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SOCIAL SECURITY AND RETIREMENT: EVIDENCE FROM THE CANADA TIME SERIES

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Summary

This study examines whether social security influences the aggregate retirement rate in Canada. The life-cycle model of individual behavior provides the foundation for this study. The model indicates how social security can affect an individual's decision to retire. Further, the model is used to specify the variable that measures this effect. This variable is social security wealth which equals the present value of the social security benefits to which an individual is entitled. The model for individual retirement decisions is used to construct a model for the aggregate retirement rate.

Time series data from Canada include a measure of social security wealth that matches the specification given by the life-cycle model. The estimate of the model yields evidence that social security induces retirement. An increase in social security wealth of approximately $2300 per capita measured in 1971 dollars has been estimated to raise the retirement rate by 5 to 6 points. The effect of the creation of the Canada and Quebec Pension Plan was to raise the retirement rate by 1.5 points in 1967.

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Social security is a major source of income support for retirement in Canada; the program paid benefits of approximately $4.5 billion in 1975. These benefits are provided through a combination of three programs that make up the social security system. These programs are[1]:

(1) Old Age Security, a universal program with a benefit paid to all who reach age 65;

(2) Canada and Quebec Pension Plan, a social insurance plan with earnings-related benefits to those who contributed during their working lives;

(3) Guaranteed Income Supplement, a social welfare plan with benefits subject to an income test.

The provision of a pension as a right under Old Age Security is based on the assumption that people retire because of poor health or because they are forced out of their jobs and pension benefits compensate, in part, for the concomitant reduction in earnings. This assumption implies that social security should have little or no effect on retirement. The purpose of this study is to examine whether this view is correct.

Static labor supply theory holds that a person retires when his market wage is less than the value of his time in nonmarket activity.[2] Theoretical work on life-cycle labor supply[3] has generalized this static condition. The generalization is due to the dynamic nature of the life-cycle model, which uses the path that a person's wage follows, his subjective rate of discounting, and the market rate of interest. Social security can have additional economic effects on the retirement decision in the life-cycle model. Section I discusses in more detail how social security can influence retirement using the life-cycle model.[4]

The main implication of the theoretical discussion is that a social security variable (derived from the lifetime budget constraint) be included in an econometric analysis of the retirement decision. The standard model of labor force participation is used to construct a model for the aggregate retirement rate; this model includes the variable that measures social security's effect on retirement. The development of the model and a framework for evaluating how economic variables may influence retirement are given in section II.

The time series data used in this study come from the Economic Council of Canada. The data include an estimate of the value of the social security benefits that individuals are entitled to receive. Benefits are evaluated in a way that matches the specification of the variable derived in the theoretical discussion for measuring social security's effect on retirement. The data and empirical specification of the model are given in section III. This section also discusses how a consistent estimate of the model is obtained. The estimate of the model for the aggregate retirement rate is given in section IV. The study is summarized and concluded in section V.

I. The Life-Cycle Model and Social Security

The effect of social security on retirement will be discussed using the model of life-cycle behavior. In the absence of social security, an individual chooses a path of lifetime consumption and labor supply by maximizing lifetime utility subject to the following constraint:

$$(1) \qquad \sum_{t=1}^{T} c_t D_t = \sum_{t=1}^{R-1} w_t \ell_t D_t$$

where T = years in an individual's life

c_t = consumption expenditures in year t

ℓ_t = labor supply in year t

R = year of retirement, ($\ell_R = \ell_{R+1} = \ldots = \ell_T = 0$)

w_t = wage rate in year t

D_t = discount factor from year t to whatever year defines present value

This simply says that the present value of total lifetime consumption must equal the present value of total lifetime earnings.

Social security lowers a person's earnings over his working life by collecting contributions, and raises his income during retirement by paying benefits. The budget constraint becomes:

(2) $$\sum_{t=1}^{T} c_t D_t = \sum_{t=1}^{R-1} (1-p_t) w_t \ell_t D_t + \sum_{t=R}^{T} b_t D_t$$

where p_t = contribution rate in year t

b_t = social security benefit payments in year t .

