Income Security Programs and Retirement in Canada

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Part 1: Introduction

Government transfers to older persons in Canada are one of the largest and fastest growing components of the government budget. Total expenditures on the three primary transfer programs for older Canadians amounted to $22.7 billion in 1998/99 (current dollars), which represented 20 percent of program spending in the federal budget of that fiscal year. In 1974/75, total expenditures were only $3.4 billion (current dollars), amounting to just 10 percent of program spending. The contributory public pension faces fiscal similar pressures. In 1975 contributions per capita exceeded benefits per capita by roughly $200 (1998 dollars). By 1998, it was benefits per capita that exceeded contributions per capita by roughly $200 (Baker and Benjamin 1999c). Moreover, without changes to the system, these trends will likely continue in the foreseeable future. The ratio of persons aged 65 and over to persons aged 20-64 is projected to grow from its current level of 19 percent to over 40 percent by the year 2075. As a result, the payroll tax necessary to finance the public pension for older persons, the Canada/Quebec Pension plan, will grow from 7.0 percent in of wages in 2000 to 9.9 percent by the year 2003. Similar cost increases are in store for the transfer programs for older Canadians, which are financed from general revenues: the Old Age Security demogrant, and the income tested Guaranteed Income Supplement and the Spouse Allowance programs.

In this context, a notable trend in labour force behavior in Canada is the steady decline in work among many groups of older workers, as documented in Figure 1. It is particularly striking for older males. Note that the participation rate for 45-to 64 year olds masks a large decline among the older individuals in this group. For example, in 1960, 87 percent of men aged 55-64 were participating in the labour force; by 1999, this proportion had fallen to 61 percent. For

females, any trend towards earlier retirement appears to be swamped by the century long secular increase in the participation of women.

These time series span a period in which there were a variety of changes in the structure of Income Support programs for older persons that has made retirement more attractive and work less attractive. In 1960, for example, workers under the age of 70 were not entitled to any income support upon retirement. By the mid-1990s, however, married low-income workers could receive public retirement benefits that actually exceeded their pre-retirement incomes (Gruber, 1999). Of course, it is difficult to causally relate these time trends; there were many other developments over this time period, such as growing private pension coverage and rising incomes, which may have also contributed to the decline in work among older Canadians.

In the U.S., where there are similar trends, there is an extensive literature that examines the relationship across individuals between Social Security entitlements and retirement decisions.[1] This research mostly suggests that Social Security incentives play an important role in retirement decisions, but a modest one relative to the time trends. In contrast, there is little complementary work in the Canadian context.[2] Recent studies have examined the impacts of changes in some of these programs in isolation. Baker and Benjamin (1999a) analyze the effects of the removal of the earnings tests from the CPP and QPP in the 1970s. They also examine the impact of the introduction of an early retirement option to the QPP in 1984 and to the CPP in 1987 (Baker and Benjamin 1999b, 1999d). Finally, Baker (1999) investigates the effects of the introduction of the Spouse's Allowance in 1975 on the labour market behaviour of eligible couples. To our knowledge, however, there is no previous empirical study that provides a

[1] For a review of the literature and some empirical evidence see Coile and Gruber (1999).
[2] Papers by Burbidge (1987) and Pesando and Rea (1977) provide a careful outline of the potential effects of the various IS programs, but no estimate of their empirical magnitude.

comprehensive analysis of the combined impacts of the web of Canadian Income Security programs.

The purpose of our study is to remedy this deficiency. This is done by drawing on a comprehensive data set (based on the Statistics Canada Longitudinal Worker File) that has information for a very large sample of older Canadians on their earnings histories, work decisions, marital status and spousal characteristics, and the characteristics of their jobs. These data are employed to construct a simulation model that incorporates the incentives for retirement under the three pillars of the Canadian public Income Security (IS) system: the Canada Pension Plan/Quebec Pension Plan; the Old Age Security (OAS) system comprising the basic OAS benefit; the Guaranteed Income Supplement (GIS) and the Spouse Allowance (SPA).

For each person in our data set, the financial incentives for retirement are computed along two dimensions. First, the present discounted value of all future entitlements to benefits from the different programs of the public IS system is calculated. This measure of Income Security Wealth (ISW) is recalculated for each year the person appears in our data set to reflect the changes to their benefit entitlements. The second dimension is a measure of how ISW evolves through time. By comparing the ISW of the person if he/she retired in the present year to the ISW of the person if he/she worked an extra year, an ISW accrual measure can be calculated. Several different measures of accrual are contemplated, which alternatively assume that individuals look only one year forward in making their retirement decision, and that individuals look forward to some "optimal" retirement date in making their decision. An empirical model of the retirement decision as a function of these incentive variables, as well as a rich set of control variables designed to capture other impacts on retirement, is then estimated.

There are two findings of importance. First, for the typical worker, the public IS system provides increasingly strong disincentives to work after age 60. Workers actually see the present discounted value of their IS entitlement fall from additional work after age 61, and by age 69 the reduction in IS entitlement amounts to 43 percent of what they would earn in that year. Second, there is a significant impact of these disincentives on work decisions. Using both one-year and more forward looking measures, we estimate that workers with larger returns to additional work are less likely to leave the labor force.

Part II: Background

The decision to retire in Canada is made in the context of a complicated web of program incentives.

The Old Age Security System

The oldest component of the Income Security system for older Canadians is the OAS System, which was put into place in 1952, replacing a provincially run income tested benefits system that had existed since 1927. This program is available to anyone aged 65 or over who meets certain residence requirements.[3] The program originally provided benefits to those of age 70 or over, and the age of eligibility was dropped to 65 over a five-year period beginning in 1966.

The OAS pension itself is a uniform demogrant that was equal to $419.92 in March 2000. Individuals who do not fully meet residence requirements may be entitled to a partial OAS

[3] Individuals must have been a Canadian citizen or legal resident of Canada at some point before application, and have resided in Canada for at least 10 years (if currently in Canada) or 20 years (if currently outside Canada). The benefit is prorated for pensioners with less than 40 years of Canadian residence, unless they are "grandfathered" under rules that apply to the persons who were over age 25 and had established attachment to Canada prior to July 1977.

benefit. OAS benefits have been indexed to the Consumer Price Index (CPI) since 1972. OAS benefits are fully taxable. In addition, there is a clawback of OAS benefits from very high-income individuals; the OAS for an individual is reduced by 15 cents per dollar of personal net income exceeding $53,215. The OAS basic benefit is financed from general taxation revenues.

The Canada/Quebec Pension Plan

The largest component of the income security system is the Canada Pension Plan (CPP) and Quebec Pension Plan (QPP). These programs began on January 1, 1966, and are administered separately by Quebec for the QPP, and the federal government for the CPP.

The plan is financed by a payroll tax of 3.5 percent (2000) each, on both employers and employees. This payroll tax is levied on earnings between the Year's Basic Exemption ($3,500) up to the Year's Maximum Pensionable Earnings (YMPE), $37,600 in 2000 (which approximates median annual earnings). The YMPE is indexed to the growth in average wages in Canada.

Eligibility for this plan is conditioned on contributions in at least one calendar year during the contributory period, which is the period from attainment of age 18, or January 1, 1966 if later and normally extended to age 70 or commencement of the retirement pension, whichever is earlier. Benefits are then computed in several steps.

First, the number of months used to compute the retirement pension is determined by subtracting from the number of months in the contributory period, months (a) receiving a disability pension, (b) spent rearing small children,[4] (c) between age 65 and the commencement of the pension[5], and (d) 15 percent of the remaining months. The last three of these conditions is subject to the provision that it not reduce the contributory period below 120 months after taking

[4] This is defined as months where there was a child less than 7 years of age and the worker had zero or below average annual earnings.

into account the allowable offset for months of disability pension receipt. In addition, excess earnings in one month above 1/12 of the YMPE may be applied to months in the same year where earnings are below 1/12 of the YMPE.

Second, the remaining months of earnings history are converted to current dollars, using the following adjustment factor – up to 1998, the ratio of the YMPE in each year to the average of the YMPE over the three years prior to (and including) the year of pension receipt. This average was raised to four years for benefits claimed in 1998 and five years for benefits beginning in 1999. Finally, the benefit is computed as 25 percent of the average of this real earnings history. This 25 percent ratio has been in place since 1976; from 1967-1976, the program was phased in, with the share of average earnings paid out in benefits rising from 2.5 percent in 1967 to 25 percent in 1976. The maximum retirement benefit is $762.92 in 2000.

Until 1984 for the QPP and 1987 for the CPP, benefits could not be claimed before the 65th birthday, and there was no actuarial adjustment for delayed claiming. Beginning at these times, individuals were allowed to claim benefits as early as age 60, with an actuarial reduction of 0.5 percent for each month of early claiming (before age 65), and an actuarial increase of 0.5 percent for each month of delayed claiming (after age 65, and up to the age of 70).

Since this early retirement provision has been in place, about half the new CPP recipients each year have claimed a retirement benefit before the age of 65. The Office of the Superintendent of Financial Institutions (OSFI) estimated that after 1991, a CPP pension for someone retiring before the age of 65 was, on average, 82 percent of what it would have been had they not opted for early retirement.[6]

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[5] Periods after age 65 to age 70 can be substituted for periods prior to age 65 if this will increase their future retirement pension.

[6] Special calculations for the 1992 Old Age Security Program Evaluation performed by OSFI.

Initially, receipt of benefits between ages 65 and 70 under the CPP and QPP was conditioned on low earnings levels, with earnings above these ceilings taxed away at high rates. In 1975 and 1977, these earnings tests were eliminated from the CPP and QPP, respectively. With the introduction of early retirement in the 1980s, workers can only claim early benefits if their annual rate of earnings at that point does not exceed the maximum retirement pension payable at age 65, for the year in which the pension is claimed. This earnings test is only applied at the point of application, however; after that point, there is no additional check on the individual's earnings.[7] Moreover, the earnings test does not apply once the individual reaches age 65.

CPP/QPP benefits are based on an individual's earnings history, and the retirement benefits of one spouse are not linked to that of the other spouse.[8] But there is interdependence through survivor benefits (as well as the interdependencies through the income-tested programs described below). Spouses are eligible for survivor pensions if the deceased contributor made contributions for the lesser of 10 years or one third of the number of years in the contributory period, and if the spouse is over age 45 or is disabled or has dependent children. For non-disabled spouses with children, the CPP benefit is pro-rated downward by age between 45 and 35.[9] For spouses under age 65, the survivor pension is a combination of a flat rate portion plus 37.5 percent of the earnings-related pension of the deceased spouse. For spouses age 65 and above, the survivor's pension is equal to 60 percent of the earnings-related pension. The pension used to calculate the survivor's benefit is not subject to actuarial adjustment. If the surviving

[7] There are no restrictions on returning to work after the benefit is being paid.

[8] Couples do have the option of sharing their benefits for income tax purposes, since taxation is at the individual level. Each spouse can claim up to half of the couple's total CPP/QPP pension credits. The exact calculation depends on the ratio of their cohabitation period to their joint contributory period.

spouse is receiving his or her own CPP disability or retirement pension then the combination of the earnings-related portion of the two pensions cannot exceed the maximum retirement pension available in the year. Under changes made effective in 1998, the two benefits do not stack up to this ceiling; rather the contributor receives the larger of the two earnings-related portions plus 60 percent of the smaller. As well, if under the age of 65, the survivor receives the flat rate portion of the survivor benefit or, if a disability pensioner, the (larger) disability flat rate benefit only.

Children of deceased contributors are also entitled to a CPP survivor's benefit if under 18 or a full time student between 18 and 25; this benefit is a flat amount. The corresponding QPP benefit ends at age of 18. There is also a lump sum death benefit, which is generally equal to one-half of the annual CPP/QPP pension amount up to a maximum ($3,500 in 1997)[10].

Since 1973 benefits have been legislated to increase annually with the CPI: this annual indexation factor is the ratio of the CPI average over the 12 month period ending with October of the preceding year to the average of the prior 12 month period. Benefits are fully taxable by the federal and provincial governments.

Another dimension of the CPP/QPP that is potentially important here is the disability benefit program. This program provides benefits to those workers unable to work due to disability. The basic benefits structure consists of two portions: a flat-rate portion, which is a lump sum paid to all disabled workers; and an earnings-related portion, which is 75 percent of the applicable CPP/QPP retirement pension, calculated with the contributory period ending at the date of disability. This program is fairly stringently screened, and fewer than 5 percent of older Canadian men are on CPP/ QPP disability.

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[9] QPP rules for younger surviving spouses differ from those of the CPP.
[10] Under the 1997 legislation, this maximum is fixed at $2,500 for all years after 1997, and in the case of the QPP all death benefits are set at this level.

The maximum CPP disability benefit was increased by 30 percent per month in 1987. Earlier disability coverage was also extended to new entrants. As well, persons receiving survivor benefits no longer had their benefits discontinued on remarriage.

The Guaranteed Income Supplement and Spouse's Allowance

GIS is an income-tested supplement available to recipients of OAS that was introduced in 1967. Individuals must re-apply for the GIS each year, and the income test for eligibility is repeated. The definition of income for the purpose of income testing is the same as for income tax purposes, with the important exclusion of OAS pension income. Unlike the OAS clawback or CPP/QPP, GIS benefits are based on family income levels.

There are separate single and married guarantee levels for the GIS; in 2000 (January to March), these were $499.05 for singles and $325.06 (per person) monthly for married. Benefits are then reduced at a rate of 50 percent as other income rises, although a couple with one member over age 65 and one under age 60 is taxed at only 25 percent with an initial amount of income exempted.

The SPA, which was introduced in 1975, is an income-tested monthly benefit available to 60-64 year old spouses of OAS recipients and to 60-64 year old widows/widowers. For the spouse of an OAS recipient, the benefit is equal to the OAS benefit plus GIS at the married age; the OAS portion is reduced by 75 percent of other income until it is reduced to zero, and then the combined GIS benefits of both spouses are reduced at 50 percent, as other income rises. For a widowed spouse, the benefit is equal to the OAS plus GIS at the widowed rate, and is "taxed-back" equivalently. Both the GIS and SPA guarantees are also indexed to inflation, and neither source of income is taxable by either the federal or provincial governments.

Other Public Programs

In addition to the federal retirement programs, there are a variety of provincial programs that provide supplements to low-income retirees. For example, the GAINS-A program in Ontario provides $80/month to Ontario residents who are recipients of the GIS; these benefits are taxed back at 50 percent as other (non-OAS or GIS) income rises.

Private Pension Coverage

Another important feature of the retirement landscape is private pensions. Defined benefit pension plans share many of the same incentive features as public insurance plans. In fact, many Canadian workers are covered by occupational pensions, or RPP's. In 1997, 41.2 percent of paid workers were covered by occupational pensions, with coverage slightly higher for males than for females (Statistics Canada 1999). Eighty-six percent of plan members were in defined benefit plans, although the share in defined contribution plans has been growing recently. Defined contribution plans may also affect retirement through income effects, but there should not be tax/subsidy effects on the work decision since the payout is not dependent on work patterns.

One weakness of the data that are employed in this study is a lack of information about private pension plan coverage. As a result, it is only possible to include an indicator for whether the individual is likely to have a pension (based on industry of employment), but not for the retirement incentives inherent in that particular pension plan (as is done, for example, in Gruber and Madrian, 1995). The methods and data sources for this imputation are described below.

The Different Paths to Retirement

Given the differences in the age of initial eligibility across the different IS programs, and the availability of other income support programs before the age of 65, there are a variety of

paths that individuals may follow into retirement. Perhaps the most straightforward is from employment onto IS benefits at age 65 or later. At these ages an individual is eligible for all the IS programs so the full potential retirement income from public sources will be available.

Early entitlement for CPP/QPP benefits is available starting at age 60. Receipt is conditioned a one-time retirement test, although beneficiaries are free to work once the test is met. Since other sources of support such as OAS and GIS are not available until age 65, benefit income may be augmented by earnings from full or part time employment. Income is also potentially available from other social insurance programs such as Employment Insurance, although there are conditions (e.g., unemployment) and pension income is deducted from any benefits from this source.

Even if early CPP/QPP benefits are not claimed, Employment Insurance benefits and/or Social Assistance benefits are another potential source of support for older workers and thus a path into IS receipt. Also, disabled individuals are eligible for a CPP/QPP pension prior to age 60 that gets automatically converted to a "retirement pension'' at age 65. Finally individuals who participate in RPP's with attractive early retirement packages may start claiming these benefits as a prelude to IS benefit receipt at later ages.

As explained below, our measure of retirement is based on earnings (or the lack thereof), and therefore employment. We have no direct measure of IS benefit receipt, so alternative definitions of retirement on this basis are not possible. Our data do record Employment Insurance benefit receipt, however, so there is some possibility of tracking individuals who use this path to retirement. Data on other forms of income such as an RPP pension or Social Assistance are not available, however, so these paths are also not visible.

