The retirement incentive effects of Canada's Income Security programs

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Abstract. Canada has a large Income Security system for retirement that provides significant and widely varying disincentives to work at older ages. We provide an empirical analysis of the retirement incentives of the Canadian Income Security system using a new administrative database. We find that the work disincentives inherent in the Canadian Income Security system have significant impacts on retirement. This suggests that program reform can play a role in responses to fiscal pressures. We also demonstrate the importance of controlling for lifetime earnings in retirement models. Specifications without these controls overestimate the effects of the Income Security system. JEL Classification: H55, J26

Les effets d'incitation à la retraite des programmes de la sécurité du revenu au Canada. Le Canada a un important système de sécurité du revenu après retraite qui crée des désincitations importantes et diverses au travail pour les gens d'un âge avancé. Les auteurs donnent des résultats d'une analyse empirique de ces incitations en utilisant certaines données administratives nouvelles. Il semble que ces désincitations au travailont un impact significatif sur les décisions de retraite. Voilà qui suggère qu'une réforme des programmes peut avoir un impact important sur les réactions aux pressions fiscales. On montre aussi que la prise en compte des revenus tout au long de lavie active a une grande importance dans les modèles de retraite. Il est clair que toutes les spécifications de modèles qui ne prennent pas en compte ces facteurs tendent à sur-estimer les effets des programmes de la sécurité du revenu.

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Canada's Income Security programs for seniors face an uncertain fiscal future. Unfortunate collisions of demography and 'pay as you go' financing have precipitated periodic crises for both the Canada and the Quebec Pension Plans. Another trend that is equally ominous for long-run fiscal balances is the substantial reduction in the work effort of older Canadians. From the beginning of the 1960s through the end of the 1990s the labour force participation rate of 55–64 year-old-men fell from 87% to 61%. For men aged 65+ it fell from 30% to under 10%. The decline in work of the older age population lowers the tax revenues that finance Income Security programs and raises the benefit payments from these programs, worsening their net fiscal position.

Ironically, the Income Security programs may have made a significant contribution to the trends in retirement that threaten them. The time series correlation is striking: during the period there was an enormous expansion of these programs as the Canada/Quebec Pension Plans were introduced and new income support programs for low-income seniors were established or enhanced. Of course, simple trend comparisons are not a sufficient basis for concluding that Income Security programs played a major role in these trends, or for contemplating Income Security reform. Instead, we require formal, robust inference on the behavioural effects of program parameters. For many countries there are large and growing literatures on the incentive effects of their national social security programs. Furthermore, many governments are investing in research programs on aging to help to refine the inference. In contrast, there are but a handful of studies of Canada's Income Security programs. One explanation of this outcome is the lack of data sets in Canada with sufficient samples of older individuals and adequate information on their Income Security entitlements to support such a program.

In this paper we attempt to fill some of the gaps in the Canadian literature, providing estimates of the incentive effects of the full web of federal Income Security programs using an extraordinary new data set. These data are a union of numerous administrative sources and provide a large sample of older workers and detailed information on their earnings histories, marital circumstances, spousal and job characteristics and labour supply choices.

Using this information we construct estimates of individuals' entitlements to Canada and Quebec Pension Plan (CPP and QPP) benefits, the Old Age Security Pension (OAS), the Guaranteed Income Supplement (GIS), and Spouse's Allowance (SPA). Our measure of the labour market incentives provided by these programs is based on the present discounted value of the stream of benefit entitlements from these programs for a given retirement age. By recalculating this sum at each possible retirement age we create accrual variables that capture the change in total Income Security entitlements with additional years of work. We construct a variety of accrual variables, which alternatively assume the worker is relatively short or long sighted when making the retirement decision. We then relate these incentive measures to individuals' labour market decisions between age 55 and age 64 – the primary retirement ages.

There is a growing recognition in the literature that identification can be problematic in empirical models of retirement (Coile and Gruber 2000; Chan and Stevens 2001). This is because cross individual variation in benefit entitlement is typically the basis of identification. There are a variety of sources of variation in benefit entitlement across individuals, but clearly one of the more important is lifetime wages or earnings. The problem arises because variation in lifetime wages may in turn capture heterogeneity in work preferences. Accordingly, we are careful to document any variation in inference across specifications that, alternatively, do and do not control for individuals' lifetime earnings.

We also explore variation in the results across samples defined by the probability of being a member of an employment-based pension plan and particular income quartile, as well as across different definitions of retirement. The estimates vary in sensible ways, which lends greater confidence to our inferences.

The rest of the paper is laid out as follows. First, we describe the previous literature and the elements of Canada's income security system and the retirement income environment. Next, we describe the construction of the data set and the incentive variables used in the analysis. We then proceed to lay out the empirical framework and present the results. Finally, we offer some conclusions.

1. Previous literature

There is an enormous U.S. literature on the impacts of the Social Security system on retirement. This literature is reviewed in detail in Diamond and Gruber (1999) and Coile and Gruber (2000). There are four classes of study in this literature.

The earliest work in this area, from the early 1970s through the mid-1980s, considered reduced-form models of the retirement decision as a function of Social Security wealth and pension levels. While these articles differ in the estimation strategies employed, with the more recent work using richer models such as non-linear 2SLS or hazard modelling, the results consistently suggest a significant role for Social Security, but a role that is small relative to the time trends in retirement behaviour documented in the introduction.

A key limitation of this first class of study is that it considers Social Security effects at a point in time, but not any impacts on the retirement decision arising from the time pattern of Social Security wealth accruals. This was remedied in three different ways by subsequent literatures. The first was to consider structural modelling of retirement decisions by workers facing a lifetime budget constraint. The second was to continue to estimate reduced-form models, but to incorporate the accrual of Social Security wealth with a year of additional work. Both of these types of study continued to find an important, but modest, role for Social Security, and some indicated a larger role for private pensions. The final strand of this literature is recent 'option value' models of retirement. These models recognize that it is not simply the level of retirement wealth or

the increment with one additional year of work that matters, but the entire evolution of future wealth with further work. So retirement decisions are modelled as a function of the difference between the utility of retirement at the current date and at the date that maximizes one's utility.

The most recent studies in this literature, such as Coile and Gruber (2000), have worked with different forms of the option value formulation. We follow the methodology of these studies in our work below, and describe it in more detail there.

In contrast to the U.S. literature, the economics of aging literature in Canada is relatively new and still quite small.[1] Specific features of the CPP/QPP programs have recently been examined by Baker and Benjamin (1999a, b) and Baker (2002). These include the elimination of the CPP/QPP earnings test and the introduction of the Spouse's Allowance (SPA) in the 1970s and the introduction of early retirement to the CPP/QPP in the 1980s. In another study, Tompa (1999) investigates the determinants of the CPP take-up decision. Much of this research adopts the 'natural experiment' approach, rooting identification in policy interventions rather than cross individual variation in entitlement. On balance the results are mixed: some of the program reforms appear to have affected retirement behaviour (the earnings test and SPA), while others did not (early retirement). An obvious shortcoming of this research for the purposes of program reform is its focus on single features of programs in isolation.

Compton (2001) offers a recent, more comprehensive contribution to this literature. She estimates the incentive effects of the CPP/QPP program using Survey of Labour and Income Dynamics data for 1993–96, and concludes that program parameters have little effect on retirement decisions. However, her study suffers from several weaknesses, including the short time period of observed worker histories, a focus on CPP/QPP benefits in isolation from other programs, and potential problems with the two-stage estimation procedure used.[2] In addition, the precision of her estimates is low, so large incentive effects cannot be statistically ruled out.

Gruber (1999) also provides a more comprehensive analysis, documenting the incentive effects of the entire web of Income Security programs based on simulated earnings histories. He shows that there are positive incentives for retirement starting at age 60 that grow particularly large by age 69.

1 Our focus here is on studies of public pension and income security programs. Pesando and Rea (1977) and Burbidge (1987) are early studies that document the parameters of Canada's Income Security system and provide theoretical analyses of some of their incentives. There is a small, related literature on the incentives in Registered Pension Plans. See Gunderson and Pesando (1988, 1991).

2 The variables that are used to predict CPP/QPP benefits are included in the retirement regressions alongside the imputed CPP/QPP benefit. With no variables from the first stage excluded, there is no identifying variation left for the CPP/QPP effect, which renders its explanatory power inert.

