Retirement Decisions and Retirement Incentives: New Evidence from Canada

Kevin Milligan
Vancouver School of Economics
University of British Columbia
kevin.milligan@ubc.ca

Tammy Schirle
Department of Economics
Wilfrid Laurier University
tschirle@wlu.ca

This draft: January 2023

This paper is part of the International Social Security Project, organized through the National Bureau of Economic Research by Axel Börsch-Supan and Courtney Coile. We thank all participants in the project for their suggestions and comments.

1. Introduction

The labor force participation rates of older men and women in Canada have increased steadily since the mid-1990s. Milligan and Schirle (2019; 2020) have documented these labor market trends, alongside measures of incentives to continue working at older ages that are built into Canada's social security programs. That previous work shows that the incentives to enter earlier retirement have diminished over time. However, the means testing of benefits designed to boost the retirement incomes of low-income seniors continues to create a substantial implicit tax on work at older ages for those facing the phase-out range of the means-tested benefits.

Past studies have demonstrated the importance of public pension incentives for the retirement decision. Canadian evidence starts from Baker, Gruber and Milligan (2003; 2004) which used administrative data covering the 1978-1996 period and found that work disincentives inherent to the Canadian system had significant impacts on retirement. Schirle (2010) examined more recent survey data (1996-2001) and found similar effects of pension incentives. Using survey data from 1996-2009, Milligan and Schirle (2016) consider the additional role of the disability benefits available from CPP/QPP. While the evidence is clear that the social security incentives for retirement have significant effects, the additional incentives associated with the disability benefits are modest given the structure of the disability program.

The purpose of this study is to use microdata to estimate the behavioral effects of the retirement incentives embodied in Canada's social security system. We build on and extend the previous work. Nearly twenty years more data is now available compared to Baker, Gruber and Milligan (2003; 2004) and those twenty years have seen a remarkable change in retirement behavior. This allows us an opportunity to examine if the social security system in Canada has contributed to the trends in overall retirement behavior.

We primarily use data from the Longitudinal Administrative Database (LAD), which provides a large sample of older individuals and detailed information about their earnings histories since 1982, other sources of income, and family characteristics. We use the available information to construct measures of individuals' implicit tax on continued work at each age based on provisions of the Canada and Quebec Pension Plans (C/QPP), Old Age Security (OAS), the Guaranteed Income Supplement (GIS) and the Allowances, taking into account provincial and federal income taxation.

We begin by providing some Canadian context: describing key components of Canada's retirement system, recent trends and patterns in the retirement behavior of Canadian men and women, and the decisions made by spouses. We then describe our data and our measures of retirement incentives, with a focus on the implicit tax on continued work at older ages. Next, we present the regression framework used to estimate the effects of retirement incentives on retirement behavior, and results for men and women. Finally, we offer some simulations to illustrate the extent to which retirement behavior may have been different had retirement incentives not changed after 1995.

2. Background

In this section we provide background on Canada's retirement income system and social security programs, followed by an exploration of different paths to retirement.

2.1 Canada's social security programs

A detailed review of the Canadian social security programs and the relevant parameters is provided in Milligan and Schirle (2016; 2020); here we provide a brief overview. There are two major components considered in this study. The first offers seniors a guaranteed minimum income, providing a near-universal old age pension to all individuals over age 65 (OAS) as well as a means-tested benefit (GIS).[1] The Allowance is an additional means-tested benefit available to spouses of OAS pensioners between ages 60 and 64 (since 1975), and the Survivor's Allowance is available to widows (since 1985). While made slightly more generous over time, there have been few changes to these benefits since their introduction. We note that OAS benefits are considered taxable income, while GIS and the Allowance are non-taxable benefits.

[1] For OAS, individuals must meet residency requirements and a 15 percent clawback rate is applied to high individual incomes. For GIS, a 50 percent clawback rate is applied to income earned by individuals or their spouses, with clawback rates up to 75 percent applying to very low-income seniors.

The second major component, the Canada and Quebec Pension Plans (C/QPP), offers a contribution-based pension with payments that largely depend on an individual's earnings history after age 18, or since 1966. Until 1986 (1983), the statutory eligibility age for CPP (QPP) was 65. In 1987 (1984), CPP (QPP) introduced early eligibility at age 60, as well as a benefit adjustment factor of 6.0 percent per year for retirement at ages before and after age 65. New adjustment factors were phased in beginning in 2011, rising to 7.2% per year for CPP claims before age 65 and 8.4% per year for CPP claims after age 65.[2] The C/QPP pension formula is designed to replace roughly 25% of average earnings after age 18, up to an earnings cap known as the Year's Maximum Pensionable Earnings (YMPE). There are provisions that allow individuals to drop 15 percent of the lowest earnings from their earnings history when calculating their benefits. C/QPP benefits are taxable income, and it is important to note that C/QPP benefits are included as income when determining eligibility for GIS benefits.

It is worth emphasizing three main provisions that create incentives and disincentives to continued work at older ages. First, the C/QPP's drop-out provisions may reward additional work if it can result in higher average earnings. If additional work means that a higher-earnings year replaces a lower-earnings year, career average earnings will be higher and this pushes C/QPP benefits higher. These drop-out provisions are particularly important when individuals have experienced career interruptions, extended spells out of the labor force, or delayed their entry to the labor force after leaving high school. All of these circumstances can lead to low- or zero-earnings years being included in their career average earnings used in the C/QPP benefits formula. The second main provision that affects incentives is the actuarial adjustment of benefits depending on the benefit claiming age. Since the policy changes in the 1980s, delayed C/QPP claims are also rewarded with higher monthly benefits via the adjustment factors. Of course, these provisions are only effective to the extent that they adequately compensate for the delay in claiming benefits. Working against these incentives, is the third main provision that matters for retirement incentives: the clawback of GIS benefits with additional work. If C/QPP benefits increase because of the drop-out provisions or an actuarial adjustment, half or more of the value

[2] Adjustment factors for the QPP no longer align with CPP; most notably reductions for claims before age 65 are smaller for people with lower benefits.

of these increases may be clawed back because of the reduction of GIS benefits through the means testing. While other provisions (like taxes and details of the benefit formulas) also affect incentives, it is these three provisions that drive the pattern of incentives the most.

2.2 Paths to retirement

In this study our primary focus is on incentives to enter full retirement with immediate claiming of C/QPP benefits (as early as possible upon retirement). Other benefits (OAS, GIS and the Allowance) we assume are claimed as soon as one becomes age-eligible since making a claim for these benefits does not require retirement and over the period we study there are few reasons to delay a claim.[3]

More realistically, we recognize that some Canadians will choose to claim C/QPP benefits prior to retirement, as C/QPP benefits are contribution based and not clawed back for any income earned after the claim is made. So, there may be some work contemporaneous with C/QPP benefit receipt. As we can see in Figure 1, the portion of men and women in each age group that are receiving C/QPP benefits is higher than the portion that are not in the labor force all year. Some of this gap will reflect the fact these indicators are measured on an annual basis, so that individuals who retire and then claim late in the year will appear as C/QPP recipients but were in the labor force part of the year (rather than not in the labor force all year).

To consider the likelihood of observing flexible or partial retirement in Canada, we also look for individuals who have pension income (from C/QPP or private pensions) and work part-time. It appears only a small portion of individuals at older ages pursue part-time work after receiving pension income.

[3] Since 2013, individuals may opt to delay the initiation of OAS payments and receive a higher monthly amount in return. The adjustment factors for delayed OAS take-up align with those for CPP.

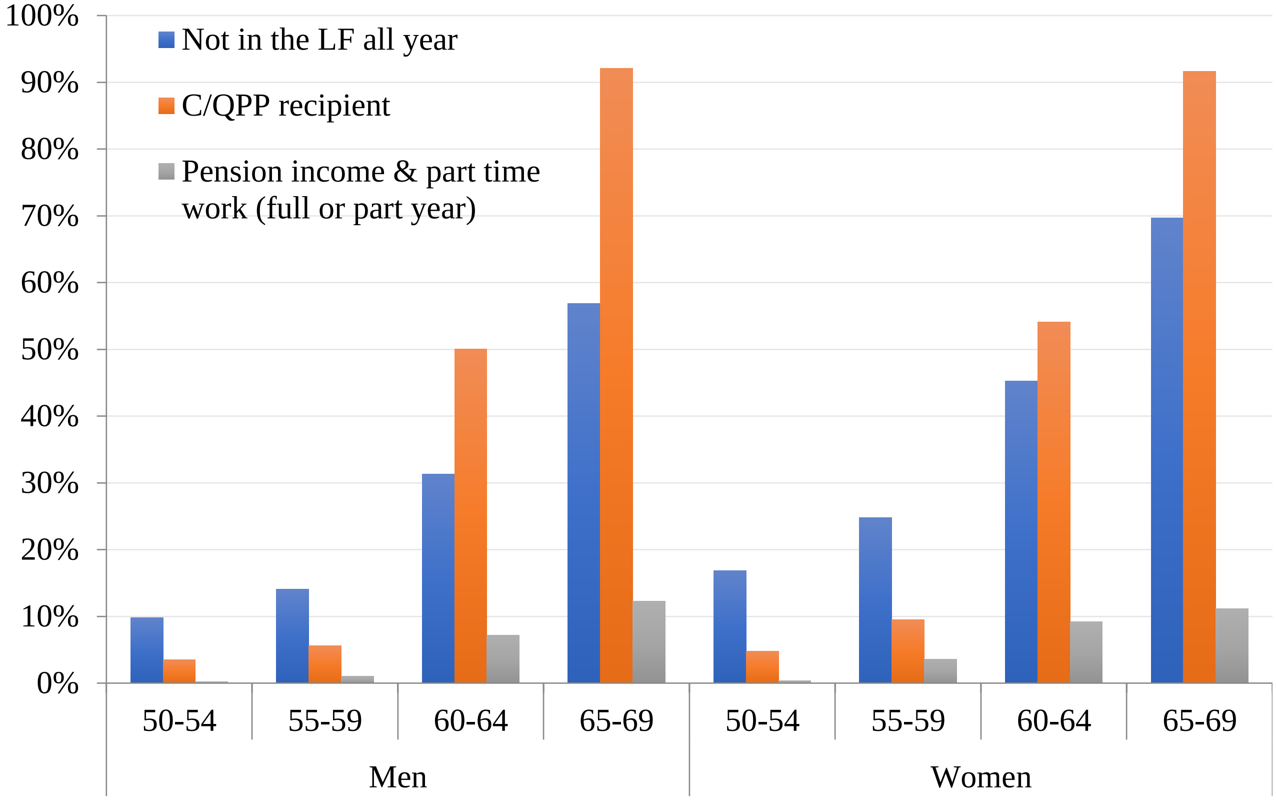

Figure 1. Labor market activity and pension income, 2016.
Note: Canadian Income Survey 2016. C/QPP recipients may be receiving retirement, disability, or survivor pensions. Pension income refers to private retirement pensions or C/QPP receipt.