In table 1 we provide a view of the employment and program participation of older Canadians using data from the 1998 Individual Files of the Survey of Consumer Finances. Full-time work declines dramatically for both males and females between the ages of 50 and 64. Between the ages of 60 and 64, 34 percent of men and just 13 percent of women are in this category. A constant fraction of males work part-time in each age group, but for females the proportion displays a moderate decline before age 65 and dramatic falloff in the oldest age group. The proportions not working, and therefore by some measures retired, rise steadily for either sex with age. Interestingly in the age group 60-64, when early CPP/QPP benefit receipt is available, 60 percent of males and 77 percent of females are not working. In the older age group just 10 percent of males and virtually no females are still employed.

The table also reveals that benefits from a variety of programs may support those in the younger age groups that are not working. The proportion drawing a private pension or RRSP benefits rises steadily to almost 1 in 3 males and 1 in 5 females by ages 60-64. Income from Employment Insurance and Social Assistance flows to a relatively constant proportion (17 percent of males and 13 percent of females) between the ages of 50 and 64. The popularity of the early retirement option of the CPP/QPP program for both sexes is apparent: over 40 percent of both males and females between the ages of 60 and 64 receive this sort of income. The statistics also show that females are far more likely to take advantage of the SPA program, and thus receive OAS/GIS/SPA income between the ages of 60 and 64, than males.

This message here, therefore, is that in the late 1990s a majority of older Canadians are not working by ages 60 to 64. In fact a significant minority are not working by ages 55 to 59. Income support at these younger ages may be coming from private pensions and other social

insurance programs. In their early 60s, a significant number of Canadians also avail themselves of the early retirement option in the public pension program.

Part III: Data

There are few Canadian data sets that provide both large sample sizes of older individuals and the information necessary to calculate their incentives to retire. This has hindered research on retirement in Canada. To overcome this obstacle, the analysis here makes use of data from a number of sources. These data provide the most comprehensive setting available in which to study the incentives of the Canadian IS system on retirement.

The primary data source is the Longitudinal Worker File (LWF) developed by the Business and Labour Market Analysis (BLMA) Division of Statistics Canada.[11] It is a 10 percent random sample of Canadian workers for the period 1978-1996. These data are the product of information from three administrative data files: the T-4 file of Revenue Canada, the Record of Employment (ROE) file of Human Resources Development Canada and the Longitudinal Employment Analysis Program (LEAP) file of BLMA.

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 Employment Insurance (EI) premiums.[12][13] The earnings information from this

[11] The construction of the database is described in Picot and Lin, (1997) and Statistics Canada (1998). Our description draws heavily on these sources.

[12] The data include incorporated self-employed individuals who pay themselves a salary, but not other self-employed workers.

[13] The federal program that provides insurance against unemployment changed names *from Unemployment Insurance* to *Employment Insurance* in 1996. In this paper we use *Employment Insurance* throughout when referring to this program.

source has several advantages over its counterparts in survey data and other administrative files. Most importantly, it is based on employers' reports under the provisions of the income tax laws. Therefore, the earnings variable should be free of the measurement error often observed in survey data.

Employers issue ROE forms to employees in insurable employment[14] whenever an earnings interruption occurs. Earnings interruptions result from events such as strikes, layoffs, quits, dismissals, retirement and maternity or parental leave. The reason for the interruption is recorded on the ROE form.

Finally the LEAP is a longitudinal data file on Canadian businesses at the company level. It is the source of information on the company size and industry of the jobs in which employees work.

The LWF data provide information on the (T-4) wages and salaries and 3-digit industry for each job an individual holds in a given year, their age and sex,[15] the province and size (employees) of the establishment for which they work,[16] and their job tenure starting in 1978.

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[14] Over the sample period, insurable employment covers most employer-employee relationships. Exclusion includes self-employed workers, full time students, employees who work less than 15 hours per week and earn less than 20 percent of maximum weekly insurable earnings (20 percent*$750=$150 in 1999). Individuals working in insurable employment pay Employment Insurance (EI) contributions on their earnings and are eligible for EI benefits subject to the other parameters of the EI program.

[15] Information on the age and sex of individuals is taken from the T-1 tax returns which individuals file each year. To obtain this information, therefore, it is necessary that he or she filed a tax return at least once in the sample period.

[16] The records of the LWF data are at the person/year/job level. For some calculations it is necessary to aggregate the data to the person/year level. In years in which an individual has more than one job, there will be multiple measures of tenure, industry, firm size and in some cases province. In these cases the characteristics of the job with the highest earnings for the year are used.

Because T-4's are also issued for EI income we also observe any insured unemployment /maternity/sickness spells.

For current purposes the prime advantage of the LWF data are the earnings histories stretching back to 1978. These were extended further to 1975 for each individual using the T-4 earnings files for these years. For the purposes of calculating CPP/QPP entitlement these histories are still nine years short, however, as these programs started operating in 1966. Our methods of backcasting the missing years are described below.

The focus of the analysis is the period 1985-1996. Separate samples of males and females aged 55 through 69 in 1985 are drawn, and then younger cohorts of individuals are added as they turn 55 in the years 1986-1991.[17] Agricultural workers and individuals in other primary industries are excluded.[18] The sample is selected conditional on working so that the incentives for retirement conditional on being in the labour force are examined. Work is defined as positive T-4 earnings in two consecutive years. If an individual has positive earnings in one year and zero earnings in the next, the year of positive earnings is considered the retirement year. Since T-4's are not issued to the unincorporated self-employed, this definition of retirement will also capture any persons moving from paid employment into this sector.[19] Only the first

[17] Individuals with missing age, sex or province variables are excluded from the sample

[18] 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. For example, individuals in these industries are observed with years of very small earnings (in the hundreds of dollars) and no (or sporadic) evidence of EI benefits, who were too young to collect IS benefits. One possibility is that they are primarily unincorporated self-employed and therefore the majority of their earnings are unobserved.

[19] While older individuals do work in unincorporated self-employment, the proportion doing so remains fairly constant over our sample period. For males, Canadian Census data (Individual Files for 1981, 1986, 1991, 1996) reveal that the proportion of the population of 60-64 year olds (65+ year olds) working in this sector is 0.08-0.09 (0.04) in Quebec and 0.13-0.16 (0.06-0.8) in

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. Finally, individuals are only followed until age 69. The retirement of an individual who has positive earnings in every year up to this age is not observed since it presumably occurs after the age of 69. The working sample, therefore, is a panel data set for the years 1985 through 1996 of individuals between the ages of 55 and 69, who worked in 1985 or in the year they turned 55, whichever is later.[20]

The marital status and any spouses of individuals in our sample are identified using information from the T-1 family file maintained by Statistics Canada. T-4 earnings histories for the period 1975-1996 are then constructed for the spouses, again through reference to the T-4 earnings files for these years.

An important piece of information for calculating retirement incentives that is not available in the LWF data is participation in a RPP. We estimate the probability of RPP coverage by 3-digit industry[21] using cross section samples of males or females from the 1986-1990 Labour Market Activity Survey (LMAS) and the 1993-1996 Survey of Labour and Income Dynamics (SLID). In these surveys individuals are asked if they participate in any RPP. These probabilities are then imputed to individuals in the LWF, matching on industry codes.

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the rest of Canada between 1980 and 1995. For females the statistics are 0.01 (0.00-0.01) in Quebec and 0.2-0.4 (0.01) in the rest of Canada.

[20] ROE's were considered as an alternative source of information on when individuals retired. It was found, however, that generally less than one-third of individuals who retired in the earnings sense (e.g., had zero T-4 earnings), also had "retirement" coded on their last ROE. "Still working" or "unknown" were the most common codes for those in the complementary group. The ROE's, therefore, would appear to impose a restrictive definition of retirement that has an unknown basis.

[21] 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.

Probabilities for the years 1991 and 1992 are simple linear interpolations. The sample definitions for these additional data sources are described in the Appendix.

Part IV: Earnings and Non-Labor Income Projections

The following analysis involves constructing each sample individual's entitlement to IS benefits at any given age, as well as estimates of future entitlements. To calculate the CPP/QPP component, we require a full earnings history from 1966, the year in which the program started. As noted above, our earnings information only extends back until 1975. In estimating future entitlement, we must project future earnings to construct the relevant earnings history. Therefore, both earnings backcasts and forecasts are needed for these calculations.

After experimenting with a number of projection methods, earnings are forecasted by applying a real growth rate of zero percent per year to the average of an individual's observed earnings in the three years preceding the retirement year. Within sample evaluation revealed this method 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.

To backcast the missing earnings data, cohort specific earnings growth rates calculated from the 1972, 1974 and 1976 Census Family files of the Survey of Consumer Finance[22] were applied to a three year average of an individual's last valid earnings observations in the LWF sample. This allows us to construct earnings histories back to 1971. For the remaining five years, earnings growth rates implied by the cross section profile from the 1972 SCF were used,

[22] We use samples of paid workers with positive earnings in the relevant birth cohorts.

appropriately discounted for inflation and productivity gains using the Industrial Composite wage for the period 1966-1970.[23]

The GIS/SPA and OAS components of IS benefits are fully or partly means tested. Our data set contains no information on non-labour income although these are clearly a crucial input to calculating entitlement to these benefits. To project non-labour income, 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.[24] The data for these profiles are from the 1986 and 1991 census family files of the Canadian Census. While the formal definition of the measure of non-labour income is provided in the Appendix, it includes investment income and income from private pensions.

When entitlement is projected in future retirement years, it is necessary to impute the level of non-labour income an individual will receive at different ages when he/she is retired. To do this, we use the age profile for this income for individuals out of the labour market in the relevant sex, region and marital status cell. Likewise, for individuals who continue to work past age 65 (60 for the SPA), it is necessary to impute their level of non-labour income to calculate the benefits they might draw from OAS/GIS/SPA. To do this, the age profile for employed individuals in the relevant sex, region and industry cell is used. The sample and cell definitions that are employed are also described in the Appendix.

Both projected earnings and non-labour income are net of federal and provincial income taxes. Also deducted are the employee's portion of the CPP/QPP payroll tax that they would pay

[23] The data on the Industrial Composite wage are from Statistics Canada (1983). The obvious limitation of this backcasting approach is that we will not predict absences from the labour market, which may be important at younger ages.

[24] The age profiles are appropriately inflated by the CPI for use in future years.

if they worked. In either case the parameters of the tax system are held constant in real terms for all future years.

Part V: Construction of the Incentive Measures

Benefit Entitlements

The retirement incentives inherent in the three pillars of the Canadian Income Security system for seniors are calculated: the OAS, the GIS/SPA and the CPP/QPP. The first step is to calculate an individual's entitlement in any given year. This will involve both his/her entitlements to each of the programs and the entitlements of any spouse.

The OAS benefit is the most straightforward as it is a uniform benefit available to anyone who is 65 years or order. Two possible complications are the residency requirements and the clawback of benefits from high-income recipients. The residency requirement for this benefit is not implemented, as there is no information on the place of birth or year of arrival in Canada of individuals in the sample. The clawback provisions (starting in 1989) are fully implemented, however, based on projections of labour and non-labour income.

The GIS/SPA entitlement is a function of the age requirements described above and family income. The ages of individuals and any spouses are directly observable in the data. The income test on benefits is again fully incorporated based on projections of labour and non-labour income.

As discussed above, non-labour income is projected using census data and matched to our data. For each individual, the OAS and GIS/SPA benefit, entitlement with and without the imputed level of non-labour income is calculated. The two results are then averaged using the cell specific probability that non-labour income is positive as weights.

The calculation of CPP/QPP entitlement involves constructing an individual's and their spouse's earnings history over the contributory period. Given the age range in the sample this is the period starting in 1966. The direct observations on T-4 earnings back to 1975 and predicted earnings in the period 1966-1974 are used. The drop out provisions for years between the 65th birthday and the commencement of retirement and for low earnings months up to 15 percent of the contributory period are fully implemented. Disabilities or time spent in childcare are not observed, however, and therefore deletions for these reasons are not captured.[25] This information in tandem with earnings projections for future years permits the construction of Average Pensionable Earnings (APE) at all future retirement dates for any given individual. The reforms of the CPP/QPP system over the period are also accounted for, including the introduction of early retirement to the CPP, the retirement test on benefit receipt at ages 60-64 and the actuarial adjustment to benefits for initiating benefit receipt at ages other than 65, all in 1987.

Spousal Behaviour

A complete model of family labour supply is beyond the scope of this paper. The simplifying assumption that the spouse starts collecting any entitlement at the earliest age possible under the current rules of IS programs is made: for most of the sample period this is age 65 for OAS and GIS, age 60 for the SPA 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's employment (i.e., retirement). Gruber (1999) and Baker and Benjamin (1999c) provide estimates of age/employment profiles and employment hazards (the conditional probability of

[25] Note that the dropout provisions for child care came in to effect in 1977 under the QPP and 1978 under the CPP. The childbearing years of many females in our sample will have been prior to these dates.

labour market exit) 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 spouses are females. On the other hand, this assumption may prematurely remove the male spouses of individuals in our sample of females from the labour market. This is unlikely to have a large effect on our estimates, as the independence across spouses in determination of most of the benefits means that spousal retirement is only a minor contributor to IS incentive calculations.

The Present Discounted Value of ISW

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

The One-Year Accrual Calculation

We compute a number of different incentive variables using these estimates of the present discounted value (PDV**)** of ISW at all future retirement dates. The first is the one-year accrual of ISW resulting from an additional year of work. In the Canadian system an additional

year of work can raise ISW through the drop out provisions of the CPP/QPP, and it can either raise or lower ISW through the actuarial adjustment of benefits.[26]

The first of these factors is fairly small. In the Canadian system, the contributory period is a fixed age interval, so that other things equal the marginal year replaces only 15 percent of a low earnings year.[27] Furthermore, this benefit is attenuated in the period examined here, by the real decline in the Year's Maximum Pensionable Earnings (YMPE) in the early 1970s. Initially set to match average wages, the YMPE declined dramatically in the initial years of the program, falling to 67 percent of the Industrial Composite wage in 1973.[28] In 1975 both the CPP and QPP were amended to allow the YMPE to rise at a rate of 12 ½ percent per annum until equality with average wages was re-attained, but this did not occur until 1987. The upshot is that even individuals with low wages would have made the maximum contribution to the system in the 1970s. Therefore, a marginal year in the late 1980s and early 1990s would not necessarily dominate earlier years when the relative YMPE was much lower.

Starting at age 60 (in years 1987+ for the CPP) an additional year of work also implies a delay in claiming, and thus both an (upward) actuarial adjustment in benefits and reduction in the years of potential receipt. The actuarial adjustment between ages 60 and 70 is a linear 6 percent per annum.[29] Whether this provides a net increment or decrement to ISW depends on the size of the adjustment relative to the expected number of years of remaining life-time over which

[26] We use here the value of the accrual, rather than normalizing the accrual by earnings to form an implicit tax/subsidy, as is done in Gruber (1999). We do this because we are controlling for earnings itself in the regression model, so that we in essence capture both pieces of the incentive to work (earnings and ISW accrual) separately.
[27] This contrasts, for example, with the U.S. Social Security system where the substitution is one for one: for those with less than 35 years of work the marginal year replaces a zero in the SS calculation; for those with 35 years or more of work it replaces a full low earnings year.
[28] The YMPE equaled 99.8 percent of the Industrial Composite wage in 1966.
[29] CCH Canadian Limited (1996).

benefits will be collected. Given the linear nature of the adjustment, it will clearly become more and more unfair with age. This adjustment also interacts with the income testing of the GIS/SPA program. Low-income individuals may get some of the actuarial reduction in CPP/QPP benefits for early retirement back starting at age 65 through qualification for a higher GIS benefit. This further increases the disincentives for additional work after age 60 for those who are likely to be on the GIS program. Another way of looking at this is that the actuarial increase in benefits for delaying retirement may reduce entitlement to means tested benefits starting at age 65. For these individuals, therefore, the effective actuarial adjustment is less than 6 percent per year and therefore, much more likely to be unfair.

The Peak Value Calculation

Forward looking measures of retirement incentives that involve the future path of ISW are also considered. The simple measure of one-year accrual only accounts for the immediate benefit to working an additional year. But an additional year of work also sustains the option of retiring at an even later date. The value of this choice can be important if there are large non-linearities in the accrual profile. For example, if there is a small negative accrual at age 59, but a large positive accrual at age 60, it would be misleading to say that the system induces retirement at age 59; the disincentive to work at that age is dominated by incentives to work at age 60.

One way of capturing this possibility is to use the "peak value" calculation suggested by Coile and Gruber (1999). Rather than taking the difference between ISW today and next year, peak value takes the difference between ISW today and in the year in which the expected value of ISW is maximized. This measure therefore captures the tradeoff between retiring today and working until a year with a much higher ISW: the option dollar value of continued work. In

years beyond the year of peak expected value ISW, this calculation collapses to the simple one-year accrual variable.

The Option Value Calculation

If a utility function that captures work preferences can be appropriately defined then an approach that compares the utility of retirement at future dates is preferable. To explore this approach, the option value calculation of Stock and Wise (1988) is used. Here the utility of retiring today is compared to its value at the optimal retirement year in the future. The calculation uses a specification of the individual's indirect utility function

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

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 ($k \geq 1$)
- T is maximum life length.