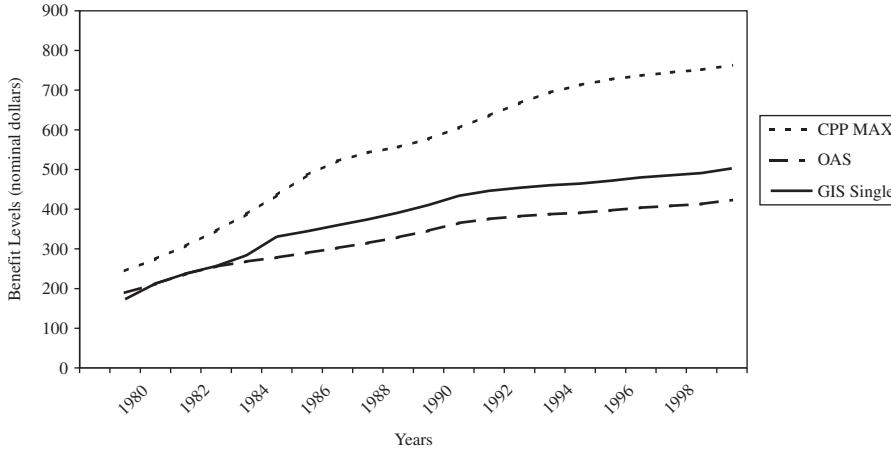

FIGURE 1 Monthly CPP, OAS, and GIS Benefits in the 1980s and 1990s
NOTES: CPP benefit is maximum monthly pension for that year. GIS benefits are for single claimants. Source is Human Resources Development Canada (2001).

2. An overview of the income security system

Canadians make their retirement decisions within the context of an Income Security system developed largely in the 1960s. There are three main components. The first and oldest component, the OAS pension, is a demogrant available to individuals starting at age 65. The second component is the GIS, and the related SPA, which are income-tested benefits. The third component is the contributory public pension plans, the CPP and QPP, in which benefit entitlement is directly related to individuals' lifetime work histories. As reference for the following overview of the system, a graph of the monthly levels of benefits paid out by these programs since 1980 is presented in figure 1.

The OAS was established in 1952, and since the 1970s has been funded out of general revenues. Benefits are available to any individual, starting at age 65, who meets certain residency requirements,[3] with no actuarial adjustment to benefits for delaying receipt beyond this age. Benefits are fully taxable, and

3 An individual (a) must be a Canadian citizen or legal resident of Canada on the day preceding the application's approval; or (b) if no longer living in Canada, must have been a Canadian citizen or a legal resident of Canada on the day preceding the day he or she stopped living in Canada. A minimum of ten years of residence in Canada after reaching age 18 is required to receive a pension. The amount of a person's pension is determined by how long he or she has lived in Canada. For example, a person who has lived in Canada for at least 40 years after reaching age 18 may qualify for a full OAS pension. The benefit is prorated for pensioners with fewer than 40 years of residence.

since 1989 they have been clawed back from high-income individuals.[4] Finally, benefits have been fully indexed to the Consumer Price Index since 1972.

The GIS, established in 1967, is an (annually) income-tested benefit, available to OAS pensioners. There are separate benefits for singles and individuals living in couples. The calculation of income for the purposes of the test is similar to that for income tax, with the exclusion of OAS benefits. Unlike the clawback of OAS benefits, however, the test is applied to family rather than to individual income. The 'tax back' of benefits is 50 cents for each dollar of family income except couples in which the partner is under age 60, where the tax back is 25 cents for each dollar of family income.

The SPA, established in 1975, is another income-tested benefit.[5] Individuals aged 60 to 64 who are partnered to an OAS pensioner are eligible.[6] The maximum benefit is equal to the sum of the current OAS benefit and current GIS benefit at the married rate. The income test is again applied at the family level but is more stringent than that for the GIS. The tax on benefits is 75 cents for each dollar of income until an amount equivalent to the OAS benefit has been retrieved. At this point the tax is reduced: the sum of the remaining SPA benefit and the other partner's GIS benefits are reduced by 50 cents for each dollar of additional income. In 1986 the SPA was extended to individuals aged 60 to 64 who had been widowed and had not remarried. Benefits for these surviving spouses are somewhat larger but are taxed back similarly.

Both GIS and SPA benefits are financed out of general tax revenues and fully indexed to increases in the Consumer Price Index. Furthermore, neither benefit is subject to income taxes at the federal or provincial level.

The third component of the Income Security system is the QPP and CPP, both established in 1966. These two similar programs serve individuals living in the province of Quebec and individuals living in the other provinces and territories of the country, respectively.[7] The two key differences between the CPP/QPP and the other programs are the financing of benefits through a payroll tax and the dependence of benefits on work histories.

Both employees and employers contribute a payroll tax of 4.7% (2002). The tax is levied on employment earnings in excess of the Year's Basic Exemption, currently frozen at $3,500, up to the Year's Maximum Pensionable Earnings, which equalled $39,100 in 2002. The Year's Maximum Pensionable Earnings approximates, and is indexed to, the growth in average earnings in the

4 A special clawback tax of 15% comes into effect as a beneficiary's personal net income reaches $56,968 (in 2002).

5 On 31 July 2000 the name of the Spouse's Allowance was changed to 'Allowance.' We use the older name here to correspond to the program in place during our sample period.

6 Beneficiaries must also meet residence requirements.

7 The salient difference between the QPP and the CPP for benefits lies in the survivor pension, which uses a different mixture of flat amounts and work history dependent amounts in the two plans. We fully account for these differences in our calculations.

labour market. Benefits have been fully indexed to the Consumer Price Index since 1972 and are fully taxable under federal and provincial income tax laws.

Benefit entitlement is determined by a series of calculations. First, the individual's contributory period is determined. The contributory period starts at age 18 or 1 January 1966, whichever is later, and normally extends to age 65 or commencement of the retirement pension, whichever is earlier. To be eligible for benefits, an individual must have made CPP/QPP contributions in at least one year of the contributory period. There are provisions for excluding months in which a disability benefit was received, time out of the labour force caring for children under age 7, and for work after age 65. As well, 15% of the remaining low earnings months are excluded.[8]

The second calculation updates the earnings history to the prevailing level of current earnings in two steps. In the first step, for each of the non-excluded months in the contributory period, the ratio of earnings to one-twelfth of the relevant Year's Maximum Pensionable Earnings is calculated. In the second step, the average of this set of ratios is multiplied by a five-year moving average of the Year's Maximum Pensionable Earnings in order to bring the earnings history up to prevailing earnings levels.[9] The result of this calculation is referred to as the Average Pensionable Earnings (APE). The APE is then multiplied by 25% to determine the annual CPP/QPP benefit. To summarize, the CPP/QPP can be thought of as providing a pension that replaces 25% of earnings for a worker earning the average industrial wage.

Benefits can be claimed at any age between 60 and 70 subject to an actuarial adjustment. The 'normal' retirement age is 65. Benefits are reduced (increased) by 0.5% for each month the benefit application precedes (succeeds) this age.[10] Benefit receipt prior to age 65 is conditional on a retirement test. Annual earnings in the year the pension is claimed cannot exceed the maximum retirement pension payable at age 65 for that year. However, this test is applied only at the point of application; after that point, there is no additional check on the individual's earnings.

The CPP/QPP pays a spousal benefit to the surviving spouse of a CPP/QPP retirement benefit recipient. The survivor's benefit comprises a flat-rate amount and an amount that depends on the earnings history of the deceased. This provides some dependence of benefits across partners.[11] Several other features of the CPP/QPP are important, but are not addressed in our present work.

8 Exclusions for childcare, work after 65, and low earnings cannot take the contributory period lower than 120 months.

9 The moving average is calculated as the year of application and the preceding four years. The method of calculation has been in place since 1999. Prior to 1998 a three-year moving average was used. In 1998 a four-year moving average was used.

10 This early retirement option has been available from the QPP since 1984 and from the CPP since 1987.

11 Further details of the surviving spouse pension can be found in CCH Canadian Ltd (2001) and Baker, Hanna, and Kantarevic (2001).

These include the disability pensions paid to those unable to work due to disability, a benefit paid to orphaned children, and a death benefit.[12]

While we focus in this paper on the incentives in the federal Income Security programs, several other pensions may be inputs to the retirement decision. Some provinces run small means-tested income assistance programs for seniors.[13] Employment-based pensions, called Registered Pension Plans, covered almost 42% of paid workers in 1997.[14] Individuals can also save through a Registered Retirement Savings Plan. Contributions are deductible from taxable income, accrue free from tax, and are taxable upon withdrawal.[15] Pension income from these sources is income for the purposes of the GIS/SPA income tests and the OAS clawback and so can have an important impact on Income Security system incentives.

3. The data

Retirement research in Canada has been impeded by the lack of appropriate data. Proper modelling of retirement incentives requires a panel data set of older workers that contains sufficient information – in particular, full earnings histories – to accurately calculate their entitlements to Income Security programs. In this study we make use of a unique administrative data set that possesses many of these characteristics.

Our starting point is the Longitudinal Worker File developed by the Business and Labour Market Analysis Division of Statistics Canada and described in detail in Picot and Lin (1997) and Statistics Canada (1998). It is a 10% random sample of Canadian workers for the period 1978–96. These data are the product of information from three administrative data files: the T-4 file of Revenue Canada, the Record of Employment file of Human Resources Development Canada and the Longitudinal Employment Analysis Program file of the Business and Labour Market Analysis Division. They provide information on individuals' annual T-4 earnings[16] and province of residence,[17] the timing

12 See Gruber (2000) for further information on the CPP and QPP disability programs.

13 For example, the GAINS program in Ontario 'tops up' the GIS for seniors by a maximum of $83. In 2000, approximately 8% of Ontario OAS recipients received GAINS. We do not include these programs in our calculations.

