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SOCIAL SECURITY AND THE LABOR SUPPLY OF AGED MEN: EVIDENCE FROM THE U.S. TIME SERIES

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I. Introduction

Following Feldstein's seminal paper (1974), most of the early empirical research on the economic effects of the social security system focused on the effect of social security on saving and capital formation. Recently the focus has shifted to the effect of social security on labor supply. With the exception of Burkhauser and Turner (1978), who investigated the effect of social security on the labor supply of prime-aged males, empirical research has centered on the effect of social security on the retirement decision or, more precisely, the labor supply of the aged (e.g., Boskin, 1977; Burkhauser, 1977; Quinn, 1977; Boskin and Hurd, 1978; Pellechio, 1978a, 1978b, and 1979; Brown, 1979; Kotlikoff, 1979; and Morgan, 1980).[1/] Most of the studies on the labor supply of the aged have used cross section data.[2/] The two exceptions are Pellechio (1979) and Brown (1979) who used time series data. The general conclusion of most of these studies is that social security induces retirement, i.e., has a negative effect on the labor supply of the aged. The major difference among these studies concerns the relative importance of social security as compared to other demographic and economic variables in influencing the labor supply decision of the aged. For example, Boskin (1977) concludes, on the basis of his empirical analysis, that the major cause of the decrease in the labor supply of the aged is the social security system, whereas Brown (1979) concludes that the major cause is past income growth.

1/ Given the ever growing empirical literature on the determinants of the labor supply of the aged, this list is not exhaustive. For example, there have been several studies (e.g., Feldstein (1977) and Kopits and Gotur (1980)) which have investigated the effects of social security on both saving and the labor supply of the aged using international cross-section data.

2/ For a review of many of the studies using household cross-section data, see Break (1980) or Gustafson (1979).

The purpose of this paper is to investigate the effect of the social security system on the labor supply of aged men using U.S. time series data for the period 1947 to 1975. The specific phenomena to be explained is the dramatic decrease in the labor supply of aged men during this period. Between 1947 and 1975, the annual labor force participation rate of men 65 and over decreased from 47.8 percent to 21.7 percent--a decrease of 55 percent. In terms of annual hours worked per capita for men 65 and over, there was a decrease from about 880 hours to 312 hours during this period--a decrease of 65 percent. The specific focus of the analysis will be on the relative importance of social security in explaining this decrease in labor supply.

The empirical analysis presented in this paper differs in two respects from most of the previous empirical research on the effect of social security on the labor supply of the aged. First, the measure of labor supply used is hours worked by aged men. Previous time series and international cross-section analyses have used the labor force participation rate of the aged. Due to data limitations on hours worked, most of the household cross-section studies, with one exception (Pellechio, 1978b), use arbitrary definitions of the work state and the retirement state and then investigate the effect of social security in inducing individuals to move from the work state to the retirement state.[3/] The use of hours worked as the measure of labor supply of the aged is superior to these other measures of labor supply because it not only allows for withdrawal from the labor force, i.e.,

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3/ Two household cross-section studies (Kotlikoff, 1979 and Morgan, 1980) analyze the effect of social security on labor supply of the aged by estimating the effect of social security on the expected age of retirement.

reducing hours worked to zero, but also allows for various types of part-time work, i.e., reducing hours worked but not to zero. Second, most of the empirical analysis has generally focused on the wealth effect of the social security system, i.e., the existence of social security benefits may increase the individual's lifetime wealth and therefore induce him to reduce his labor supply especially in the later part of the life cycle when these benefits become available.[4/] The appropriate variable to measure the wealth effect of the social security system on labor supply is the difference between the present discounted value of expected benefits and the present discounted value of lifetime social security taxes. This difference can be referred to as the lifetime wealth increment (LWI) due to social security. With one exception (Kotlikoff, 1979), all the empirical studies investigating the effect of social security on the labor supply of the aged use either actual or potential social security benefits or gross social security wealth (GSSW), i.e., the present discounted value of expected benefits, to measure the wealth effect of social security. Unfortunately, the use of social security benefits or GSSW as a proxy for the lifetime wealth increment due to social security leads to ambiguity in the interpretation of the empirical results. First, since the size of an individual's social security benefits are, to a significant degree, determined by the individual's past earnings, social security benefits or GSSW may be serving as a proxy for the individual's past earnings. Thus, it becomes critical to take effective

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4/ The other important aspect of the social security system which can affect labor supply is the earnings test. Boskin (1977) and Kotlikoff (1979) attempt to indirectly estimate the effect of the earnings test on the retirement decision. Pellechio (1978b) attempts a direct estimate of the effects of the various parameters of the earnings test on the hours worked of the aged.

account of past earnings in any empirical analysis if one is to separate the influence of social security from the influence of past earnings on the labor supply decision of the aged. Second, the use of social security benefits (or GSSW) to explain labor supply decisions raises the question of causality. Most empirical analyses assume that cause and effect runs from social security to labor supply. In fact, cause and effect, to a substantial degree, may run in the opposite direction. It may well be that the growth of the social security system in the post-war period has been caused by an increasing desire on the part of individuals to retire or reduce their labor supply during the later part of the life cycle.[5/] Thus, a negative relationship between social security benefits and labor supply cannot be interpreted unambiguously.

A more powerful test (i.e., less ambiguous) of the social security wealth effect on labor supply is achieved when a variable representing the LWI due to social security is used in the empirical analysis. It is interesting to note, in this regard, that the only study (Kotlikoff, 1979) to employ such a measure found there was no significant relationship between the LWI due to social security and expected age of retirement. The empirical analysis presented in this paper employs a measure of the LWI to estimate the wealth effect of the social security system on the labor supply of aged men.

In section II, we briefly examine the effects of social security on labor supply in a simple two-period life cycle model. Section III contains a discussion of the specification of the labor supply equation to be estimated

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5/ For an excellent treatment of the social security system as an endogeneous rather than exogeneous system, see Hagens (1979).

and the definition and measurement of the variables employed. The estimated labor supply equations for aged men are presented in Section IV. In Section V the decline in the labor supply of aged men over the period 1947 to 1975 is analyzed. Section VI contains a brief summary and conclusions.

II. The Effects of Social Security on Labor Supply

The effects of the social security system on labor supply are analyzed within a simple two-period life cycle model. An individual is assumed to maximize the following lifetime utility function:

$$U = u(C_1, C_2, L_1, L_2) \qquad (1)$$

where C represents the goods consumed and L represents the leisure consumed in each period.