In this model additional years of work have three effects. First they raise total wage earnings, increasing utility. Second, they reduce the number of years over which benefits are received, lowering utility. Third, they may raise or lower the benefit amount depending on the shape of the benefit function B(R). The last two effects receive greater weight than the first due to the disutility of labour. The optimal year for retirement is the year in which the utility gained from

additional earnings is outweighed by the utility lost from the reduction in retirement income. The option value is the difference in utility from retirement at the optimal date and retirement today.

Relative to peak value, option value has one major advantage, and several disadvantages. The advantage is that the reference year in the peak value calculation (the year in which ISW is maximized) is arbitrary; there is no particular reason why this should be the year to which a given worker compares this year's ISW in making their retirement decision. The option value approach more carefully specifies the optimal retirement date, and as such provides an economic basis for the reference year.

Offsetting this advantage, however, are a number of disadvantages. The option value approach requires a particular specification of the indirect utility function, and evaluation of its structural parameters. Also, 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 undermined.

To implement this approach, values of k, the parameter for the disutility of labour, d, the discount rate, and g, the parameter of risk aversion, are taken from the literature. Following Stock and Wise (1988), k=1.5 and g=0.75, while d=0.03 following Coile and Gruber (1999). Sensitivity analysis suggests that the results are not dramatically different for sensible variations in these parameter values.

Sample Estimates of the Different Incentive Measures

In table 2 we provide information on the distribution of the one-year accrual measure, by age, for the male sample. The median ISW rises to a peak at age 61, then starts on a smooth

descent. The median one-year accrual is positive to age 60, but becomes increasingly negative thereafter. The initial positive accrual is due to the dropout provisions, which work in favour of the worker with the median PDV of ISW. This effect is attenuated with age, however, as the implied larger CPP/QPP entitlement reduces GIS/SPA entitlement through the income test. The negative accruals start at age 61 as the early retirement provisions of the CPP/QPP come into play. Important here is that the linear CPP/QPP actuarial adjustment becomes increasingly unfair as the person delays retirement. There is an additional consideration for individuals who will eventually claim on GIS benefits (45 percent of OAS pensioners received GIS benefits in 1990). The higher CPP/QPP benefits gained by delaying retirement, either through improving the earnings history or the actuarial adjustment are offset by reduced income tested GIS benefits at older ages. The net effect of these factors is increasingly negative, as the median accrual falls from -$249 to -$1397 between ages 61 and 64. The median accrual rises in absolute value at age 65 as OAS and GIS benefits come on line (there are SPA benefits in this range as well, given that the spouses of these male workers are typically several years younger). This jump reflects the fact that additional earnings after 65 will decrease the OAS, GIS, and SPA benefits through the income test for many workers. From age 66 to age 69, the accrual becomes more negative quickly, reflecting the increasingly unfair actuarial adjustment of CPP/QPP benefits, and that continued work sacrifices GIS benefits through the income test, and OAS benefits, if earnings are high enough, through the clawback. Overall, the loss in ISW wealth in table 2 is substantial between ages 61 and 69: the sum of the median accrual over these ages is -$21709.

In the second last column the Median Tax/Subsidy Rates are reported. This is calculated as the median ratio of the one-year accrual to current after tax earnings. After the initial period of subsidy the tax rate becomes positive at age 61. By age 69, the median tax rate is about 43

percent. These figures are somewhat lower than the estimates from Gruber (1999), presumably reflecting the fact that the dropout provisions have greater value here because we use real rather than simulated earnings histories. That is, if the real earnings history is more variable than a simulated earnings history, there will be more value to replacing lower earnings years that will in turn increase the incentive to continue working.

The median accrual masks considerable variation in the one-year accrual across individuals. For example, the standard deviation averages $1122 across age groups. The accrual at the 90th percentile does not turn negative until age 65. Presumably few of these individuals would qualify for GIS due to private pensions and savings. Many should also be in the clawback range for the OAS. As a consequence, we might not expect age 65 to be so pivotal for these individuals. That said, average non-labour income is imputed to individuals, and this will be more inappropriate for people in the tails of the income distribution.

Corresponding information for the peak value accrual is provided in table 3. Not surprisingly, the main difference from the one-year accrual is at ages 55 to 59. The median accrual is larger at these ages, but the change is fairly modest. For example, the median one-year accrual at age 57 is $534, while the median peak value accrual is $1164. Correspondingly, adding together the median one-year accruals in table 3 between ages 55 and 60, the distance to the "peak" is not that large. The primary inducement to continued work at older ages is the drop out provisions of the CPP/QPP, which, as explained above, are modest, and attenuated in the period we examine due to the real decline in YMPE over the 1970s. That is, continued work may not qualify the individual for a larger CPP/QPP entitlement. Furthermore, the CPP/QPP is only one of three components of ISW. Therefore we might expect the financial option value of

continued work to be modest at older ages.[30] Note that once age 60 is reached the peak value calculation is the same as the one-year calculation for most individuals, since they have already reached their peak.

Table 3 also contains information on the option value accrual. Here the accrual is positive throughout the age range reflecting the fact that the median optimal age of retirement by this measure is at age 70 or 71. The magnitudes of these numbers are difficult to interpret as they are in units of utility.

In Table 4 we present corresponding information on the one-year accrual in the female sample. The age profile of the one-year accrual largely reflects the same factors as the profile for males (e.g., drop out provisions of the CPP/QPP, the straight line actuarial adjustment of CPP/QPP benefits). One might reason that females' lower earnings entitle them to smaller CPP/QPP benefits and therefore their ISW entitlement should be smaller. This effect is attenuated by the large relative decline in the YMPE over the 1970s and that CPP/QPP is only one of three components of the IS package. Another consideration is that the longer lifespan of females means that the actuarial adjustment for delayed receipt of CPP/QPP benefits will be fairer for this group. We can see this in the smaller proportionate changes in the accrual over the age profile. For males, the median accrual increases (in absolute value) by $1427 between ages 60 and 64 and by $1409 between ages 65 and 69. For females the corresponding changes are $938 and $931 respectively. Also it is important to remember that the sample individuals are selected conditioning on positive earnings in the first year the individual enters the sample.

[30] In contrast, Coile and Gruber (1999) report large differences between one-year and peak value accrual for the US. This is not surprising, for as explained above the drop out provisions of the US Social Security can lead to large changes in Social Security wealth with work at older ages.

These, therefore, are a select sample of females who worked at older ages, yet belong to birth cohorts that historically have not had high participation rates.[31]

The peak value and option statistics presented in table 5 are also very similar to their counterparts for males. Again the early peak in ISW, and the lack of any strong variation in accrual mean there are only modest differences between the one-year and peak value calculations.

In figures 2 and 3 we graph the age profiles of the median of the various measures of accrual. The relative levels are meaningless, as the option value is measured in utility units. A comparison of the age profiles of the different measures of accrual, however, is meaningful, highlighting the differences among the measures. For both sexes the one-year and peak value have very similar age profiles. The median accruals decline over the full age range, with increases in the rate of decline noticeable at ages 60 and 65. The difference in the peak value measure is all in the age range 55-59. The option value calculation provides a very different profile, as accrual declines continuously at a decreasing rate over the age range.

Part VI: Empirical Framework and Estimation Results

The Empirical Framework

The regression equation relates the retirement decisions of individuals to their demographic and economic characteristics as well as their ISW. ISW plays a dual role in the decision. First, higher levels of ISW have wealth effects which cause individuals to retire earlier; more wealth through IS programs will lead to increased consumption of all goods, including leisure. Second, however, higher accruals of ISW from additional work should have a

[31] The participation rate of 45-64 year old females was 41 percent in 1976, 48 percent in 1986,

substitution effect which leads to later retirement; if there is a large financial incentive to additional years of work, then individuals will retire later.

Therefore equations are estimated of the form:

$$(2) \qquad \begin{aligned} R_{it} &= \delta_0 + \delta_1 ISW_{it} + \delta_2 ACC_{it} + \delta_3 AGE_{it} + \delta_4 EARN_{it} + \\ &\delta_5 APE_{it} + \delta_6 SPEARN_{it} + \delta_7 SPAPE + \delta_8 RPP_{it} + \delta_9 X_{it} + \upsilon_{it}. \end{aligned}$$

where

- R_{it} is a variable which equals one in the year of retirement and 0 otherwise,
- ISW_{it} is the expected PDV of ISW in year t,
- ACC_{it} is one of the measures of accrual outlined above: the simple one-year accrual, the peak value accrual, or the utility based option value accrual,
- AGE_{it} represents a set of dummy variables for each age in our sample, and a measure of the difference in ages across spouses,
- $EARN_{it}$ and APE_{it} represent cubics in measures of the individual's projected earnings in year t and his/her Average Pensionable Earnings (for CPP/QPP calculations),
- $SPEARN_{it}$ and $SPAPE_{it}$ are the corresponding variables of any spouse,
- RPP_{it} is the measure of the probability of RPP coverage at the 3-digit industry level,[32]
- X_{it} are a set of additional control variables, including a dummy variable for marital status, a quadratic in tenure on the job and a dummy variable which equals one if tenure is censored at 1978, a quadratic in the individual's and his/her spouse's labour market

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and 58 percent in 1996 (source CANSIM).

[32] 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.

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.

To capture potential non-linear relationships between earnings and retirement decisions, we include a full set of interactions between the cubics in $EARN_{it}$ and APE_{it}, and $SPEARN_{it}$ and $SPAPE_{it}$. The equations are estimated separately for males and females as a probit.

As mentioned at various points of this discussion, the Canadian IS system went through a number of reforms in our period of analysis. This is a distinct advantage of evaluating the retirement incentives of the Canadian IS system relative to other countries. These policy interventions potentially provide more credible identifying variation for the parameters of the ISW incentive variables than the variation across individuals due to differences in earnings histories, family circumstances and tastes. This advantage is highlighted in the reforms of the CPP system that do not have a counterpart in the QPP system in the period 1985-1996. In this case, the residents of Quebec provide a control group for the effects of the reform. Of particular importance here is the introduction of early retirement to the CPP system in 1987. A similar reform of the QPP was accomplished in 1984.[33]

Sample Characteristics

In tables 6 and 7 some average demographic and job characteristics for the male and female samples are presented, calculated over all the observations.[34] The average age in our male sample is almost 60 years old. Fifty six percent of the sample observations are for married

[33] Another reform during our sample period is the introduction of the clawback of OAS benefits in 1989. This applied to individuals in all parts of the country.
[34] An alternative would be to calculate the means over individuals.

men. Average projected earnings for the males are $19503, while the average APE is $19847. The corresponding averages for the spouses' are $3033 and $5393 respectively.[35] Finally, the average probability of RPP coverage across observations is 58 percent.

The average age in our female sample is 59½ years. Both the married and RPP proportions are lower than in the male sample, at 0.40 and 0.43 respectively. Average projected earnings are $11458, while the average APE is $13871. It is interesting to note that these female workers have similar tenure (length of time with the current employer) and experience (number of years in the labour market) as their male counterparts, but this is likely because our measures are only since 1978 (tenure) and 1975 (experience); over the full working life, presumably these means are much lower for women. The reason that the means of spousal earnings are lower than own earnings for women is because average spousal earnings is calculated using zeros for non-married working women.

In figures 4 and 5 we present estimates of the retirement hazard for males and females in our sample, calculated across all birth cohorts in the sample and all years. The hazard for each sex displays a distinct jump at age 59/60, which is the point of first eligibility for CPP/QPP benefits. This is also the age at which individuals are first eligible for the SPA. They then increase modestly at ages 61 through 64. Finally, there is a spike at age 65. Relative to the profile for males, the hazard for females is slightly higher at ages younger than 60, rises more quickly and higher at 59/60, remains above its male counterpart until age 64, and has a smaller spike at age 65.

[35] Note that the averages for the spouses are much less than the averages for the males. This is part because we calculate these averages over all males, including those who have no spouse or whose spouse doesn't work. In these cases, spousal earnings will be 0, thus lowering the average.

Retirement Regression Results

In table 8 are the regression results (estimates of equation (2)), for males using the one-year accrual incentive variable. In the first panel of the column are the results for a parsimonious specification in which ISW and one-year accrual are the only explanatory variables. Here the ISW incentives are allowed to have the maximum impact. The first thing to note is that one-year accrual has an expected negative sign, while the level of ISW has an unexpected negative sign. This latter result suggests that higher levels of ISW lower the probability of retirement, although in this specification ISW could be capturing the effects of excluded individual level characteristics that are correlated with both ISW and retirement. For example, individuals with high earnings over their lifetime will have higher ISW and may also have higher propensities for work. Each $1000 in accrual lowers the probability of retirement by 3.88 percentage points which is 26.2 percent of the baseline retirement rate of 14.8 (table 6).

In the second panel of this column we add some simple controls for age. The first is a dummy variable for age 65. This should help control for any institutional bases for retirement at this age, such as mandatory retirement rules or RPP provisions. The second is the interaction of a dummy variable for being between ages 60 and 64 and a dummy variable which equals 1 if CPP or QPP pension receipt is currently available as early as age 60. As noted above early pension receipt was available from the QPP in all years of the sample, and from the CPP starting in 1987.

The addition of these controls lowers the estimated effect of the accrual variable and almost doubles the estimated effect of ISW. Also, the added age controls hold some interest in their own right. First, the estimate of the age 65 dummy (not reported) is positive and significant, capturing the large increase in the probability of retirement at this age (see figure 4).

Second, the estimate of the "early retirement" at ages 60 to 64 interaction is positive, indicating an increase in retirement at this age in jurisdictions where early CPP/QPP benefit receipt was available. This coefficient is partly identified by Quebec/rest of Canada differences in retirement rates at this age in 1986, when early receipt was available under the QPP but not the CPP.

In the succeeding columns we control for additional individual and employment characteristics that may also be important determinants of retirement. A potential problem with the results in column 1 is if these variables are also correlated with our ISW variables. The expectation, therefore, is that the ISW effects will be smaller as we add the additional controls.

This is indeed the case in column 2 we add controls for marital status, own tenure, own and spouse's labour market experience, a linear control for age, a variable which measures the age difference between spouses, single year effects, province effects, industry effects and dummies for five categories of establishment size. We again compare the results with (second panel) and without (first panel) the dummies for age 65, and the age 60 to 64 in early retirement jurisdictions interaction. Now a $1000 in accrual decreases the probability of retirement by 2.65 percentage points (2.12 points with the extra age controls) which is 17.9 (14.3) percent of the baseline retirement rate. The estimated coefficient on the level of ISW is now positive without the age controls, but becomes negative again with the age controls included. The message here, therefore, is that the added variables are important correlates with both the probability of retirement and with the ISW incentive variables.

The parameters on most of the added explanatory variables are as expected. Of particular interest is that the effect of our measure of the probability of RPP coverage is positive and statistically significant. This is consistent with a wealth effect as result of the additional savings represented by the RPP entitlement. Marriage and larger age differences (Agediff) between

spouses have a negative relationship with the probability of retirement. Conditional on age, both experience and tenure reduce the probability of retirement, although in each case at a decreasing rate.

The estimates of the year effects (not reported) reveal that most of the time effects are cyclical. Also, the probability of retirement displays a vague U shape with establishment size: larger in the smallest and largest establishments. The higher probability of retirement in the largest establishments may be partly an (unobserved) RPP effect.

In column 3 we add earnings controls: cubics in own and spouse's projected earnings and APE as well as a full set of interactions between the cubics in projected earnings and APE. This is potentially an important innovation because ISW is mechanically a function of past earnings, and accrual depends on projected earnings, but either earnings may have independent effects on retirement. The cubics and the interactions provide a very flexible way of accounting for these independent effects. The result is two important changes in inference. First, the coefficient on the level of ISW is now consistently positive as expected, and quite large. Each $10,000 increase in ISW increases the probability of retirement by 1.97 percentage points (0.92 with the age controls). In previous specifications ISW may have been picking up the independent effects of earnings on retirement. Conditional on the earnings controls, however, ISW has the expected wealth effect. Second, the estimate on one-year accrual is again smaller. For the specification without the extra age controls a $1000 increase in accrual now reduces the probability of retirement by 2.21 percentage points (1.49 with age controls).

In the final column we replace the linear variable in the worker's age with age dummies for ages 56 through 69. Here we absorb any age specific tastes for retirement in a very flexible way. The estimated effects of ISW and accrual are now fairly similar across the specifications

with and without the additional age controls. This suggests that differences between these specifications in previous columns were driven by the inclusion of the age 65 dummy which is now present in both panels of column 4. A $10,000 increase in ISW increases the probability of retirement by 0.51 percentage points (first panel), which is 3.4 percent of the baseline retirement rate. A $1000 increase in accrual reduces the probability of retirement by 1.52 percentage points which is 10.3 percent of the baseline rate. The IS system, thus, has two countervailing impacts on retirement decisions: larger IS entitlements raise retirement, but larger accruals for additional work lower retirement.

Table 9 contains corresponding results using the peak value measure of accrual. Again, moving across columns we gradually add control variables moving from a parsimonious to very rich specification, while the second panel contains results conditional on the extra age controls. There are strong similarities with the results in table 8. As an example, the estimated effects of the IS incentive variables grow smaller as we add more control variables. The estimated effect of the level of ISW is generally similar to the previous estimates, but the effects of the accrual are more modest. In column 4, a $10,000 increase in ISW increases the probability of retirement by 0.51 (0.54 percentage points with extra age controls). A $1000 increase in peak value reduces the probability of retirement by 0.73 (0.68 percentage points), roughly half of the corresponding estimates from Table 8. As is clear in figure 2, at the median there is little difference in the one-year and peak value accrual after age 60. What distinguishes the two measures is their profile between age 50 and 59. Peak value would predict a greater slope in the run up in retirement rates leading to age 60.

