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RETIREMENT INCENTIVES AND DECISIONS ACROSS THE INCOME DISTRIBUTION: EVIDENCE IN CANADA

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ABSTRACT

We evaluate the retirement incentives embedded in Canada's retirement income system with attention to where individuals are located in the income distribution. We find that larger social security benefits are available to individuals with lower earnings in their work history because of the benefit income tests, but those from the top of the income distribution tend to enjoy longer lives over which they may receive benefits. Overall, we see greater Social Security Wealth among individuals from lower deciles. The implicit tax rates on continued work tend to be higher for workers from lower-earning deciles. Considering changes to actuarial adjustments associated with early pension take up, these implicit tax rates on work at older ages fell substantially after 2011. Our regression estimates confirm the importance of incentives on retirement behavior, with substantially larger effects for individuals in lower deciles. These effects are greater for women than men. In simulations, we show that changes to the actuarial adjustment had some impact on retirement rates by lowering the implicit tax on work. The overall redistributive effect of these induced retirement changes was fairly small, however, as the actuarial adjustments brought the system closer to actuarial fairness.

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1. Introduction

In 2021 nearly one in five Canadians were aged 65 or older. More Canadians were approaching typical retirement ages of 55-64 than approaching typical labour-market entry ages 15-24 (Statistics Canada, 2022). These long-run demographic trends add to a more cyclical perception of labour shortages as the economy adjusts after the COVID-19 pandemic to result in a keen focus on expanding labour supply. As part of this focus, public policy for retirement incentives and decisions plays a role. However, policy makers may also be concerned with the effect of retirement policy differentially by retirees' socio-economic status. Who's labour supply is affected by retirement incentives and who might be able to work longer?

In this study we evaluate the retirement incentives embedded in Canada's retirement income system, with a more direct and specific focus on whether the system differentially affects individuals across the income distribution. This builds on earlier work in Milligan and Schirle (2023), where we examined how these retirement incentives affected an average Canadian's retirement decision over the years 1995-2019. That study confirmed that the incentive structure of Canada's public pensions significantly influenced the decision to retire. We were able to show that the main mechanism at work was the implicit tax placed on additional years of work at older ages (reflecting a loss of lifetime pension benefits). However, when taking a historical perspective, it was clear any changes to public pensions over this period were not a major contributor to the large shifts toward later retirement we see happening in Canada.

The evidence in Milligan and Schirle (2023) is consistent with evidence presented in earlier studies (including Baker Gruber and Milligan 2003, 2004, Schirle 2010, and Milligan and Schirle 2016). Milligan and Schirle (2023) also show, however, that there were substantial and significant differences across groups in how people respond to public pension incentives. Most importantly, it was vital to account for whether individuals appeared to have access to an employer-sponsored registered pension plan (RPP) as those without an RPP appeared most responsive to public pension incentives. We expect this difference in responsiveness reflects a greater likelihood those without a workplace pension fall under the income-tested parts of the Canadian retirement income system, which leads to a sharp increase in retirement incentives. In addition, there may be incentives for retirement embedded in employer-provided pensions that are more dominant than the incentives in the public system.

To examine retirement decisions across the income distribution more carefully, we employ methods used in Milligan and Schirle (2023), while accounting for the position of individuals in the income distribution. We use data from the Longitudinal Administrative Databank (LAD) representing the years 1982-2020, providing us with a large sample of older individuals and detailed information about their earnings histories, other sources of income and some family characteristics. We use the available information to characterize their position in the income distribution, and to construct measures of individuals' implicit tax on continued work at each potential age of retirement based on the provisions of the Canada and Quebec Pension Plans, Old Age Security, the Guaranteed Income Supplement and related Allowances, as well as federal and provincial income taxation.

This paper begins with a background on the retirement income system in Canada. We then describe our data and provide details on our empirical approach. We next report our main empirical results, followed by policy simulations which help put the empirical estimates in context.