The second term on the right-hand side of eq. (2) will be called "social security wealth" and denoted SSW. It represents the actuarial present value of social security benefits to which an individual is entitled (the survival probabilities that make it an actuarial calcualtion are included in D_t). If SSW equals the present value of contributions then

(3) $$\sum_{t=1}^{R-1} p_t w_t \ell_t D_t = SSW .$$

In this case, eq. (2) is equivalent to eq. (1) and there is no change in individual behavior. However, if SSW exceeds the present value of contributions, social security has raised a person's lifetime income. The life-cycle model predicts a potential decrease in labor supply on the usual assumption that leisure is a normal good. This decrease could occur as a reduction in labor supply (ℓ_t) in all years of a person's life or in the number of years of work (R-1). It may be harder to do the former because employers offer jobs only at standard hours of work. This is a reasonable observation, but only suggests that early retirement is the feasible alternative. This paper will not examine labor market constraints or arrangements between the firm and employee to reduce hours of work. The main point here is that the lifetime income effect can cause early retirement.

Barro's (1974) theory of life-cycle behavior with bequests implies that there is no lifetime income effect. Intergenerational transfers cancel any change in lifetime income imposed by social security. The data used in this study permit a good calculation of how social security affects an individual over his own lifetime. However, there is little information on transfers suitable for this study. Consequently, this paper does not address the Barro thesis on theoretical grounds by incorporating bequests because this cannot be carried through in the empirical analysis. However, Barro's argument depends on the assumption that lifetime labor supply is fixed. This paper examines that assumption. Evidence that social security influences retirement at least challenges Barro's conclusion that social security has no effect on other economic behavior.

Another effect of social security comes from the influence of an additional year of earnings on an individual's basic benefit. This influence arises because his benefit is computed from an average of his annual earnings. To see this effect consider the change in the budget constraint when a person works in year R instead of retiring:

(4) $$\sum_{t=1}^{T} c_t D_t = \sum_{t=1}^{R} (1-p_t)w_t \ell_t D_t + SSW - b_R D_R + \sum_{r=R+1}^{T} (b_t'-b_t)D_t$$

where b_t' = the benefit obtained in year t by adding another year of earnings in the benefit calculation.

Benefits in year R are forgone as shown by substracting b_R from SSW. However, earnings in year R may raise benefit payments in the future. Whether another year of work is worth it with respect to social security is decided by comparing the forgone benefit payment with the present value of the increase in future payments. Thus, earnings are not the only compensation for market work. There may be additional compensation from an earnings-induced increase in the basic benefit. Like the direct monetary compensation of wage payments, the increase in future benefits can have a price effect on behavior.

The main point of this section is that social security has two potential effects on retirement: a lifetime income effect measured through SSW, and a price effect arising from an earnings-induced increase in benefits. The time series data used in this study provide a good measure of SSW. However, it is not clear how to measure the price effect or whether it can be measured in time series data. The price effect is probably best examined in a cross-section dataset in which an accurate observation on individual wage rates is given. In this study, the coefficient for wages will incorporate the effect of additional compensation for market work coming through social security. The retirement model that will be developed in the next section will include SSW for the purpose of testing the hypothesis that social security affects retirement.

II. The Retirement Model

The analysis of labor force participation by Clark and Summers (1978) is used to construct an econometric model for estimating the effect of social security on retirement. The theory underlying the model assumes that individuals maximize an intertemporal utility function of the form:

$$(5) \qquad U = U(c_1, \ldots, c_T, \ell_1, \ldots, \ell_T)$$

subject to the budget constraint given by eq. (2). Since the focus of attention is on retirement decisions the analysis does not rely heavily on first-order conditions for the maximization of eq. (5) subject to eq. (2). As a result, a more concise expression for the utility function than eq. (5) can be adopted:

$$(6) \qquad U = U(c_{t-1}, c_t, c_{t+1}, \ell_{t-1}, \ell_t, \ell_{t+1})$$

where the period t-1 now summarizes the past up to year t and t+1, the future after year t.