To consider this further, we present in Figure 2 the likelihood of receiving income from work (earnings) or C/QPP at each age. After age 60, a substantial minority of both men and women receive C/QPP benefits while still working during the year. Based on annual income, one must offer cautious interpretations, but at older ages individuals are more likely to rely on C/QPP and not earnings. Among those with both sources of income, a large part represents retirements that occur part way through the year.

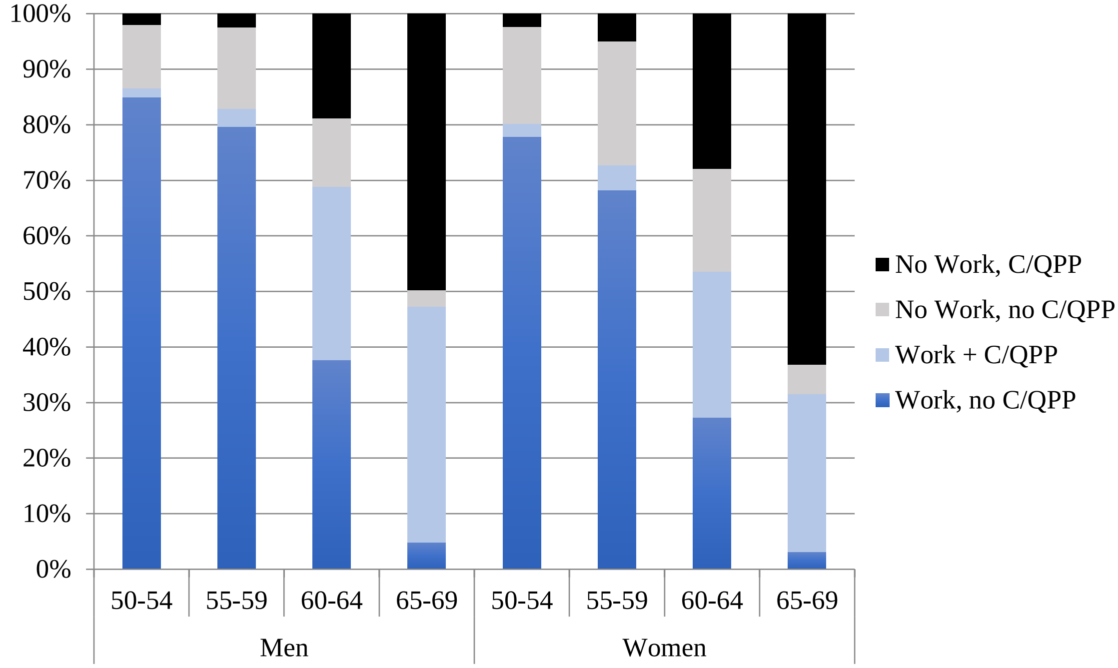

Figure 2: Receipt of earnings and C/QPP at older ages, 2016.
Source: Canadian Income Survey, 2016. Work and C/QPP indicate whether there is positive income from each source in the calendar year.

We also want to consider the importance of spouses in the retirement decision, but for the purposes of tractability in our model, we will later assume spouses enter retirement at age 60 and immediate make their C/QPP claims. More realistically, evidence has shown that husbands and wives tend to retire together (see Schirle 2008), although there are clearly many factors influencing the timing of their individual retirements distinct from their decisions as a couple. As we show in Figure 3, husbands and wives tend to share labor force status. Among husbands aged 65-69 that are not in the labor force all year (in 2016), only 19 percent of their wives were employed for the year. Among husbands that are in the labor force, particularly those who are unemployed, wives are much more likely to participate.

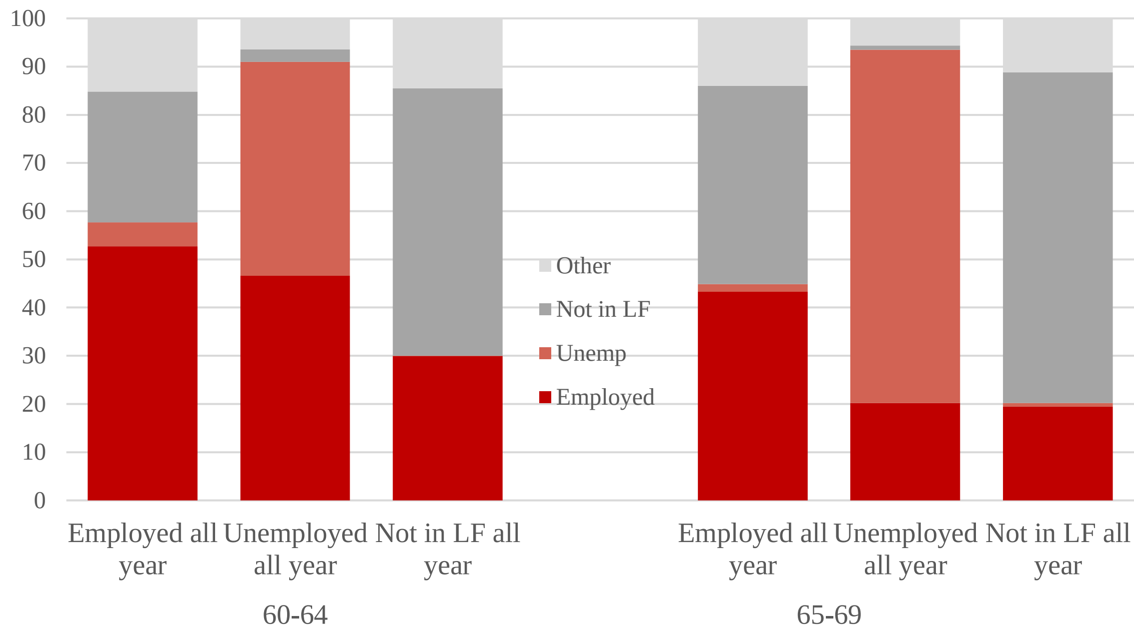

Figure 3. The labor force status of wives conditional on husbands' status
Source: Authors' tabulations using the Canadian Income Survey, 2016

3. Empirical Approach

We seek to estimate the extent to which the provisions of Canada's social security system affect individuals' retirement decisions. We account for a single path into retirement: one in which a person works, enters retirement and initiates their C/QPP benefits as soon as possible. In this section, we describe the data used, how we measure incentives to enter retirement, and how we estimate the effect of retirement incentives on retirement behavior.

3.1 Data

For this study we use the Longitudinal Administrative Databank, which comprises a 20% sample of tax filers derived from the annual T1 Family File, which draws data directly from tax filing records. We use all available years, from 1982 to 2019. The dataset offers rich and accurate information on individual sources of income, as reported for tax purposes. However, the availability of other demographic information is limited to what is on the tax form. While we can observe an individual’s sex, age, marital status, and link individuals to their spouses in each year, we are not able to observe information unless it is reported for tax filing. As such we have very little information regarding other individual or job characteristics.

We focus on men and women aged 55-69 and on the period 1995-2018.[4] To be in the sample, we require the individual to have positive labor market earnings at age 54. So, our first year-of-birth cohort is those for whom we can see age 54 earnings in 1982, which is those born in 1928. Our last year-of-birth cohort is those reaching age 55 in 2018, born in 1963. A person is defined as entering retirement when we observe that a year of positive employment earnings is followed by a year of zero earning after age 55. Individuals are dropped from the sample after they have entered retirement. We do not account for multiple retirements.

In Table 1, we provide some descriptive statistics for our estimation sample (of individuals, not individual-year observations). Our sample is comprised of about 896,000 males and 777,000 females. There are more males because of our sample requirement to be working when observed at age 54, and fewer women are working at that age for these cohorts. We also show the split of the sample into those with employment-based pensions and those without. In Canada, employment-based pensions are usually organized as Registered Pension Plans, so we use the acronym RPP.

Earnings at age 54 is shown in 2018 Euros, with males out-earning females 56,000 to 34,000. Those with an RPP earn more than those without, in about the same proportion as the male-female earnings gap. The next row of Table 1 shows the lifetime average of the ratio of earnings to the pensionable earnings cap, the YMPE. This gives an indication of average earnings from age 18 to age 54, as a ratio of the earnings cap (with the maximum value being 1.0). Like with age 54 earnings, men and those with an RPP have much higher lifetime earnings than women and those without RPPs. The next two rows show the marital status and the age gap between men and women. Men are more likely to be married than women in our sample, in part because of

[4] Some key variables—such as employment-based pensions—are not available in early years of our data, so we begin in 1995. This timing coincides with the beginning of the upswing in labor market participation by older workers. We end in 2018 because we need to observe the last year of data (2019) to form our retirement variable, since we define retirement as the year before the first year of zero earnings.

higher mortality for males meaning there are more widows. The age gap for males is 1.9 years, but this includes a zero for the 16.1 percent of men without a spouse, so the average among the married is 2.2 years.