In the absence of social security, the individual's budget constraint, making several simplifying assumptions, can be written as [6/]

$$C_1 + rC_2 = W_1H_1 + rW_2H_2 \qquad (2)$$

where W is the wage rate, H is labor supply measured in hours and r is the discount factor (r = 1/1+i where i is the market rate of interest). The budget constraint simply states that lifetime consumption must equal lifetime earnings.

The introduction of a social security system will have its effect through the individual's budget constraint. The social security system has three features--a payroll tax, retirement benefits, and an earnings test--which can affect life cycle saving and labor supply decisions. For expository purposes, we first introduce the payroll tax and social

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6/ The simplifying assumptions are (1) the individual receives no inheritance and leaves no bequest and (2) the price of consumption goods is the same in each period and its value is arbitrarily set at one.

security benefits and analyze their impact on the individual's budget constraint. Following this we discuss the effect of the earnings test.

The social security system imposes a tax on all earnings (the payroll tax rate is t) and during the second period of his life the individual receives a social security benefit, B.[7/] Under these conditions, the individual's budget constraint becomes

$$C_1 + rC_2 = (1-t)W_1H_1 + r(1-t)W_2H_2 + rB \tag{3}$$

Equation (3) demonstrates that the payroll tax reduces the individual's lifetime resources while the social security benefit increases the individual's lifetime resources. Following Kotlikoff (1979), we define the lifetime wealth increment (LWI) due to social security as the present discounted value of expected lifetime benefits minus the present discounted value of lifetime payroll taxes:

$$LWI = rB - (tW_1H_1 + rtW_2H_2) \quad . \tag{4}$$

If the LWI equals zero, the individual's lifetime budget constraint is unchanged. Therefore, in the absence of capital market constraints, the social security system will not influence the individual's lifetime consumption and labor supply nor their time paths. A positive LWI indicates an increase in the individual's lifetime resources which should result in an increase in the consumption of both goods and leisure (assuming leisure is a normal good) in both periods. Thus, the life-cycle model predicts that a positive LWI will decrease the individual's labor supply during both the earlier part of the life cycle and the later part of the life cycle. The impact of the LWI on labor

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7/ In actuality, the payroll tax is a two-part tax. Both the employee and employer pay a tax at rate t on the employee's earnings up to some maximum earnings level. In our analysis, we assume that the tax applies to all earnings and is borne entirely by the employee. Benefits are loosely based on the amount of payroll taxes paid, but this relationship is not specified in our model.

supply can be referred to as the wealth effect of the social security system.

The above analysis states that if the LWI equals zero, then the social security system does not influence the individual's consumption and labor supply decisions. An important necessary condition for this result is that there be no capital market constraints, i.e., the individual can borrow against future social security benefits at the market rate of interest.[8/] If the individual cannot engage in such borrowing, then, even if the LWI equals zero, the social security system may alter the pattern of lifetime labor supply with no necessary change in total lifetime labor supply. Assume the individual has a desired time path of consumption and labor supply in the absence of social security. If the individual's expected social security benefit exceeds his desired level of dissaving during the later part of the life cycle, then, in the presence of capital market constraints, the individual can only maintain his desired time path of consumption by reducing his labor supply during the later part of the life cycle and increasing his labor supply during the early part of the life cycle. This effect of the social security system can be referred to as the intertemporal substitution effect of social security on labor supply. This analysis implies that increasing the social security benefit, in the presence of capital market constraints, can lead to a reduction in labor supply during the later part of the life cycle even if the LWI due to social security remains unchanged.

8/ Another necessary condition is that the social security system not affect the capital stock. In a pay-as-you-go system, such as in the United States, the system will be neutral with respect to the capital stock only if any decrease in saving (or increase in borrowing) on the part of the payroll taxpayers is completely offset by an increase in saving (or a decrease in borrowing or dissaving) on the part of social security benefit recipients. In a closed economy, if the capital stock is adversely affected by the system, then, over time, one expects the wage rate to fall and the interest rate to rise. Either of these events will alter the individual's budget constraint and affect his lifetime goods and leisure consumption.

We now introduce an earnings test and analyze its effect on the individual's budget constraint.[9/] During the second period of an individual's life (when he is eligible for his social security benefit), his earnings are subject not only to the payroll tax, t, but a portion of his earnings are also subject to an earnings tax at the rate e. The earnings tax applies after the individual's earnings exceed some exempt amount, E, and becomes nonoperational once it taxes away all social security benefits (at the earnings level E+B/e).[10/] Given the earnings test, the individual's budget constraint becomes

$$C_1 + rC_2 = (1-t)W_1H_1 + r(1-t)W_2H_2 + rB-rZ \tag{5}$$

where Z is the reduction in expected social security benefits as a result of the earnings test. The value of Z is defined as follows:

$$Z = \begin{cases} 0 & \text{if } W_2H_2 \leq E \\ e(W_2H_2-E) & \text{if } E<W_2H_2<E+B/e \\ B & \text{if } W_2H_2 \geq E+B/e \end{cases} \tag{6}$$

The introduction of the earnings test makes the individual's budget constraint non-linear. In figure 1 the line ABC represents the budget constraint the individual faces if there is no earnings test.[11/] When the