An individual's retirement decision depends on the minimum wage at which he will participate in the labor force. This minimum wage is his reservation wage, s, given by U_{ℓ_t}/U_{c_t}. In other words, s equals the rate at which the individual trades leisure for market goods. The hypothesis in this study is that s depends on social security wealth, SSW, as well as other variables that usually affect reservation wage. These other variables are past employment, future wages and prices, and tastes. The shadow price relationship is given in the following general form:

$$(7) \qquad s = f(SSW_t, w_t^e, \pi_t^e, \ell_{t-1}, b)$$

where the superscript e denotes expected future values and the variable b measures unobserved determinants of shadow price like tastes or ability. An individual will retire when his shadow price of time exceeds his market wage, w_t. Thus, an individual's decision to retire is expressed formally as:

(8) $$w_t < s_t = f(SSW_t, w_t^e, \pi_t^e, \ell_{t-1}, b)$$

The aggregate retirement rate is derived from the preceding model for the individual. In general, individuals face different wages and have different employment experiences, expectations and tastes. As a result, market and reservation wages have a joint distribution; g(w, s), in the population. The aggregate retirement rate, R, is given as follows:

(9) $$R = \iint_{w<s} g(w, s)\, dwds$$

This equation implies that the retirement rate is a function of market wage and the variables that influence shadow price. A logarithmic functional form is assumed so that eq. (9) becomes:

(10) $$\ell n\ R = \beta_0 + \beta_1\ \ell n\ SSW_t + \beta_2\ \ell n\ w_t + \beta_3\ \ell n\ w_t^e + \beta_4\ \ell n\ \pi_t^e + \beta_5\ \ell n\ \ell_{t-1} + v_t$$

where v_t is a disturbance term.

It is useful at this point to consider the expected signs of the coefficients for the model. When SSW increases, the lifetime income of a larger segment of the population is likely to be increased by social security. As discussed in section I, the lifetime income effect works to reduce labor supply. Retirement is one way in which this reduction can take place. Consequently, β_1 is expected to be positive. The major purpose of this study is to examine whether ℓn SSW has a positive coefficient in eq. (10).

The expected signs of other coefficients depend on what view is taken about labor force participation in the life-cycle model. Two views of participation, which are discussed by Clark and Summers (1978), are relevant in this study. One view is the timing hypothesis which states that individuals substitute market work for nonmarket activity in response to transitory movements in real wages. As a result, individuals time their labor force activity so that they work more when wages are high and less when wages are low. This follows from separating life-cycle decision making into two steps. First, individuals determine how much total time they will spend in their lifetime based on their average wage. Also, they know that their wage will fluctuate around the average. Consequently, in the second step, they distribute their working time so that periods of high labor supply are timed with periods when wages are high. The timing hypothesis has been developed formally by Ghez and Becker (1974) who state it succinctly when they say: "In our analysis there is no income or wealth effect because all changes in wealth are perfectly foreseen. Hence, a rise in wage rates with age generates only substitution effects, and the supply curve of labor would be positively sloped." (p. 12).

The first, most obvious conclusion to draw from the timing hypothesis is that the retirement rate will be low when w_t is high. Hence β_2 is expected to be negative. The timing hypothesis also implies how the retirement rate should respond to w_t^e and π_t^e. If individuals expect future wages to be high relative to current wages they will work less in the current period. Therefore, R_t should increase when w_{t+1}^e is high so that the expected sign of β_3 is positive. The argument for a positive β_3 also implies that β_4 should be negative. This follows because future real wages will be lower when future prices are expected to be higher. Finally, employment experience should have no effect on current behavior according to the timing hypothesis. Any fluctuations in employment occur in response to transitory wage changes. Because these changes are transitory, employment will not be correlated between periods and hence β_5 should be zero.