	Full sample	Males	Females	Has RPP	No RPP
Number of Individuals	1,673,175	896,380	776,795	786,370	886,800
Earnings at 54	45,800	56,000	34,000	56,300	36,500
	(90,200)	(117,700)	(36,100)	(74,900)	(101,000)
Lifetime YMPE ratio	0.679	0.777	0.565	0.797	0.574
	(0.288)	(0.255)	(0.283)	(0.229)	(0.295)
Employer pension (RPP)	0.470	0.469	0.471	1.000	0.000
	(0.499)	(0.499)	(0.499)	(0.000)	(0.000)
Married	0.789	0.833	0.737	0.786	0.791
	(0.408)	(0.373)	(0.440)	(0.410)	(0.407)
Spouse age gap	1.6	1.9	1.3	1.5	1.6
	(2.9)	(2.9)	(2.8)	(2.8)	(2.9)

Table 1. Sample characteristics
Source: Authors' tabulations using the Longitudinal Administrative Database. Reported are means with the standard deviation in parentheses. Currency values are 2018 Euros.

3.2 Retirement patterns

We now present several figures to explore the patterns of retirement in Canada. First, in Figure 4 we present the distribution of retirement ages in our sample, across cohorts we can see to age 70 (birth years 1928-1946). For males, the most common retirement age is age 65 with 9 percent of the sample retiring. However, 11.8 percent are working continuously to age 70 or later. For women, age 55 is the most common age for this sample, with spikes at age 60 and age 65. Working to age 70 or later is also common among women, with 9.4 percent working at least that long.

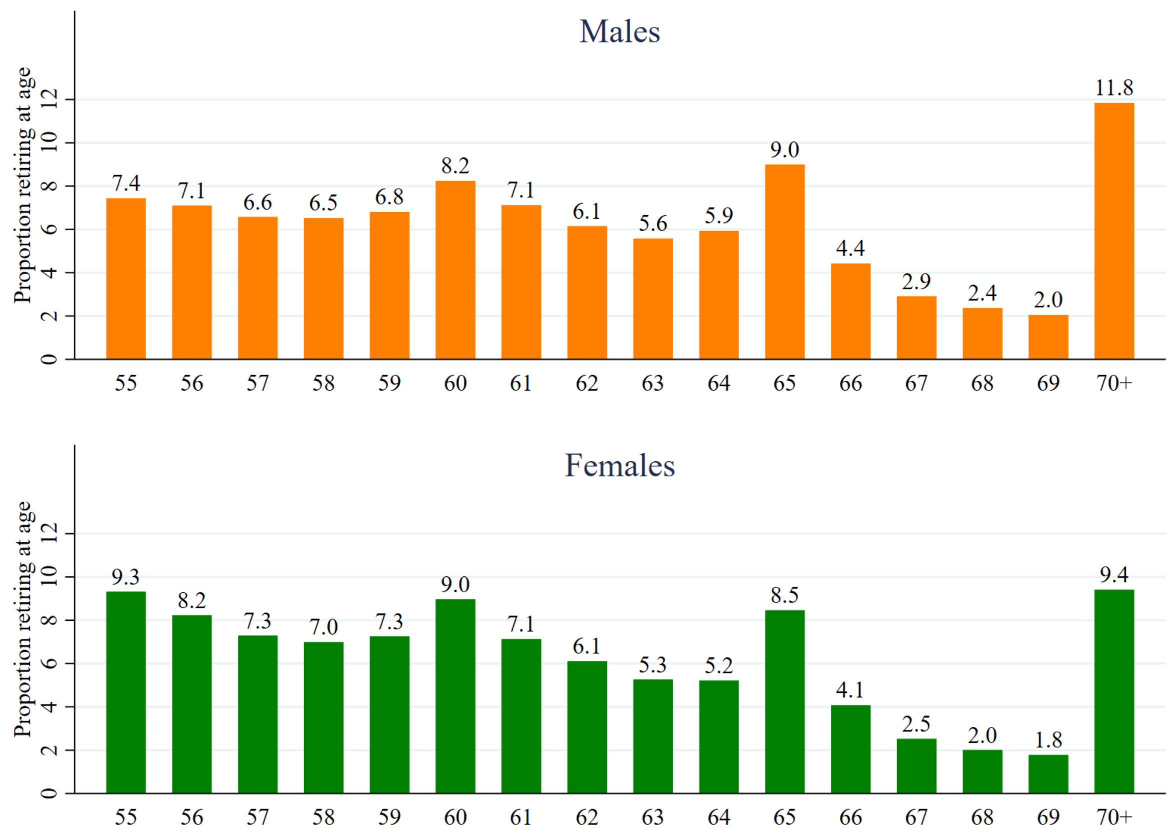

Figure 4: Distribution of retirement ages
Source: Authors' tabulations using the Longitudinal Administrative Database. Reported is the percent of those born between 1928 and 1946 who worked continuously to each age.

To see the changes over time, we graph in Figure 5 the proportion of three different birth cohorts that is still working at each age. At age 54, all are still working because our sample definition requires everyone to be working. For both males and females, there is a substantial reversal in work at older ages across the birth cohorts. At age 60, 59.5 percent of the male 1928 birth cohort was working. By the 1937 cohort, this age 60 employment rate fell to 53.5 percent, a drop of 6 percentage points. However, the 1946 birth cohort (who reached age 60 in 2006) has 62 percent still working. A similar pattern is seen for women, with a drop of 5.5 percentage points between the 1928 and 1937 birth cohorts, followed by a leap of 12.6 upward by 1946. For ages between 65 and 69, the proportion working from the 1946 cohort is around double the proportion working from the 1928 cohort, for both men and women. This is a substantial increase in work at older ages.

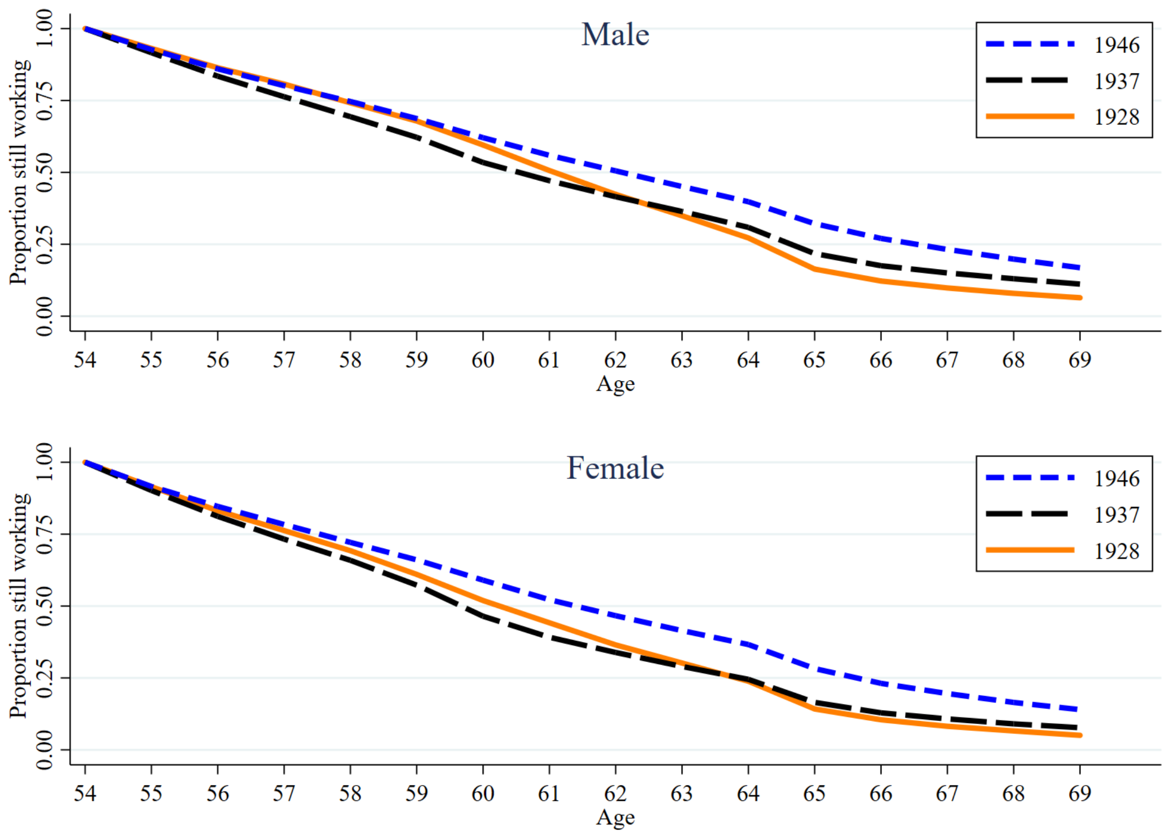

Figure 5: Proportion still working by birth cohort
Source: Authors' tabulations using the Longitudinal Administrative Database. Reported is the percent of those born between 1928 and 1946 who were still working at each age.

Another view on these changes over time can be seen by plotting the hazard rates—the percent of those still working who retire at each age. This can be seen in Figure 6 where we turn to cross-sectional analysis of the years 1995, 2005, and 2018. In 1995, the hazard rate at age 65 was 39.0 percent for females and 34.7 percent for males. By 2018, this had fallen to 17 percent for men and 20.9 percent for women. This shows a substantial shift in behavior toward later retirement over the years covered by our sample. Males and females follow roughly the same pattern and shifts through time.