Table 10 contains the results using the option value incentive measure. Here there are some substantial differences from previous results. First, the profile of the age dummies in

column 4 are unintuitive: largely negative to as late as age 64 (the excluded age is 55). Importantly, the estimated effect of the level of ISW switches from positive to negative as more controls are included, although the estimates in column 4 are not statistically significant. Finally, one point of agreement with the previous results is the negative effect of accrual, although in this case the effect is not easily quantified because the variable is measured in units of utility.

Comparing figure 2 to figure 4, the age profile of the option value accrual has no visibly obvious relationship with the age profile of the retirement hazard, at least at the median. It would predict a monotonically increasing hazard with age, with gradually decreasing slope. In this case, then, the other variables must compensate. For example, the profile of the age dummies is flatter in the age intervals 55 through 59 and 60 through 64 to compensate for the fact that the change in option value would predict the probability of retirement increasing at a faster clip than the other two measures of accrual.

Tables 11, 12 and 13 contain corresponding results for females. The one-year accrual results in table 11 are broadly consistent with the one-year accrual results for males. One distinguishing feature is that the presence of an RPP has a greater effect. In column 4 it raises the probability of retirement by 3.3 percentage points or 22 percent of the baseline hazard of 15.1 (table 7). The corresponding estimate for males (column 4 of table 8) implies the presence of an RPP increases the probability of retirement 2.4 percentage points 16 percent of the male baseline rate. Note also that the effect of the age difference between spouses is now positive.

The estimated effect of the level of ISW and one-year accrual are very similar to the male results. In the richest specifications (column 4), $10,000 in ISW raises the probability of retirement by about 0.45 to 0.47 percentage points while $1000 in accrual lowers it by 1.28 to 1.22 percentage points.

Table 12 contains the peak value results. Relative to the one-year results the changes are again similar to those observed for males. The effect of the level of ISW is little changed, while the accrual effect is much weaker. Here $10,000 in ISW raises the probability of retirement 0.60 percentage points while $1000 in accrual lowers the probability 0.17 percentage points (top panel column 4).

Finally, the option value results for females are in table 10. As was the case for males there are some unintuitive estimates, particularly in the richer specifications. While the effect of the level of ISW is positive in each column, the effect of accrual is also positive in columns 3 through 4. Again, it is difficult to provide context for the magnitude of the latter coefficient as the variable is measured in units of utility.

Part VII: Policy Simulations

The results presented above are difficult to interpret in a vacuum. Thus, we have applied our model to the consideration of two significant reforms to the Canadian system. The first is an increase of three years in the age of both early and normal entitlement for income security programs. The second is a shift to a system with a 60% replacement rate at age 65 for all, and an actuarial adjustment both before and after age 60 of 6% per year (the "common" reform for all countries).

The results of these simulations are presented in Tables S1-S16. For the purposes of this discussion, we focus on the results from Table 8, our richest specification; we will return below to discussing the differences that emerge from other specifications. We show the results from each of our models: accrual, peak value, and option value. Since the option value model

performs fairly badly, as documented above, we focus on the results from accrual and peak value models.

For the first reform, we estimate that there would be a significant reduction in retirement rates at all ages. The effects rise with age in absolute value, but are similar in percentage terms. At age 55, there is a 0.5 to 1.2 percentage point effect; this represents a 7 to 16 percent effect (the smaller estimate is from the accrual model; the larger from the peak value model). The effects grow with age, and become fairly large between ages 60 and 65, peaking at a 5 (peak) to 8 (accrual) percentage point effect (or 10 to 16 percent). The effects then fall, although they remain non-trivial even at age 69. Thus, we estimate that this reform would lower retirement by 10 to 16 percent.

The second reform serves to lower retirement rates at younger ages, and then raise them at older ages. The key to understanding the impacts of this reform is to recognize that this common reform would in essence replace the complicated set of IS incentives with an expanded CPP-like program. This amplifies the impact of actuarial adjustments, since the benefit under this common plan is so much larger than under the CPP. Thus, the lower retirement rates before age 60 are due to the fact that the actuarial adjustment under the common reform is fairer than under the CPP plan, which is further magnified by the fact that these adjustments apply to a 60% replacement rate. From age 60 to 64, there is little effect of the common reform. This appears to reflect the canceling of two opposing forces: on the one hand, the actuarial adjustment is increasingly unfair, and it applies to a larger base of benefits; on the other hand, this reform gets rid of the excess taxes through the GIS and SPA programs. Then, after age 65, we predict much larger retirement rates under the common reform, due to the increasing unfairness of the actuarial adjustment; once again, this has large effects because it applies to such a large benefit. By age

69, these effects are enormous; we estimate that retirement rates at that age will be 6.3 to 10 percentage points higher (22 to 42%). Of course, since these effects apply to the small base of workers still in the labor force at those older ages, there may be only a small cumulative effect on the size of the labor force.

The results from the other models, shown in the earlier tables for males, are fairly similar to those discussed above in age pattern, although the magnitudes differ somewhat. But, overall, the conclusion is clear: delaying the age of retirement benefit eligibility by three years lowers retirement rates at all ages; the common reform first lowers, then raises, retirement rates.

For women, the direction of the results is similar. The three year delay simulation shows smaller effects in percentage point terms, but similar impacts in percentage terms. The common reform shows much smaller effects, however, in particular after age 65. This is because the 6% actuarial adjustment is more actuarially fair for the longer lived females.

PART VIII: Conclusions

The aging of the Canadian population, coupled with a trend towards earlier retirement, places financial stress on the Canadian IS system. It is important, therefore, to understand how this complicated system effects retirement decisions. Other papers have suggested some role for IS programs, but no previous paper has taken a comprehensive look at how this panoply of programs impacts retirement in Canada. This paper accomplishes this task, using an excellent data source matched to a rich simulation model that allows us to assign IS entitlements to our sample workers. Also, a variety of parameterizations of the incentives for retirement are considered.

We have two findings of importance. First, for the typical worker, the IS system provides increasingly strong disincentives to work after age 60. Workers actually see the present discounted value of their IS entitlement fall from additional work after age 61, and by age 69 the reduction in IS entitlement amounts to 43 percent of what they would earn in that year. Second, there is a significant impact of these disincentives on work decisions. Using both one year forward measures and measures which account for the entire future path of incentives, we estimate that workers with larger returns to additional work are less likely to leave the labor force.

This finding in turn has implications for policy evaluation. Evaluations of changes to the Canadian IS system cannot be done assuming static retirement decisions; these evaluations must build in the type of dynamic retirement behavior that we observe. We illustrate these effects through two reforms, and show that these changes can have important effects on the retirement decisions of older Canadian workers.

Appendix: Data Descriptions and Sample Definitions

LWF Data

List of Variables from LWF data

Agediff: A variable recording the difference in age between an individual and his/her spouse (in years).

AGE55-AGE69: A dummy variable that equals 1 if an individual is the indicated age and 0 otherwise. *Age55* is the excluded variable.

APE: a variable recording an in estimate of an individual's current Average Pensionable Earnings.

Experience: A variable recording the number years since 1975 that an individual has had positive T-4 earnings.

Married: A dummy variable that equals 1 if the individual is married and 0 otherwise.

RPP: A variable that ranges between 0 and 1 recording the proportion of workers in an individual's 3-digit industry that is a member of an RPP.

Tenure: A variable recording the number of years since 1978 that an individual has been with the current firm.

Tenure Censored: A dummy variable that equals 1 if an individual has been with his/her current firm continuously since 1978.

Y85-Y96: a dummy variable that equals 1 in the indicated year and 0 otherwise. *Y90* is the excluded variable.

S04-S500p: a dummy variable that equals 1 for the indicated size of the workforce at the place of work and 0 otherwise. Categories are 0-4,5-19,20-49,50-99,100-199,200-499,500+. *S5099* is the excluded variable.

IND1-IND10: A dummy variable that equals 1 for the indicated industry of employment and 0 otherwise. *IND1* is the excluded variable. The ten are:

IND1 – manufacturing (SIC 100 to 399)
IND2 – construction (SIC 400 to 449)
IND3 – storage and transportation (SIC 450 to 499)
IND4 – wholesale trade (SIC 500 to 599)
IND5 – retail trade (SIC 600 to 699)
IND6 – finance, insurance, real estate (SIC 700 to 769)

IND7 – business services (SIC 770 to 809)
IND8 – government services (SIC 810 to 849)
IND9 – education, health and social services (SIC 850 to 909)
IND10 – accommodation, food, and other services (SIC 910 to 999)

NF: A dummy variable that equals 1 if resident of Newfoundland and 0 otherwise.

PEI: A dummy variable that equals 1 if resident of PEI and 0 otherwise.

NS: A dummy variable that equals 1 if resident of Nova Scotia and 0 otherwise.

NB: A dummy variable that equals 1 if resident of New Brunswick and 0 otherwise.

QU: A dummy variable that equals 1 if resident of Quebec and 0 otherwise.

ON: A dummy variable that equals 1 if resident of Ontario and 0 otherwise (excluded variable).

MB: A dummy variable that equals 1 if resident of Manitoba and 0 otherwise.

SA: A dummy variable that equals 1 if resident of Saskatchewan and 0 otherwise.

AB: A dummy variable that equals 1 if resident of Alberta and 0 otherwise.

BC: A dummy variable that equals 1 if resident of British Columbia and 0 otherwise.

TERR: A dummy variable that equals 1 if resident of Yukon or Northwest Territories and 0 otherwise.

Reconciliation of Sample Sizes from LWF Data

	Observations		Individuals	
	Males	Females	Males	Females
Base Sample from LWF	770989	523322	141182	103726
Missing Earnings Data	20306	10165	2563	1378
Primary Industries	44158	23146	6444	4387
Already Retired at Age 55	99196	100203	14244	20579
Final Sample	607329	389808	117931	77382

Notes: LWF is the Longitudinal Worker File. The base sample is all individuals aged 55 through 69 in 1985, plus the cohorts of individuals who turn age 55 in years 1986 through 1991. The deletions for missing earnings data are due to nonsensical earnings records for some individuals in Quebec in 1992 (e.g., some individuals with earnings of $46 billion). An attempt was made to replace these records with information from an alternative T4 data set for this year. This was not successful in all cases, however, which led to the deletion of all observations for these individuals. The deletions for employment in primary industries are explained in the text. The sample is conditioned on employment at age 55, so individuals with 0 earnings at this age are deemed to have already retired and are thus deleted from the data set.

LMAS and SLID Data

Cross section samples from the 1986-1990 LMAS and the 1993-1996 SLID. In each year, males or females, 23-69, who are paid workers in jobs in the month of September of the indicated year. The RPP coverage probabilities are calculated by 3-digit industry. Probabilities for 1991-1992 are simple linear interpolations of the 1990 and 1993 data.

Census Family Files of the Canadian Census

The data are from the 1986 and 1991 public use microdata files. In each year, males or females who are 54 and older are selected. 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's age < age-1; married, spouses age = age1+/- 1; married, spouse's age > age+1; not married) by age(54-60, 61-63, 64-66, …,73-75, 76+),

Females 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+),

Females Who are Not Employed: region (East; Ontario; West) by marital status (married, spouse's age < age-1; married, spouses age = age1+/- 1; married, spouse's age > age+1; not married) by age(54-60, 61-63, 64-66, …,73-75, 76-80, 81+).

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Table 1: Labour Market Participation and Program Participation in 1997/98

	Age			
	50-54	55-59	60-64	65+
Males				
Labour Market Participation In April 1998				
Working Full Time	0.76	0.60	0.34	0.07
Working Part-Time	0.04	0.05	0.05	0.04
Not Working	0.21	0.35	0.60	0.89
Program Participation in 1997				
Received OAS/GIS/SPA Benefits	0.00	0.00	0.03	0.97
Received CPP/QPP Benefits	0.05	0.07	0.44	0.92
Received Private Pension/RRSP Benefits	0.05	0.15	0.30	0.58
Received Employment Insurance Benefits	0.10	0.09	0.06	0.01
Received Social Assistance Benefits	0.06	0.08	0.12	0.08
Females				
Labour Market Participation In April 1998				
Working Full Time	0.50	0.33	0.13	0.01
Working Part-Time	0.14	0.13	0.10	0.02
Not Working	0.36	0.54	0.77	0.97
Program Participation in 1997				
Received OAS/GIS/SPA Benefits	0.00	0.00	0.15	0.97
Received CPP/QPP Benefits	0.06	0.09	0.40	0.74
Received Private Pension/RRSP Benefits	0.03	0.10	0.20	0.35
Received Employment Insurance Benefits	0.07	0.07	0.04	0.00
Received Social Assistance Benefits	0.05	0.06	0.09	0.11

Notes: Source ~ Individual Files of the 1998 Survey of Consumer Finances (1997 Income Year). The statistics on labour market participation are for the reference week (April 1998). The statistics for program participation are for the reference year (1997).

Table 2: The Distribution of the One-Year Accrual, Male Sample

Age	N	Median ISW ($)	Median ($)	10th Percentile ($)	90th Percentile ($)	Standard Deviation	Median Tax Rate 1	Median Tax Rate 2
55	57387	107533	1169	547	1736	467	-0.049	-0.042
56	61167	108702	829	0	1775	655	-0.038	0.005
57	63818	109531	534	0	1821	729	-0.027	0.036
58	65091	110065	320	0	1873	775	-0.018	0.037
59	65541	110385	218	0	1933	807	-0.012	0.038
60	60051	110603	30	-1259	1620	1103	-0.002	0.077
61	52539	110633	-249	-1491	1270	1068	0.014	0.085
62	45898	110384	-648	-1987	853	1108	0.037	0.085
63	39711	109737	-1053	-2479	505	1217	0.063	0.096
64	33776	108684	-1397	-2903	209	1335	0.086	0.186
65	27118	107287	-2931	-4694	-838	1518	0.188	0.367
66	13932	104356	-3334	-5095	-1252	1514	0.237	0.413
67	9008	101022	-3718	-5403	-1532	1497	0.298	0.396
68	6812	97304	-4040	-5749	-1826	1513	0.366	0.327
69	5480	93265	-4340	-6026	-2131	1523	0.425	0.340

Notes: N=number of observations, ISW=Income Security Wealth. All dollar values in 1998 US dollars. Definitions of the different measures of Income Security Wealth accrual are provided in the text. The numbers reported are the result of the Income Security wealth calculation described in the text. Median Tax Rate 1 is calculated from the analysis sample. Median Tax Rate 2 is from Gruber (1999).

Table 3: The Distribution of the Peak Value and Option Value Accrual, Male Sample

	Peak Value				Option Value			
Age	Median ($)	10th Percentile ($)	90th Percentile ($)	Standard Deviation	Median ($)	10th Percentile ($)	90th Percentile ($)	Standard Deviation
55	2997	1012	9363	3423	16804	7814	26397	10764
56	1998	120	8283	3399	14839	7040	23719	9983
57	1164	0	7061	3082	12965	5980	21106	9484
58	807	0	5592	2642	11131	4686	18657	8771
59	577	0	4188	2183	9396	3555	16296	8011
60	47	-1258	2929	2100	8151	2755	14319	6903
61	-247	-1491	1766	1798	6993	2108	12324	6790
62	-647	-1987	1149	1621	5878	1424	10471	6333
63	-1053	-2479	654	1503	4820	835	8707	5841
64	-1397	-2902	278	1374	3808	381	6996	5141
65	-2931	-4694	-838	1563	2698	97	5556	4675
66	-3334	-5095	-1252	1549	1695	-2186	4538	5142
67	-3718	-5403	-1532	1520	977	-4177	3400	4886
68	-4040	-5749	-1826	1529	516	-4865	2270	4427
69	-4340	-6026	-2131	1523	210	-5257	1128	3151

Notes: N=number of observations. All dollar values in 1998 US dollars. Definitions of the different measures of Income Security Wealth accrual are provided in the text. The numbers reported are the result of the Income Security wealth calculation described in the text.

Table 4: The Distribution of the One-Year Accrual, Female Sample

Age	N	Median ISW ($)	Median ($)	10th Percentile ($)	90th Percentile ($)	Standard Deviation	Median Tax Rate 1
55	43062	102235	673	116	1426	475	-0.049
56	43889	102908	563	79	1408	492	-0.045
57	44160	103471	526	20	1445	531	-0.045
58	43528	103997	484	0	1483	568	-0.045
59	42611	104481	448	0	1510	597	-0.046
60	37306	104929	107	-980	1455	933	-0.011
61	31320	105036	-30	-1130	1115	895	0.003
62	26480	105007	-307	-1460	777	915	0.030
63	22364	104700	-614	-1815	560	996	0.061
64	18646	104086	-831	-2198	403	1090	0.087
65	15072	103255	-2391	-3962	-642	1278	0.241
66	8298	100865	-2631	-4364	-797	1365	0.301
67	5564	98234	-2825	-4748	-899	1467	0.357
68	4196	95409	-3038	-5130	-1157	1533	0.423
69	3312	92371	-3321	-5389	-1406	1585	0.481

Notes: N=number of observations, ISW=Income Security Wealth. All dollar values in 1998 US dollars. Definitions of the different measures of Income Security Wealth accrual are provided in the text. The numbers reported are the result of the Income Security wealth calculation described in the text. Median Tax Rate 1 is calculated from the analysis sample.