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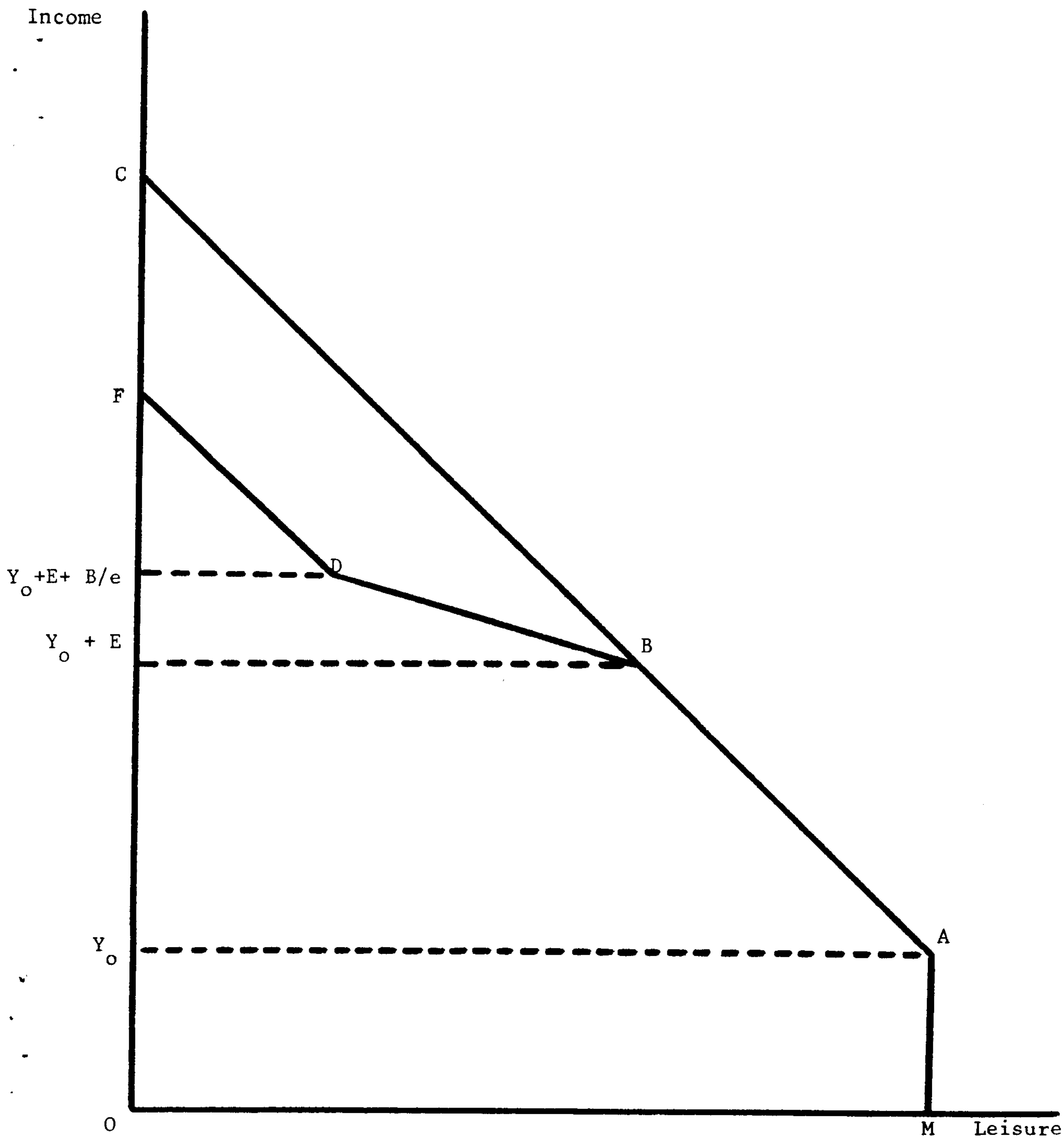
9/ For an excellent analysis of how an earnings test affects labor supply, see Hanoch and Honig (1978).

10/ The earnings test of the United States social security system is only in effect for eligible recipients between the ages of 62 and 71. Starting in 1982, the relevant ages will be 62 to 69. Thus the test will not tax away all expected benefits. Further, if benefits are foregone because of the earnings test, later benefits will be increased, although not actuarially for those over age 64. This increase will partially offset the loss in lifetime wealth caused by the earnings test.

11/ The distance AM represents the individual's unearned income including social security benefits in the second period. If the LWI as defined in equation 4 is equal to zero, then, with no capital market or capital stock effects, ABC represents the budget constraint the individual would face in the absence of a social security system. If the LWI is positive (negative), the budget constraint, in the absence of social security, would lie below (above) ABC.

Figure 1: The budget constraint with and without an earnings test.



earnings test is in effect, the budget constraint becomes ABDF. Those individuals on the AB segment of the nonlinear budget constraint, other than point B, will not be affected by the earnings test.[12/] Increases in the exempt amount or decreases in the earnings test tax rate will not affect their labor supply. Some individuals located at point B will increase their labor supply with increases in the exempt amount or decreases in the tax rate.

Individuals located on the BD segment of the budget constraint will have their social security benefits reduced by an amount Z $(0 \leq Z < B)$. Those located on the DF segment will lose all benefits (Z=B).[13/] Those individuals located on the BD or DF segments will find their lifetime wealth reduced because of the earnings test. The reduction in lifetime wealth will be greater or less than Z depending on how the individual adjusts his labor supply. If labor supply in the first period remains constant, then the reduction in lifetime wealth will be less than Z if he increases his labor supply in the second period and greater than Z if he reduces it. Reducing the earnings test tax rate will cause some individuals on the DF segment of the budget constraint to jump to the BD segment, decreasing their labor supply. Those on the BD segment will increase or decrease their labor supply depending on whether the substitution (price) effect or the wealth effect dominates.

12/ Individuals on the AB portion of the kinked budget constraint will not pay any earnings test taxes (Z=0). However, some of those at point B will have reduced their earnings from the BC portion of ABC to point B. Thus, while the earnings test does not reduce these individual's social security benefits, it does reduce their second period earnings and, hence, their lifetime wealth.

13/ See footnote 10.

With respect to changes in the exempt amount, an increase in the exempt amount may cause some individuals on the DF segment of the budget constraint to reduce their labor supply in the second period by jumping to the BD segment. For those originally on the BD segments, an increase in the exempt amount should act as a pure wealth increase and should cause a reduction in their second period labor supply. 14/

The above analysis assumes that first period labor supply is constant. If this constraint is relaxed then those individuals whose expected second period income (earnings plus social security benefits) is reduced because of the earnings test tax may shift some of their labor supply from the second period to the first period. When the constraints of an existing earnings test are relaxed via either a tax rate reduction or an exempt amount increase, the relative returns to work effort will shift in favor of the second period. Those individuals affected by the earnings test will shift some of their hours worked back to the second period. 15/ In summary, changes in either component of the earnings test have ambiguous effects on aggregate second period labor supply.

Having discussed the effects of social security on labor supply, we derive the second period labor supply equation by maximizing equation (1) subject to equation (5). The resulting labor supply function is

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14/ For some individuals, the increase in the exempt amount could cause them to move from a tangency on BD to a tangency at the new B. The increase in the exempt amount slides B up the BC portion of the budget constraint. These individuals and those at the original B may well increase their labor supply due to the increase in the exempt amount.