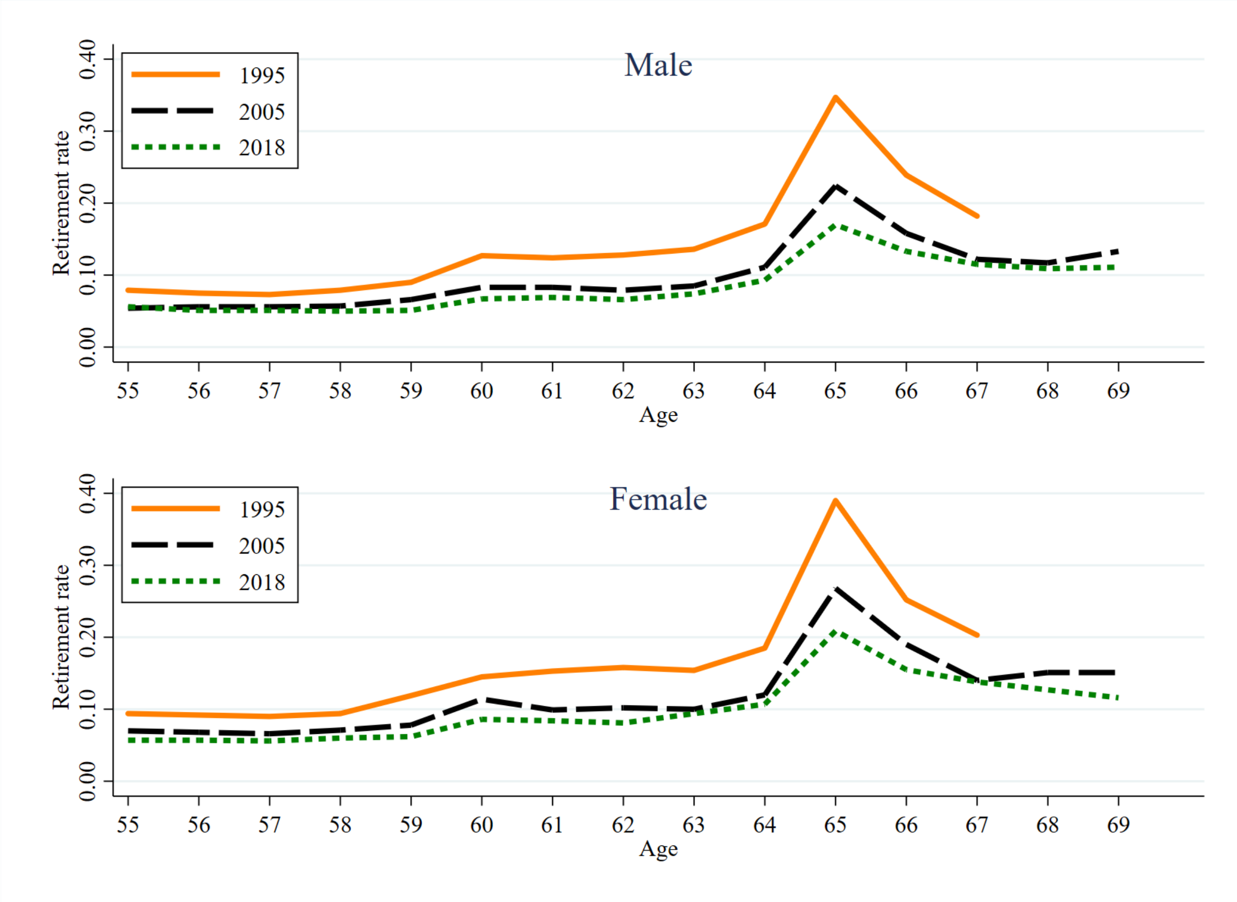

Figure 6: Hazard rates to retirement at each age
Source: Authors' tabulations using the Longitudinal Administrative Database. Reported is the percent of those still working who retire at each age.

3.3 Measurement of incentives

In this section we describe the construction of our incentive measures using the available earnings history in the LAD and the program rules. We begin by constructing a social security wealth (SSW) measure, representing the value of benefits received from social security programs (after tax) in one's lifetime as it depends on the age at which one enters retirement (R). This is given by:

$$SSW_{S,l}(R) = \sum_{t=R}^{T} B_{t,l}(R) \cdot \sigma_{S,t} \cdot \beta^{t-S} - \sum_{t=S}^{R-1} c_{t,l} \cdot Y_t \cdot \sigma_{S,t} \cdot \beta^{t-S}$$

Individuals, planning at age *S*, and given the policy rules in year *l*, will consider the social security contributions they will continue to make while working between ages *S* and *R-1* (stated here as a proportion *c* of earnings *Y*). They will also consider the net benefits (*B*, after tax) they receive while retired from ages *R* to their last age *T*. The benefit amount will depend on the retirement age under consideration and the rules in place at the time. The individual discounts future benefits using a discount rate r=3%, where $\beta = \left(1/_{1+r}\right)$, and for their probability of survival to age *t* conditional on having lived until age *S* (based on life tables).

The main component to calculate, then, is the future benefits (*B*) that an individual will be eligible for at each possible future retirement age given the legal environment in which they are making their decisions. Since C/QPP eligibility depends on individuals' earnings history after age 18 (or 1966, whichever is later), we must first construct earnings histories back to age 18 or 1966, as earnings are only observed in the LAD from 1982. To do this, we take the observed earnings history back to the first year available in the LAD, which is in most cases 1982. To fill in between age 18 (or 1966) and the first observed year, we apply gender-birth cohort specific growth rates in median earnings to backcast the first observed earnings for each individual. We then use this constructed and complete earnings history to calculate the C/QPP benefit for which a person is eligible at each considered age of retirement. In our calculations we allow for the low-earnings years drop-out provisions, but we do not apply individual-specific child dropout provisions. For married individuals, we also calculate the benefits a spouse is eligible for, assuming spouses enter retirement at age 60. For each individual and their spouse, we then calculate the OAS, GIS, and Allowance benefits they are eligible for and income taxes they would pay, given our projections of their expected incomes from all other sources. Since eligibility for GIS depends on private retirement savings, we project future values for capital income and employer-sponsored pension plans.[5]

[5] To impute capital income we first place individuals into 10 earnings groups based on their earnings at age 54. These 10 groups are not deciles, but instead are picked to provide more granularity at top earnings ranges where capital income is more prevalent. The first of the ten groups includes those with earnings in the first quartile, while the last group includes those in the top percentile. We then use the mean RRSP, dividends, and capital income within each observed decile of each source of income and assign those means to each of the 10 earnings groups. Expected RPP eligibility is based on observance of RPP contributions or a Pension Adjustment prior to age 55. When eligible, we assign an RPP pension equal to 50% of earnings at age 54 that begins paying at age 60. It is important to note that we cannot observe RPP eligibility consistently before 1995, so we have randomly assigned

For taxes, we use the Canadian Tax and Credit Simulator (CTaCS) to determine each person's federal and provincial income tax liability for each future age, given their own and their spouse's incomes.[6] These incomes come from the C/QPP, OAS, and imputed capital income and RPP pension income.

Life expectancies are drawn from lifetables derived from the Canadian Human Mortality Database (2019). We use the available mortality probabilities for each year from 1995 to 2019, and then extrapolate from 2019 to fill in years in the future.

We then estimate the extent to which SSW increases or decreases by delaying retirement (R) for one year (ACC, known as a one-year accrual). This is simply the difference

$$ACC_{l,R} = SSW_{S,l}(R+1) - SSW_{S,l}(R)$$

When ACC is positive, the individual will gain social security wealth by delaying retirement by one year; when negative the individual will lose SSW and would have greater incentives to enter retirement immediately.

Finally, we define the implicit tax on continued work for one more year after age *R* as

$$ITAX_{l,R} = -\frac{ACC_{l,R}}{Y^{Net}}.$$

where Y^{Net} represents the income that could be earned during the year of delayed labor force departure. As one would think about taxes most generally, when the implicit tax is positive, there is a penalty for continued work after age *R*. When negative, the negative tax means that social security wealth can be gained with delayed retirement.

We evaluate the benefit calculator by comparing the simulated benefits received at age 70 to the actual benefits as recorded in the LAD. This analysis is done only for those who lived to age 70. We separate the analysis by age of retirement, as we expect our simulated benefits to be less accurate for those who retired well before age 70. The results are shown in Table 2. We take the

---

eligibility for cohorts born 1931 or earlier, such that RPP membership rates match those found in administrative data.

[6] See Milligan (2019) for an explanation of CTaCS. We use version 2019-1.

average difference between actual and simulated benefits and express this as a percentage of actual benefits. We do this separately for the three main components of public pensions: Old Age Security, the Guaranteed Income Supplement, and the Canada/Quebec Pension Plan. Everyone in this sample survived to age 70, but they are sorted by their age of retirement.

The average deviation for Old Age Security is small, averaging 3% across the sample. Since the OAS is a flat demogrant, this accuracy is not surprising. The over-estimate may be driven by the residency requirement which lowers OAS for those who have lived less than 40 years in Canada. We do not observe immigration status in the LAD. For the GIS, our estimate is fairly inaccurate at early ages of retirement but grows in accuracy for those who worked longer. Our GIS estimate depends on imputations of capital income and employer-provided pensions for both the person and spouse, so obtaining a high degree of accuracy is challenging. The third column shows the accuracy of the Canada and Quebec Pension Plans. Here, we may err because of incomplete observation of earnings for years before 1982. In general, we overestimate CQPP retirement benefits, suggesting there are more years of low or zero earnings in the true earnings histories than we have imputed.

Age	OAS	GIS	CQPP
55	4%	36%	6%
56	4%	33%	7%
57	3%	30%	8%
58	3%	30%	9%
59	2%	29%	9%
60	2%	35%	10%
61	2%	25%	9%
62	2%	23%	7%
63	3%	11%	6%
64	3%	3%	5%
65	3%	-5%	4%
66	2%	7%	5%
67	2%	9%	5%
68	2%	9%	6%
69	1%	23%	6%

Table 2. Simulator evaluation of benefits at age 70
Source: Authors' tabulations using the Longitudinal Administrative Database. Shown is the average deviation between actual and simulated benefits expressed as a percentage of average actual benefits. This calculation is made separately for Old Age Security, the Guaranteed Income Supplement, and the Canada/Quebec Pension Plan.

3.4 Pattern of incentives

To give some insight into how these incentives change with age, and how they have changed over time, we graph the mean ITAX by age for males and females in three different years in Figure 7. There is little difference before age 60, as work at those ages typically improves the Canada/Quebec Pension Plan benefit incrementally by replacing a lower-earning year in the C/QPP calculation. There is not much difference between men and women, or across years.