The second view of labor force participation is the persistence hypothesis which emphasizes employment experience as a determinant of current participation. This view is based on recent econometric studies[5] of labor supply which posit that an individual's past labor force status can have an effect on current status. This effect is independent of influences exerted by economic variables like wages, prices, and wealth, or individual differences in behavior. This hypothesis, defined as state dependence in the econometrics literature, asserts that there is a real effect of occupying a certain state of economic activity on future behavior. As a result, individuals who have participated in the labor force will continue to do so, while those who have retired will stay in that state. The persistence hypothesis implies less movement between retirement and work in response to economic incentives than the timing hypothesis.

The persistence hypothesis suggests a pattern of coefficients in the model that differs from that given by the timing hypothesis. Both hypotheses predict that higher current wages will decrease the retirement rate. However, because those who are retired are likely to stay retired under the persistence hypothesis, the magnitude of the wage effect will be smaller. Also, this hypothesis holds that labor force status is correlated over time implying that individuals do not closely match their labor market activity with random fluctuations in wages. Consequently, future wages and prices will have a negligible impact on current retirement status so that β_3 and β_4 are expected to be close to zero. However, while the timing view predicts that β_5 is zero, the persistence hypothesis is given by the assertion that past experience influences current behavior so that β_5 should be nonzero. The sign of β_5 will follow from the definition of employment experience.

In this section a model has been developed for examining the economic determinants of the aggregate retirement rate. The effect of social security on retirement is the main focus of attention. This effect is measured through social security wealth which enters the model as an explanatory variable whose coefficient is expected to be positive. Two hypotheses of labor force activity provide a framework for evaluating the effect of other economic variables. The hypotheses of timing and persistence make different predictions about the coefficients of variables. When one hypothesis predicts that a coefficient should have a certain sign, the other predicts a zero or, at least, smaller coefficiently. Therefore, expectations are not completely indeterminate as a result of these different hypotheses. Empirical results from estimating the model will show whether expectations are borne out in observed behavior. Before this can be done the variables discussed in general in this section must be defined based on actual data. Also, an estimation technique must be adopted that solves econometric problems posed by the model. The next section is devoted to these tasks.

III. Specification and Estimation

Operational measures of the variables discussed in the last section must be developed before the retirement model can be estimated. The data base for estimation is time series data for Canada provided by the Economic Council.[6] The data give measures of social security wealth, labor force participation rates, wages and prices in the period 1946-1975. All monetary values are expressed in 1971 dollars in the empirical specification of the model.

In this study, SSW is defined to be the present value of Old Age Security (OAS) benefits to which individuals are entitled; this present value is divided by population to give a per capita measure of SSW. There are a few reasons for restricting attention to the OAS plan. One reason is that contributions from earnings are made only in the Canada and Quebec Pension Plan, CQPP. If CQPP satisfies eq. (3) (the present value of contributions equals the present value of benefits), then this plan does not contribute to the lifetime income effect of social security. For the population as a whole CQPP approximately satisfies eq. (3). Therefore, in a model for the aggregate retirement rate, it is not necessary to include CQPP benefits in SSW. Even so, lifetime income may be redistributed between individuals and this redistribution may influence the aggregate retirement rate. However, even for the individual, CQPP contributions balance benefit payments to some extent and this mitigates the lifetime income effect of CQPP. Another reason for excluding CQPP benefits from SSW is that including these benefits would pose problems for the measurement of SSW. Problems arise because CQPP became effective in 1966. As a result, the time series for the value of CQPP benefits is zero up to 1966 and then jumps to some nonzero value. Such a series essentially signals the creation of CQPP and adding it to SSW would only blur what SSW is supposed to measure. A binary variable, DCQPP, is added to the model to capture the effect of the creation of CQPP.[7] It could be argued that the public anticipated CQPP so that the present value of CQPP benefits becomes positive before 1966. However, the measurement of anticipated unlegislated benefits is not an objective in this study.

The reason for not including Guaranteed Income Supplement (GIS) benefits in SSW is that these benefits are inversely related to OAS and CQPP benefits and are earnings-tested. Thus, GIS benefits are a small component of social security intended for low earners. It is important to note that OAS accounted for approximately 80 percent of social security benefit payments in 1975. Conseqently, restricting SSW to OAS benefits is justified on practical grounds.