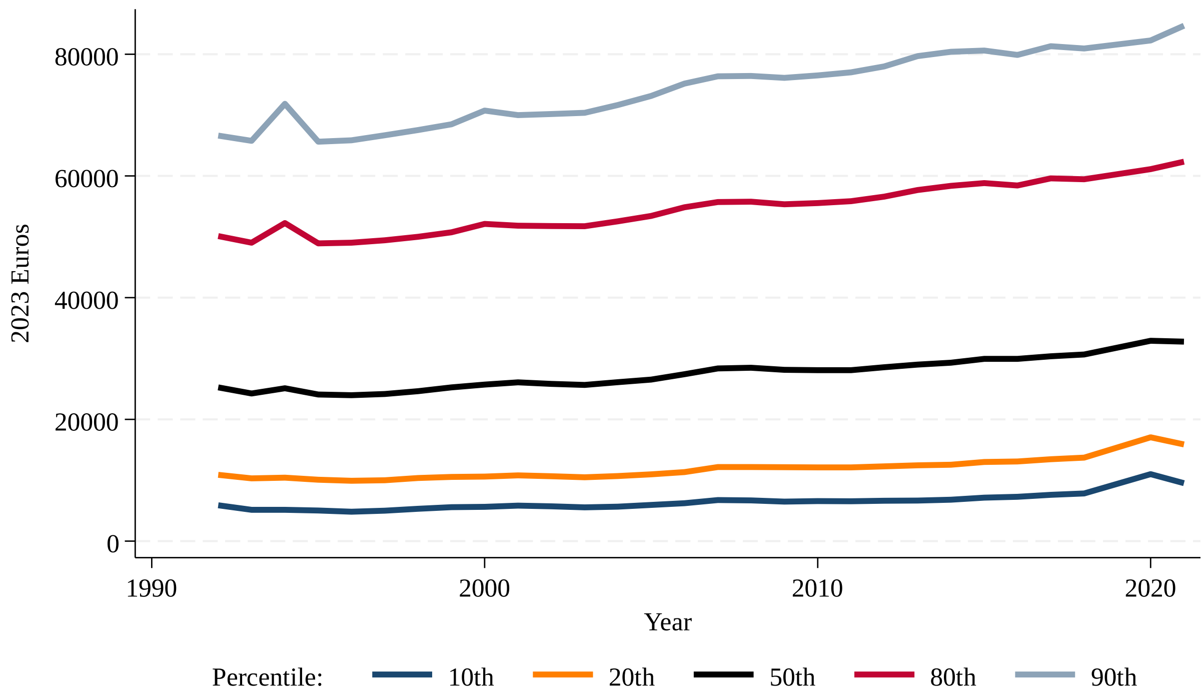
2. Background

In this background section we begin with a general description of income across the population and document how inequality is changing over time. We compare before- and after-tax outcomes to highlight the role of the tax system on inequality. We also provide specific information on how seniors fit into these inequality and income distribution measures. The second part of the background provides details on how Canada's social security system works for the provision of retirement income. We explain each of the main programs in detail.

2.1 Income and Inequality in Canada

Our overview of income and inequality in Canada begins with total income, in the 1992-2021 time period for all Canadians regardless of age. We graph percentiles of total individual income in Figure 1 in 2023 Euros. Incomes have risen across the income distribution with the largest gains in the 20 years up to 2021 at the top of the income distribution. In 2020 income transfers associated with the Covid-19 pandemic boosted incomes proportionately more for lower-income Canadians.