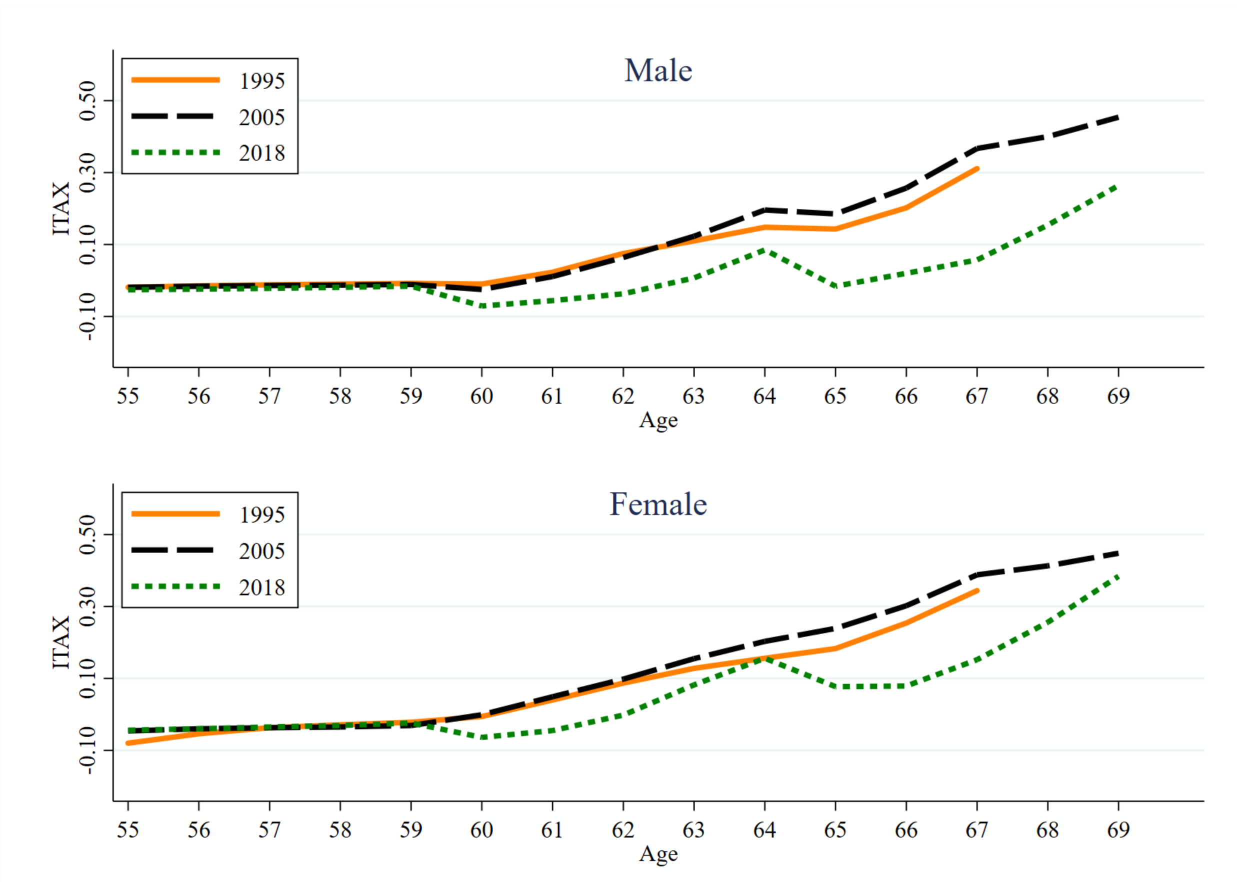

Figure 7: Retirement incentives by age
Source: Authors' tabulations using the Longitudinal Administrative Database. Reported is the mean ITAX incentive variable by age for selected years.

However, after age 60 things change dramatically. Continued work means that a year of pension receipt is foregone. There is an actuarial adjustment of benefits for each year of delay that attempts to compensate for this foregone year of pension receipt. In principle, these two factors could offset each other to produce neutral incentives. In practice, after accounting for taxes and the impact on other benefits (like the income-tested GIS), the average tax on continued work begins to climb. Again, there is little difference between males and females, but a clear drop in 2018 compared to previous years. This drop is driven by improvements in the earnings adjustment factor used to calculated C/QPP benefits.[7] Because the YMPE earnings cap that forms the adjustment factor grew faster than inflation in the 2000s, delaying retirement meant that the benefits grew more quickly in value when benefit uptake was delayed. So, this increased the return to work and lowered the ITAX disincentive.

In addition to the changes induced by the YMPE, there are also changes in the income distribution over time that contribute to these trends. As incomes grow, fewer are subject to the income test of the GIS. Since the GIS is phased out at a rate of 50 cents for each dollar of other income, whether or not someone is subject to the GIS phase-out makes a large difference to the return to an extra year of work and their ITAX. The proportion of those over age 65 who were entitled to the GIS fell from 40 percent in 1995 to 30 percent by 2018, meaning that part of the trends we see in Figure 7 are driven by the improvements in incomes among lower-income Canadians over the age of 65 across cohorts.

Another angle on the ITAX incentive can be seen by looking at the time series of ITAX for each age. In Figure 8 we show this for males and females combined. There is a different line in the graph for each age, with key ages highlighted. There has been a compression of ITAX through time. In the late 1990s, ITAX reached over 50 percent at older ages. However, by 2015 ITAX on average was under 25 percent at all ages, before rebounding up until 2018. There is little change in ITAX at ages under 60 over time. The two most important factors affecting these trends have been the faster increases in the earnings adjustment factor mentioned above, along with the

[7] Benefits are calculated by updating average career earnings using an adjustment factor based on the earnings cap (called the Years Maximum Pensionable Earnings or YMPE). Since 1998, the adjustment factor is the five-year average of this earnings cap.

change in the actuarial adjustment factor for delayed retirement that was implemented starting in 2011.

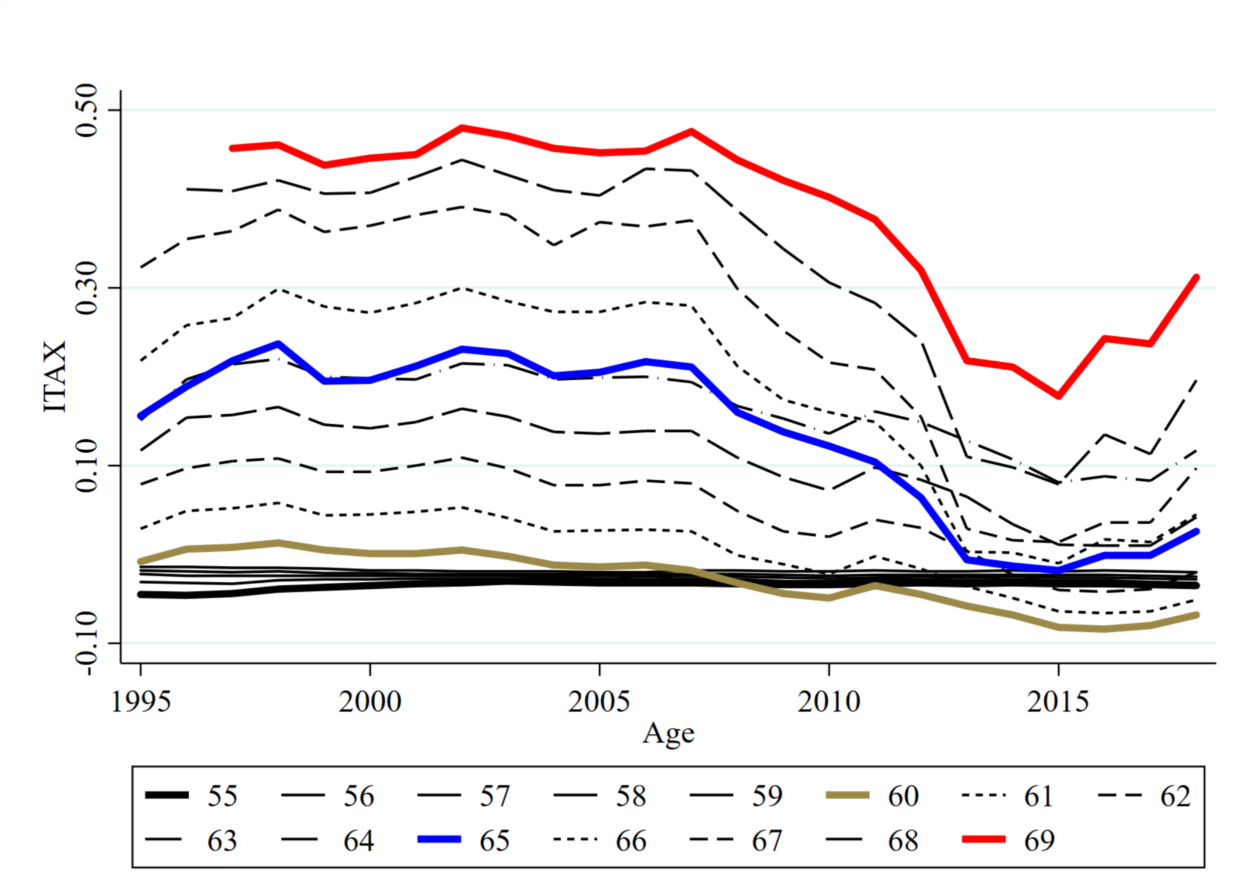

Figure 8: Retirement incentives by year
Source: Authors' tabulations using the Longitudinal Administrative Database. Reported is the mean ITAX incentive variable by age for all years.

An improvement in benefits can also be seen by looking at the overall value of SSW by age across years. In Figure 9 we show how SSW (in 2018 Euros) has evolved. Later cohorts hitting their 60s in the 2010s have a higher level of Social Security Wealth than previous cohorts. This is in part because of lower taxes, but it is also driven by higher lifetime earnings for these cohorts and the more generous earnings adjustment factor for the C/QPP in the 2000s.

