on the Effect of Old-Age and Survivors Insurance on Retirement." Economic Inquiry, vol. 14, September 1976, pp. 369-388.

Chamberlain, Gary. "Unobservables in Earnings Functions: Applications in the Malmo Data." Harvard University, November 1975.

________. "Education, Income, and Ability Revisited." Journal of Econometrics, vol. 5, 1977, pp. 241-257.

Chiswick, Barry R. Income Inequality. National Bureau of Economic Research. 1974.

Griliches, Zvi. "Estimating the Returns to Schooling: Some Econometric Problems." Econometrica, vol. 45, no. 1, January 1977, pp. 1-2.

Gronau, Reuben. "The Effect of Children on the Housewife's Value of Time." Journal of Political Economy, vol. 81, no. 2, part 2, March/April 1973, pp. S168-S199.

________. "Leisure, Home Production, and Work--The Theory of the Allocation of Time Revisited." Journal of Political Economy, vol. 85, no. 6, December 1977, pp. 1099-1125.

Hall, Robert E. "Wages, Income, and Hours of Work in the U.S. Labor Force." Income Maintenance and Labor Supply, G. Cain and H. Watts (eds.), 1973.

________. "Effects of the Experimental Negative Income Tax on Labor Supply." Work Incentives and Income Guarantees, J. Pechman and P. Timpane (eds.), 1975.

Hanoch, Giora. "Hours and Weeks in the Theory of Labor Supply." The Rand Corporation, R-1787-HEW, August 1976a.

________. "A Multivariate Model of Labor Supply: Methodology for Estimation." The Rand Corporation, R-1869-HEW, September 1976b.

Hanoch, Giora and Marjorie Honig. "The Effect of Social Security Benefits on Labor Supply." The Hebrew University of Jerusalem, Research Report No. 88, May 1976.

Heckman, James. "Shadow Prices, Market Wages, and Labor Supply." Econometrica, vol. 42, no. 4, July 1974a, pp. 679-694.

________. "Effects of Child-Care Programs on Woman's Work Effort." Journal of Political Economy, vol. 82, no. 2, part 2, March/April 1974b, pp. S136-S163.

________. "A Life-Cycle Model of Earnings, Learning, and Consumption." Journal of Political Economy, vol. 84, no. 4, part 2, August 1976, pp. S11-S44.

________. "Sample Selection Bias as a Specification Error." The Rand Corporation and The National Bureau of Economic Research, February 1977.

Maddala, G.S. "Identification and Estimation Problems in Limited Dependent Variable Models." University of Florida Working Paper No. 76-77-12, November 1976.

Mincer, J. Schooling, Experience, and Earnings. National Bureau of Economic Research, 1974.

Myers, R.J. "Earnings Test Under Old-Age Survivors and Disability Insurance: Basic, Background, and Experience." Social Security Bulletin, 1964.

Pellechio, A.J. "The Effect of Social Security on Retirement." Harvard University, April 1978a.

________. "Social Security Financing and Retirement Behavior." Prepared for the American Economic Association's Annual Meeting on August 28-31, 1978. August 1978b.

Sander, Kenneth G. "The Retirement Test: Its Effect on Older Workers' Earnings." Social Security Bulletin, June 1968, pp. 3-6.

Schulz, James H. "The Social Security Retirement Test: Time for a Change?" Urban and Social Change Review, vol. 10, no. 2, Summer 1977, pp. 14-18.

Vroman, Wayne. "Older Worker Earnings and the 1965 Social Security Amendments." Social Security Administration, Office of Research and Statistics, Research Report No. 38, July 1971.

Notes

1. In 1977 a person could earn $3,000 without losing any social security retirement benefit income. Once the $3,000 exempt amount was exceeded, the retirement test was administered on a monthly basis where $1 in benefits is lost for every $2 of earned income over $250 in a given month. Since retirement is tested solely through earned income, this mechanism will be called the "earnings test."

2. See Bixby (1976) and Campbell and Campbell (1976).

3. See Chiswick (1974), Chamberlain (1977), Griliches (1977), Gronau (1973, 1977), Hanoch (1976b), Heckman (1974a, 1977), and Mincer (1974).

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

5. Pellechio (1978a, p. 26, Table 2).

6. Income tax along the budget line segments is computed using dividend and interest income and number of exemptions given in the IRS data in the Exact Match file. The tax rate at $1,500 in earnings is used for segment (a), and $2,500 for segment (b). The payroll tax rate was 5.2 percent in 1972.

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