14 Defined contribution plans influence retirement primarily through a wealth effect, while defined benefit plans can have complex incentive effects. Gunderson and Pesando (1988, 1991) outline the retirement incentives in some Canadian employer-provided pension plans.

15 An annual contribution limit of 18% of earned income up to $13,500 constrains contributions. Those in an employer-provided pension system have an adjustment to their limit, and unused contribution room may be carried forward. See Milligan (2002) for greater detail.

16 T-4 tax forms are issued annually by employers for any employment earnings that (1) exceed a certain annual threshold and/or (2) trigger income tax, contributions to Canada's public pension plans, or unemployment insurance premiums.

17 This is established by the province in which the T-4 form is issued. T-4s for some individuals will be issued from offices that are not in their province of residence. It is not possible to assess the severity of this problem.

and reason of any interruptions in earnings, job tenure (starting in 1978) at a given establishment, company (employee) size, and the 3-digit industry of the jobs in which individuals work. The data also provide information on individuals' age and sex, through reference to T-1 tax returns that they file each year.[18]

We draw separate samples of males and females aged 55 through 65 who worked in 1985. Younger cohorts of individuals are added as they turn 55 in the years 1986–91 again conditional on working in that year. Each individual contributes an observation for each year from their entry to the sample to the year of retirement or age 64, whichever comes first. An individual is followed until 1995, at which point the observation is censored.[19] The sample is selected conditional on working, so that the incentives for retirement conditional on being in the labour force are examined. While it makes sense to insist on some initial labour market activity in an analysis of retirement, our requirement of earnings in a given one-year interval will exclude individuals who retain some attachment to the labour market but who experience an extended period of joblessness.[20]

We exclude some individuals: first, those with missing age, sex, or province variables; second, agricultural workers and individuals in other primary industries. We make this exclusion because our definitions of retirement are based on earnings, and the earnings streams for these workers, given high rates of self-employment and special provisions in the Employment Insurance system for fishers and other seasonal workers, are difficult to interpret.

The Longitudinal Worker File spans the period 1978 through 1996. Earnings histories of this length are not sufficient, however, to establish individuals' entitlements to CPP/QPP benefits, which may depend on earnings histories back to as early as 1966. The years 1975 through 1977 are filled in by reference to the T-4 earnings records for these years. T-4 records for the years 1966 through 1974, however, are not available. To predict earnings in these years, cohort specific earnings growth rates calculated from the 1972, 1974, and 1976 census family files of the Survey of Consumer Finance[21] are applied to a three-year average of an individual's last valid earnings observations in the Longitudinal Worker File sample. This allows us to construct earnings histories back unto 1971. For the remaining five years, earnings growth rates implied by a cross-section age profile estimated from the 1972 Survey of Consumer Finances

18 To obtain this information, therefore, it is necessary that he or she filed a tax return at least once in the sample period.

19 The 1996 data are used to determine the retirement status of the 1995 observations, but cannot be included in the analysis for lack of information on their subsequent work or retirement in 1997. See below.

20 Depending on when the period of joblessness falls in the calendar year, our sample captures all individuals whose period lasts 11 months or less, and some individuals whose period is as long as 22 months.

21 We use samples of paid workers with positive earnings in the relevant birth cohorts.

are used, appropriately discounted for inflation and productivity gains using the Industrial Composite wage for the period 1966–70.[22] The result is an earnings history for each individual from 1966 until 1996.

The marital status and any spouse/common-law partners of individuals in the sample are identified through reference to the T-1 Family File maintained by Statistics Canada. T-4 earnings histories for the period 1966–96 are then constructed for the spouse/common-law partners, following the procedures used for the sample individuals.

Finally, two additional pieces of information are added to these data. First, to determine entitlement for income-tested benefits, we need information on non-labour income such as income from employment-based pensions or Registered Retirement Savings Plans. To do this we construct age profiles of family level income by sex/region/industry and sex/region/marital status cells, for individuals in and out of the labour market, respectively,[23] using data from the 1986 and 1991 census family files of the Canadian Census. The measure of non-labour income includes investment income and income from private pensions. We then impute non-labour income to individuals using the profile appropriate to their current or (assumed) future labour market state. The sample and cell definitions that are employed are more fully described in the appendix.

Second, information on the probability of employment-based pension coverage, by 3-digit industry,[24] is computed using cross section samples of males or females from the 1986–90 Labour Market Activity Survey and the 1993–96 Survey of Labour and Income Dynamics. In these surveys individuals are asked if they participate in any employment-based pension. These probabilities are then imputed to individuals in the Longitudinal Worker File, matching on the industry codes. Probabilities for the years 1991 and 1992 are simple averages of the 1990 and 1993 calculated probabilities. Again, the sample definitions for these data sources are described in the appendix.

4. Definitions of the dependent and key explanatory variables

Our definitions of work and retirement follow from fact that we observe the earnings of individuals as captured on the T-4 forms, but have no direct

22 The data on the Industrial Composite wage are from Statistics Canada (1983). The obvious limitations of these backcasting procedures are that we smooth years of low earnings and will not predict absences from the labour market. These 'simplifications' may be misleading for individuals at younger ages. Mitigating any biases, however, is the fact that the youngest cohort in our analysis is 30 in 1966. This means that absences for child bearing or years of extreme low earnings due to the employment instability of youth will not play a large role for most members of our data set.

23 The age profiles are appropriately inflated by the Consumer Price Index for use in future years.

24 Some industries are aggregated to obtain sufficient sample sizes. Unfortunately, the sample sizes of these data sets would not permit us to calculate these probabilities exclusively for older individuals.

information on their labour market activity. An individual is coded as working in a given year if s/he has positive T-4 earnings in both that year and the following year. If, instead, we observe positive earnings in one year and zero earnings in the next, the year of positive earnings is denoted the retirement year. T-4s are not issued to the unincorporated self-employed, so movements from paid employment into this sector also will be labelled as retirement.[25] These mislabeled transitions will induce measurement error in our 0/1 indicator of retirement, which is the dependent variable in our empirical model. Assuming that this measurement error is uncorrelated with the explanatory variables, the result will be an underestimate of the marginal effects of the characteristics of individuals and their jobs, as well as the Income Security incentives, on the probability of retirement.[26] That said, we consider alternative definitions of retirement and document the sensitivity of the results on this margin.

Only the first observed 'retirement' for each individual is considered. If a person re-enters the labour market after a year of zero earnings, the later observations are not used. Labour market return is potentially an important topic, but is outside the scope of the current analysis. Furthermore, first retirements may be more important from the perspective of the fiscal health of various Income Security programs. Finally, individuals are followed only until age 64. Therefore, an individual who has positive earnings in every year up to age 64 will pass out of our sample before we observe their retirement and will contribute a censored observation. The age 64 cutoff makes sense given that there is mandatory retirement at age 65 in most jurisdictions in Canada over the period we examine.

The construction of the Income Security incentive variables starts with an estimate of individuals' Income Security entitlements. We calculate entitlement on a family rather than on an individual basis, so we also must calculate the Income Security entitlement of any spouse and common-law partner. The calculations incorporate all components of the federal Income Security system, but data constraints necessitate certain simplifications. OAS and GIS/SPA eligibility is determined by age, spousal status, and income. We observe age and spousal status in the data and use projections of labour and non-labour income to implement the income tests. We determine CPP/QPP entitlement using individuals' earnings histories to construct estimates of their APE. The

25 In 1991, a year in the middle of our sample period, 13.2% of working males and 6.8% of working females aged 55 to 64 reported themselves as unincorporated self-employed (1991 Public Use Microdata Files of the Canadian Census). Note that some of these individuals will have worked in this sector from before they turned 55 and so will never appear in our sample. It is not obvious how the exclusion of this group might affect our conclusions.

26 Because our retirement indicator is dichotomous (i.e., 0/1), the resulting measurement error is not 'classical.' Furthermore, the error is 'one-sided' in that we may mistakenly code a '0' as a '1' when someone enters unincorporated self-employment, but we will not miscode '1' as '0,' since we define working as receiving a T-4 form. In this case, there is attenuation bias in the estimated marginal effects. See Hausman, Abrevaya, and Scott-Morton (1998).

drop-out provisions for low-earnings months are fully implemented.[27] Disabilities or time spent in childcare are not observed, however, and therefore deletions for these reasons are not captured.[28] The 1984/1987 reforms of the CPP/QPP system over the period also are accounted for, including the introduction of actuarially adjusted early retirement benefits. We assume that CPP/QPP benefits are claimed at the time of retirement, or at age 60 for those retiring at ages 55 to 59.