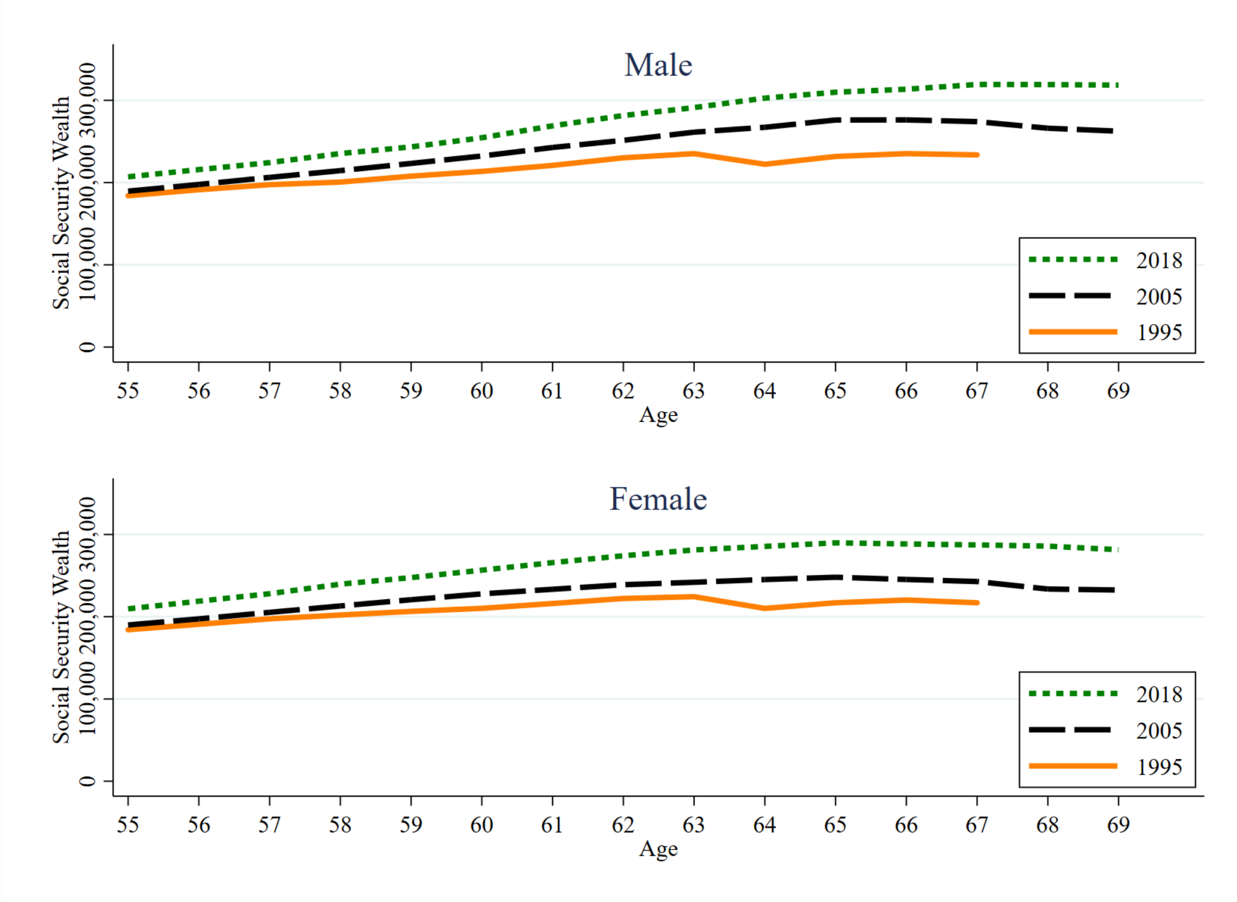

Figure 9: Social Security Wealth by age
Source: Authors' tabulations using the Longitudinal Administrative Database. Reported is the mean SSW incentive variable by age for selected years. The currency is expressed in 2018 Euros.

4. Regression results

In this section we present our main regression results. We begin by explaining our empirical approach, followed by the presentation of the main results along with robustness checks for specification, estimation method, sample definition, sex, and marital status.

4.1 Empirical approach

The equation we estimate takes the form

$$R_{it} = \beta_0 + \beta_1 SSW_{it} + \beta_2 ITAX_{it} + \beta_4 X_{it} + \varepsilon_{it}$$

where entry to retirement (Rit) is set equal to one when we observe the individual retire (a year of positive earnings followed by a year of zero earnings). Social security wealth (SSWit) and the implicit tax (ITAXit) capture incentives associated with Canada's social security system. As controls, we account for age, year, marital status, province of residence, spouse's age, sex, and access to RPP income for the individual and their spouse. We further control for individuals' (and spouses') earnings at age 54 and for career earnings through the average ratio of their earnings at each age in their history to the Year's Maximum Pensionable Earnings. We estimate the equation using a linear probability model but check probit results as well. In addition, we try models accounting for the panel nature of our data through fixed and random effects.

Our main estimates are based on the time period 1995-2018. We chose this period given our ability to observe RPP eligibility after 1995, in the context that RPP eligibility largely determines whether one is eligible for the means-tested GIS support that creates substantial disincentives to continue work at older ages. Moreover, since we are restricted to those who attained age 54 in 1982 or later, by 1995 we have nearly the full range of ages available. Finally, choosing 1995 allows us to examine the upsurge in work at older ages that happened after 1995 and complements the work done by Baker, Gruber, and Milligan (2003, 2004) using data from the 1980s and 1990s.

To begin, we present a scatter plot of average retirement rates and the ITAX incentive by age/year cells. That is, each age and year combination is a separate point in the graph in Figure 10. Overall, there is a clear positive association between ITAX and the retirement rate in this graph. This is the expected sign, indicating that higher ITAX rates are associated with higher retirement rates.

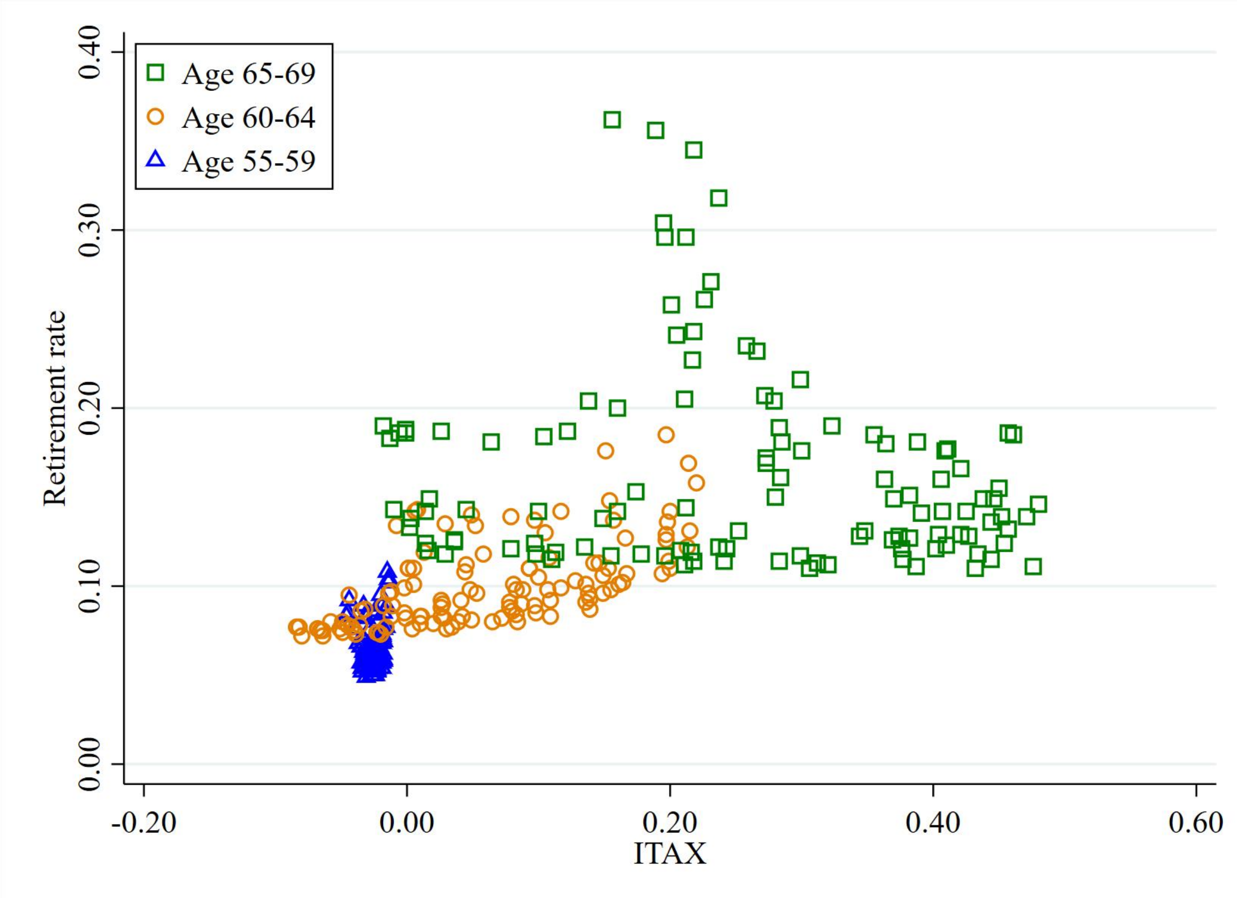

Figure 10: Average retirement age vs ITAX
Source: Authors' tabulations using the Longitudinal Administrative Database. The average ITAX and retirement rate for age-year cells (pooled genders) are shown.

4.2 Main results

Our main regression results are presented in Table 3. In the first column, we report the results of a regression of a binary retirement indicator on SSW, ITAX, and a very basic set of controls consisting only of a linear year term and a quadratic in age. Both genders are pooled here, giving us more than 10 million person-year observations. As the results proceed across the table, more control variables are added to see how the estimates on the incentive measures change.