The wage variable, w_t, is the per capita wage. A regression of w_t on its values for the past three years is used to construct expected wages. The value of w_t predicted by this regression equals the expected wage variable, w_t^e. Adding the fourth lagged observation on wage or a time trend to the regression did not substantially change the final results.

The price expectations of the population in a given year are summarized by the inflation rate for that year. In other words, people's attitude about future prices are formed by price changes in the current year. The inflation rate observed at the end of the year summarizes the price expectations formed during the year. Thus, the rate of change in the consumer price index equals the expected price variable, π_t^e. An attempt was made, along the lines of what was done for wages, to calculate expected prices based on a regression for price changes. The fitted values of this regression never followed actual values well enough to justify using the regression for computing a price expectation variable.

The labor force participation rate is used to define both the retirement rate and the employment experience variable. The retirement rate, R, equals 100 minus the labor force participation rate for persons aged 65 and over. The definition of the employment experience variable, ℓ_{t-1}, is based on the assumption that employment experience is described, at least in part, by past participation rates. This is equivalent to saying that ℓ_{t-1} depends on past values of R because the participation and retirement rates differ by a constant. More specifically, ℓ_{t-1} is given by a distributed lag in R as follows:

$$(11) \qquad \ln \ell_{t-1} = \sum_{i=1}^{\infty} \lambda^i \ln R_{t-i} = \frac{\ln R_{t-1}}{1 - \lambda L}$$

where L is the lag operator. For the moment, let the other variables and their coefficients be summarized by $Z_t\beta$ so that the model can be written as:

(12) $$\ell n\ R_t = Z_t\beta + \beta_5 \frac{\ell n\ R_{t-1}}{1 - \lambda L} + v_t$$

Multiplying through by $1-\lambda L$ yields the following:

(13) $$\ell n\ R_t = Z_t\beta + Z_{t-1}(-\lambda\beta) + (\beta_5 + \lambda)\ \ell n\ R_{t-1} - v_t - \lambda v_{t-1}$$

Some implications for estimating the model follow from this tranformation. Lagged values of the independent variables must be included in the empirical estimation of the model. As a result, λ is estimated by the negative of the ratio of the lagged coefficient of a variable in Z to its current coefficient. Of course, λ is overidentified when Z contains more than one variable. An important feature of the transformation for estimation purposes is that the transformed error term is correlated with R_{t-1}. Consequently, ordinary least squares estimates of eq. (13) are inconsistent. A method for consistently estimating the model must be sought.

Before discussing consistent estimation, it is important to recognize the full source of potential correlation between R_{t-1} and the error term. There are two ways in which this correlation can occur. First, as mentioned above, the error term in the model to be estimated equals $v_t - \lambda v_{t-1}$ which is correlated with R_{t-1}. Second, the v's may be serially correlated independently of the transformation implied by eq. (11) and hence v_t is correlated with R_{t-1}. Therefore, either eq. (11) or serial correlation among the v's induces correlation between R_{t-1} and the error term.[8] There are techniques[9] for consistently estimating the model when the error term is serially correlated and the model includes a lagged dependent variable. These techniques require some assumption about the pattern of serial correlation. Johnston (1972) points out that these methods are computationally burdensome and "one would only embark on them if one felt very convinced about the specification of the disturbance term." For these reasons, these techniques are not employed here.

The method of two-stage least squares (TSLS) is used here for obtaining a consistent estimate of the model. Potential correlation between R_{t-1} and the error term from either source discussed above is eliminated by using instrumental variables for R_{t-1}. The model suggests what instruments to use; they are the twice-lagged values of the Z's. These instruments appear as explanatory variables in the equation for R_{t-1} and hence are correlated with R_{t-1}. Also, they are uncorrelated with the error term in the model by construction. Consequently, TSLS yields consistent estimates whether R_{t-1} is correlated with the error term because of eq. (13) or because the v's are serially correlated. The consistency of TSLS does not depend on a particular specification for serial correlation among the v's.