Income Security entitlement is calculated for the current year and for all future years up to age 64. To do this we require a projection of individuals' (and their spouse/common-law partners') potential labour and non-labour income in future years. After experimenting with a number of projection methods, we projected earnings by applying a real growth rate of 0% per year to the average of an individual's observed earnings in the three years preceding the retirement year.[29] Non-labour income is projected following the method outlined above. For each individual, entitlement with and without the imputed level of non-labour income is calculated and then averaged, using as weights the cell-specific probability that non-labour income is positive. Both projected earnings and non-labour income are net of federal and provincial income taxes. Also deducted is the employee's portion of the CPP/QPP payroll tax that would be paid if the individual worked. In either case the tax provisions of the year in which the calculation is made are assumed to be in effect in all future years.

Since Income Security entitlement is calculated at the family level, we require some assumption about any spouse/common law partner's retirement decision. A complete model of family labour supply is beyond the scope of this paper. The simplifying assumption made here is that any partner starts collecting entitlements at the earliest age possible under the current rules of Income Security programs.[30]

27 Our earnings backcasting procedure may understate the number of low-earnings periods, which would likely be dropped out in the APE calculation. However, the youngest members of our sample are age 30 in 1966, and so would be past the early part of their life cycle in which spells of low earnings are more common.

28 The dropout provisions for childcare came into effect in 1977 under the QPP and in 1978 under the CPP. The childbearing years of many females in our sample will have been prior to these dates.

29 Within-sample evaluation revealed this method as a better predictor (in a mean-squared error sense) of future earnings than methods involving a projection equation that included demographic variables, lagged earnings, and individual fixed effects.

30 For most of the sample period this is age 65 for OAS and GIS, age 60 for the Allowance, and age 60 for the CPP/QPP. For CPP/QPP benefits prior to age 65 and any income-tested benefit, the assumption implies a cessation of the spouse/common-law partner's employment (i.e., retirement). Gruber (1999) and Baker and Benjamin (2000) provide estimates of age/employment profiles and employment hazards for older men and women over the sample period. This evidence provides some justification for this assumption about labour market exit rates in our analysis of the male sample, in which the spouse/common-law partners are females. On the other hand, this assumption may prematurely remove the male spouse/common-law partners of individuals in our sample of females from the labour market. This is unlikely to have a large effect on our estimates, since the independence across spouse/common-law partners in determination of most of the benefits means that spousal retirement is only a minor contributor to Income Security incentive calculations.

Once these calculations are completed, we construct the expected net present value of the family's Income Security Wealth associated with each retirement date. For single workers this is the sum of future benefits discounted backwards by time preference and survival probabilities for each possible year of retirement. For married workers we account for the likelihood of the joint survival of worker and the spouse/common-law partner and the survivor provisions of the CPP/QPP and the SPA, as described in more detail in Gruber (1999). We use a real discount rate of 3% and survival probabilities from the age/sex-specific Canadian life tables from Statistics Canada (1984).

The result is a profile of the present discounted value of Income Security Wealth at all possible retirement dates. This allows us to construct three different incentive variables that are current in the literature.

The first, and most common in the literature, is the one-year accrual. We form this measure by taking the difference of Income Security Wealth between adjacent potential retirement ages. It reveals the effect of choosing to work an additional year. If the age profile of Income Security Wealth is close to linear, then this measure will capture the affect of the Income Security Wealth accrual profile on retirement well.

The second is the peak value accrual introduced by Coile and Gruber (2000). The peak value is calculated as the difference between Income Security Wealth at the current age and Income Security Wealth at the financially optimal retirement age – the age at which Income Security Wealth is maximized. Relative to the one-year accrual, the peak value calculation accommodates non-linearities in the Income Security Wealth profile. If the Income Security Wealth profile is flat for some years followed by a sharp jump, the one-year accrual would miss the jump. The peak value calculation captures the idea that continued work preserves an option to retire in the future, which is valuable if there are significant increases in Income Security Wealth at later ages. After the optimal retirement age the peak value calculation collapses to the one-year accrual.

The final measure is the option value accrual of Stock and Wise (1990). Similar to the peak value calculation, the option value measure compares the current age to an optimal retirement age in the future, but defines the optimal age in terms of utility rather than in terms of dollars of Income Security Wealth. To implement this calculation we adopt the indirect utility function used by Stock and Wise, but directly parameterize it rather than estimating its parameters. The individual's indirect utility function is assumed to be

$$V_t(R) = \sum_{s=t}^{R-1} p_{s|t} d^{s-t} (y_s)^g + \sum_{s=R}^{T} p_{s|t} d^{s-t} [k \cdot B_s(R)]^g, \tag{1}$$

where R is the retirement date, d is the discount rate, p is the probability of being alive at some future date conditional on being alive today, y is income while working, B is retirement benefits, g is the parameter of risk aversion, k is

a parameter to account for disutility of labour ($k \geq 1$) and T is maximum life length. Following Stock and Wise (1990), we set $k = 1.5$ and $g = 0.75$, and set $d = 0.03$ following Coile and Gruber (2000). Sensitivity analysis suggests that the results are not dramatically different for sensible variations in these parameter values. Relative to the peak value measure, the option value accrual provides a specific economic rational for the optimal retirement date accounting for the disutility of work and value of leisure. Its primary disadvantages are its (possibly incorrect) assumed specification of the indirect utility function and the fact that earnings enter directly into the utility calculation and thus will drive some part of the variation of the option value across individuals. If earnings are in turn correlated with some unobserved component of tastes for retirement, the identification of the option value effects can be problematic.

Variation in these incentive variables has a variety of sources. Individuals with identical earnings histories will have different Income Security incentives, depending on spouse/common-law status, province of residence, year, and non-labour income. Those with a spouse or common-law partner benefit from the survivor pension of the CPP/QPP and face different treatment under the SPA/GIS clawback. Each province has its own taxation regime, which affects the after-tax value of pension benefits and varies through time for each province. The early retirement provision was introduced for the QPP in Quebec in 1984 but not until 1987 for the CPP in the rest of Canada. This introduces variation in pension incentives between Quebec and the rest of the country for the first years of our sample. Finally, the amount of non-labour income affects Income Security through the clawbacks on OAS, GIS, and SPA. This variation across individuals with similar earnings histories helps in the identification of our estimated parameters.

5. Empirical framework

The estimating equation relates the retirement decisions of individuals to their demographic and economic characteristics as well as their Income Security Wealth. We estimate a reduced-form model and consider both myopic and forward-looking incentive measures. Our framework is similar to that used in many recent studies that provide a dynamic yet reduced-form analysis of the retirement decision.

Both the level of Income Security Wealth and the different incentive variables enter the equation. The level captures wealth effects: more wealth through Income Security programs will lead to increased consumption of all goods, including leisure, if leisure is a normal good. The incentive variables capture a substitution effect: if there is a large financial incentive to additional years of work, then individuals will retire later. The equation estimated is:

$$R_{it} = \delta_0 + \delta_1 ISW_{it} + \delta_2 ACC_{it} + \delta_3 AGE_{it} + \delta_4 EARN_{it} + \delta_5 SPEARN_{it} + \delta_6 RPP_{it} + \delta_7 X_{it} + \upsilon_{it}, \qquad (2)$$

where R_{it} is a variable that equals one in the year of retirement and 0 otherwise, ISW_{it} is the expected present discounted value of Income Security Wealth in year t, ACC_{it} is one of the incentive variables outlined above, AGE_{it} represents a set of dummy variables for each age in our sample, and a measure of the difference in ages across spouse/common-law partners, and $EARN_{it}$ is a set of controls for the individual's earnings. These controls include a cubic in the individual's projected earnings in the current year t, a cubic in a measure of lifetime earnings, and the interaction of these cubics. $SPEARN_{it}$ represents the corresponding variables of any spouse/common-law partner. RPP_{it} is the measure of the probability of employer-provided Registered Pension Plan coverage at the 3-digit industry level,[31] and X_{it} are a set of additional control variables, including a dummy variable for having a spouse or common-law partner, a quadratic in tenure on the job, a dummy variable for having tenure is censored at 1978,[32] an interaction of the tenure censored dummy with the tenure quadratic, a quadratic in the individual's and his/her spouse/common-law partner's labour market experience measured as the number of years of positive T-4 earnings between 1975 and year t, 11 industry dummies, dummies for 6 categories of establishment size, and province and year effects. The equations are estimated separately for males and females as a probit. Standard error estimates are cluster corrected on individuals to account for the multiple observations for each worker.

6. Results

Descriptive statistics for the male and female samples are presented in table 1. We have 550,839 observations on 110,977 males, and 347,775 observations on 71,066 females. On average, therefore, we observe 5.0 observations per male and 4.9 observations per female. The means are calculated over observations in the sample, rather than individuals. The spousal characteristic means are calculated only over the observations for which a spouse or common-law partner is present. Some of the most interesting insights come from comparisons of the male and female results. The female means reflect the conditioning of our sample on working at age 55. Fewer women than men work at this age, making working females a less representative sample of the entire female

31 The standard errors here are potentially biased due to a correlation of the error term across individuals within 3-digit industry (the 'grouped data problem'). Correcting for this bias would lead to larger estimated standard errors on the parameter on RPP. Also, RPP is a predicted value and using a predicted value as an independent variable in a probit may lead to a biased coefficient. We have re-estimated the reported regressions excluding RPP and obtained comparable results for the other variables.