Table 5: The Distribution of the Peak Value and Option Value Accrual, Female Sample

	Peak Value				Option Value			
Age	Median ($)	10th Percentile ($)	90th Percentile ($)	Standard Deviation	Median ($)	10th Percentile ($)	90th Percentile ($)	Standard Deviation
55	2684	708	7407	2683	10589	2994	19840	7051
56	2205	399	6639	2576	9431	3153	17416	6254
57	1736	182	5771	2345	8253	2859	15323	5484
58	1235	44	4671	2041	7135	2377	13323	4786
59	741	0	3562	1785	6038	1836	11498	4257
60	194	-979	2769	1821	5230	1421	10193	3859
61	-14	-1130	2019	1586	4531	1149	8910	3613
62	-303	-1460	1382	1399	3795	828	7624	3262
63	-612	-1815	944	1284	3118	517	6322	2787
64	-831	-2198	506	1164	2427	242	5203	2543
65	-2391	-3962	-642	1363	1626	-1691	3991	2491
66	-2631	-4364	-795	1451	960	-2309	3057	2248
67	-2825	-4748	-899	1519	576	-3560	2245	2351
68	-3038	-5130	-1157	1557	283	-4343	1521	2404
69	-3321	-5389	-1406	1585	114	-4867	747	2278

Notes: N=number of observations. All dollar values in 1998 US dollars. Definitions of the different measures of Income Security Wealth accrual are provided in the text. The numbers reported are the result of the Income Security wealth calculation described in the text.

Table 6: Summary Statistics for the Male Sample

	Mean	Standard Deviation
Retired	0.148	0.355
Probability of RPP	0.582	0.256
Married	0.558	0.497
Tenure	8.763	4.500
Tenure Censored	0.441	0.496
Experience	15.235	5.162
Spouse's Experience	5.144	6.848
Age	59.779	3.375
Age Difference	2.067	3.820
Projected Earnings	$19503	29088
Projected Spousal Earnings	$3033	7732
APE	$19847	4525
Spouse's APE	$5393	7996
Observations	607329	
Individuals	121204	

Table 7: Summary Statistics for the Female Sample

	Mean	Standard Deviation
Retired	0.151	0.358
Probability of RPP	0.428	0.262
Married	0.404	0.491
Tenure	8.660	4.423
Tenure Censored	0.374	0.484
Experience	14.450	5.551
Spouse's Experience	5.279	7.187
Age	59.488	3.365
Age Difference	-0.684	2.718
Projected Earnings	$11458	8433
Projected Spousal Earnings	$4050	12897
APE	$13871	6924
Spouse's APE	$7500	10189
Observations	389808	
Individuals	77845	

Notes: The reported statistics are means (averages) calculated over all observations in the male and female data sets, respectively (rather than over all individuals). All dollar values are in 1998 US dollars. APE is Average Pensionable earnings. Definitions of all variables are provided in Appendix A.

Table 8: Retirement Probits using the One-Year Accrual Incentive Variable- Males Sample

	1	2	3	4
ISW	**-0.008**	**0.012**	**0.093**	**0.025**
	(0.001)	**(0.002)**	**(0.003)**	**(0.004)**
$10000 change	**-0.18**	**0.27**	**1.97**	**0.51**
ACCRUAL	**-1.988**	**-1.343**	**-1.183**	**-0.798**
	(0.012)	**(0.022)**	**(0.023)**	**(0.028)**
$1000 change	**-3.88**	**-2.65**	**-2.21**	**-1.52**
RPP		0.100	0.125	-0.031
		(0.012)	(0.013)	(0.002)
MARRIED		-0.103	-0.539	0.002
		(0.012)	(0.018)	(0.0001)
TENURE		-0.053	-0.029	0.026
		(0.002)	(0.002)	(0.007)
TENURESQ		0.003	0.002	-0.020
		(0.0001)	(0.0001)	(0.002)
TENURE CENS		0.027	0.026	0.000
		(0.006)	(0.006)	(0.0001)
EXP		-0.029	-0.022	-0.028
		(0.002)	(0.002)	(0.003)
EXP SQ		0.001	0.000	0.001
		(0.00004)	(0.0001)	(0.0001)
SPOUSE EXP		-0.028	-0.027	-0.031
		(0.001)	(0.003)	(0.002)
SPOUSE EXPSQ		0.001	0.001	
		(0.0001)	(0.0001)	
AGE		0.045	0.013	
		(0.001)	(0.001)	
AGEDIFF		-0.002	0.003	-0.003
		(0.001)	(0.001)	(0.001)
AGE56				-0.036
				(0.011)
AGE57				-0.053
				(0.011)
AGE58				0.002
				(0.012)
AGE59				0.050
				(0.012)
AGE60				0.199
				(0.012)
AGE61				0.162
				(0.014)
AGE62				0.162
				(0.015)
AGE63				0.171
				(0.016)
AGE64				0.309
				(0.017)
AGE65				-0.036
				(0.011)
AGE66				-0.053
				(0.011)
AGE67				0.002
				(0.012)

AGE68				0.050
				(0.012)
AGE69				0.199
				(0.012)
Pseudo R-squared	0.058	0.076	0.103	0.116

Estimates Adding Dummy Variables for Early Retirement and Age 65

ISW	**-0.014**	**-0.005**	**0.045**	**0.025**
	(0.001)	**(0.002)**	**(0.004)**	**(0.004)**
$10000 change	**-0.30**	**-0.11**	**0.92**	**0.51**
ACCRUAL	**-1.487**	**-1.061**	**-0.781**	**-0.781**
	(0.013)	**(0.023)**	**(0.024)**	**(0.030)**
$1000 change	**-2.96**	**-2.12**	**-1.49**	**-1.49**
EARLY*AGE6064	0.168	0.105	0.065	0.019
	(0.005)	(0.009)	(0.006)	(0.012)
Pseudo R-squared	0.072	0.087	0.113	0.116
INDUSTRY CONTROLS	NO	YES	YES	YES
FIRM SIZE CONTROLS	NO	YES	YES	YES
PROVINCE CONTROLS	NO	YES	YES	YES
EARNINGS CONTROLS	NO	NO	YES	YES
YEAR CONTROLS	NO	YES	YES	YES

Notes: ISW=Income Security Wealth. Agediff is the difference in ages between the individual and his spouse (coded 0 for singles). * ~ reported statistic is the percentage point change in the probability of retirement for the indicated change in ISW or accrual. Other control variables are 11 industry dummies, dummies for 6 categories of establishment size, province and year effects, a cubic in both own and spouse's predicted earnings and APE, and a full set of interactions between these cubics. The estimated parameters on these additional variables are not reported.

Table 9: Retirement Probits using the Peak Value Incentive Variable- Males Sample

	1	2	3	4
ISW	**-0.010**	**-0.008**	**0.088**	**0.025**
	(0.001)	**(0.002)**	**(0.004)**	**(0.004)**
$10000 change	**-0.21**	**-0.17**	**1.86**	**0.51**
ACCRUAL	**-1.207**	**-0.777**	**-0.626**	**-0.373**
	(0.008)	**(0.014)**	**(0.017)**	**(0.018)**
$1000 change	**-2.41**	**-1.57**	**-1.21**	**-0.73**
RPP		0.099	0.122	0.122
		(0.012)	(0.013)	(0.013)
MARRIED		0.007	-0.525	-0191
		(0.013)	(0.021)	(0.022)
TENURE		-0.055	-0.033	-0.033
		(0.002)	(0.002)	(0.002)
TENURESQ		0.003	0.002	0.002
		(0.0001)	(0.0001)	(0.0001)
TENURE CENS		0.018	0.027	0.027
		(0.006)	(0.006)	(0.007)
EXP		-0.029	-0.20	-0.018
		(0.002)	(0.002)	(0.002)
EXP SQ		0.001	0.000	0.000
		(0.00004)	(0.0001)	(0.0001)
SPOUSE EXP		-0.020	-0.030	-0.029
		(0.002)	(0.003)	(0.003)
SPOUSE EXPSQ		0.001	0.001	0.001
		(0.0001)	(0.0001)	(0.0001)
AGE		0.059	0.033	
		(0.001)	(0.001)	
Agediff		-0.004	0.002	-0.003
		(0.001)	(0.001)	(0.001)
AGE56				-0.033
				(0.011)
AGE57				-0.050
				(0.012)
AGE58				-0.003
				(0.012)
AGE59				0.036
				(0.012)
AGE60				0.202
				(0.013)
AGE61				0.174
				(0.014)
AGE62				0.191
				(0.015)
AGE63				0.214
				(0.016)
AGE64				0.362
				(0.017)
AGE65				1.033
				(0.019)
AGE66				0.661
				(0.021)
AGE67				0.339
				(0.023)

AGE68				0.262
				(0.024)
AGE69				0.238
				(0.026)
Pseudo R-squared	0.055	0.076	0.101	0.115
Estimates Adding Dummy Variables for Early Retirement and Age 65				
ISW	**-0.015**	**-0.024**	**0.038**	**0.027**
	(0.001)	**(0.002)**	**(0.004)**	**(0.004)**
$10000 change	**-0.32**	**-0.50**	**0.78**	**0.54**
ACCRUAL	**-0.908**	**-0.692**	**-0.415**	**-0.349**
	(0.009)	**(0.013)**	**(0.018)**	**(0.018)**
$1000 change	**-1.84**	**-1.40**	**-0.81**	**-0.68**
EARLY*AGE6064	0.120	0.086	0.055	0.103
	(0.006)	(0.005)	(0.006)	(0.011)
Pseudo R-squared	0.073	0.088	0.113	0.115
INDUSTRY CONTROLS	NO	YES	YES	YES
FIRM SIZE CONTROLS	NO	YES	YES	YES
PROVINCE CONTROLS	NO	YES	YES	YES
EARNINGS CONTROLS	NO	NO	YES	YES
YEAR CONTROLS	NO	YES	YES	YES

Notes: ISW=Income Security Wealth. Agediff is the difference in ages between the individual and his spouse (coded 0 for singles). * ~ reported statistic is the percentage point change in the probability of retirement for the indicated change in ISW or accrual. Other control variables are 11 industry dummies, dummies for 6 categories of establishment size, province and year effects, a cubic in both own and spouse's predicted earnings and APE, and a full set of interactions between these cubics. The estimated parameters on these additional variables are not reported.

Table 10: Retirement Probits using the Option Value Incentive Variable- Males Sample

	1	2	3	4
ISW	**0.000**	**0.044**	**0.052**	**-0.005**
	(0.001)	**(0.002)**	**(0.004)**	**(0.004)**
$10000 change	**0.00**	**0.91**	**1.08**	**-0.10**
ACCRUAL	**-0.598**	**-0.483**	**-0.831**	**-1.021**
	(0.003)	**(0.005)**	**(0.023)**	**(0.025)**
$1000 change	**n.a.**	**n.a.**	**n.a.**	**n.a.**
RPP		0.130	0.121	0.123
		(0.013)	(0.013)	(0.013)
MARRIED		-0.268	-0.330	-0.013
		(0.012)	(0.021)	(0.023)
TENURE		-0.036	-0.029	-0.027
		(0.002)	(0.002)	(0.002)
TENURESQ		0.002	0.002	0.001
		(0.0001)	(0.0001)	(0.0001)
TENURE CENS		0.042	0.034	0.031
		(0.006)	(0.006)	(0.007)
EXP		-0.010	-0.015	-0.015
		(0.002)	(0.002)	(0.002)
EXP SQ		0.000	0.000	0.000
		(0.0001)	(0.0001)	(0.0001)
SPOUSE EXP		-0.025	-0.027	-0.028
		(0.002)	(0.003)	(0.003)
SPOUSE EXPSQ		0.001	0.001	0.001
		(0.0001)	(0.0001)	(0.0001)
AGE		0.029	0.028	
		(0.001)	(0.002)	
AGEDIFF		-0.001	0.001	-0.002
		(0.001)	(0.001)	(0.001)
AGE56				-0.073
				(0.011)
AGE57				-0.141
				(0.013)
AGE58				-0.149
				(0.013)
AGE59				-0165
				(0.013)
AGE60				-0.017
				(0.014)
AGE61				-0.062
				(0.015)
AGE62				-0.063
				(0.016)
AGE63				-0.058
				(0.018)
AGE64				0.074
				(0.019)
AGE65				0.765
				(0.020)
AGE66				0.389
				(0.022)
AGE67				0.042
				(0.024)

AGE68				-0.064
				(0.026)
AGE69				-0.109
				(0.027)
Pseudo R-squared	0.075	0.092	0.100	0.118

Estimates Adding Dummy Variables for Early Retirement and Age 65

ISW	**-0.007**	**0.029**	**0.005**	**-0.004**
	(0.001)	**(0.002)**	**(0.004)**	**(0.004)**
$10000 change	**-0.15**	**0.59**	**0.10**	**-0.09**
ACCRUAL	**-0.512**	**-0.479**	**-0.903**	**-1.014**
	(0.004)	**(0.005)**	**(0.023)**	**(0.024)**
$1000 change	**n.a.**	**n.a.**	**n.a.**	**n.a.**
EARLY*AGE6064	0.079	0.030	0.023	0.126
	(0.005)	(0.005)	(0.006)	(0.011)
Pseudo R-squared	0.094	0.105	0.114	0.118
INDUSTRY CONTROLS	NO	NO	YES	YES
FIRM SIZE CONTROLS	NO	NO	YES	YES
PROVINCE CONTROLS	NO	NO	YES	YES
EARNINGS CONTROLS	NO	NO	NO	NO
YEAR CONTROLS	NO	NO	YES	YES

Notes: ISW=Income Security Wealth. Agediff is the difference in ages between the individual and his spouse (coded 0 for singles). * ~ reported statistic is the percentage point change in the probability of retirement for the indicated change in ISW or accrual. Other control variables are 11 industry dummies, dummies for 6 categories of establishment size, province and year effects, a cubic in both own and spouse's predicted earnings and APE, and a full set of interactions between these cubics. The estimated parameters on these additional variables are not reported.

Table 11: Retirement Probits using the One-Year Accrual Incentive Variable- Female Sample

	1	2	3	4
ISW	**-0.004**	**0.002**	**0.091**	**0.022**
	(0.001)	**(0.002)**	**(0.005)**	**(0.005)**
$10000 change	**-0.10**	**0.05**	**1.96**	**0.45**
ACCRUAL	**-2.301**	**-2.076**	**-1.074**	**-0.653**
	(0.018)	**(0.030)**	**(0.033)**	**(0.040)**
$1000 change	**-4.52**	**-4.07**	**-2.06**	**-1.28**
RPP		0.150	0.164	0.161
		(0.016)	(0.016)	(0.017)
MARRIED		-0.016	-0.254	-0.079
		(0.016)	(0.020)	(0.021)
TENURE		-0.057	-0.009	-0.008
		(0.002)	(0.002)	(0.002)
TENURESQ		0.003	0.001	0.001
		(0.0001)	(0.0001)	(0.0001)
TENURE CENS		-0.015	-0.038	-0.037
		(0.008)	(0.008)	(0.008)
EXP		-0.023	-0.038	-0.038
		(0.002)	(0.002)	(0.002)
EXP SQ		0.001	0.001	0.001
		(0.00004)	(0.00004)	(0.00004)
SPOUSE EXP		-0.007	-0.010	-0.010
		(0.003)	(0.007)	(0.007)
SPOUSE EXPSQ		0.000	0.000	0.000
		(0.0001)	(0.0002)	(0.0002)
AGE		0.021	0.010	
		(0.001)	(0.002)	
AGEDIFF		0.004	0.015	0.004
		(0.001)	(0.001)	(0.001)
AGE56				-0.010
				(0.013)
AGE57				-0.010
				(0.013)
AGE58				0.007
				(0.013)
AGE59				0.063
				(0.014)
AGE60				0.227
				(0.015)
AGE61				0.146
				(0.016)
AGE62				0.159
				(0.018)
AGE63				0.169
				(0.019)
AGE64				0.250
				(0.020)
AGE65				0.844
				(0.023)
AGE66				0.456
				(0.025)
AGE67				0.169
				(0.028)

AGE68				0.053
				(0.030)
AGE69				0.046
				(0.032)
Pseudo R-squared	0.050	0.060	0.107	0.117

Estimates Adding Dummy Variables for Early Retirement and Age 65

ISW	**-0.006**	**-0.009**	**0.041**	**0.023**
	(0.001)	**(0.002)**	**(0.005)**	**(0.004)**
$10000 change	**-0.14**	**-0.20**	**0.85**	**0.47**
ACCRUAL	**-1.862**	**-1.887**	**-0.649**	**-0.626**
	(0.020)	**(0.031)**	**(0.035)**	**(0.042)**
$1000 change	**-3.74**	**-3.73**	**-1.27**	**-1.22**
EARLY*AGE6064	0.125	0.126	0.078	0.029
	(0.006)	(0.007)	(0.007)	(0.015)
Pseudo R-squared	0.057	0.066	0.115	0.117
INDUSTRY CONTROLS	NO	NO	YES	YES
FIRM SIZE CONTROLS	NO	NO	YES	YES
PROVINCE CONTROLS	NO	NO	YES	YES
EARNINGS CONTROLS	NO	NO	NO	NO
YEAR CONTROLS	NO	NO	YES	YES

Notes: ISW=Income Security Wealth. Agediff is the difference in ages between the individual and his spouse (coded 0 for singles). * ~ reported statistic is the percentage point change in the probability of retirement for the indicated change in ISW or accrual. Other control variables are 11 industry dummies, dummies for 6 categories of establishment size, province and year effects, a cubic in both own and spouse's predicted earnings and APE, and a full set of interactions between these cubics. The estimated parameters on these additional variables are not reported.