15/ The earnings test effectively reduces the return to second period work if earnings are above the exempt amount and this affects the relative returns to work between the first and second periods. First period work now earns a relatively greater return and affected individuals will substitute first period labor supply for second period labor supply. For an empirical analysis of this effect, see Burkhauser and Turner (1978).

$$H_2 = h_2(W_1, W_2, LWI, Z, r) \qquad (7)$$

where LWI is defined in equation (4), and Z in equation (6). Equation (7) states that hours worked in the second period will be a function of the wage rate in each period, the lifetime wealth increment due to social security, the earnings test, and the market rate of interest. Second period labor supply should unambiguously decrease with increases in the lifetime wealth increment, the market interest rate,16/ and the first period wage rate. The earnings test will have an ambiguous effect on second period labor as will the second period wage. An increase in the second period wage will increase potential lifetime earnings which leads to a decrease in hours worked in the second period (wealth effect). It also results in an increase in the price of second period leisure which should increase second period labor supply (price or substitution effect).

III. Labor Supply Equation for Aged Men

In order to estimate the effects of social security on the labor supply of aged men, we specify the following linear labor supply equation:

$$H_t = a+b_1W_t+b_2PW_t+b_3LWI_t+b_4E_t+b_5AGE_t+b_6RU_t+u$$

where H_t is annual hours worked per male 65 years of age and over in period t.

W_t is the average hourly wage rate (in 1972 dollars) in period t.

PW_t is an 18-year moving average of the average hourly wage rate (adjusted for the degree of unemployment) in period t.

LWI_t is the lifetime wealth increment (in 1972 dollars) due to social security per male 65 years of age and over in period t.

16/ Recall that $r = 1/(1+i)$ where i is the market rate of interest.

E_t is the annual amount of earnings (in 1972 dollars) not subject to the earnings test tax rate in period t.

AGE_t is the average age of men 65 years of age and over in period t.

RU_t is the unemployment rate for men 65 years of age and over in period t.

u is the error term.

We present here a brief description of each of the variables employed in the empirical analysis. For a more detailed discussion of the measurement and construction of each of these variables, the data sources used, and a complete listing of the data set, see the Appendix.

The measure of labor supply is annual hours worked (H). It is superior to the labor force participation rate as a measure of the labor supply of aged men since it allows for changes in labor supply other than complete withdrawal from the labor force.

The average hourly wage rate variable (W) is total compensation per manhour.[17/] It is an economy-wide variable and it can be argued that it overstates the wage available to aged men. However, if the wage rate available to aged men moves in the same direction and by the same relative magnitude as the economy-wide wage rate during the time period under analysis, then the economy-wide wage rate will serve as a proxy for the wage rate available to aged men. W serves as a proxy for both the current and expected future wage rate.

17/ The wage rate should be net of personal income taxes. One possibility is to construct a time series on the effective marginal income tax rate for a hypothetical male aged 65 and over making various assumptions about earnings, family size, etc. The alternative is to assume that the typical male 65 and over faces an effective marginal tax rate of zero. By not netting out income taxes, we have implicitly assumed the latter.

The past wage variable (PW) is an 18-year moving average of the average hourly wage rate (W) adjusted for the degree of unemployment in the economy. Since the wage rate (W) could only be constructed back to 1929 and since the period of our analysis begins in 1947, we maximize the information available on past wage rates by utilizing an 18-year average. This variable is meant to proxy the wage rate available to aged men during the earlier part of the life cycle. Since "availability" depends, to a large extent, on the degree of unemployment in the economy, the average hourly wage rate (W) is multiplied by one minus the economy-wide unemployment rate. This adjustment should be especially important for those aged men whose prime working years encompassed the depression of the 1930's.

The social security lifetime wealth increment (LWI) is the per capita discounted value of expected social security benefits less the value of all past and future payroll taxes for men 65 and over. Two different LWI variables are used in the empirical analysis. These variables differ only with respect to the estimated value of expected future social security benefits. The tax variable used is the same in each case. The two benefit variables are constructed using a social security wealth algorithm developed by Leimer and Lesnoy (1980). For those individuals who are retired, the expected benefit is estimated as the product of average earnings per worker and the expected benefit ratio, i.e., the ratio of the average social security benefit to average earnings per worker.[18/] The expected benefit is assumed to grow at 2 percent per year which is the assumed annual rate of growth in average earnings per worker. In constructing LWI1, expected benefits are calculated under

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18/ Those individuals over 65 and not yet retired are assumed to retire the following year and their benefit is computed in a similar fashion.

the assumption that individuals believe their expected benefit ratio equals the current benefit ratio. LWI2 is calculated under the assumption that individuals consider both past and current benefit ratios in calculating their expected benefit ratio. Specifically, it is assumed that individuals believe their expected benefit ratio will equal the average of the current year's actual benefit ratio and the previous year's expected benefit ratio.[19/] It should be noted that both of the social security lifetime wealth increment variables underestimate the true lifetime wealth increment because they do not include the accumulated value of benefits already received by men 65 years of age and over.[20/] This underestimate probably biases the regression coefficient of LWI toward zero.

The annual exempt amount (E) is the amount that can be earned annually with no reduction in social security benefits.[21/] Given the complexity of the social security earnings test especially during the early part of the time period under consideration, it is virtually impossible to construct a meaningful time series variable to capture its

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19/ LWI1 and LWI 2 were also constructed under the assumption that real benefits would remain constant after retirement rather than grow at an annual real rate of two percent. The empirical results using the LWI variables constructed with the assumption of no growth in real benefits were esentially the same as the results using the LWI variables discussed above and, therefore, for brevity are not presented in Table 1.

20/ For a more detailed discussion of the construction of the LWI variables used in the empirical analysis, see the Appendix. For a complete description of the Leimer-Lesnoy social security wealth algorithm, see Leimer and Lesnoy (1980).

21/ Up until 1978, the earnings test was based on monthly rather than annual earnings for employees. The monthly exempt amount was multiplied by 12 to obtain the annual exempt amount.

effect.[22/] Instead, we enter, in the estimated equations, E, the annual exempt amount. In essence, we disregard the effect of the earnings test tax rate on labor supply.[23/] Although this is unfortunate, there is evidence to suggest that the most important parameter of the earnings test is the exempt amount. Social security beneficiaries with earnings tend to cluster heavily near the exempt amount (e.g., Vroman, 1971). Since the effect of the exempt amount on labor supply depends upon the individual's position on the nonlinear budget constraint, the regression coefficient on E represents the net effect of the annual exempt amount on the aggregate labor supply of aged men.