Two variables are added to the model to measure other factors that may influence the retirement rate. The unemployment rate, UR, is added to account for general market conditions. The model also includes a time trend, TIME, to control for a common trend component that may be present in both R and other right-hand side variables. This trend component could make a right-hand side variable appear to have a causal effect on R when no such effect is present.

Given the variables described in this section, the empirical specification of eq. (13) is:

$$(14) \quad \ell n\, R_t = \beta_0 + \beta_1\, \ell n\, SSW_t + \beta_1'\, DCQPP + \beta_2\, \ell n\, w_t$$

$$+ \beta_3\, \ell n\, w_t^e + \beta_4\, \ell n\, \pi_t^e + (\beta_5 + \lambda)\ \ell n\, R_{t-1}$$

$$+ \beta_6\, \ell n\, UR_t + \beta_7\, TIME - \lambda\beta_1\, \ell n\, SSW_{t-1}$$

$$- \lambda\beta_2\, \ell n\, w_{t-1} - \lambda\beta_3\, \ell n\, w_{t-1}^e - \lambda\beta_4\, \ell n\, \pi_{t-1}^e$$

$$- \lambda\beta_6\, \ell n\, UR_{t-1} + v_t - \lambda v_{t-1}$$

The focus of attention is on the estimates of β_1 and β_1' which measure the effect of social security on retirement.

IV. Empirical Results

This section presents the estimated model for the aggregate retirement rate. The estimate of the model obtained by two-stage least squares is given in Table 1. Of primary interest are the positive coefficient estimates for the variables measuring social security's effect on retirement - ℓn SSW and DCQPP. The measurement of these coefficients is the main focus of this study.

The signs of other coefficients conform with expectations but the estimates are generally imprecise, except for the price expectations variable. There are (at least) two reasons for not obtaining precise estimates. First, there is a loss of efficiency when two-stage least squares is used. In other words, there is a cost in terms of lost precision when the simplest way of getting consistent estimates is employed. The second reason is that the retirement rate for 65 year olds and over is being explained by economic variables measured for the entire population. Consequently, the economic effects of these variables on retirement are attenuated. In light of these reasons, the

Table 1

ESTIMATE OF THE MODEL FOR THE AGGREGATE RETIREMENT RATE+

Coefficient Estimates
(Standard Errors)

Variables	Coefficient Estimates (Standard Errors)
ℓn SSW	.594 (.373)
DCQPP	.248 (.199)
ℓn w	-.291 (.400)
ℓn w^e	.869 (1.03)
ℓn π^e	-.709 (.384)
* ℓn R_{-1}	.412 (.388)
ℓn UR	-.249 (.383)
TIME	.411 (.438)
ℓn SSW_{-1}	-.581 (.440)
ℓn w_{-1}	-.826 (1.02)
ℓn w^e_{-1}	.342 (.359)
ℓn π^e_{-1}	-.503 (.315)
ℓn UR_{-1}	.110 (.338)
CONSTANT	1.66 (1.62)
R^2	.992

Footnotes to Table 1

+ The method of two-stage least squares is used to estimate the model in the period 1948-1975; the first two years of the original sample period 1946-1975 had to be dropped to allow for the twice-lagged values of the variables used as instruments for $\ell n\ R_{-1}$. The "t" subscripts are dropped and the "-1" subscript denotes lagged values.

* The instrumental variables for $\ell n\ R_{-1}$ are the twice-lagged values of the explanatory variables - $\ell n\ SSW_{-2}$, $\ell n\ w_{-2}$, $\ell n\ w^e_{-2}$, $\ell n\ \pi^e_{-2}$ and $\ell n\ UR_{-2}$.

empirical results are somewhat encouraging. In the following discussion, the effect of a variable is illustrated by calculating the change in the retirement rate when the value of that variable is increased by two standard deviations around its mean and the other variables are held at their mean values.