Figure 1: Percentiles of Total Income, 1992-2021

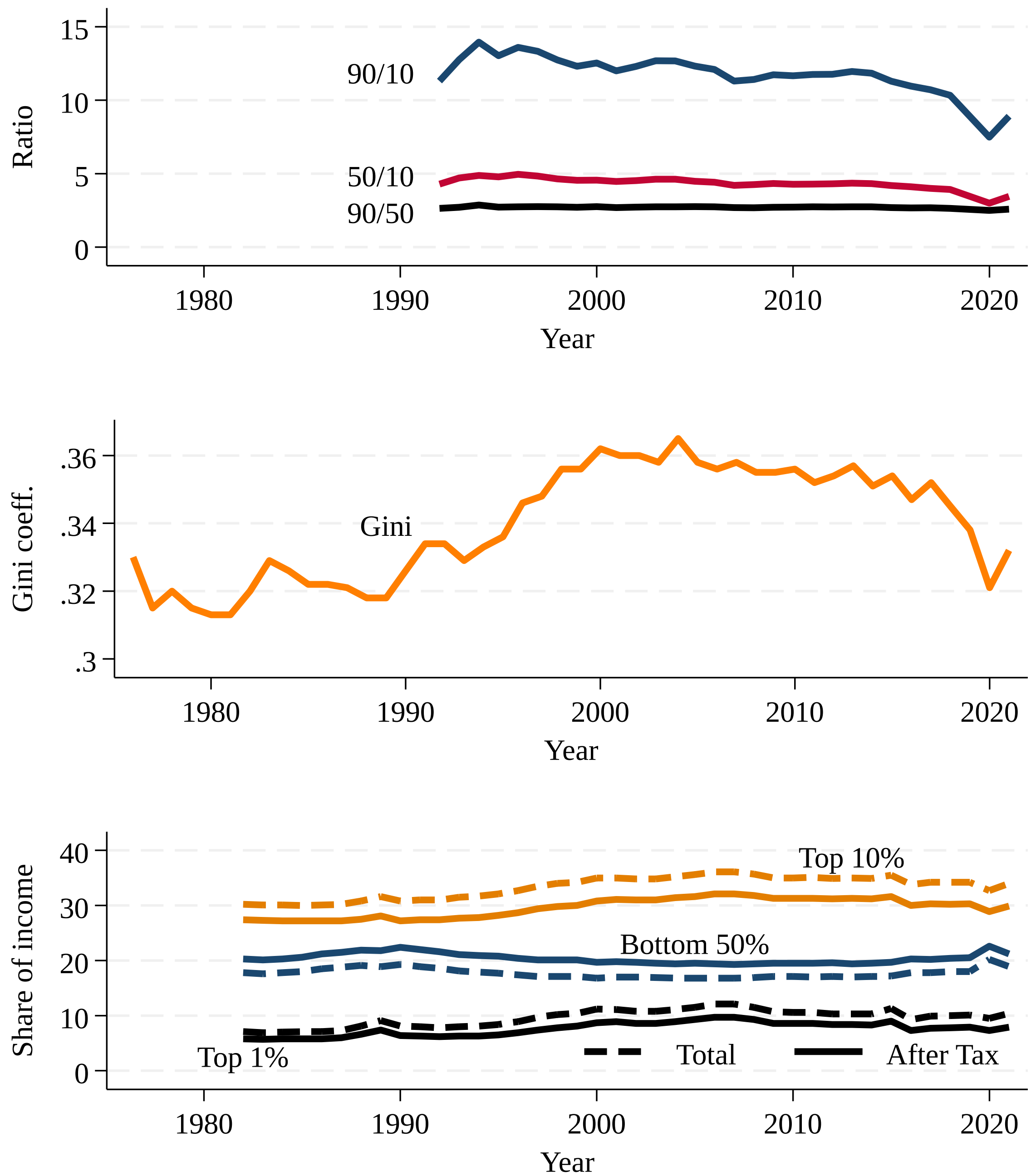


Note: Source is Statistics Canada tables 11100054 and 18100005, using the 'modified' measure of individual total income in 2023 Euros.

We form several measures of income dispersion and inequality using these same data. In the top panel of Figure 2 the ratios of various percentiles describe the changing shape of the total income distribution. Since the mid-1990s, the 90/10 and 50/10 ratios declined steadily as the incomes in the bottom of the distribution increased faster than the median or 90^{th} percentiles. There is less change with respect to the distance between middle and top incomes (90/50). In the middle panel of Figure 2 the Gini coefficient steadily declines after the early 2000s, with sharper reductions in recent years.[1]

[1] Note our source for this panel uses a slightly different definition of total income, measured across households rather than individuals.

Figure 2: Measures of Income Inequality



Notes: Source is Statistics Canada Table 11-10-0054 (top panel), 11-10-00134 (middle panel), and 11-10-0055-01 (bottom panel).