32 Again, the quadratic specification allows a more flexible affect of tenure on the retirement decision than a linear specification. In the Longitudinal Worker File, the tenure variable begins counting in 1978. Therefore, an individual observed in the same job between, for example, 1978 and 1985, has tenure of *at least* seven years. The dummy variable for this censoring helps account for the uncertainty about the *exact* tenure.

TABLE 1
Summary Statistics

	Males		Females	
	Mean	Standard Deviation	Mean	Standard Deviation
Retired	0.122	0.328	0.130	0.336
Probability of RPP	0.585	0.256	0.433	0.263
Has Spouse/common-law partner	0.564	0.466	0.422	0.494
Tenure	8.683	4.521	8.607	4.430
Tenure Censored	0.438	0.496	0.374	0.484
Experience	13.865	3.371	13.109	3.737
Spouse/common-law partner's Experience	9.396	6.733	13.188	4.988
Age	58.968	2.676	58.732	2.640
Age Difference	3.474	4.375	−1.750	3.997
Projected Current Earnings	28634	38007	17068	12172
Projected Current Spousal Earnings	8757	14203	15256	27513
Average Pensionable Earnings	29767	7585	20616	10656
Spouse/common-law partner's Average Pensionable Earnings	14724	12839	28721	10806
Average Lifetime Earnings	44048	30629	19827	15876
Spouse/common-law partner's Average Lifetime Earnings	12713	15556	44538	43077
Observations	550,839		347,775	
Individuals	110,977		71,066	

NOTES: The reported statistics are means (averages) calculated over all observations in the male and female data sets, respectively (rather than over all individuals). For spousal characteristics, the means are calculated only over those with spouses. All dollar values are in 1998 Canadian dollars. Definitions of all variables are provided in the text.

population.[33] The age difference between partners (spouses) for males is similar to those found in the 1992 Family Expenditure Survey for this age group, but the −1.75 age difference for females is smaller.[34] The males partnered to the sample females have earnings characteristics similar to the sample males. For example, the APE is $29,767 for the sample males and $28,721 for the spousal males. However, the females partnered to the sample males display lower earnings than the sample females. This reflects the fact that all of the sample females work, while only some of the spousal females work. The projected current earnings for the females partnered to sample males seems quite low at $8,757. However, this is an average over females both in and out

33 For example, in the 1998 Survey of Consumer Finance data 65% of males aged 55–59 were working in the survey week compared with 46% of females. For those ages 60–64 the rates are 39% and 23%, respectively.

34 In the 1992 Family Expenditure Survey, the age difference among married males age 55–64 is 3.2. For females, it is 3.1.

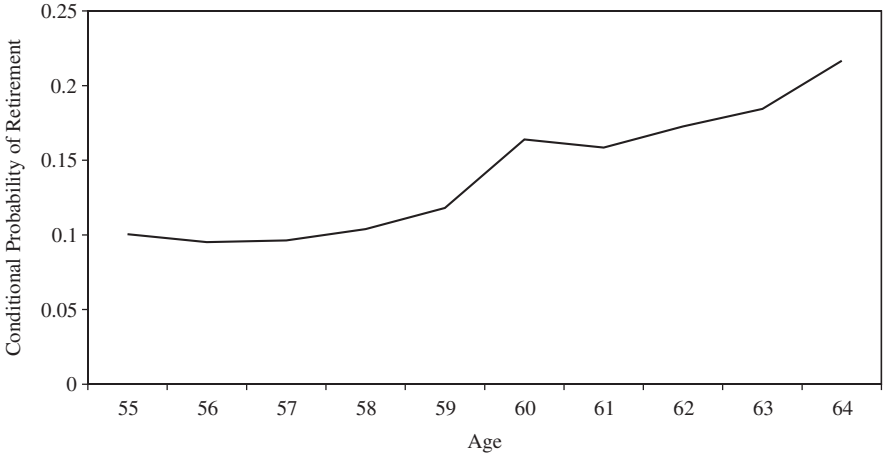

FIGURE 2 The Conditional Probability of Retirement at Different Ages Calculated from the Female Sample

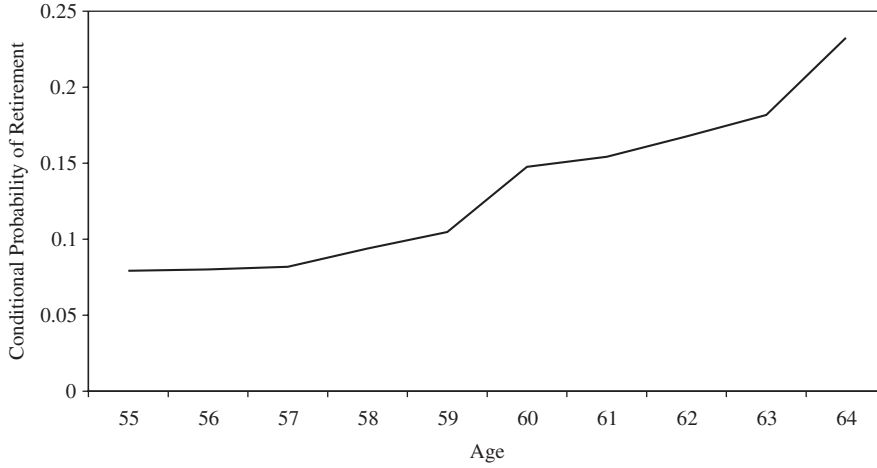

FIGURE 3 The Conditional Probability of Retirement at Different Ages Calculated from the Male Sample

of the labour force, so the average conditional on labour force participation would be higher.

The hazard rates to retirement in our sample are presented in figures 2 and 3 for males and females, respectively. For both sexes the hazards are relatively flat through the 50s leading to a jump at age 60. This is the first age that individuals can claim CPP/QPP benefits. For males the hazard continues to rise through the 60s, with another pronounced jump at age 64, the year before the mandatory retirement age in many jurisdictions. For females the hazard levels off at ages 61 through 63 and then jumps at age 64, as in the male sample.

In table 2 we present summaries of our incentive measures by age. We report the median value, as well as the 1st and 9th deciles and the standard deviation to give some indication of their variation. For both males and females the one-year accrual is positive at the median until age 60, but then turns sharply negative. This implies that there is an incentive to retire and start drawing Income Security benefits at age 61.

A number of factors influence the patterns of accruals in the table. At early ages, years of extra work can improve CPP/QPP entitlements if the extra year of work replaces a poor earnings year in the APE calculation. Starting at age 60, extra work implies that a year of potential CPP/QPP pension receipt has been forgone. However, the eventual CPP/QPP entitlement grows through the actuarial adjustment, which is intended to keep the present discounted value of benefits roughly constant across retirement ages. It is important to note that, if a pensioner will receive GIS after age 65, then half of any increase to the CPP/QPP pension through the actuarial adjustment will be clawed back from the GIS payment. In other words, the GIS acts as a 50% surtax on the actuarial adjustment. This accounts for the sharp decrease in the one-year accrual starting at age 60 at the 1st decile, but not at the median.[35]

The peak value accrual displays a similar pattern to the one-year accrual, turning from positive to negative at age 61. There are no strong non-linearities at the median of the one-year accrual, so the peak value calculation does not convey much additional information. Also, note that the peak value and one-year statistics are identical once the one-year accrual turns negative.

Finally in the last columns are the statistics for the option value accrual. They are in units of utility and so are hard to interpret. Their most important characteristic is that in contrast to the two other measures, the option value accrual remains positive throughout the age range. This reflects the fact that the optimal retirement age for our assumed parameters at the median is about age 71.

In table 3 we report estimates of equation (1) for males. Moving across blocks, we vary the incentive measures, while moving across columns within blocks, we sequentially add control variables to the estimating equation. The results in the first block are for the one-year accrual. In the first column (specification 1) there are no other control variables, so the Income Security variables can have their maximum impact. The estimate for the level of Income Security Wealth is, surprisingly, negative, suggesting that leisure may be an inferior good. This could result from the mechanical relationship between Income Security Wealth and lifetime wages. Variation in lifetime wages may in turn capture heterogeneity in work preferences. Because we do not separately control for lifetime wages in this specification, the estimate on Income Security Wealth may simply reflect the fact that higher lifetime earners have both higher levels of Income Security Wealth and greater preferences for work.

35 The percentage of OAS pensioners in receipt of the GIS was roughly 40% during our sample period. In 2001 the percentage was 34.6.