The age variable (AGE) is entered in the estimated labor supply equation to capture the effect of the "aging" process on the labor supply decision of older men. The aging process reduces or eliminates the ability of the individual to perform certain work tasks or work at certain occupations. Also, the aging process may simply increase the individual's preference for leisure relative to work. The age variable used is the average age of men 65 years of age and over.

22/ For example, prior to 1955, an individual would lose one month's benefits if he earned $1 above the monthly exempt amount. Between 1955 and 1958, the individual would lose one month's benefits for each $80 (the monthly exempt amount) or fraction thereof. In the 1960's there was a two-tier system: for a certain amount of earnings above the exempt amount, the effective earnings test tax rate was 50 percent while for earnings above this certain amount the effective tax rate was 100 percent. Under these conditions, it is virtually impossible to construct a time series for the effective earnings test tax rate which in turn makes it virtually impossible to construct, in a reasonably direct manner, a time series for the earnings test.

23/ For an attempt to capture the joint effect of benefits, the exempt amount, and the earnings test tax rate on the number of social security beneficiaries over the time period 1958 to 1974, see Hambor (1978).

The unemployment rate (RU) for men 65 years of age and over enters the estimated labor supply equation because the dependent variable is actual hours worked. The appropriate dependent variable is "desired" hours of work rather than actual hours of work. The unemployment rate which reflects labor market conditions for aged men should serve to take account of this difference.

The labor supply equations for aged men are estimated using ordinary least squares. The data employed are annual U.S. time series data for the period 1947 to 1975. In interpreting the empirical results one should keep in mind that there is no measure of the growth of private and public pension wealth included in the estimated labor supply equations.[24/] It is possible that the past wage and/or LWI variables may also reflect the impact of private and public pensions on labor supply.

IV. Empirical Results

Table 1 presents the estimated labor supply equations for aged men.[25/] Equations (1) and (2) differ only with respect to the measure

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24/ Analogous to our discussion of the wealth effect of social security on labor supply, the appropriate variable, in a life cycle context, to measure the impact of private and public pensions on labor supply would be the lifetime wealth increment due to private and public pensions for men 65 years of age and over. The data for construction of such a variable are not readily available. We have not attempted to construct such a variable for the present analysis.

25/ The rather huge values of the constant term in Table 1 result from the units of measurement of the age variable (e.g., 72.33 years in 1947). If we use average age minus 72 as the age variable, then the value of the constant term is about 920.

Table 1.--Estimated Labor Supply Equations for Aged Men

Variable	Equation (1)	Equation (2)
W	298.95 (2.87)	220.08 (2.77)
PW	-338.48 (-2.70)	-223.22 (-2.14)
RU	-14.36 (-1.65)	-14.25 (-2.17)
AGE	-458.88 (-4.73)	-407.73 (-5.75)
E	0.0492 (1.63)	0.0591 (2.60)
LWI1	-0.0157 (-2.73)	
LWI2		-0.0221 (-4.91)
Constant	33967.0 (4.91)	30276.7 (5.97)
$\bar{R}^2$	0.976	0.985
DW	1.33	1.36

The dependent variable is hours worked per male 65 years of age and over. The equation is estimated using annual data for the period 1947 to 1975. The variables W, PW, E, LWI1 and LWI2 are measured in 1972 dollars; RU is measured in percentage points and the variable AGE is measured in years.

"t" statistics are in parentheses.

of the lifetime wealth increment (LWI) due to social security.[26,27] A comparison of equations (1) and (2) indicates that the estimated coefficients with the exception of the coefficient on the unemployment rate, are somewhat sensitive to the measurement of the lifetime wealth increment due to social security (LWI). Using LWI2 instead of LWI1 reduces the estimated regression coefficients on the current wage rate (W) and the past wage (PW) by about 25 to 35 percent and increases the regression coefficient on the annual exempt amount (E) by about 20 percent. Also, the regression coefficient on LWI2 is about 40 percent greater than the coefficient on LWI1. Thus, substituting LWI2 for LWI1 increases the estimated effect of social security on labor supply and decreases the estimated effects of the current and past wage rates.[28]

26/ The estimated labor supply equations were initially estimated including a time trend. There were two reasons for including a time trend. First, it was included to correct for the bias resulting from the measurement of the LWI variable. Second, it was included to capture the effect of the significant growth in private and public pension wealth in the post-war period. In the estimated equations including the time trend, the regression coefficient on time was insignificant (t-values very close to zero). The inclusion of the time trend reduced the size and significance of the regression coefficient on the annual exempt amount and generally increased the absolute value of the regression coefficients on the wage rate variables.

27/ The LWI variables used in the empirical analysis are constructed using the Leimer-Lesnoy social security wealth algorithm. Leimer and Lesnoy have also replicated the social security wealth algorithm of Martin Feldstein (1974). LWI variables constructed using the Feldstein algorithm were substituted for those constructed using the Leimer-Lesnoy algorithm in the estimated labor supply equations. The empirical results, with one noteworthy exception, were basically unaffected by the substitution. The one exception is the LWI variables. The regression coefficients of the LWI variables constructed using the Feldstein algorithm were about one-half the size of the regression coefficients of the LWI variables constructed using the Leimer-Lesnoy algorithm. For a discussion of the basic differences between the Leimer-Lesnoy algorithm and the Feldstein algorithm, see Leimer and Lesnoy (1980).

28/ We have no ready explanation for why the substitution of LWI2 for LWI1 in the estimated labor supply equations changes the coefficients on W, PW, and E other than the obvious explanation that the intercorrelation pattern between LWI2 and the other independent variables is different than that with LWI1.

In order to compare the sensitivity of the labor supply of aged men to a given change in the independent variables, elasticities at the mean were calculated (Table 2). Looking at the elasticities at the mean, it appears that the labor supply decision of aged men is most sensitive to the aging process. The age elasticity of 51 to 57 is about 30 times greater than the current wage elasticity (1.35 to 1.84), the next highest elasticity. The current wage, the past wage, and the lifetime wealth increment due to social security also appear to exert a significant influence on the labor supply decision of aged men. However, whereas the current and past wage elasticities are of a similar order of magnitude (e.g., 1.84 and -1.51, respectively, in equation (1)), the LWI elasticity is substantially less than either wage elasticity (5 to 6 times less in equation (1) and 2 to 3 times less in equation (2)). In evaluating the relative impact of LWI on the labor supply decision of aged men, one should keep in mind that, as stated earlier, the estimated regression coefficient on LWI is probably biased toward zero, i.e., it likely understates the negative impact of LWI on the labor supply of aged men.