A similar pattern is seen in the bottom panel of Figure 2, where we plot the share of before-tax total income and after-tax income attributed to the top 1%, top 10% or bottom 50% of Canadians (among all taxfilers). The share of income going to high income Canadians increased steadily until 2007 and has gradually declined since. In all these measures, the sharp changes in 2020 reflect the impact of the Covid-19 emergency income supports.

Table 1: Income of Individuals in Canada, 2021, by age group

	25-54	55-69	70+
Total income after tax			
P10	11478	7612	11912
P90	70172	66214	48890
P90/10	6.11	8.70	4.10
Mean	39687	34993	27843
Median	34641	28917	22211
Total income before tax			
P10	11627	8468	12426
P90	89438	82892	57849
P90/10	7.69	9.79	4.66
Mean	48599	43256	31951
Median	39315	32540	23577

Source: Authors' tabulations using the 2021 Canadian Income Survey, representing individuals' income in 2023 Euros. Total income includes government transfers.

How does the distribution of income among seniors compare to the general population? In Table 1, we describe the distribution of income (before- and after-tax) within select age groups—ages 25-54, 55-69 and 70 or older. There are several interesting things to notice here. First, the average, median and 90th percentile incomes of seniors are substantially lower than for younger adults (25-54); as one might expect. Second, the 10th percentile of income for seniors age 70+ is higher than for other age groups. This reflects the important role of Canada's public pensions (as described later in this section) in providing a guaranteed minimum income to Canadians over age 65. It is not surprising then that the ratio of the 90th to 10th percentile of income is lowest among those age 70 than in any other group. Third, the 90/10 ratio is highest among those aged 55-69, reflecting the fact that some individuals in this group may not be working nor have access to public pensions yet, while others will be continuing to work full time. Finally, in addition to the public pension transfers, the tax system also plays an important role in redistribution. For all age groups, but especially younger adults, the 90-10 ratio is substantially smaller for after tax than before tax income.

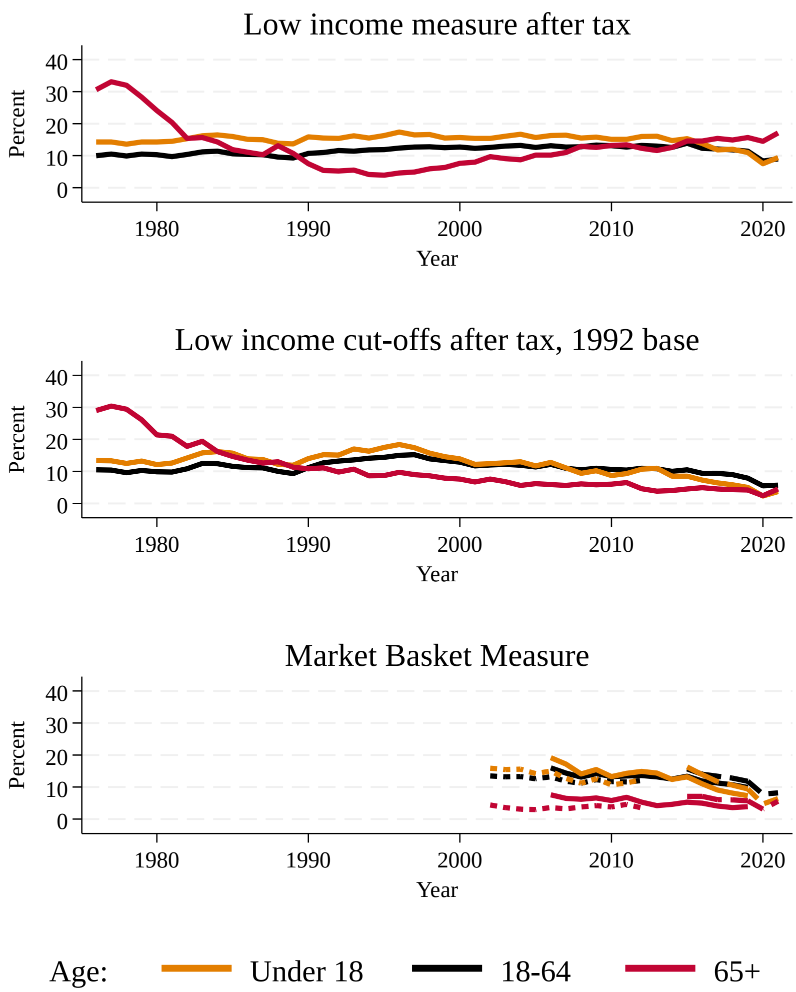
While seniors have lower income on average, it is clear the social security system is an important source of income for those at the bottom of the distribution. This is even more clear when we consider the likelihood of poverty among individuals in different age groups. A description of the early trends for senior poverty in the 1970s and 1980s can be found in Schirle (2013) and Milligan (2008). Both of those papers report on periods in which the social security system became more generous for those in the bottom half of the income distribution.