The estimated effect of social security on retirement is in accord with expectations. Based on the life-cycle model of behavior, high social security wealth was expected to induce retirement through a lifetime income effect. The positive coefficient estimate for ℓn SSW is evidence that this effect takes place. The point estimate of .594 for this coefficient implies that a two standard deviation ($2300) increase in SSW raises the retirement rate from 67.9 to 73.2 This estimate is marginally significant; this significance is achieved in the presence of a variable controlling for a pure time trend effect, and of the factors working against precise estimation discussed above. Therefore, the estimated coefficient for ℓn SSW consistutes some evidence for accepting the hypothesis that social security induces retirement.

Additional support for this hypothesis comes from the binary variable DCQPP that attempts to capture the effect of the beginning of the Canada and Quebec Pension Plan. When this program was started benefits were paid immediately to eligible individuals.[10] Because they never made contributions into the program, it amounted to an exogenous increase in their lifetime income. This had the effect of raising the retirement rate by approximately 1.5 points in 1967. The positive coefficient estimates for ℓn SSW and DCQPP taken together provide support for the theoretical argument that social security has a lifetime income effect on behavior.

The coefficient estimate of the wage variable, $\ln w$, has the expected sign but is insignificantly measured. Accepting for the moment the point estimate of this coefficient, a two standard deviation increase in real per capita wages lowers the retirement rate from 75.9 to 63.2. However, the insignificance of this estimate may be interpreted as evidence in support of the persistence hypothesis.

The two variables measuring expected future wages and prices enter the model with coefficient estimates predicted by the timing hypothesis. The standard error of the coefficient for $\ln w^e$ is large so that its sign and magnitude are not statistically significant. The point estimate of .869 implies that the retirement rate increases from 54.3 to 91.6 when expected wages rise by two standard deviations. The effect is large but has a wide margin of error. However, the measurement of the coefficient for $\ln \pi^e$ is close to conventional levels of significance. An increase in the inflation rate of two standard deviations lowers the retirement rate from 71.3 to 69.8. This response of retirement to inflation is expected based on the timing hypothesis and is of reasonable magnitude.

The coefficients of the wage, expected wage, and expected price variables have the signs predicted by the timing hypothesis. While only the expected price coefficient has a significant sign, these coefficients taken together may be interpreted as providing some evidence in favor of the timing hypothesis. Such an interpretation would stress the importance of obtaining the correct pattern of signs for the wage and price variables given the factors working against precise estimation given above.

The estimate of the model can also be interpreted to give some support to the persistence hypothesis. The coefficient for $\ln R_{-1}$ has the expected sign and implies that a two standard deviation increase in the lagged retirement rate raises the current rate from 67.4 to 73.8. The magnitude of this effect, however, is not precise. In general, the esitmate of the model cannot be used to resolve whether the timing or persistence hypothesis explains behavior. The imprecision in the coefficient estimates makes an interpretation of the evidence in favor of one hypothesis a matter of selective emphasis.

The coefficient for TIME shows that the retirement rate does follow the expected trend of increasing retirement over time. The point estimate of this coefficient implies that every year in the sample period adds on average .3 to the retirement rate. The unemployment rate was added to the model to measure the effect of general market conditions on retirement. The coefficient of ℓn UR is expected to be positive on the assumption that individuals are more likely to retire when market conditions are not favorable. This coefficient is insignificantly estimated with the unexpected sign.

As shown in eq. (14), the factor λ measuring the contribution of the most recent retirement rate to the stock of employment experience can be estimated from the coefficients for a variable and its lagged value. More precisely, λ is estimated as the negative of the ratio of the coefficent of a lagged variable to the coefficient of its current value. The two variables with nearly significantly measured current and lagged coefficients are ℓn SSW and $\ell n\ \pi^e$. However, they give estimates of λ that differ; ℓn SSW's coefficients imply λ equals .978 and $\ell n\ \pi^e$'s coefficients imply λ equals -.71. This problem arises as a result of λ's overidentification in the specification of the model. There is a way to estimate λ in this situation. The strategy is to select values of λ in a particular range and compute estimates of the model for λ set equal to each value. The value of λ and the associated estimates of the other coefficients that yield the minimum sum of squares are selected as maximum likelihood estimates of λ and the coefficients. This is the technique developed by Zellner and Geisel (1970). Setting λ equal to a single value can be justified as an identifying constraint. The justification would rest on the fact that the results in Table 1 did not give a precise estimate for λ. In my judgement it is best to estimate the model without incorporating a priori constraints - at least to start.