Table 12: Retirement Probits using the Peak Value Incentive Variable- Female Sample

	1	2	3	4
ISW	**-0.004**	**-0.013**	**0.090**	**0.029**
	(0.001)	**(0.002)**	**(0.005)**	**(0.005)**
$10000 change	**-0.09**	**-0.28**	**1.94**	**0.60**
ACCRUAL	**-1.349**	**-1.262**	**-0.345**	**-0.083**
	(0.011)	**(0.018)**	**(0.022)**	**(0.023)**
$1000 change	**-2.74**	**-2.55**	**-0.69**	**-0.17**
RPP		0.161	0.159	0.158
		(0.016)	(0.016)	(0.017)
MARRIED		0.040	-0.271	-0.112
		(0.016)	(0.020)	(0.021)
TENURE		-0.059	-0.012	-0.008
		(0.002)	(0.002)	(0.002)
TENURESQ		0.003	0.001	0.001
		(0.0001)	(0.0001)	(0.0001)
TENURE CENS		-0.021	-0.032	-0.032
		(0.008)	(0.008)	(0.008)
EXP		-0.027	-0.039	-0.038
		(0.002)	(0.002)	(0.002)
EXP SQ		0.001	0.001	0.001
		(0.00004)	(0.00004)	(0.00004)
SPOUSE EXP		0.005	-0.008	-0.009
		(0.003)	(0.007)	(0.007)
SPOUSE EXPSQ		0.000	0.000	0.000
		(0.0001)	(0.0002)	(0.0002)
AGE		0.027	0.030	
		(0.001)	(0.002)	
AGEDIFF		0.003	0.010	0.003
		(0.001)	(0.001)	(0.001)
AGE56				-0.010
				(0.013)
AGE57				-0.013
				(0.013)
AGE58				-0.002
				(0.014)
AGE59				0.047
				(0.014)
AGE60				0.232
				(0.015)
AGE61				0.155
				(0.017)
AGE62				0.182
				(0.018)
AGE63				0.203
				(0.019)
AGE64				0.293
				(0.021)
AGE65				0.971
				(0.022)
AGE66				0.599
				(0.024)
AGE67				0.325
				(0.027)

AGE68				0.223
				(0.029)
AGE69				0.233
				(0.031)
Pseudo R-squared	0.050	0.061	0.104	0.116
Estimates Adding Dummy Variables for Early Retirement and Age 65				
ISW	**-0.006**	**-0.022**	**0.037**	**0.030**
	(0.001)	**(0.002)**	**(0.005)**	**(0.005)**
$10000 change	**-0.13**	**-0.48**	**0.78**	**0.62**
ACCRUAL	**-1.117**	**-1.167**	**-0.140**	**-0.058**
	(0.012)	**(0.018)**	**(0.023)**	**(0.023)**
$1000 change	**-2.31**	**-2.37**	**-0.28**	**-0.12**
EARLY*AGE6064	0.050	0.077	0.064	0.101
	(0.006)	(0.006)	(0.007)	(0.014)
Pseudo R-squared	0.059	0.068	0.114	0.116
INDUSTRY CONTROLS	NO	NO	YES	YES
FIRM SIZE CONTROLS	NO	NO	YES	YES
PROVINCE CONTROLS	NO	NO	YES	YES
EARNINGS CONTROLS	NO	NO	NO	NO
YEAR CONTROLS	NO	NO	YES	YES

Notes: ISW=Income Security Wealth. Agediff is the difference in ages between the individual and his spouse (coded 0 for singles). * ~ reported statistic is the percentage point change in the probability of retirement for the indicated change in ISW or accrual. Other control variables are 11 industry dummies, dummies for 6 categories of establishment size, province and year effects, a cubic in both own and spouse's predicted earnings and APE, and a full set of interactions between these cubics. The estimated parameters on these additional variables are not reported.

Table 13: Retirement Probits using the Option Value Incentive Variable- Female Sample

	1	2	3	4
ISW	**0.012**	**0.060**	**0.082**	**0.021**
	(0.001)	**(0.002)**	**(0.005)**	**(0.006)**
$10000 change	**0.25**	**1.28**	**1.75**	**0.43**
ACCRUAL	**-0.852**	**-0.886**	**0.106**	**0.019**
	(0.006)	**(0.009)**	**(0.040)**	**(0.041)**
$1000 change	**n.a.**	**n.a.**	**n.a.**	**n.a.**
RPP		0.202	0.157	0.159
		(0.016)	(0.016)	(0.017)
MARRIED		-0.118	-0.259	-0.085
		(0.016)	(0.021)	(0.022)
TENURE		-0.036	-0.011	-0.007
		(0.002)	(0.002)	(0.002)
TENURESQ		0.002	0.001	0.001
		(0.0001)	(0.0001)	(0.0001)
TENURE CENS		0.018	-0.029	-0.031
		(0.008)	(0.008)	(0.008)
EXP		-0.013	-0.038	-0.037
		(0.002)	(0.002)	(0.002)
EXP SQ		0.000	0.001	0.001
		(0.00004)	(0.00004)	(0.00004)
SPOUSE EXP		-0.015	-0.009	-0.009
		(0.003)	(0.007)	(0.007)
SPOUSE EXPSQ		0.000	0.000	0.000
		(0.0001)	(0.0002)	(0.0002)
AGE		-0.005	0.039	
		(0.001)	(0.002)	
AGEDIFF		0.019	0.008	0.001
		(0.001)	(0.001)	(0.001)
AGE56				-0.013
				(0.013)
AGE57				-0.019
				(0.013)
AGE58				-0.011
				(0.014)
AGE59				0.037
				(0.015)
AGE60				0.226
				(0.016)
AGE61				0.148
				(0.017)
AGE62				0.173
				(0.018)
AGE63				0.193
				(0.020)
AGE64				0.280
				(0.021)
AGE65				0.962
				(0.022)
AGE66				0.587
				(0.024)
AGE67				0.310
				(0.027)

AGE68				0.206
				(0.029)
AGE69				0.212
				(0.031)
Pseudo R-squared	0.072	0.081	0.104	0.116

Estimates Adding Dummy Variables for Early Retirement and Age 65

ISW	**0.008**	**0.049**	**0.028**	**0.022**
	(0.001)	**(0.002)**	**(0.005)**	**(0.006)**
$10000 change	**0.17**	**1.06**	**0.57**	**0.45**
ACCRUAL	**-0.769**	**-0.875**	**0.059**	**0.021**
	(0.006)	**(0.009)**	**(0.040)**	**(0.041)**
$1000 change	**n.a.**	**n.a.**	**n.a.**	**n.a.**
EARLY*AGE6064	0.030	0.035	0.070	0.117
	(0.006)	(0.007)	(0.007)	(0.014)
Pseudo R-squared	0.083	0.090	0.114	0.116
INDUSTRY CONTROLS	NO	NO	YES	YES
FIRM SIZE CONTROLS	NO	NO	YES	YES
PROVINCE CONTROLS	NO	NO	YES	YES
EARNINGS CONTROLS	NO	NO	NO	NO
YEAR CONTROLS	NO	NO	YES	YES

Notes: ISW=Income Security Wealth. Agediff is the difference in ages between the individual and his spouse (coded 0 for singles). * ~ reported statistic is the percentage point change in the probability of retirement for the indicated change in ISW or accrual. Other control variables are 11 industry dummies, dummies for 6 categories of establishment size, province and year effects, a cubic in both own and spouse's predicted earnings and APE, and a full set of interactions between these cubics. The estimated parameters on these additional variables are not reported.

Table S1: Model 1 Simulation Results – Male Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.092	0.103	0.046	0.080	0.061	0.041	0.072	0.058	0.076
56	0.103	0.100	0.072	0.098	0.070	0.067	0.085	0.068	0.090
57	0.108	0.097	0.087	0.110	0.081	0.084	0.099	0.079	0.107
58	0.109	0.101	0.093	0.119	0.097	0.095	0.116	0.093	0.126
59	0.109	0.110	0.096	0.128	0.112	0.100	0.135	0.109	0.147
60	0.132	0.114	0.100	0.149	0.121	0.112	0.151	0.126	0.164
61	0.144	0.114	0.119	0.160	0.129	0.131	0.168	0.145	0.181
62	0.163	0.114	0.151	0.174	0.136	0.155	0.185	0.164	0.198
63	0.182	0.142	0.186	0.186	0.158	0.178	0.201	0.182	0.214
64	0.199	0.158	0.227	0.198	0.171	0.202	0.219	0.199	0.231
65	0.297	0.179	0.273	0.256	0.187	0.232	0.238	0.219	0.254
66	0.321	0.198	0.351	0.270	0.199	0.281	0.255	0.238	0.282
67	0.345	0.217	0.446	0.284	0.211	0.342	0.278	0.260	0.325
68	0.371	0.300	0.532	0.299	0.260	0.399	0.298	0.281	0.365
69	0.392	0.330	0.585	0.312	0.278	0.438	0.311	0.295	0.393

Table S2: Model 2 Simulation Results – Male Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.088	0.098	0.051	0.079	0.067	0.044	0.069	0.059	0.072
56	0.095	0.096	0.069	0.091	0.073	0.064	0.080	0.067	0.083
57	0.098	0.093	0.080	0.100	0.082	0.077	0.091	0.077	0.096
58	0.098	0.095	0.084	0.107	0.093	0.086	0.105	0.088	0.110
59	0.098	0.102	0.085	0.113	0.104	0.089	0.119	0.101	0.126
60	0.143	0.133	0.112	0.150	0.132	0.117	0.147	0.128	0.155
61	0.153	0.132	0.127	0.158	0.138	0.131	0.160	0.145	0.168
62	0.167	0.131	0.152	0.168	0.143	0.149	0.173	0.161	0.181
63	0.179	0.153	0.177	0.176	0.160	0.165	0.186	0.175	0.193
64	0.192	0.165	0.207	0.184	0.169	0.182	0.200	0.188	0.207
65	0.494	0.389	0.444	0.494	0.431	0.450	0.495	0.479	0.505
66	0.233	0.157	0.252	0.205	0.162	0.207	0.210	0.200	0.227
67	0.250	0.169	0.322	0.215	0.170	0.248	0.229	0.217	0.261
68	0.267	0.222	0.389	0.225	0.201	0.288	0.245	0.233	0.293
69	0.282	0.243	0.433	0.234	0.214	0.316	0.256	0.245	0.316

Table S3: Model 3 Simulation Results – Male Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.066	0.067	0.042	0.058	0.049	0.034	0.054	0.038	0.062
56	0.080	0.073	0.065	0.073	0.060	0.054	0.067	0.047	0.080
57	0.092	0.080	0.083	0.088	0.073	0.071	0.083	0.058	0.100
58	0.100	0.089	0.094	0.102	0.089	0.086	0.101	0.071	0.124
59	0.109	0.102	0.104	0.118	0.107	0.097	0.122	0.087	0.151
60	0.132	0.114	0.110	0.142	0.124	0.113	0.145	0.107	0.178
61	0.153	0.125	0.135	0.163	0.142	0.138	0.171	0.130	0.205
62	0.179	0.135	0.171	0.187	0.161	0.168	0.196	0.155	0.234
63	0.204	0.165	0.209	0.211	0.191	0.199	0.223	0.180	0.261
64	0.230	0.189	0.254	0.236	0.217	0.230	0.252	0.207	0.291
65	0.316	0.218	0.300	0.294	0.244	0.267	0.283	0.236	0.325
66	0.341	0.242	0.370	0.318	0.267	0.317	0.298	0.259	0.354
67	0.371	0.269	0.454	0.346	0.294	0.379	0.320	0.286	0.394
68	0.401	0.346	0.529	0.376	0.348	0.438	0.342	0.315	0.432
69	0.430	0.383	0.583	0.407	0.383	0.486	0.358	0.335	0.461

Table S4: Model 4 Simulation Results – Male Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.069	0.074	0.047	0.063	0.058	0.037	0.060	0.045	0.066
56	0.080	0.079	0.064	0.076	0.068	0.054	0.072	0.053	0.081
57	0.089	0.085	0.077	0.087	0.079	0.067	0.084	0.063	0.098
58	0.095	0.092	0.085	0.098	0.092	0.078	0.100	0.075	0.116
59	0.101	0.102	0.092	0.109	0.106	0.086	0.117	0.088	0.137
60	0.137	0.129	0.113	0.142	0.135	0.110	0.140	0.109	0.163
61	0.153	0.138	0.132	0.159	0.149	0.130	0.159	0.128	0.184
62	0.173	0.146	0.159	0.176	0.163	0.152	0.179	0.147	0.205
63	0.192	0.170	0.187	0.193	0.186	0.174	0.197	0.166	0.224
64	0.211	0.189	0.221	0.210	0.205	0.197	0.218	0.186	0.245
65	0.494	0.415	0.458	0.494	0.456	0.449	0.495	0.450	0.528
66	0.266	0.203	0.277	0.251	0.219	0.240	0.244	0.216	0.284
67	0.290	0.223	0.342	0.273	0.237	0.287	0.260	0.235	0.318
68	0.314	0.278	0.404	0.296	0.278	0.335	0.276	0.255	0.350
69	0.339	0.307	0.451	0.321	0.306	0.376	0.287	0.269	0.373

Table S5: Model 5 Simulation Results – Male Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.064	0.048	0.056	0.059	0.037	0.052	0.052	0.031	0.066
56	0.077	0.052	0.083	0.073	0.044	0.078	0.066	0.039	0.086
57	0.089	0.057	0.107	0.086	0.052	0.099	0.082	0.048	0.109
58	0.098	0.065	0.124	0.099	0.062	0.119	0.101	0.060	0.136
59	0.109	0.076	0.139	0.114	0.075	0.136	0.123	0.075	0.165
60	0.134	0.087	0.151	0.139	0.089	0.158	0.146	0.093	0.192
61	0.159	0.100	0.185	0.166	0.107	0.195	0.173	0.117	0.223
62	0.187	0.110	0.228	0.192	0.125	0.233	0.199	0.143	0.252
63	0.213	0.137	0.270	0.219	0.152	0.269	0.225	0.167	0.278
64	0.241	0.160	0.316	0.248	0.177	0.306	0.254	0.193	0.307
65	0.319	0.187	0.361	0.302	0.205	0.346	0.284	0.222	0.341
66	0.332	0.208	0.421	0.317	0.229	0.391	0.296	0.243	0.373
67	0.352	0.237	0.490	0.337	0.260	0.441	0.317	0.269	0.423
68	0.372	0.303	0.547	0.358	0.311	0.485	0.338	0.300	0.470
69	0.377	0.320	0.575	0.366	0.327	0.507	0.347	0.314	0.499

Table S6: Model 6 Simulation Results – Male Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.066	0.058	0.057	0.063	0.050	0.052	0.058	0.040	0.065
56	0.078	0.064	0.076	0.075	0.058	0.070	0.071	0.049	0.081
57	0.087	0.070	0.092	0.086	0.067	0.085	0.084	0.058	0.098
58	0.096	0.078	0.104	0.097	0.077	0.100	0.100	0.069	0.117
59	0.105	0.088	0.115	0.109	0.089	0.113	0.118	0.083	0.138
60	0.135	0.109	0.137	0.138	0.111	0.139	0.141	0.104	0.163
61	0.156	0.122	0.162	0.159	0.128	0.165	0.161	0.126	0.184
62	0.177	0.132	0.191	0.178	0.143	0.191	0.180	0.148	0.203
63	0.196	0.154	0.219	0.197	0.164	0.214	0.197	0.166	0.219
64	0.216	0.173	0.252	0.218	0.184	0.240	0.216	0.185	0.238
65	0.496	0.400	0.502	0.496	0.431	0.506	0.495	0.453	0.522
66	0.264	0.196	0.308	0.254	0.210	0.284	0.242	0.215	0.286
67	0.283	0.218	0.360	0.273	0.233	0.322	0.262	0.233	0.336
68	0.302	0.263	0.407	0.292	0.268	0.357	0.282	0.255	0.384
69	0.310	0.278	0.432	0.301	0.281	0.376	0.291	0.267	0.414