TABLE 2
The Distribution of Different Measures of Income Security Wealth Accrual

			One-Year Accrual				Peak Value Accrual				Option Value Accrual			
Age	N	Median ISW	Median	1st Decile	9th Decile	Std. Dev.	Median	1st Decile	9th Decile	Std. Dev.	Median	1st Decile	9th Decile	Std. Dev.
Male Sample														
55	60286	157853	1636	586	2504	707	4824	1608	13433	4807	22972	9203	36292	15214
56	63460	165216	1418	6	2622	954	3720	255	11940	4787	21426	9714	33320	14399
57	65700	171713	971	0	2685	1066	2190	0	10133	4391	18998	8645	29810	13679
58	66687	177573	632	0	2745	1128	1354	0	8087	3797	16512	6954	26440	12733
59	66761	182815	420	0	2826	1179	925	0	6087	3119	14063	5390	23148	11750
60	60578	188676	49	−1929	2443	1622	77	−1929	4212	2985	12216	4203	20365	10169
61	52427	193976	−388	−2237	1840	1571	−386	−2237	2456	2525	10449	3223	17573	9890
62	44954	195554	−1024	−3041	1110	1598	−1024	−3041	1484	2229	8757	2197	14907	9350
63	38168	197002	−1651	−3792	580	1754	−1651	−3792	756	2095	7144	1256	12412	8789
64	31818	188842	−2196	−4440	149	1931	−2196	−4440	205	1975	5589	564	10077	7871
Female Sample														
55	43104	155089	915	152	2050	699	3905	1055	10341	3758	14659	4095	27767	9819
56	43870	147083	865	141	2079	734	3451	672	9466	3598	13850	4662	24947	8777
57	44122	145894	825	63	2124	783	2699	327	8148	3281	12261	4309	22115	7748
58	43482	148384	757	0	2145	831	1935	81	6642	2857	10719	3632	19456	6810
59	42452	152285	701	0	2197	877	1170	0	5127	2488	9175	2852	16967	6094
60	36937	156092	164	−1487	2099	1390	293	−1484	4016	2568	7936	2196	14936	5556
61	30662	160337	−63	−1722	1651	1335	−41	−1722	2824	2214	6848	1776	13016	5253
62	25357	165506	−518	−2248	1029	1340	−515	−2246	1769	1908	5730	1274	11070	4822
63	20839	169825	−1040	−2846	669	1441	−1038	−2846	1070	1768	4661	779	9211	4149
64	16950	173793	−1406	−3404	399	1580	−1405	−3404	538	1666	3585	363	7665	3878

NOTES: N = number of observations, Income Security Wealth = Income Security Wealth, Std. Dev. = standard deviation. All dollar values in 1998 Canadian dollars. Definitions of the different measures of Income Security Wealth accrual are provided in the text.

TABLE 3
Estimates of the Retirement Probits with Various Measures of Income Security Wealth Accrual Male Sample

	One-Year Accrual				Peak Value Accrual				Option Value Accrual			
	1	2	3	4	1	2	3	4	1	2	3	4
ISW	−0.010	−0.006	0.018	0.037	−0.012	−0.017	0.013	0.032	−0.004	0.025	0.006	0.035
	(0.0004)	(0.002)	(0.003)	(0.003)	(0.0004)	(0.002)	(0.003)	(0.004)	(0.0004)	(0.002)	(0.004)	(0.004)
$10,000 Increase	−0.20%	−0.12%	0.34%	0.69%	−0.23%	−0.32%	0.26%	0.61%				
Accrual	−1.335	−1.236	−0.537	−0.215	−0.645	−0.600	−0.232	−0.103	−0.376	−0.359	−0.254	−0.043
	(0.012)	(0.023)	(0.035)	(0.032)	(0.007)	(0.011)	(0.020)	(0.017)	(0.008)	(0.012)	(0.043)	(0.020)
$1,000 Increase	−2.43%	−2.23%	−0.98%	−0.39%	−1.23%	−1.12%	−0.43%	−0.19%				
Demographic Controls	NO	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES
Age Dummies	NO	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES
Industry and Pension Controls	NO	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES
Firm Size Controls	NO	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES
Province Controls	NO	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES
Year Controls	NO	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES
APE Earnings Controls	NO	NO	YES	NO	NO	NO	YES	NO	NO	NO	YES	NO
Lifetime Earnings Controls	NO	NO	NO	YES	NO	NO	NO	YES	NO	NO	NO	YES

NOTES: Standard errors in parentheses. Standard errors are corrected for arbitrary heteroscedasticity, with clusters on each individual. All dollar values are in 1998 Canadian dollars. Earnings controls include both own earnings and any spouse or common-law partner earnings. Definitions of the different measures of Income Security Wealth accrual and the control variables are provided in the text.

In later specifications we explicitly control for lifetime wages. The accrual variable has the expected negative sign and is quite large. A $1000 increase in accrual lowers the retirement rate by 2.43 percentage points, which can be compared with a baseline retirement rate in the male sample of 12.2% (table 1). This represents a large drop of 19.9% in retirements.

In the next column we add the demographic controls, industry and RPP coverage, province and year effects, the firm size dummies, and dummy controls for each age. The result is a marginal reduction in the effect of the incentive variable. Note also that the estimated effect of the level of Income Security Wealth continues to be negative but is just over half its previous value.

In the third column we add cubics in current projected earnings and APE, along with the interaction of these cubics. The same set of earnings controls is added for any spouse or common-law partner. This is potentially an important innovation, because Income Security Wealth is mechanically a function of past earnings and accrual depends on current projected earnings, but both of these measures of earnings may have independent effects on retirement. In our results, we do observe quite substantial changes in inference. First, the estimated parameter on the level of Income Security Wealth is now positive as expected. This suggests that in previous specifications, Income Security Wealth was picking up some independent effect of earnings on retirement. An additional $10,000 in Income Security Wealth is estimated to increase the retirement rate by 0.34 percentage points: the expected wealth effect.

Second, the estimate on the one-year accrual variable is now dramatically smaller. An additional $1000 of accrual decreases the retirement rate by only 0.98 percentage points compared with 2.43 percentage points in specification 1. This finding is consistent with the evidence of Coile and Gruber (2000), who use a similar specification, and Chan and Stevens (2001), who compare simple estimates and fixed effects estimates.[36] The incentive effects of the Income Security system would appear to be substantially overestimated in specifications that do not attempt some control for omitted factors correlated with lifetime earnings and individuals' propensities for work.

Finally, in the fourth specification we replace the APE controls with controls for 'lifetime average earnings.' Lifetime average earnings is formed from the earnings histories, updating earnings at each age to 1998 dollars using a real wage index and then taking an average of index-adjusted earnings from 1966 to age 54.[37] Note that in specification 3 lifetime earnings affects retirement only through its effect on APE. The APE formula caps yearly income at the Year's Maximum Pensionable Earnings, which censors the yearly earnings and

36 Chan and Stevens (2001) find a substantial drop in the magnitude of their incentive coefficients when they include individual fixed effects. If the variation picked up by their fixed effects is driven by differences in earnings histories across individuals, then our results are consistent with theirs.

37 The real wage index was created using the Industrial Composite Wage from 1966 to 1984, followed by the Industrial Average Wage from 1984 to 1998, along with the Consumer Price Index. These figures are derived from Statistics Canada (1983) and Statistics Canada (2000).

makes the measure dependent on a parameter of the CPP/QPP program. We again observe a large change in the estimated parameters. Compared with specification 3, the estimated effect of Income Security Wealth doubles and the accrual effect is halved. Nevertheless, the implied sensitivity of retirement to benefits is still large. The estimated impact of a $1000 increase in one-year accrual on retirement is 0.39 percentage points, which is 3.2% of the baseline hazard for males. This is not dissimilar to the magnitude estimated by Coile and Gruber (2000), for example.

A corresponding set of results for the peak value accrual is presented in the succeeding columns of the next block. There are some strong similarities to the one-year accrual results. First, the estimate on the level of Income Security Wealth turns from negative to positive as more controls are added. Second, the estimated effect of the incentive variable falls with inclusion of APE, and again with the lifetime earnings controls. The estimated effects of the Income Security system are smaller here than they are for one-year accrual. For example, in specification 4 a $1,000 increase in peak accrual would decrease the retirement rate by 0.19 percentage points.

In interpreting this result it is important to note that one-year accrual and peak value are identical at the median, starting at age 61, so leverage to distinguish between the two measures is limited. The main difference between the two measures is between ages 55 and 59, where the peak value predicts a greater slope in the run up in retirement rates leading to age 60. Reference to the retirement hazard (figure 2) provides little support for this prediction, however, at least at the mean. Finally, note that a $1000 increase in one-year accrual represents roughly one standard deviation at many ages, but only about a third of a standard deviation for peak value (see table 2). Using a one-standard-deviation increase for each measure, the increment to the retirement probability (specification 4) for the one-year accrual estimate is −0.68 percentage points and −0.82 percentage points for peak value. From this perspective then, the peak value estimate indicates a stronger response than the one-year accrual estimate.