The main empirical result in this section is the evidence that social security affects retirement through the lifetime income effect described in section I. The underlying assertion of this study is that social security can influence retirement and varies independently of other variables that also have an influence on retirement.

V. Summary and Conclusion

This study has examined whether social security affects the aggregate retirement rate. The lifetime budget constraint for an indivdiual has been used to identify a lifetime income effect of social security on retirement. Further, this constraint also specified the variable that is used for measuring this effect. This variable is social security wealth which equals the present value of the social security benefits to which individuals are entitled. The standard model for labor force participation of individuals was used to derive the model for the aggregate retirement rate. This model includes social security wealth. The underlying assumption of this study is that social security can have an effect on retirement that is independent of other variables that also influence retirement.

The estimate of the retirement model obtained in this study yields evidence for accepting the hypothesis that social security induces retirement. An increase in social security wealth of approximately $2300 per capita measured in 1971 dollars has been estimated to raise the retirement rate by 5 to 6 points. This effect was calculated around the mean values of variables in the sample period 1948-1975. The effect of the creation of the Canada and Quebec Pension Plan was to raise the retirement rate by 1.5 points in 1967.

Two hypotheses on labor force activity - timing and persistence - provided a framework for analyzing the effect of wages and prices on retirement. The evidence on the effect of these variables conformed with expectations but precise estimates of these effects were not obtained. This imprecision did not permit a resolution of what hypothesis explained retirement behavior.

One purpose of this study, in its conclusion, is that the empirical results within will encourage further research on the important policy issue of the relationship between social security and retirement. Two reasons for there being some loss of precision in these results were discussed. Future work is likely to improve on the empirical specification and econometric methodology used in this study. It is my opinion that future evidence will continue to show that social security induces retirement and will give sharper measures of the effect of social security and other economic variables on retirement behavior.

Footnotes

1. This description is given by Coward (1977, p. 213). A more detailed description and history of the development of the social security program is given in Chapters 18 and 19 of Coward's book.

2. See Gronau (1973).

3. See Blinder (1974), Blinder and Weiss (1976), and Heckman (1976).

4. This description is based on my effort (1978a) at incorporating a model of a pension program into a simplified version of the Blinder-Weiss (1976) model.

5. See Chamberlain (1978), Heckman (1977), and Yatchew (1977).

6. A listing of the time series data was provided by Peter Wrage of the Economic Council of Canada.

7. DCQPP is set equal to one in 1967 and to zero in other years. The Canada and Quebec Pension Plan became effective on January 1, 1966 at which time contributions were collected from earnings. In order to collect benefits, individuals had to generate a claim on the system. In order to do this, they had to have at least one year of earnings covered by the plan. This year of earnings could then be used to calculate benefit payments. Consequently, the creation of the Canada and Quebec Pension Plan would have its effect in 1967.

8. It is possible that the combination of the transformation implied by eq. (11) and serial correlation in the error term produces an error term that is uncorrelated with R_{t-1}. This will occur if v_t follows a first-order Markov

process given by:

$$v_t = \lambda v_{t-1} + u_t$$

where the u's are independently and identically distributed. In this case, the transformation leaves only u_t in the error term which is serially uncorrelated by assumption and uncorrelated with R_{t-1}. Assuming this to be the case, a priori, would be heroic.

9. See Zellner and Geisel (1970), Johnston (1972), or Kmenta (1971).

10. This statement is subject to a slight qualification which is that eligible individuals had to generate a claim on the system by having one year of earnings covered by the program. This is explained in n. 7.

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