	(1)	(2)	(3)	(4)	(5)
N	10,692,105	10,692,105	10,692,105	10,692,105	10,692,105
R-Squared	0.0136	0.0147	0.0194	0.0202	0.0267
	OLS	OLS	OLS	OLS	OLS
Social Security Wealth	-0.0084***	-0.0061***	-0.0042***	0.0051***	0.0011***
(100,000 Euros)	(0.0001)	(0.0002)	(0.0002)	(0.0003)	(0.0003)
ITAX	0.0279***	0.0258***	0.0310***	0.0290***	0.0381***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Male		-0.0154***	-0.0154***	-0.0049***	-0.0060***
		(0.0002)	(0.0002)	(0.0002)	(0.0002)
Married		-0.0023***	-0.0040***	-0.0133***	-0.0088***
		(0.0003)	(0.0003)	(0.0004)	(0.0004)
Spouse age gap		-0.0004***	-0.0004***	-0.0005***	-0.0005***
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
Employer pension (RPP)			-2.6060***	-2.6667***	-0.0078***
			(0.0465)	(0.0465)	(0.0004)
Spouse RPP			0.0004	0.0044***	0.0038***
			(0.0002)	(0.0002)	(0.0002)
Earnings at age 54				-0.0035***	-0.0037***
				(0.0001)	(0.0001)
Spouse earnings at age 54				0.0006***	0.0005**
				(0.0002)	(0.0002)
Lifetime YMPE ratio				-0.0447***	-0.0408***
				(0.0004)	(0.0004)
Age	Quadratic	Quadratic	Quadratic	Quadratic	Dummies
Year	Linear	Linear	Linear	Linear	Dummies
Province dummies		Y	Y	Y	Y
Age*RPP			Y	Y	Y

Table 3: Main Regression Results
Source: Regressions using the Longitudinal Administrative Database. The dependent variable in each case is a binary indicator for being retired. Three stars indicates significance at the 1% level of confidence; two stars is 5%; one star is 10%. Estimation is by OLS linear probability model. Robust standard errors are reported below in parentheses.

In the first column with only basic controls, the estimated coefficient on SSW is -0.0084, which suggests that an extra 100,000 Euros of SSW will decrease the probability of retirement by 0.84 percentage points. This is the opposite sign to what was expected, as higher wealth should lead to more leisure and earlier retirement, not later. However, without controls for earnings this estimated coefficient may reflect differences in retirement across earnings groups.

The ITAX incentive variable has an estimated coefficient of 0.0279, which suggests that an increase of ten percentage points in ITAX increases the retirement probability at a given age by about a quarter of a percentage point. At some ages in Figure 8, ITAX dropped by 20 percentage points or more, so movements in ITAX should have a noticeable impact on observed retirement.

In the 2nd column of Table 3, we introduce controls for province of residence, being male, married, and the difference in spouse ages. This addition of control variables does not materially change the message. Including the employer-provided pension control in the third column (RPP and Spouse RPP) also has minimal impact on the coefficients for Social Security Wealth and ITAX.

In the 4th column of Table 3, we add a set of controls for earnings at age 54, spousal earnings at age 54, and the lifetime YMPE ratio to control for lifetime earnings patterns. With these controls, the coefficient on SSW goes to positive 0.0051. This is consistent with findings in Baker, Gruber, and Milligan (2003,2004) showing that including rich earnings controls has a substantial impact on the coefficient for SSW, since SSW and lifetime earnings are correlated.[8] While the sign is now showing the expected direction, it is important to note that this estimate is still quite small. An increase in SSW of 100,000 euros leads to a tiny 0.51 percentage point increase in retirement. The coefficient on ITAX is largely unchanged between the 3rd and 4th columns.

In the final column of Table 3 we replace the year and age controls with a full set of dummy variables for each year and age. This specification is the most demanding but does not have a

[8] We explored still-richer sets of controls for earnings, including cubics in age 54 earnings and the career earnings ratio, but found they did not materially change the estimates of the incentive variables.

large effect on our estimate of ITAX which is now 0.0381. The impact of SSW is still positive and significant, but is even smaller.

We next extend our analysis by looking at alternative estimation approaches. Because of computational demands for some specifications, we implemented a small change by taking the natural log of age 54 earnings. Otherwise, the specifications we use for the exploration of different estimation approaches are the same as the fourth column of Table 3.

	(1)	(2)	(3)	(4)	(5)
N	10,692,105	10,692,105	10,692,105	10,692,105	10,692,105
R-Squared	0.0181	0.0926		0.0301	
	OLS	OLS	OLS	Probit	Probit
Panel controls		Fixed effects	Random effects		Random Effects
Social Security Wealth	0.0004	-0.0614***	0.0004	0.0027***	0.0035***
	(0.0003)	(0.0009)	(0.0003)	(0.0001)	(0.0004)
ITAX	0.0252***	0.0399***	0.0254***	0.0148***	0.0201***
	(0.0005)	(0.0006)	(0.0004)	(0.0002)	(0.0005)

Table 4: Specification checks
Source: Regressions using the Longitudinal Administrative Database. The dependent variable in each case is a binary indicator for being retired. All columns include the full set of controls from Table 3 column 4. Three stars indicates significance at the 1% level of confidence; two stars is 5%; one star is 10%. Estimation method varies by column. Robust standard errors are reported below in parentheses.

For the first column of Table 4, we repeat the results of the fourth column of Table 3, but with the log earnings control in place. The results are similar. In the second column, we add fixed effects to our linear probability model / OLS estimation. In this specification, the impact of ITAX strengthens to 0.0399, while the coefficient on SSW becomes negative and is much larger in absolute value. This finding likely results from a lack of within-person across-age variability in the value for SSW, since SSW largely reflects lifetime earnings and doesn’t vary strongly over time within an individual's observations. ITAX, on the other hand, changes more sharply across ages for each person, allowing more variation to identify the effect. The third column estimates with random effects instead of fixed effects, and the results revert close to the values seen in the first column. The final two columns implement probit estimation without and with random effects. The estimates for ITAX and SSW are smaller here than with OLS / linear probability model.

	Males			Females		
	All	Married	Single	All	Married	Single
	(1)	(2)	(3)	(4)	(5)	(6)
N	5,921,530	5,012,525	909,005	4,770,575	3,413,890	1,356,680
R-squared	0.0174	0.0177	0.0137	0.0165	0.0154	0.0202
Social Security Wealth	0.0088***	0.0093***	0.0427***	0.0005	-0.0020***	0.0382***
	(0.0003)	(0.0004)	(0.0023)	(0.0004)	(0.0005)	(0.0018)
ITAX	0.0213***	0.0205***	0.0342***	0.0364***	0.0347***	0.0380***
	(0.0006)	(0.0007)	(0.0019)	(0.0009)	(0.0011)	(0.0017)

Table 5: Results by gender and marital status
Source: Regressions using the Longitudinal Administrative Database. The dependent variable in each case is a binary indicator for being retired. All columns include the full set of controls from Table 3 column 4. Three stars indicates significance at the 1% level of confidence; two stars is 5%; one star is 10%. Estimation method is linear probability OLS. Robust standard errors are reported below in parentheses.

We now turn to differences in our estimates across gender and marital status. In Table 5, we report results for separate regressions for males, females, singles, and married. For the SSW variable, we estimate positive coefficients for males, and negative for females (except for singles). These positive coefficients for males are the expected sign. However, in all cases these SSW estimates remain quite small. For the ITAX incentive, the estimate is 0.0213 for all men, but stronger for women at 0.0364. So, women appear to be more responsive to the retirement incentive. For both men and women, singles seem to be more responsive to the ITAX incentive.

The final set of regression results checks the sensitivity of our estimates to different samples. In Table 6 we first show the results in the full 1983-2018 sample. For the years before 1995 we do not see RPP status and we do not have broad coverage of the age 55-69 age range. The estimated impact of ITAX here is 0.0230, which is slightly smaller than our main specification. For SSW, the estimate is -0.0066.

However, our main estimates include controls for RPP status which is not available for the early years of the sample included in the first column. So, in the 2nd column we show the results for years 1995 to 2018 leaving out the controls for RPP and spouse RPP. The estimates are very similar to the results in the first column, suggesting a consistency in our results across year ranges. The third column reintroduces the RPP effects to replicate the main specification in Table 3 column 4. The SSW coefficient is now positive and significant. This highlights the importance of the RPP controls in our estimates.

	(1)	(2)	(3)	(4)	(5)
Years	1983-2018	1995-2018	1995-2018	1995-2018	1995-2018
RPP control	No	No	Yes	No	No
RPP sample			with/without	With RPP	Without RPP
N	12,497,765	10,692,105	10,692,105	5,000,810	5,691,295
R-Squared	0.059	0.0158	0.0167	0.0195	0.0197
Social Security Wealth	-0.0066***	-0.0072***	0.0051***	0.0144***	0.0029***
	(0.0002)	(0.0002)	(0.0003)	(0.0004)	(0.0004)
ITAX	0.0230***	0.0228***	0.0290***	-0.0029***	0.0979***
	(0.0005)	(0.0005)	(0.0005)	(0.0006)	(0.0010)

Table 5: Results by year and pension plan membership
Source: Regressions using the Longitudinal Administrative Database. The dependent variable in each case is a binary indicator for being retired. All columns include the full set of controls from Table 3 column 4 and also a full cubic in each of the earnings variables. Three stars indicates significance at the 1% level of confidence; two stars is 5%; one star is 10%. Estimation method is linear probability OLS. Robust standard errors are reported below in parentheses.

Because of the sensitivity of our results to the RPP controls, we explore in the last two columns of Table 6 what happens in two mutually exclusive and exhaustive subsamples for those with and those without RPPs. The results suggest substantial differences, with coefficients on ITAX of -0.0029 for those with RPPs and 0.0979 for those without. This indicates that our results are driven in large part by those without RPPs. This makes sense, as those with RPPs may be more responsive to the incentives within their workplace RPP pension than they are to the public pension, while those without an RPP in the workplace may pay more heed to the incentives in the public pension programs.