The empirical results of the estimated labor supply equations suggest that the labor supply decision of aged men is most responsive to the aging process. The current wage rate exerts a substantial positive effect on labor supply and past wages, as expected, exert a sizable negative effect. The wealth effect of social security on the labor supply of aged men is negative and sizable. The significant postive regression coefficient on the annual exempt amount suggests that an increase in

Table 2.--Elasticities at the Mean

Variable	Equation (1)	Equation (2)
W	1.84	1.35
PW	-1.51	-1.00
RU	-0.09	-0.09
AGE	-57.38	-50.99
E	0.12	0.15
LWI1	-0.30	
LWI2		-0.42

this variable has a positive effect on the aggregate labor supply of aged men. However, the calculated elasticities at the mean suggests a relatively small effect. The unemployment rate has the expected negative effect on hours worked.

V. The Decline in the Labor Supply of Aged Men

Having analyzed the responsiveness of the labor supply of aged men to the individual variables in the labor supply model, we now turn our attention to the relative importance of social security in explaining the actual decline in the labor supply of aged men over the period 1947 to 1975. Annual hours worked per male 65 years of age and over declined from 880 hours in 1947 to 312 hours in 1975--a decrease of 568 hours. In order to assess the relative importance of each labor supply determinant over the period 1947 to 1975, we multiply the estimated regression coefficient of each independent variable by the actual change in that variable over the period and obtain an estimate of the change in labor supply resulting from the change in each independent variable. These estimates are presented in Table 3.

Since we are concerned with explaining the substantial decline in the labor supply of aged men over the period 1947 to 1975, we focus our attention on those variables which have a negative impact on labor supply. Comparing the implied changes in labor supply presented in Columns 4 and 5 of Table 3, it is clear that the most important factors explaining the decline in the labor supply of aged men over the period 1947 to 1975 are the growth in past wages, the growth in the lifetime wealth increment due to social security, and the aging process. In

Table 3.--Implied Change in Labor Supply of Aged Men Resulting from Change in Independent Variables over the Period 1947 to 1975

Variable	(1) Change in Variable 1947-1975	(2) Regression Coefficient	(3)	(4) Change in Labor Supply	(5)
		Equation 1	Equation 2	Equation 1	Equation 2
W	$2.58	298.95	220.08	771	568
PW	$2.25	-338.48	-223.22	-762	-502
RU	2.6	-14.36	-14.25	-37	-37
AGE	0.81	-458.88	-407.73	-372	-330
E	$1,653	0.0492	0.0591	81	98
LWI1	$18,952	-0.0157		-298	
LWI2	$17,820		-0.0221		-394

equation (1), the implied reduction in labor supply due to past wage growth is two and one-half times larger than the implied reduction in labor supply due to the growth in the lifetime wealth increment and two times greater than the implied reduction in labor supply due to the aging process. Making this same comparison using equation (2) results in the past wage effect being only about 25 percent greater than the LWI effect and only about 50 percent greater than the aging effect. One might be tempted by these findings to conclude that past wage growth was relatively more important than either the growth in the social security lifetime wealth increment or the aging process in explaining the decline in the labor supply of aged men over the period 1947 to 1974. Two factors mitigate against this conclusion. First, as stated earlier, the regression coefficient on LWI is probably biased toward zero, i.e., it likely understates the negative impact of LWI on labor supply. Also, the change in LWI over the period 1947 to 1975 is understated.[29/] Since the implied reduction in labor supply is the product of the regression coefficient on LWI and the change in LWI, the implied reduction in labor supply due to LWI may be substantially underestimated. Second, the implied reduction in labor supply due to each variable is clearly sensitive to the measure of LWI employed in the empirical analysis. Given these factors, we believe that the appropriate conclusion to infer from the evidence is that past wage

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29/ The difference in our LWI measure and the true LWI value is caused by our inability to measure social security benefits already received. Since the social security system was maturing over the 1947 to 1975 period, the value of benefits received but not measured was growing over this period. Thus our measured change in LWI understates the true change.

growth, the wealth effect of social security and the aging process probably had quantitatively similar effects on the decline in the labor supply of aged men over the period 1947 to 1975. 30/

It is interesting to note that although our analysis of elasticities at the mean suggested that the labor supply decision of aged men is most responsive to the aging process, the aging process was not the primary reason for the decline of the labor supply of aged men over the period 1947 to 1975. The explanation for this is simply that the age variable we used to capture the effect of the aging process (the average age of men 65 years of age and over) only increased 0.81 years, from 72.3 years to 73.1 years over the period 1947 to 1975.

VI. Summary and Conclusions

This paper has investigated the effect of social security on the labor supply of aged men within the context of a life cycle model of labor supply. The empirical results are consistent with the hypothesis that social security has a substantial negative effect on the labor supply of aged men. Our analysis further indicates that the three major factors accounting for the substantial decline in the labor supply of aged men over the period 1947 to 1975 were the growth in the real wage rate of the elderly during the earlier part of the life cycle, the

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30/ If the labor supply equations are estimated using the labor force participation rate of men 65 and over (LFPR) as the dependent variable, the empirical results are somewhat different than those reported above. The elasticities at the mean for W, PW and AGE are essentially unchanged. However, the regression coefficients on both RU and E are substantially reduced and statistically insignificant. The elasticities at the mean for LWI1 and LWI2 are reduced about 35 percent. Most importantly, the implied reduction in labor supply due to LWI is only about 35 to 40% of that estimated when hours worked (H) is used as the dependent variable rather than LFPR. This result could be the major reason explaining the conclusion reached by Brown (1979) that the growth in past wages had about twice the effect on the labor supply of aged men as did the growth in retirement income of which social security is a major portion. Brown used the LFPR as the dependent variable in her empirical analysis.

growth in social security wealth (as measured by the lifetime wealth increment due to social security), and the "aging" of aged males. These conclusions must be considered tentative rather than definitive given the well-known sensitivity of parameter estimates using time series data to equation specification, variable measurement, and the sample period used.

With respect to the future, the negative impact of social security on the labor supply of the aged should diminish since as the system matures the lifetime wealth increment should decrease. On the other hand, the aging process may play an even bigger role in the future than it has in the past. If the average age of the aged increases, then given our empirical results which suggest that the labor supply decision is extremely sensitive to the aging process, one can expect the aging process to have a substantial negative impact on the labor supply of the aged. It should be kept in mind that the age variable used in the empirical analysis probably captures a complex interaction among aging, preferences, and health status. For a given level of health, one would expect the aging process to reduce labor supply. For a given age, however, one would expect improvements in health status to increase labor supply. Thus, in the future, improvements in the health status of the aged could partially offset the negative effect of the aging process on labor supply.