Table S7: Model 7 Simulation Results – Male Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.073	0.068	0.060	0.073	0.061	0.059	0.073	0.052	0.081
56	0.076	0.068	0.071	0.077	0.063	0.069	0.077	0.053	0.087
57	0.080	0.068	0.079	0.080	0.065	0.076	0.080	0.054	0.092
58	0.092	0.080	0.093	0.092	0.077	0.091	0.092	0.063	0.106
59	0.104	0.094	0.106	0.104	0.089	0.104	0.103	0.072	0.121
60	0.148	0.128	0.140	0.148	0.126	0.145	0.148	0.109	0.169
61	0.154	0.129	0.151	0.155	0.131	0.155	0.154	0.121	0.174
62	0.168	0.134	0.171	0.168	0.142	0.173	0.168	0.139	0.187
63	0.182	0.151	0.193	0.182	0.158	0.191	0.181	0.154	0.200
64	0.232	0.198	0.256	0.232	0.206	0.246	0.232	0.202	0.251
65	0.496	0.415	0.489	0.496	0.445	0.498	0.495	0.457	0.518
66	0.359	0.290	0.388	0.359	0.318	0.381	0.360	0.331	0.403
67	0.260	0.205	0.322	0.260	0.229	0.296	0.261	0.232	0.337
68	0.245	0.214	0.332	0.244	0.227	0.292	0.245	0.218	0.350
69	0.236	0.211	0.338	0.236	0.222	0.291	0.236	0.213	0.364

Table S8: Model 8 Simulation Results – Male Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.073	0.068	0.060	0.073	0.061	0.060	0.073	0.051	0.082
56	0.076	0.068	0.071	0.077	0.063	0.070	0.077	0.053	0.088
57	0.080	0.068	0.079	0.080	0.065	0.077	0.080	0.054	0.092
58	0.092	0.080	0.093	0.092	0.077	0.092	0.092	0.063	0.107
59	0.104	0.094	0.106	0.104	0.089	0.105	0.103	0.071	0.121
60	0.148	0.128	0.140	0.148	0.126	0.146	0.148	0.110	0.169
61	0.155	0.129	0.151	0.155	0.131	0.157	0.154	0.121	0.174
62	0.168	0.134	0.171	0.168	0.142	0.175	0.168	0.139	0.188
63	0.182	0.151	0.193	0.182	0.158	0.192	0.181	0.154	0.200
64	0.232	0.198	0.256	0.232	0.206	0.247	0.232	0.202	0.252
65	0.496	0.416	0.489	0.496	0.446	0.500	0.495	0.456	0.518
66	0.359	0.291	0.388	0.359	0.318	0.381	0.360	0.330	0.403
67	0.260	0.206	0.321	0.260	0.230	0.296	0.261	0.232	0.337
68	0.245	0.215	0.331	0.244	0.227	0.291	0.245	0.218	0.349
69	0.236	0.212	0.336	0.236	0.222	0.289	0.236	0.213	0.363

Table S9: Model 1 Simulation Results – Female Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.110	0.119	0.059	0.092	0.084	0.030	0.086	0.064	0.079
56	0.113	0.116	0.068	0.101	0.087	0.036	0.095	0.069	0.088
57	0.114	0.113	0.078	0.112	0.094	0.046	0.109	0.080	0.102
58	0.115	0.113	0.083	0.123	0.104	0.057	0.124	0.092	0.119
59	0.115	0.118	0.086	0.135	0.115	0.062	0.141	0.108	0.137
60	0.138	0.119	0.074	0.155	0.124	0.069	0.156	0.123	0.152
61	0.147	0.120	0.089	0.166	0.133	0.090	0.171	0.139	0.168
62	0.164	0.120	0.111	0.179	0.142	0.113	0.186	0.158	0.184
63	0.180	0.145	0.138	0.192	0.163	0.135	0.202	0.173	0.199
64	0.196	0.159	0.170	0.204	0.177	0.155	0.218	0.190	0.216
65	0.306	0.178	0.190	0.268	0.191	0.178	0.243	0.209	0.238
66	0.330	0.196	0.263	0.281	0.204	0.228	0.260	0.230	0.273
67	0.343	0.214	0.339	0.289	0.215	0.280	0.280	0.252	0.309
68	0.367	0.311	0.429	0.303	0.272	0.344	0.303	0.282	0.359
69	0.384	0.333	0.467	0.313	0.284	0.372	0.311	0.292	0.385

Table S10: Model 2 Simulation Results – Female Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.104	0.112	0.061	0.091	0.085	0.032	0.083	0.063	0.077
56	0.106	0.109	0.069	0.099	0.088	0.038	0.091	0.068	0.085
57	0.107	0.107	0.076	0.108	0.094	0.048	0.103	0.078	0.097
58	0.107	0.107	0.080	0.117	0.102	0.057	0.117	0.089	0.112
59	0.108	0.111	0.083	0.126	0.111	0.063	0.132	0.103	0.128
60	0.149	0.134	0.088	0.153	0.127	0.074	0.151	0.122	0.146
61	0.156	0.134	0.101	0.161	0.135	0.093	0.163	0.136	0.160
62	0.169	0.134	0.121	0.172	0.143	0.113	0.177	0.153	0.174
63	0.183	0.155	0.144	0.182	0.160	0.131	0.190	0.167	0.187
64	0.196	0.166	0.170	0.192	0.171	0.148	0.205	0.181	0.202
65	0.453	0.328	0.307	0.453	0.373	0.331	0.451	0.413	0.443
66	0.266	0.169	0.217	0.240	0.181	0.196	0.234	0.209	0.244
67	0.277	0.182	0.279	0.246	0.190	0.237	0.251	0.228	0.276
68	0.296	0.254	0.357	0.257	0.233	0.290	0.271	0.253	0.320
69	0.309	0.270	0.389	0.265	0.243	0.312	0.278	0.262	0.342

Table S11: Model 3 Simulation Results – Female Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.097	0.102	0.056	0.084	0.082	0.031	0.079	0.050	0.074
56	0.102	0.102	0.065	0.093	0.084	0.034	0.087	0.053	0.086
57	0.107	0.104	0.077	0.103	0.091	0.044	0.100	0.061	0.104
58	0.111	0.108	0.084	0.115	0.102	0.054	0.117	0.072	0.126
59	0.115	0.115	0.089	0.128	0.114	0.060	0.136	0.086	0.148
60	0.138	0.120	0.076	0.151	0.126	0.067	0.155	0.102	0.167
61	0.150	0.124	0.092	0.166	0.139	0.088	0.174	0.121	0.190
62	0.170	0.128	0.116	0.184	0.153	0.113	0.195	0.142	0.213
63	0.190	0.154	0.146	0.201	0.178	0.137	0.217	0.162	0.234
64	0.210	0.172	0.180	0.219	0.197	0.161	0.239	0.182	0.257
65	0.317	0.194	0.202	0.288	0.217	0.188	0.269	0.205	0.285
66	0.345	0.217	0.277	0.309	0.236	0.244	0.279	0.226	0.318
67	0.367	0.243	0.359	0.327	0.256	0.304	0.294	0.250	0.354
68	0.392	0.339	0.450	0.347	0.318	0.374	0.307	0.278	0.397
69	0.415	0.367	0.491	0.367	0.341	0.410	0.308	0.282	0.419

Table S12: Model 4 Simulation Results – Female Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.099	0.108	0.061	0.088	0.089	0.034	0.084	0.055	0.078
56	0.102	0.106	0.067	0.094	0.090	0.036	0.090	0.057	0.088
57	0.104	0.106	0.074	0.102	0.094	0.043	0.101	0.064	0.102
58	0.105	0.107	0.078	0.111	0.102	0.052	0.115	0.073	0.120
59	0.106	0.110	0.081	0.120	0.111	0.057	0.130	0.085	0.138
60	0.147	0.135	0.085	0.153	0.134	0.070	0.152	0.103	0.160
61	0.156	0.136	0.098	0.164	0.143	0.088	0.166	0.119	0.177
62	0.171	0.137	0.118	0.176	0.153	0.109	0.181	0.135	0.194
63	0.186	0.159	0.143	0.189	0.173	0.128	0.197	0.150	0.210
64	0.201	0.173	0.171	0.201	0.187	0.147	0.213	0.165	0.226
65	0.451	0.327	0.302	0.452	0.379	0.317	0.450	0.379	0.457
66	0.280	0.179	0.223	0.255	0.197	0.197	0.234	0.190	0.267
67	0.297	0.198	0.292	0.268	0.211	0.246	0.244	0.207	0.296
68	0.317	0.274	0.374	0.283	0.260	0.304	0.252	0.227	0.335
69	0.336	0.296	0.411	0.298	0.277	0.333	0.250	0.227	0.351

Table S13: Model 5 Simulation Results – Female Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.093	0.071	0.078	0.088	0.065	0.070	0.086	0.069	0.089
56	0.094	0.069	0.088	0.090	0.064	0.078	0.088	0.069	0.098
57	0.101	0.073	0.104	0.099	0.069	0.093	0.099	0.077	0.113
58	0.112	0.081	0.121	0.113	0.080	0.112	0.114	0.090	0.133
59	0.122	0.090	0.133	0.128	0.091	0.128	0.130	0.103	0.151
60	0.144	0.100	0.128	0.148	0.105	0.143	0.148	0.118	0.169
61	0.165	0.114	0.154	0.172	0.124	0.174	0.173	0.139	0.199
62	0.187	0.126	0.183	0.194	0.142	0.203	0.196	0.159	0.224
63	0.206	0.146	0.212	0.214	0.162	0.227	0.217	0.178	0.247
64	0.231	0.167	0.244	0.240	0.186	0.255	0.244	0.203	0.273
65	0.291	0.185	0.265	0.272	0.204	0.280	0.264	0.222	0.296
66	0.310	0.213	0.324	0.292	0.234	0.321	0.286	0.254	0.324
67	0.328	0.243	0.378	0.311	0.266	0.359	0.308	0.287	0.350
68	0.351	0.310	0.440	0.335	0.312	0.401	0.332	0.321	0.377
69	0.343	0.307	0.451	0.327	0.308	0.405	0.328	0.319	0.377

Table S14: Model 6 Simulation Results – Female Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.096	0.085	0.084	0.092	0.081	0.081	0.092	0.086	0.092
56	0.094	0.082	0.087	0.092	0.080	0.083	0.091	0.085	0.093
57	0.100	0.086	0.096	0.099	0.086	0.093	0.099	0.092	0.102
58	0.109	0.094	0.107	0.110	0.096	0.107	0.111	0.103	0.115
59	0.117	0.102	0.116	0.121	0.106	0.118	0.122	0.113	0.127
60	0.146	0.124	0.130	0.147	0.128	0.142	0.147	0.137	0.153
61	0.164	0.138	0.150	0.166	0.146	0.164	0.167	0.156	0.173
62	0.180	0.148	0.170	0.182	0.161	0.183	0.183	0.171	0.190
63	0.193	0.163	0.189	0.195	0.174	0.198	0.196	0.184	0.204
64	0.211	0.181	0.212	0.214	0.192	0.218	0.215	0.203	0.223
65	0.448	0.377	0.409	0.448	0.413	0.445	0.448	0.431	0.459
66	0.248	0.199	0.248	0.236	0.214	0.245	0.232	0.223	0.243
67	0.266	0.223	0.289	0.256	0.239	0.273	0.253	0.247	0.264
68	0.290	0.269	0.338	0.280	0.271	0.305	0.278	0.275	0.289
69	0.284	0.265	0.340	0.274	0.266	0.302	0.274	0.271	0.286

Table S15: Model 7 Simulation Results – Female Sample

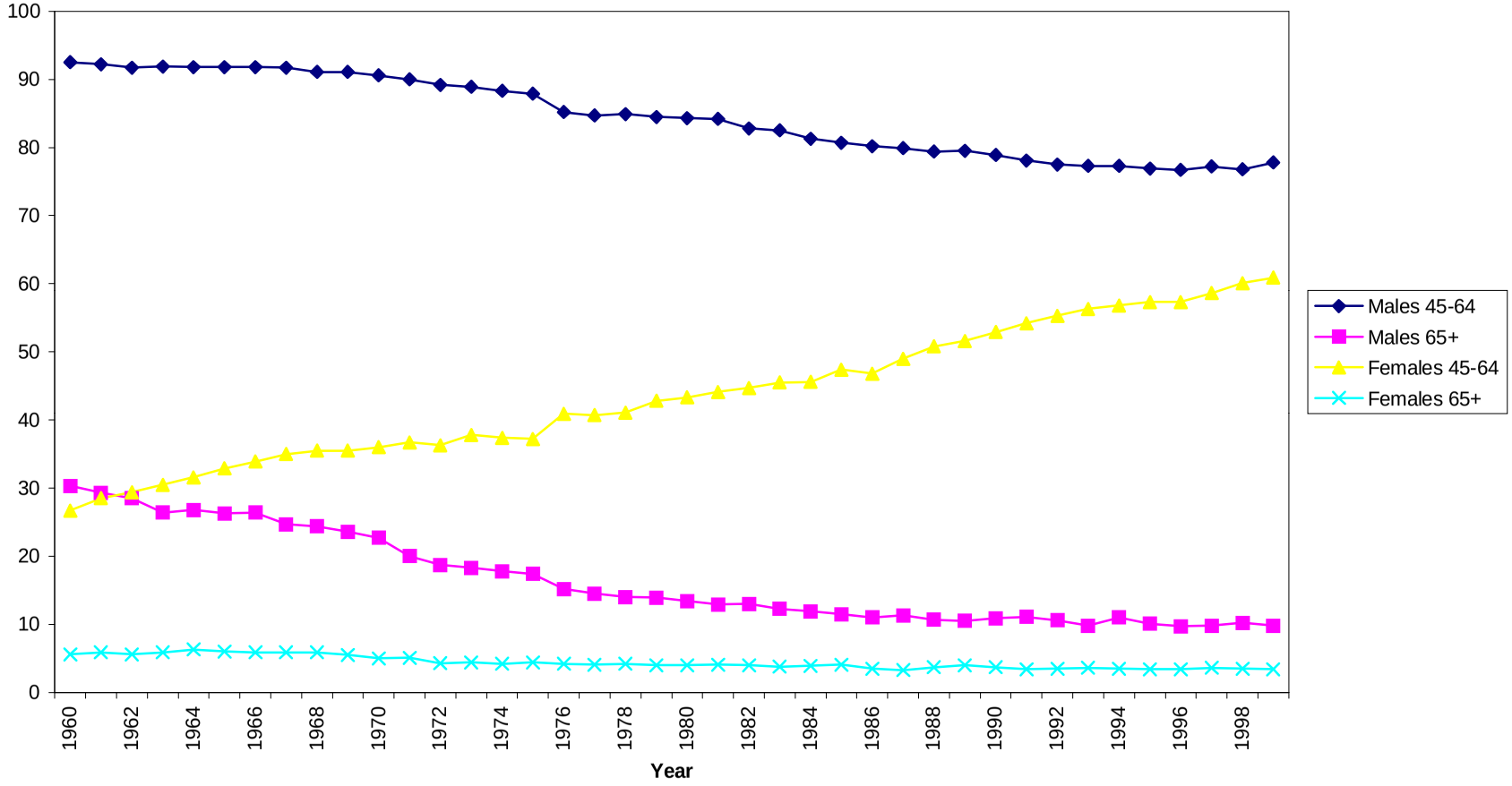
	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.099	0.094	0.086	0.099	0.090	0.091	0.099	0.094	0.099
56	0.093	0.086	0.084	0.093	0.084	0.088	0.093	0.087	0.094
57	0.095	0.087	0.089	0.095	0.085	0.092	0.095	0.089	0.097
58	0.103	0.095	0.098	0.103	0.093	0.102	0.103	0.097	0.106
59	0.117	0.109	0.112	0.117	0.105	0.116	0.117	0.110	0.121
60	0.163	0.148	0.141	0.163	0.148	0.161	0.163	0.154	0.168
61	0.158	0.141	0.140	0.158	0.143	0.158	0.158	0.149	0.163
62	0.172	0.150	0.157	0.173	0.157	0.174	0.173	0.163	0.178
63	0.182	0.162	0.172	0.183	0.167	0.185	0.183	0.173	0.188
64	0.216	0.194	0.210	0.216	0.200	0.220	0.216	0.206	0.222
65	0.448	0.390	0.401	0.448	0.422	0.449	0.448	0.434	0.456
66	0.329	0.281	0.316	0.329	0.311	0.337	0.329	0.320	0.338
67	0.254	0.216	0.267	0.255	0.243	0.267	0.254	0.249	0.263
68	0.240	0.223	0.277	0.240	0.235	0.257	0.240	0.237	0.249
69	0.228	0.214	0.272	0.229	0.224	0.248	0.229	0.227	0.239