5. Simulations

Our estimates show a reasonable sensitivity of retirement to the ITAX incentive. The 0.0290 coefficient in our main estimate (from Table 3 column 4) suggests that a 10 percentage point increase in ITAX would lead to about a 0.3 percentage point increase in retirement at a given age. Since the average retirement probability in our sample is about 10 percent, this is a notable if not large sensitivity.

On the other hand, the SSW estimates vary a lot by specification, but in those specifications with rich RPP and earnings controls the magnitude of the SSW coefficient suggests that even a large increase of 100,000 Euros would move retirement by only a few tenths of a percentage point.

In this section, we present simulations which seek to understand if these reported retirement sensitivities can help to explain much of the upswing in work at older ages seen since 1995 in Figure 6. We do this by re-calculating the retirement incentives for each individual using the rules that were in place in 1995 rather than the contemporaneous program rules. We then apply our estimated coefficients for ITAX and SSW to these new incentive calculations and predicting retirement. We use the estimates from Table 3 column 4 for this purpose.

The time path for the ITAX measure in Figures 7 and 8 suggests some scope for the change in incentives to have affected behavior, especially at ages 65 and older where ITAX dropped from

20 to 30 percentage points. This is in part driven by change in the programs—the path of the Years Maximum Pensionable Earnings pension cap for the Canada Pension Plan, for example, affects how big is the return to an extra year of work. However, it is important to note that the lines in Figures 7 and 8 embody both changes in programs and changes in the incomes of the elderly population across years. As noted earlier, in 1995 40 percent of those 65 and older received the Guaranteed Income Supplement income-tested benefit. By 2015, this had dropped to 31 percent, owing to higher incomes among this population. Because fewer now face the 50 percent phaseout rate of this income-tested benefit, the average ITAX drops because of the changing income distribution of seniors.

Our simulations here hold the incomes and other personal characteristics of each person constant, and only vary the program rules. In this way, we can see the isolate the impact of the changes in the retirement income system on retirement behavior.

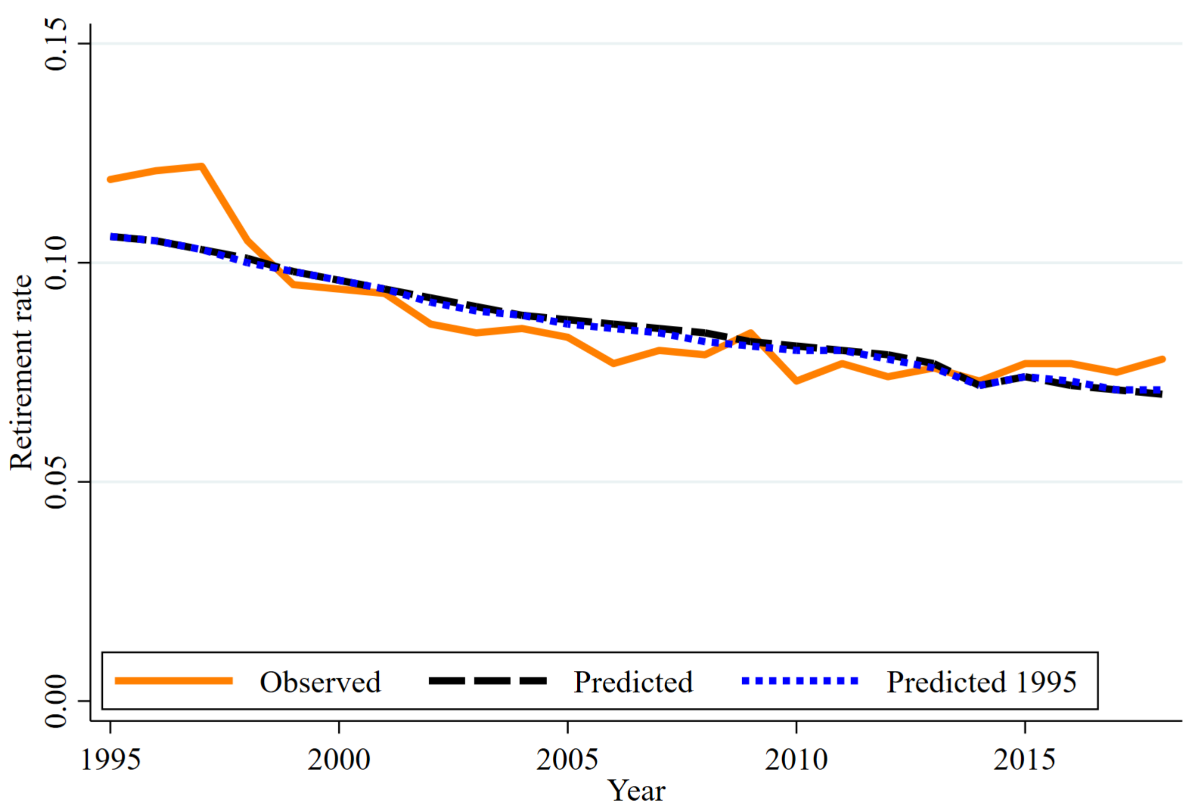

Figure 11: Counterfactual simulations
Source: Simulations using the Longitudinal Administrative Database, both genders pooled.

The aggregated results by year are shown in Figure 11. The solid line shows the average observed rate of retirement across men and women of all ages in our sample by year. The dark dashed line shows the predicted estimates from our core model. Finally, the short-dashed lighter line shows the predicted estimates under the ‘1995 rules’ counterfactual.

The results show little aggregate impact of the changes since 1995 on predicted retirement rates. This isn’t because there are no impacts on anyone—as noted above our empirical estimates do show some sensitivity of retirement to incentives. Instead, this result is driven by heterogeneous changes in incentives across the population since 1995. For some, the incentives improved while for others the incentives deteriorated. On aggregate, as shown in the figure, there was little perceptible impact. In part, this result reflects the relatively small changes in incentives driven by the changes in program parameters relative to changes driven by changing characteristics (like income) across cohorts of older workers.

But, there are some differences across groups of older workers. To show this, we disaggregate the simulations by age and by whether the worker had an employment-based pension when they were age 54. Those with an employment-based pension very rarely receive any of the income-tested GIS benefit and are generally higher earners. Those without an employment-based pension are on average lower earners but gain access to the income-tested GIS which affects their ITAX. This disaggregation is shown in Figure 12, using the specification with age and year dummies (Table 3 column 5) to obtain estimates for the impact of ITAX and SSW. We show the same three lines for those with and without a workplace pension. Here, there is some difference between the predicted values for the default and the “1995 system” predicted values; especially after age 65 for those with a workplace pension. Because the gap in predicted values is in opposite directions across the two groups, the aggregate prediction comes in very small when the two groups are averaged back together.

Figure 12: Counterfactual simulations by age and pension status in 2018
Source: Simulations using the Longitudinal Administrative Database, both genders pooled. The left-hand graph shows the results for those with a workplace pension when they were age 54 and the right-hand graph shows the results for those without a workplace pension.

Taken together, this provides evidence against the changes in Canada's public pension programs having a large impact on the rebound in work observed among older Canadians since 1995. This finding is driven more by the lack of aggregate changes in the retirement incentives than by a lack of sensitivity to incentives.

6. Conclusions

In this paper, we have extended previous analysis of public pensions and retirement in two important ways. First, we have used the richer data of the Longitudinal Administrative Database to calculate incentives and estimate their impact. Actual taxfiler information on earnings, all sources of income, and employment-based RPP pensions is a large improvement over previous work on Canadian retirement. Second, we have extended the time period of the analysis to cover the period from 1995 up to 2018, which is an era of strong labor markets and changing public pension incentives.

We have three main findings. First, there has been a very large shift toward later retirement over the past 20 years in Canada. Both men and women are retiring later, with proportions working after age 65 now double what they were in 1995. Second, we reconfirm previous findings showing that public pension incentives matter for retirement decisions. The pension penalty on extra work is consistently found to lead to more retirement through the implicit tax on extra work. On the other hand, the impact of the level of social security wealth is more mixed. For males higher pension wealth has the expected impact of encouraging retirement but for females the sign is reversed, although the estimated impact is small in either case. Finally, we find that changes in the public pension system are not a major contributor to the trends in retirements.

References

Baker, M., J Gruber and K. Milligan. 2003. "The retirement incentive effects of Canada's Income Security Programs." *Canadian Journal of Economics*, 36(2), 261-290.

Baker, M., J Gruber and K. Milligan. 2004. "Income Security Programs and Retirement in Canada," in Jonathan Gruber and David Wise (eds.) *Social Security Programs and Retirement Around the World: Micro Estimation*. Chicago: University of Chicago Press.

Canadian Human Mortality Database. 2019. Department of Demography, Université de Montréal (Canada). Available at http://www.bdlc.umontreal.ca/chmd/prov/can/can.htm (data downloaded on October 21, 2022).

Milligan, K. 2019. Canadian Tax and Credit Simulator. Database, software and documentation, Version 2019-1.

Milligan, K. and T. Schirle. 2016. "Option Value of Disability Insurance in Canada." in *Social Security Programs Around the World: Disability Insurance Programs and Retirement*, David A. Wise (ed.) NBER Book Series. University of Chicago Press.

Milligan, K. and T. Schirle. 2019. "The Labor Force Participation of Older Men in Canada," in Courtney Coile, Kevin Milligan, and David Wise (eds.) *Social Security Programs and Retirement Around the World: Working Longer*. Chicago: University of Chicago Press.

Milligan, K. and T. Schirle. 2020. "Retirement Incentives and Canada's Social Security Programs." In *Social Security Programs Around the World: Reforms and Retirement Incentives*, Courtney Coile and Axel Börsch-Supan (eds.) NBER Books Series. University of Chicago Press.

Schirle, T., 2008. "Why have the labor force participation rates of older men increased since the mid-1990s?" *Journal of Labor Economics*, 26(4), pp.549-594.

Schirle, T. 2010. "Health, Pensions, and the Retirement Decision: Evidence from Canada" *Canadian Journal on Aging*, Vol. 29 no. 4, pp. 519-527.