If increasing the labor supply of the aged is desireable as many observers are currently suggesting, then our analysis does suggest ways in which the negative effect of the social security system on the labor supply of the aged can be reduced. First, reducing real social security benefits relative to taxes paid will increase the labor supply of the aged. Alternatively, increasing the annual exempt amount will increase the labor supply of the aged. Although the labor supply of the aged may not be highly responsive to small changes in the exempt amount, it may respond substantially to large changes in the exempt amount. The empirical results indicate that doubling the exempt amount in 1975 ($1,994 in 1972 dollars) would increase annual hours worked per male 65 years of age and over by 98 to 118 hours.[31/] This would represent an increase of about 30 to 40 percent in annual hours worked (annual hours worked per male 65 years of age and over in 1975 was 312 hours). The increase in the aggregate labor supply of aged men in 1975 would be about 900 million to 1,083 million hours.

One final point can be made with respect to the controversy over the effect of social security on personal saving. The empirical results presented in this paper suggest that the retirement effect of social security was substantial over the period 1947 to 1975. This substantial retirement effect could have offset the asset substitution effect of social security and could account for the fact that the time series evidence has shown no significant negative effect of social security on private saving.[32/]

31/ The estimates differ according to which parameter estimate of the annual exempt amount is used in the calculation.

32/ For the latest contribution to the time series analysis of the effect of social security on private saving, see Leimer and Lesnoy (1980). Their extensive analysis of the time series data indicates no statistically significant effect of social security on private saving.

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Appendix

This appendix discusses the measurement and the data sources for each variable used in the empirical analysis. At the end of the appendix a listing of the data set is provided (Table A-1).

Hours Worked (H)

The hours worked variable is average annual hours worked per male 65 years of age and over. Annual data for the period 1947-1975 on total hours worked per week in the economy is taken from Edward F. Denison, Accounting for Slower Economic Growth, The Brookings Institution, 1979, Table 2-1, Col. 9, p. 8. Total hours worked per week is multiplied by 52 to obtain total annual hours worked in the economy. In order to obtain the percent of total annual hours worked by men 65 and over, annual data on the distribution of total hours worked in the non-residential business sector by sex and age is employed. This data is primarily from Edward F. Denison, Accounting for Slower Economic Growth, Table 3-6, p. 34. Data for 1947, 1949-52, and 1954-1960 are taken from Edward F. Denison, Accounting for United States Economic Growth 1929-1969, The Brookings Institution, 1974, Table F-5, p. 191. It should be noted that the distribution of total hours worked is for the nonresidential business sector.

Total annual hours worked in the economy is multiplied by the percent of total hours worked in the nonresidential business sector by men 65 and over. The resulting series, total annual hours worked by men 65 and over, is then divided by the male population 65 and over to obtain average annual hours worked per male 65 years of age and over. Data on the male population 65 years of age and over is taken from Current Population Reports, Series

P-25, No. 311, Table 1, pp. 4-29, July 1965; No. 519, Table 1, pp. 15-25, Aptil 1974; and No. 721, Table 1, p. 9, April 1978.

Hourly Wage Rate (W)

The wage rate variable is the real hourly wage rate. It is constructed for the period 1929 to 1975. It is basically total compensation per man-hour worked. Total compensation is equal to the compensation of employees (Table 6.5 in The National Income and Product Accounts of the United States, 1929-74, Statistical Tables, BEA, U.S. Department of Commerce, 1977) plus the compensation or earnings of proprietors.[1/] Proprietors' earnings in any year are assumed to be the same percentage of proprietors' income as the compensation of employees is a percent of compensation of employees plus corporate profits. The series used to make these calculations are proprietors' income with inventory valuation and capital consumption adjustments and corporate profits before tax with inventory valuation and capital consumption adjustments (Table 1.13 of the NIPA of the U.S. 1929-74). Total compensation is then divided by total annual hours worked in the economy (Denison) to obtain the money wage rate. Prior to 1947, the Denison data on total hours worked in the economy only has observations available for 1929, 1940, and 1941. The missing observations were interpolated using Kendrick's index of manhours for the national economy, 1929-1966. See John Kendrick, Postwar Productivity Trends in the United States, New York: National Bureau of Economic Research, 1973, Table A-17, pp. 236-37. The hourly wage rate is then converted into 1972 dollars using the GNP personal consumption expenditure deflator (Table 7.1 of the NIPA of the United States, 1929-74).

1/ For all data taken from the NIPA, the 1973, 1974, and 1975 estimates are the latest revised estimates which appear in the July issues of the Survey of Current Business.

Past Wage Rate (PW)

The past wage rate variable is simply an 18-year moving average of the average hourly wage rate multiplied by one minus the economy-wide unemployment rate. The economy-wide unemployment rate is taken from Historical Statistics of the United States: Colonial Times to 1970 for the years 1929-1970 and the Handbook of Labor Statistics, 1977 for the years 1971-1975. The value of the past wage rate variable in period t is the simple average of the adjusted wage rate variable over the period t-1 to t-18.

Unemployment Rate (RU)

The unemployment rate variable is the unemployment rate for men 65 years of age and over. It is taken from the Handbook of Labor Statistics, 1978, Table 58, pp. 178-179.

The Age Variable (AGE)

The variable used to represent the "aging" of the aged male population is average age of men 65 years of age and over. It was computed using data on the male population 65 years of age and older which is taken from Current Population Reports, Series P-25, No. 311, Table 1, pp. 4-29, July 1965; No. 519, Table 1, pp. 15-25, April 1974; and No. 721, Table 1, p. 9, April 1978. The average age of aged males is computed by assuming that all men between the ages of 65 and 69 are 67 years old, all those between 70 and 74 are 72, those between 75 and 79 are 77, and those 80 and over are 85. Multiplying the number of men in each age cell by the median age of that cell, summing across cells, and then dividing by the number of men 65 and over gives the average age.

Annual Exempt Amount (E)

The annual exempt amount is calculated by taking the amount of monthly wages permitted without any reduction in benefits and simply summing these amounts over each calendar year. The annual exempt amount is then converted into 1972 dollars by using the GNP personal consumption expenditure deflator. The amount of monthly wages permitted without any reduction in benefits is taken from p. 26 of the 1976 Annual Statistical Supplement of the Social Security Bulletin.