Table S16: Model 8 Simulation Results – Female Sample

	Accrual Model			Peak Value Model			Option Value Model		
Age	Baseline	3 Year	Common	Baseline	3 Year	Common	Baseline	3 Year	Common
55	0.099	0.093	0.087	0.099	0.090	0.094	0.099	0.093	0.099
56	0.093	0.086	0.084	0.093	0.083	0.090	0.093	0.087	0.094
57	0.095	0.087	0.089	0.095	0.085	0.094	0.095	0.089	0.098
58	0.103	0.095	0.099	0.103	0.093	0.104	0.103	0.097	0.107
59	0.117	0.109	0.113	0.117	0.105	0.118	0.117	0.110	0.121
60	0.163	0.147	0.142	0.163	0.148	0.164	0.163	0.154	0.168
61	0.158	0.141	0.142	0.158	0.144	0.161	0.158	0.149	0.163
62	0.172	0.150	0.158	0.173	0.157	0.176	0.173	0.163	0.178
63	0.182	0.162	0.173	0.183	0.167	0.187	0.183	0.173	0.188
64	0.216	0.194	0.211	0.216	0.200	0.221	0.216	0.206	0.222
65	0.448	0.391	0.404	0.448	0.423	0.452	0.448	0.434	0.456
66	0.329	0.282	0.317	0.329	0.312	0.339	0.329	0.320	0.339
67	0.254	0.217	0.267	0.255	0.244	0.268	0.254	0.249	0.264
68	0.240	0.224	0.276	0.240	0.235	0.256	0.239	0.237	0.249
69	0.228	0.214	0.271	0.229	0.224	0.247	0.229	0.227	0.239

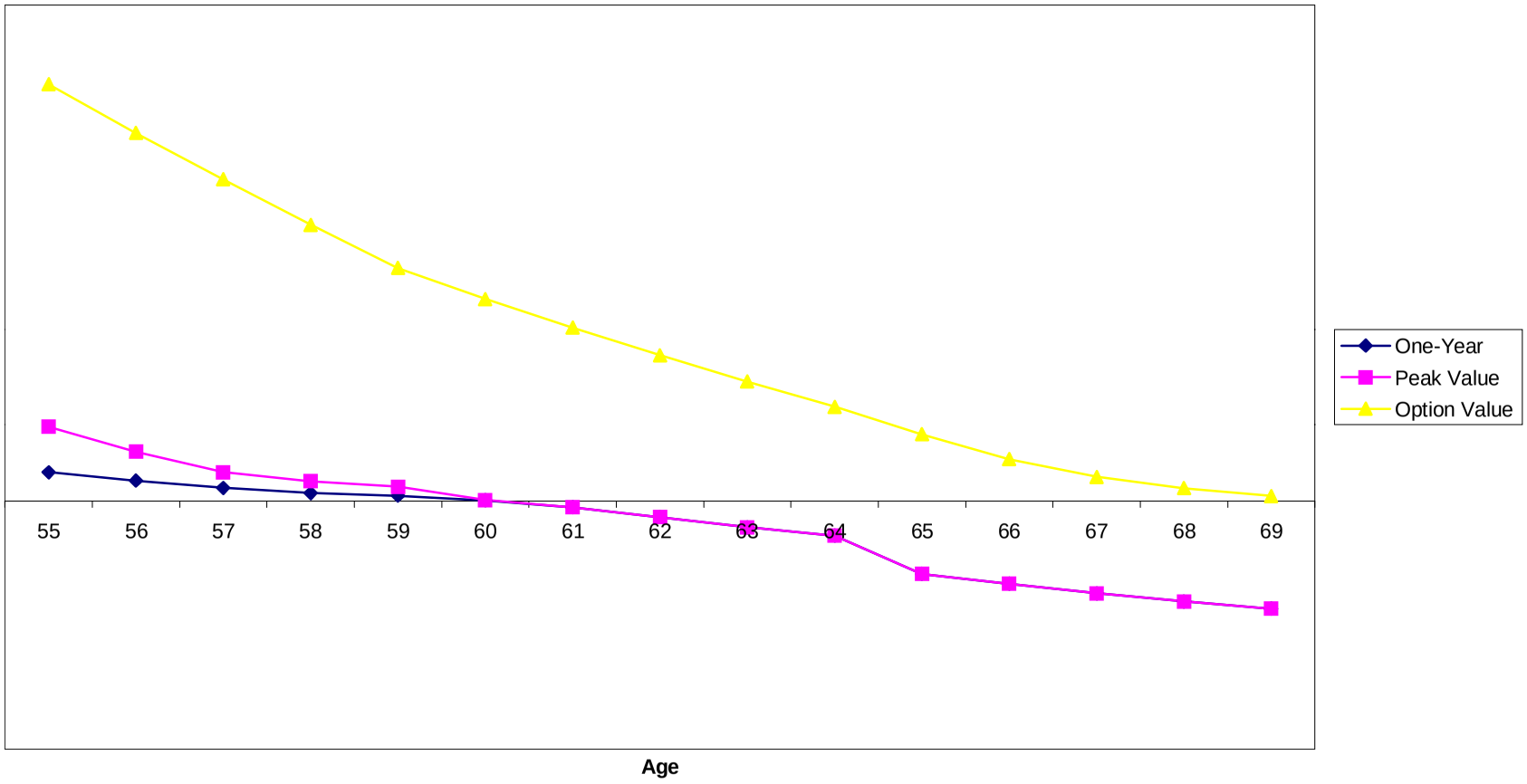
Figures

Figure 1: Historical Trends in the Labour Force Participation of Older Males and Females



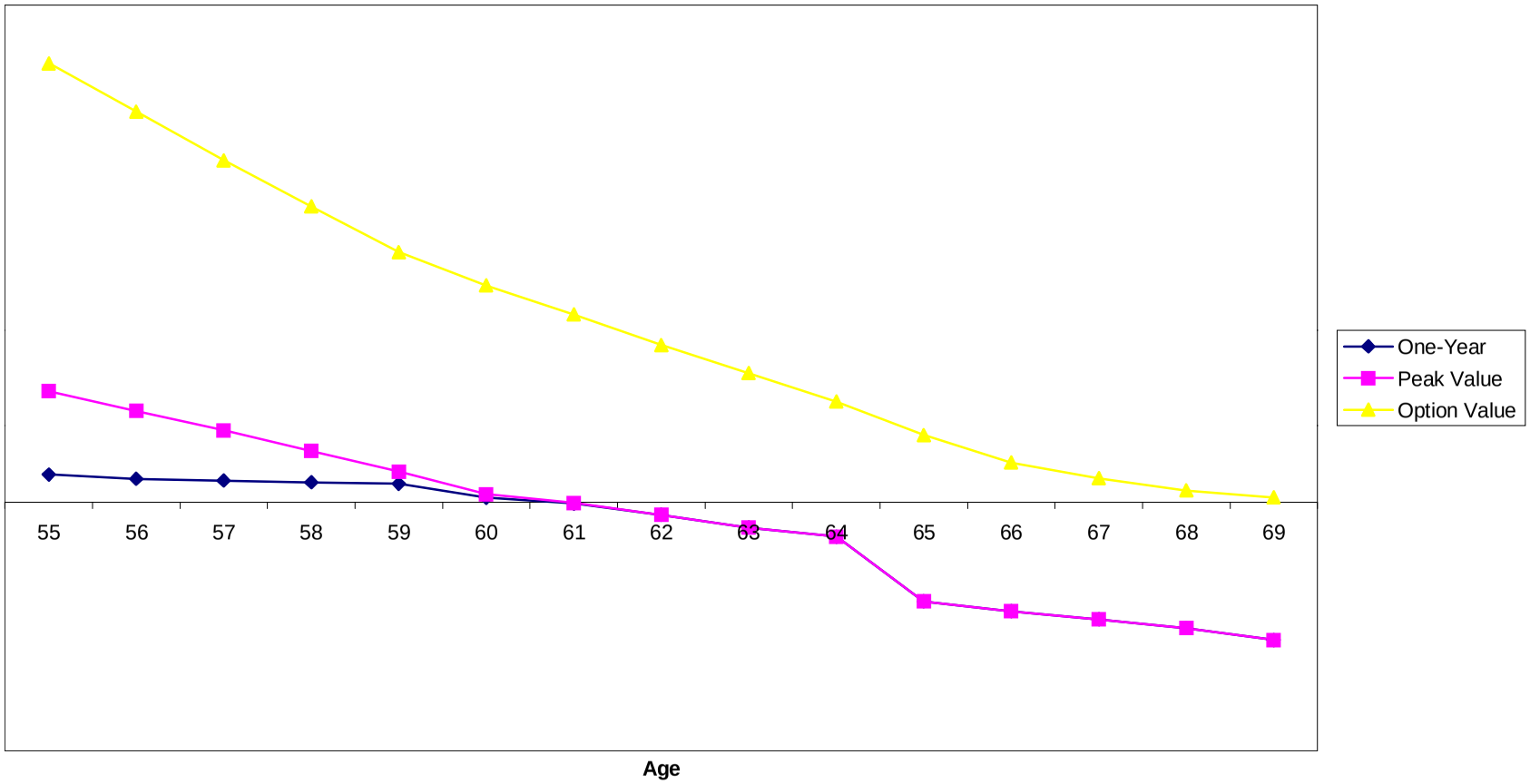
Source: Historical Statistics of Canada and CANSIM. These series span the change in the labour force questionaire in 1976.

Figure 2:The Age Profile of the Median One-Year, Peak Value and Option Value Accrual in the Male Sample



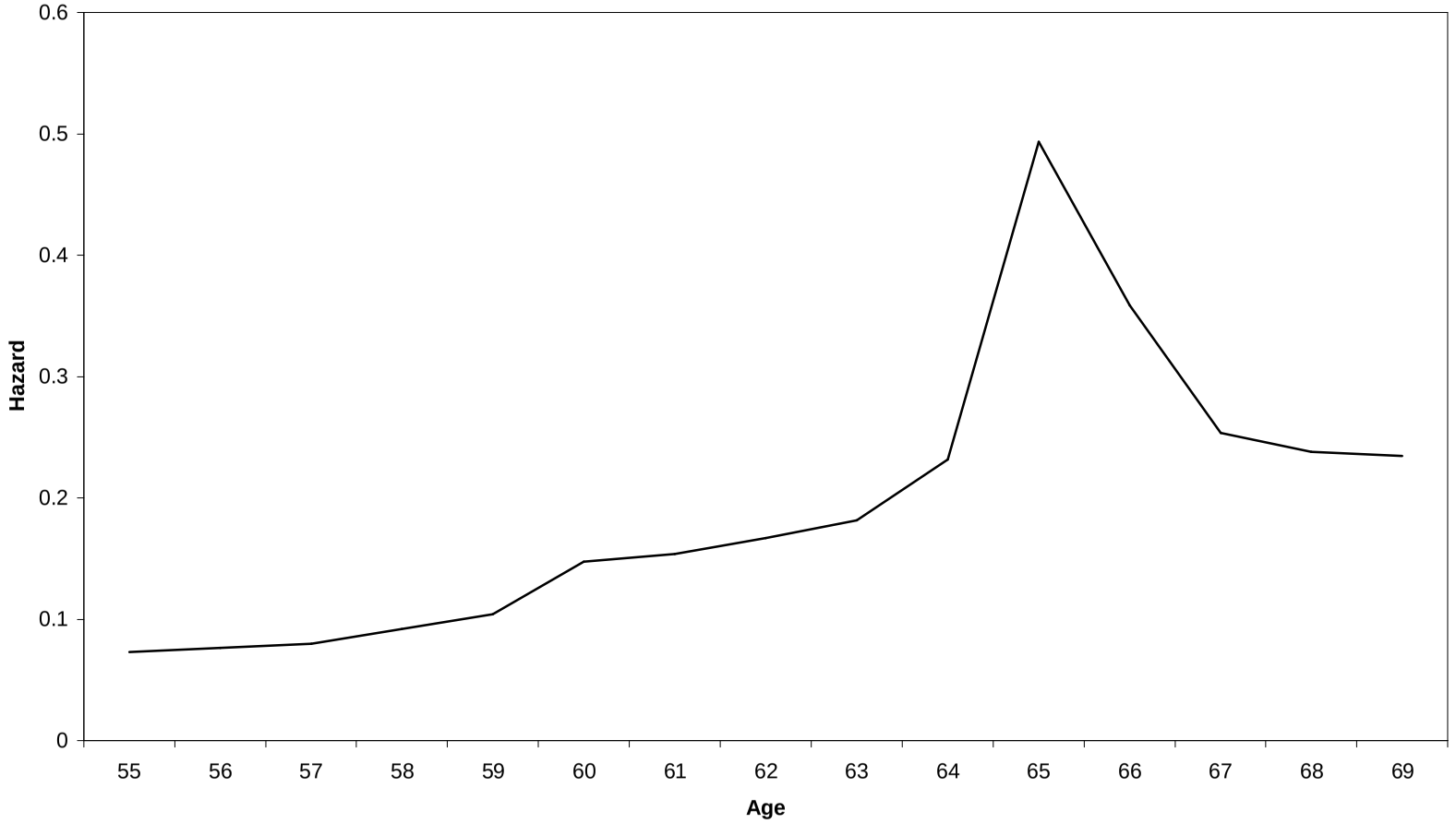
Notes: The profiles are graphs of the numbers reported in tables 2 and 3.

Figure 3: The Age Profile of the Median One-Year, Peak Value and Option Value Accrual in the Female Sample



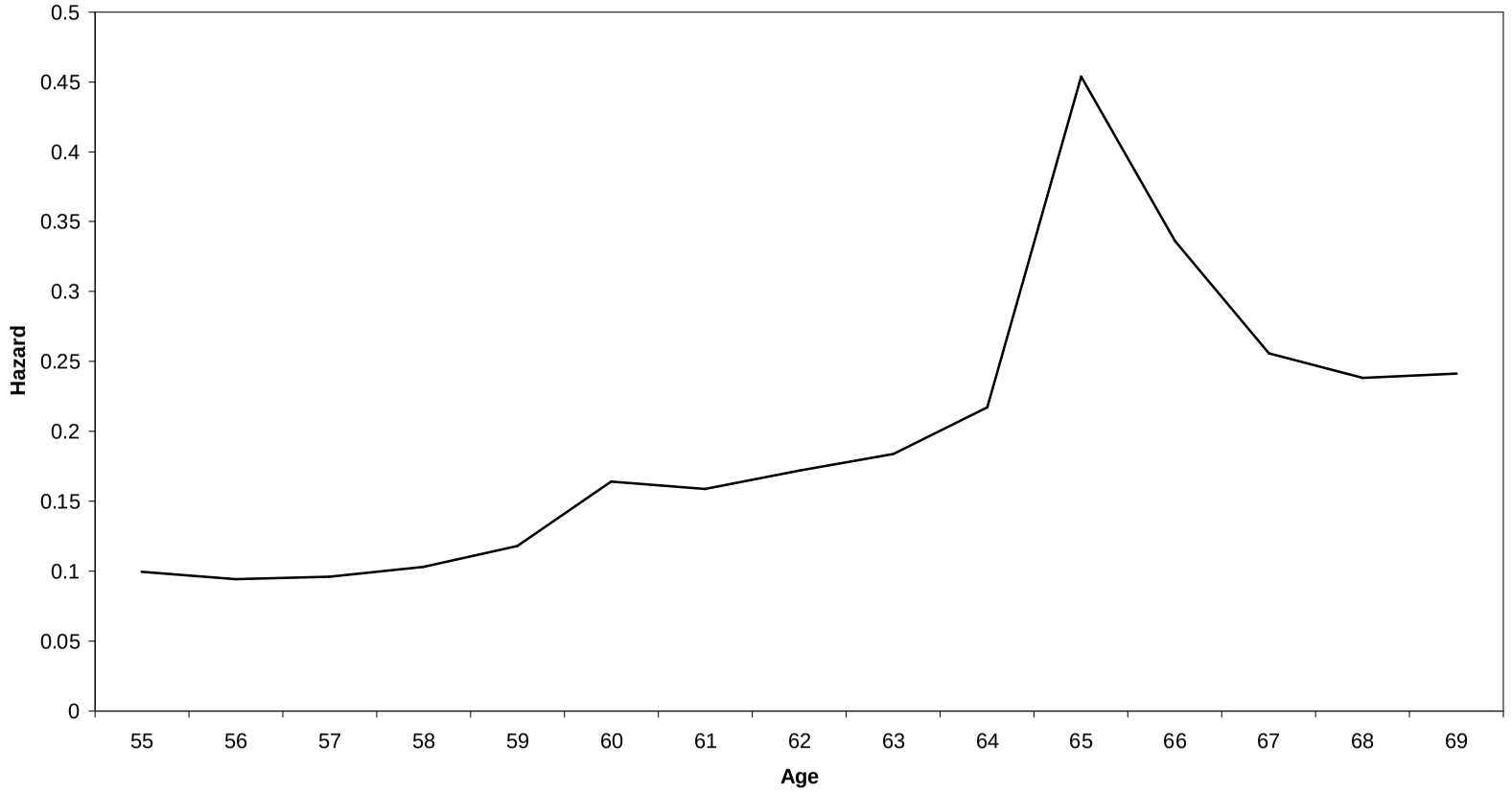
Notes: The profiles are graphs of the numbers reported in tables 4 and 5.

Figure 4: The Retirement Hazard for Males



Source: Authors calculations from the analysis sample of males (see the Appendix).

Figure 5: The Retirement Hazard for Females



Source: Authors calculations from the analysis sample of females (see the Appendix).