Finally, in the last block are the results for the option value accrual. Note that because the accrual is measured in units of utility, calibrating the marginal effects in dollar values no longer makes any sense. The results for this measure stand in some contrast to the previous results. First, the estimated parameter on Income Security Wealth becomes positive and significant in specification 2. Second, the estimated effect of the accrual incentive variable falls close to insignificance in specification 4 with lifetime earnings controls.

Results for the female sample are reported in table 4. The estimates for the one-year accrual are very similar to that in the male sample. For example, a $1000 increase in one-year accrual for specification 4 lowers the retirement rate by 0.46 percentage points in comparison with 0.39 percentage points in the male sample. The peak value and option value results also exhibit a pattern similar to that of the male counterparts, except that the accrual measure loses significance with the APE controls in specification 3.

TABLE 4
Estimates of the Retirement Probits with Various Measures of Income Security Wealth Accrual Female Sample

	One-Year Accrual				Peak Value Accrual				Option Value Accrual			
	1	2	3	4	1	2	3	4	1	2	3	4
ISW	−0.003	0.000	0.029	0.043	−0.003	−0.006	0.031	0.042	0.006	0.042	0.029	0.038
	(0.001)	(0.002)	(0.003)	(0.003)	(0.001)	(0.002)	(0.003)	(0.003)	(0.001)	(0.002)	(0.003)	(0.003)
$10,000 Increase	−0.06%	0.00%	0.57%	0.83%	−0.05%	−0.12%	0.60%	0.82%				
Accrual	−1.739	−1.914	−0.290	−0.242	−0.783	−0.829	−0.005	−0.060	−0.533	−0.595	−0.027	−0.087
	(0.020)	(0.033)	(0.037)	(0.037)	(0.011)	(0.017)	(0.018)	(0.016)	(0.007)	(0.011)	(0.016)	(0.015)
$1,000 Increase	−3.23%	−3.48%	−0.55%	−0.46%	−1.54%	−1.61%	−0.01%	−0.12%				
Demographic Controls	NO	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES
Age Dummies	NO	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES
Industry and Pension Controls	NO	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES
Firm Size Controls	NO	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES
Province Controls	NO	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES
Year Controls	NO	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES
APE Earnings Controls	NO	NO	YES	NO	NO	NO	YES	NO	NO	NO	YES	NO
Life Earnings Controls	NO	NO	NO	YES	NO	NO	NO	YES	NO	NO	NO	YES

NOTES: Standard errors in parentheses. Standard errors are corrected for arbitrary heteroscedasticity, with clusters on individuals. All dollar values are in 1998 Canadian dollars. Earnings controls include both own earnings and any spouse or common-law partner earnings. Definitions of the different measures of Income Security Wealth accrual and the different control variables are provided in the text.

To aid interpretation of these estimates we can estimate the contribution of Income Security incentives to trends in retirement over our sample period. In the male sample, the rate of retirement increased from 0.100 in 1985 to 0.156 in 1995. Over this same time period, the average Income Security Wealth in our sample increased by $15,225 to $180,121, and the average one-year accrual dropped by −2,605 to −985.[38] These average changes can be combined with the estimated parameters to find the increase in the probability of retirement that is associated with the change in incentives. Using specification 3 and the one-year accrual measure, our estimates imply that the change in incentives led to a 0.032 increase in the retirement rate, which is 58.4% of the overall 0.056 increase. Using specification 4 and the one-year accrual, the incentives account for 21.7% of the increase in retirement. These magnitudes are typical compared with those from our other incentive measures. Overall, these calculations indicate that the incentives in Canada's Income Security programs make a major contribution to retirement decisions.

7. Sensitivity analysis

Given our argument that identification in retirement models can be problematic, it is important to provide some additional checks on the inference in tables 3 and 4. In tables 5 and 6 we assess the sensitivity of our inference on a number of margins. One important issue is the definition of retirement. Our working definition clearly misses some of the paths individuals take to this state. For example, individuals may effectively retire but still generate some earnings through occasional employment, and these earnings would lead us to label the individual as still working.

We adopt two alternative definitions of retirement, which capture dimensions of this heterogeneity. In the first we allow for the possibility that individuals may proceed to retirement through a period of unemployment, funded by Unemployment Insurance benefits.[39] This is possible because Unemployment Insurance benefits generate a T4U form that is recorded in our data. We model this possibility by pooling unemployment benefits with earnings for the determination of the retirement year. Retirement under this definition is the year preceding the first year of zero combined unemployment benefits and earnings. In the second definition, we designate large reductions of earnings as retirement, without demanding that the reduction be to zero. To make this operational, we use the

38 One of the main contributing factors to these changes in incentives was the introduction of early retirement in the CPP in 1987. This can be seen in the retirement rates of those aged 60 who became eligible for early retirement. Among 60-year-old males in our sample, the retirement rate increased from 0.108 to 0.160 during 1985 to 1995 in provinces outside Quebec, but stayed nearly constant in Quebec at 0.159 in 1985 and 0.160 in 1995.

39 Unemployment Insurance is now called Employment Insurance. We use the older term, since it corresponds to the program name in place during our sample period.

TABLE 5
Sensitivity Analysis – Males

	One-Year Accrual		Peak Value Accrual		Option Value Accrual	
	ISW	Accrual	ISW	Accrual	ISW	Accrual
Base	0.037	−0.215	0.032	−0.103	0.035	−0.043
	(0.003)	(0.032)	(0.004)	(0.017)	(0.004)	(0.020)
	0.69%	−0.39%	0.61%	−0.19%		
Estimates by Alternative Definitions of Retirement						
UI Definition	0.044	−0.321	0.044	−0.054	0.043	−0.060
	(0.003)	(0.034)	(0.004)	(0.013)	(0.004)	(0.021)
	0.73%	−0.51%	0.72%	−0.09%		
Earnings Definition	−0.005	−0.264	−0.008	−0.073	0.005	0.118
	(0.003)	(0.029)	(0.003)	(0.016)	(0.004)	(0.034)
	−0.10%	−0.52%	−0.16%	−0.15%		
Estimates by Predicted Probability of RPP Participation						
RPP Low	0.024	−0.338	0.019	−0.111	0.017	−0.140
	(0.004)	(0.043)	(0.004)	(0.021)	(0.004)	(0.022)
	0.45%	−0.61%	0.35%	−0.20%		
RPP High	0.054	−0.054	0.051	−0.053	0.059	0.051
	(0.004)	(0.035)	(0.005)	(0.016)	(0.004)	(0.016)
	1.02%	−0.10%	0.96%	−0.10%		
Estimates by Age Lifetime Income Quartile						
1st Quartile	0.056	−0.672	0.054	−0.122	0.045	−0.228
	(0.006)	(0.056)	(0.006)	(0.026)	(0.006)	(0.024)
	1.12%	−1.13%	1.08%	−0.24%		
2nd Quartile	0.059	0.069	0.068	0.133	0.040	−0.268
	(0.006)	(0.054)	(0.007)	(0.027)	(0.007)	(0.035)
	1.05%	0.12%	1.21%	0.23%		
3rd Quartile	0.048	0.393	0.059	0.181	0.041	−0.080
	(0.006)	(0.054)	(0.006)	(0.029)	(0.007)	(0.032)
	0.89%	0.73%	1.10%	0.33%		
4th Quartile	0.029	0.120	0.026	−0.049	0.039	0.136
	(0.006)	(0.055)	(0.006)	(0.029)	(0.006)	(0.020)
	0.54%	0.22%	0.48%	−0.09%		

NOTES: Standard errors in parentheses. Standard errors are corrected for arbitrary heteroscedasticity, with clusters on individuals. Marginal effects are reported below the standard errors were applicable. They represent the percentage point increase implied by the corresponding coefficient for an increment of $1,000 for the accrual measures and $10,000 for the Income Security Wealth measures. All dollar values are in 1998 Canadian dollars. Definitions of the different measures of Income Security Wealth accrual are provided in the text. All estimates are for specification 4 (see tables 3 and 4).

retirement test that applies to all individuals claiming CPP or QPP benefits at ages 60 through 64. The test requires that in the year benefits are claimed, earnings be no more than the maximum retirement pension: roughly 25% of a three-year moving average of the Year's Maximum Pensionable Earnings (roughly average labour market earnings). We define retirement as the year preceding the first year that earnings fall below the threshold. By this definition, a transition from full-time employment to part-time work may now be labelled retirement.