Lifetime Wealth Increment (LWI)

Two different LWI variables for men 65 and older are used in the empirical analysis. These variables are constructed from social security wealth and tax variables developed and calculated by Leimer and Lesnoy. Our estimates of the LWI's were constructed by subtracting the Leimer-Lesnoy estimate of past and future social security taxes for men 65 and older from two of their estimates of gross social security wealth for this same group of men.[2/]

In order to obtain their gross social security wealth series for the U.S. population, Leimer and Lesnoy summed social security wealth series for thirteen groups within the population. The series for six of these groups were used to construct the gross social security wealth series for men aged 65 and older. In addition to working and retired aged men, these six groups include the dependent wives of these men. Thus, the gross social security wealth of men aged 65 and older includes the future benefits of their dependent wives.

2/ The gross social security wealth and future payroll tax series for men age 65 and older are available from Leimer and Lesnoy on request. Their series of accumulated payroll taxes for men 65 and older is preliminary.

For those individuals who are receiving benefits, the benefit expected in a current year[3/] is estimated as the product of anticipated covered earnings per worker and the expected benefit ratio.[4/] The expected benefit is expected to grow at 2 percent per year, the assumed annual growth rate of covered earnings per work. The expected benefit in any future year is weighted by the appropriate survivial probabilities. In addition, for a dependent wife the expected benefit in any year is weighted by an adjustment factor since, as a dependent wife or widow, she receives only a fraction of her husband's benefit. Expected future benefits are then discounted to the current year at a 3 percent real interest rate. This gives the present discounted value of a representative individual's expected stream of social security benefits. Such a discounted stream of benefits is calculated for a representative individual at each relevant age within each of the six groups. These values were then weighted by an estimate of the number of individuals at each age and summed across ages and groups to get the gross social security wealth for men 65 and older. These calculations were made for the period 1937-1975.

Differences in the Leimer-Lesnoy gross social security wealth series arise solely because of differences in the expected benefit ratio. The gross social security wealth series used in constructing LWI1 was calculated on the assumption that the expected benefit ratio in all future years equaled the actual benefit ratio in the current year. The expected

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3/ Current year refers to the year for which benefits are being computed. It does not refer to 1980.

4/ Eligible individuals who are not currently receiving benefits are assumed to commence receipt in the next calendar year.

benefit ratio used for the LWI2 variable was an adaptive expectation type ratio. The expected benefit ratio in future years was assumed to be equal to the average of the actual benefit ratio in the current year and the expected benefit ratio for the previous year.

The value of expected future payroll taxes were computed on the assumption that all aged male workers stop working at the end of the current calendar year. Thus, future payroll taxes equaled the current year's payroll taxes for this group. The accumulated value of past payroll taxes was estimated using the .1 percent Continuous Work History Sample (CWHS). Leimer and Lesnoy used the CWHS to estimate the average payroll taxes paid by a representative male of every age from 1937 to 1975. The accumulated payroll taxes of a representaitve individual at any age over 65 in the current year were computed by accumulating at a 3 percent per year real interest rate the average taxes he paid between 1937 and the current year. The accumulated taxes paid by the representative male were then weighted by the estimated number of eligible males his age and summed across the 65 and older age range. For each year between 1937 and 1975, the value of future payrol taxes and accumulated past taxes were summed to obtain the total payroll tax series.

LWI1 and LWI2 were estimated by subtracting this payroll tax series from the two gross social security wealth series and dividing by the number of men 65 and older. The difference in these two series resulted solely from the different expected benefit ratios used in the gross social security wealth series. The tax series used was the same for both lifetime wealth increments.

As mentioned in the text the social security lifetime wealth increment as measured is understated. The true lifetime wealth increment should also include a term for the accumulated value of social security benefits already received. That is, the true lifetime wealth increment should measure the accumulated value of past benefits plus the discounted value of expected benefits less the accumulated value of payroll taxes paid and the discounted value of those expected to be paid. It is difficult to estimate how much our LWI variables underestimate the true lifetime wealth increment values.

Table A-1.--Data Used in Regression Analysis

Year	H	W	PW	RU	AGE	E	LWI1	LWI2
1947	880	2.34	1.56	2.8	72.33	341	1662	1826
1948	851	2.40	1.60	3.4	72.38	322	1707	1873
1949	821	2.45	1.65	5.1	72.43	323	1875	1957
1950	807	2.53	1.71	4.8	72.46	563	3185	2677
1951	837	2.60	1.79	3.5	72.48	992	4046	3917
1952	813	2.69	1.87	3.0	72.50	1454	5766	5188
1953	799	2.76	1.95	2.4	72.53	1426	6230	5915
1954	746	2.83	2.03	4.4	72.56	1415	7415	6806
1955	719	2.93	2.10	4.0	72.61	1495	8270	7827
1956	719	3.05	2.18	3.5	72.65	1466	9602	9580
1957	656	3.14	2.27	3.4	72.68	1420	10276	10329
1958	588	3.24	2.36	5.2	72.69	1389	10604	10517
1959	564	3.30	2.44	4.8	72.73	1705	11611	11278
1960	542	3.38	2.52	4.2	72.75	1674	11726	11622
1961	504	3.46	2.59	5.5	72.81	1655	12470	12437
1962	510	3.56	2.65	4.9	72.86	1630	13054	13276
1963	474	3.65	2.72	4.5	72.91	1606	13033	13265
1964	464	3.78	2.79	4.0	72.97	1585	12899	13284
1965	469	3.88	2.86	3.5	73.02	1556	13691	13588
1966	457	4.03	2.94	3.1	73.06	1892	13266	13607
1967	467	4.16	3.03	2.8	73.11	1845	12792	13298
1968	478	4.30	3.12	2.9	73.14	1986	14404	13921
1969	472	4.42	3.22	2.2	73.17	1898	13659	13809
1970	444	4.57	3.31	3.3	73.20	1816	15708	14646
1971	427	4.69	3.41	3.4	73.21	1739	16869	15646
1972	384	4.87	3.50	3.6	73.19	1680	20705	18492
1973	347	5.02	3.61	3.0	73.17	1991	20326	19762
1974	338	4.90	3.72	3.3	73.15	2053	20576	19568
1975	312	4.93	3.82	5.4	73.14	1994	20614	19647

H is rounded to nearest hour.
W and PW are rounded to nearest penny.
E, LWI1, and LWI2 are rounded to nearest dollar.
All dollar amounts are in 1972 dollars.