TABLE 6
Sensitivity Analysis – Females

	One-Year Accrual		Peak Value Accrual		Option Value Accrual	
	ISW	Accrual	ISW	Accrual	ISW	Accrual
Females						
Base	0.043	−0.242	0.042	−0.060	0.038	−0.087
	(0.003)	(0.037)	(0.003)	(0.016)	(0.003)	(0.015)
	0.83%	−0.46%	0.82%	−0.12%		
Estimates by Alternative Definitions of Retirement						
Unemployment	0.043	−0.215	0.044	0.001	0.041	−0.042
Insurance Definition	(0.003)	(0.039)	(0.003)	(0.019)	(0.004)	(0.018)
	0.71%	−0.34%	0.72%	0.00%		
Earnings Definition	0.028	−0.203	0.025	−0.072	0.027	−0.006
	(0.003)	(0.041)	(0.003)	(0.020)	(0.003)	(0.017)
	0.62%	−0.45%	0.57%	−0.16%		
Estimates by Predicted Probability of RPP Participation						
RPP Low	0.046	−0.238	0.046	−0.046	0.042	−0.087
	(0.004)	(0.051)	(0.004)	(0.022)	(0.004)	(0.020)
	0.94%	−0.55%	0.93%	−0.09%		
RPP High	0.036	−0.179	0.036	−0.030	0.032	−0.060
	(0.005)	(0.057)	(0.005)	(0.026)	(0.006)	(0.025)
	0.66%	−0.32%	0.66%	−0.05%		
Estimates by Age Lifetime Income Quartile						
1st Quartile	0.038	−0.693	0.038	−0.077	0.036	−0.062
	(0.006)	(0.109)	(0.006)	(0.032)	(0.005)	(0.029)
	0.83%	−1.45%	0.84%	−0.17%		
2nd Quartile	0.056	−0.400	0.052	−0.156	0.048	−0.122
	(0.006)	(0.086)	(0.006)	(0.038)	(0.006)	(0.033)
	1.07%	−0.72%	1.00%	−0.29%		
3rd Quartile	0.052	−0.424	0.049	−0.056	0.045	−0.066
	(0.007)	(0.081)	(0.007)	(0.041)	(0.008)	(0.036)
	0.94%	−0.73%	0.88%	−0.10%		
4th Quartile	0.035	0.158	0.035	0.002	0.029	−0.090
	(0.007)	(0.073)	(0.007)	(0.036)	(0.007)	(0.031)
	0.79%	−0.52%	0.67%	0.00%		

NOTES: Standard errors in parentheses. Standard errors are corrected for arbitrary heteroskedasticity, with clusters on individuals. Marginal effects are reported below the standard errors were applicable. They represent the percentage point increase implied by the corresponding coefficient for an increment of $1000 for the accrual measures and $10,000 for the Income Security Wealth measures. All dollar values are in 1998 Canadian dollars. Definitions of the different measures of Income Security Wealth accrual are provided in the text. All estimates are for specification 4 (see tables 3 and 4).

The results are presented in table 5 for males and table 6 for females. As a point of comparison, in the first row of each table we simply replicate the estimates from specification 4 in tables 3 and 4. For males, the Unemployment Insurance definition leads to similar or larger estimates of both effects. More important, the marginal effects for a $1000 increase in accrual are very similar

to the base results for both the one-year and peak value measures. The estimates for the earnings definition tell a similar story. Here the marginal effects for the accrual measures are similar to the base results, but the estimated effect of Income Security Wealth becomes insignificant.[40] The conclusion here is that changing the definition of retirement has little effect on the one-year and peak value results for males.

The results for females show more variation. In the Unemployment Insurance results the peak value estimate is insignificant and the option value estimate is half of its previous value. For the earnings definition, only the option value estimate loses significance. In all cases, the estimated impact of Income Security Wealth is similar to the base case.

In the next rows of each table we determine whether the inference varies in sensible ways as we attempt to isolate those individuals who should be relatively more responsive to Income Security program parameters. The Income Security system will be only one element of retirement income for some individuals. For example, employment-based pensions may also play an important role. In these cases we might expect that the parameters of the employment based pension rules would also affect retirement behaviour, and so Income Security program parameters would be less important. To make this idea operational we split the sample by the imputed probability of RPP coverage. Those with a probability of less than 0.5 are denoted as 'RPP low,' while the remainder of the sample is denoted 'RPP high.' Note we are implicitly assuming that the assignment of individuals to these two groups is exogenous to any preferences for retirement that also affect any behavioural response to the Income Security system.

The results are reported in rows 4 and 5 of tables 5 and 6. As expected, we observe larger behavioural effects for both males and females in the RPP low group. These are the individuals who are predicted to be more dependent on Income Security income, and so their labour supply decisions are more sensitive to program rules. The proportionate differences in the accrual effects are largest for the one-year measure, while the proportionate changes in the effect of Income Security Wealth tend to be very similar for the one-year and peak value accrual specifications.

In the next rows we take a different approach. Here we divide the sample into quartiles based on lifetime average earnings through age 54. For both males (one year and peak value) and females (one year), we see larger behavioural effects among low-income individuals, although the relationship is not monotonic. Again, the assumption is that these individuals will be more dependent on Income Security income in their retirement years, and consequently their retirement decisions are more dependent on Income Security program parameters. This systematic variation in the estimates across individuals by their predicted dependence on the Income Security system gives us greater confidence that we are capturing the behavioural effects of Income Security program parameters.

40 Using specifications 1 to 3 with the earnings-based definition, the estimated effects of Income Security Wealth were similar to the base results.

8. Conclusions

This paper provides estimates of the retirement incentives of the Canadian Income Security system. Our results suggest that this system has significant effects on the retirement decisions of males and females in Canada. The estimated effects are larger and more robust for males. Also, we obtain the largest effects when we use relatively myopic measures of the incentives. Our results indicate that Canada's Income Security system makes a substantive contribution to retirement decisions. For example, in our preferred specification we estimate that Income Security incentives account for over 20% of the rise in the retirement rate of males over the sample period.

We also make a more general contribution to the retirement literature by evaluating the identification of the incentive effects we estimate. Controlling for lifetime earnings in a flexible way leads to substantially smaller estimates of these behavioural effects. This finding adds to the evidence in Coile and Gruber (2000) and Chan and Stevens (2001) that identification in retirement models can be problematic. Furthermore, differences in the estimates across specifications that control for lifetime earnings versus capped program-dependent earnings have implications for other researchers. For example, the Health and Retirement Survey in the United States reports only the capped Social Security earnings for each year.

Relative to comparable estimates for the U.S. in Coile and Gruber (2000), our results suggest that Canada's Income Security programs have quite large effects on retirement decisions. They find that each $1000 in peak value lowers retirement by 0.052%. On the other hand, we find that each $1000 in peak value lowers retirement by at least 0.19% (in our most stringent specification). They also find that each $10,000 in Social Security Wealth raises retirement probabilities by roughly 0.2%; we find that each $10,000 in Income Security Wealth raises retirement probabilities by roughly 0.6%. So these findings suggest that the responses to the IS system in Canada are larger than those to the Social Security system in the U.S.

Finally, these results potentially have important implications for the reform of Income Security policy. Evaluation of proposed pension reforms must account for the dynamic effect of the reformed system on retirement decisions. Reform of Income Security programs affects fiscal balances mechanically as benefits change, but also by inducing changes in the timing of retirement. Depending on the reform under consideration, this may increase or decrease its fiscal impact relative to an evaluation assuming static retirement behaviour.

Appendix

Census data

The data are samples of males and females aged 54 and older from the 1986 and 1991 public use microdata files. Non-labour income is defined as the sum of

'Investment Income of census family or non-family person' plus 'Retirement pensions and other money income of census family or non-family person' (recorded separately as 'Retirement Pensions, Superannuations and Annuities of census family or non-family person' and 'Other Money Income of census family or non-family person' in the 1991 sample). Separating individuals who work (weeks and earnings greater than 0) and don't work (weeks and hours equal to 0), the probability non-labour income is positive and its conditional mean are calculated for the following cells:

Males who are employed: region (East; Ontario; West) by industry (Manufacturing; Construction; Transportation and Communications; Wholesale and Retail Trade; FIRE and Business Services; Government, Health and Education Services; Accommodation, Food, Beverage and Other Services) by age (54–55, 56–57, . . . , 60–61, 62–64, 65+),

Males who are not employed: region (East; Ontario; West) by marital status (married, spouse/common-law partner's age $<$ age $-$ 1; married, spouse/common-law partners age $=$ age1$+/-$1; married, spouse/common-law partner's age $>$ age $+$ 1; not married) by age (54–60, 61–63, 64–66, . . . , 73–75, 76+),

Females who are employed: same as for males who are employed.

Females who are not employed: same as for males who are not employed except the age groups (54–60, 61–63, 64–66, . . . , 73–75, 76–80, 81+).

Labour market activity survey and survey of labour and income dynamics data

These data are cross-section samples from the 1986–90 Labour Market Activity Survey and the 1993–96 Survey of Labour and Income Dynamics. In each year, samples of males or females, aged 23–69, who are paid workers in jobs in the month of September of the indicated year, are constructed. The RPP coverage probabilities are then calculated by 3-digit industry. Probabilities for 1991–92, the two years not covered by the Labour Market Activity Survey or Survey of Labour and Income Dynamics, are simple linear interpolations of the 1990 and 1993 data.

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