In Figure 3 we present commonly used measures of poverty rates in Canada, for children, adults aged 18-64, and seniors aged 65+. These measures are often used to judge the effectiveness of policy in achieving redistributional goals. Note that each measure captures some aspect of inequality in the sense that the measures used are (at least in part) relative measures of poverty.

In the top panel of Figure 3 we see poverty rates based on the Low Income Measure. The LIM threshold is set as ½ of the median income for the population (here representing household income adjusted for household size). For seniors, the percent of people with income below the LIM threshold fell steadily until the 1990s. This early reduction in poverty is often attributed to the expansion of income supports (described below) available to seniors in Canada (see Schirle 2013). After the mid-1990s, however, the LIM-based poverty rates among seniors appear to increase steadily. As Milligan (2008) points out, however, this in part reflects a relative increase in the incomes of younger adults (18-64) rather than a real decline in seniors' standards of living.

This improvement in seniors' income is clearer when we consider the poverty rates in the second panel of Figure 3, based on Canada's Low Income Cut-Off (LICO). The LICO threshold was set to reflect an amount of income below which a family was spending a much larger share than was typical on necessities (such as food, clothing, and shelter). This basket of necessary goods was determined in 1992 with different thresholds accounting for family size and geographic differences in cost. Since 1992, the thresholds are adjusted for inflation. With this measure, we see a steady reduction in poverty rates among seniors reflecting growing incomes at the bottom of the distribution. Only recently, following large expansions in child benefits targeting lower income families, have the poverty rates of children aligned with the poverty rates of seniors.

Figure 3: Measures of Poverty by Age



Notes: Source is Statistics Canada Table 11-10-0135-01. Each line shows the percent of individuals within the age group below the specified threshold. In the bottom panel, the dotted line represents the MBM based on the year 2000 basket, the solid line is the 2008 basket, and the dashed line is the 2018 basket.

In 2018 the Canadian federal government established an official poverty line, based on the Market Basket Measure (MBM). The MBM thresholds are set to reflect the cost of a basket of goods deemed necessary for a family to enjoy a modest standard of living, accounting for inflation year-to-year, and adjusting for family size and geographic differences in costs. The basket is updated periodically to reflect changing needs and social standards. As such, it is difficult to make comparisons over time: while the trends for a given basket will be similar to trends using LICO, trends across baskets will be similar to changes in LIM. When considering the resulting MBM poverty rates for seniors in the bottom panel of Figure 3, it is not clear whether poverty rates have changed since the early 2000s. However, it is clear that poverty rates of seniors are generally much lower than for the rest of the population.

Thus far, we have only described inequality in terms of incomes. When comparing across age groups, however, it is important to consider the resources individuals have available in terms of the wealth they hold and may draw down to maintain their standard of living in retirement. Previous studies show that seniors (age 55+) are the least likely to be considered asset poor, defined in terms of a household's ability to maintain well-being at low-income thresholds for 3 months. Estimates from Rothwell and Robson (2017) suggest a clear age gradient to asset poverty, as 39% of those 55 and older and 65% of those age 25-34 were asset poor.

In Table 2, we describe the distribution of wealth in terms of a family's net worth (including pensions). Across all ages, we can see the distribution of wealth is highly skewed. Moreover, as families in the lower end of the distribution hold very little wealth compared to those at the top. Among families with 55-69 year olds as the major income earner, the 90/10 ratio for net worth is 249. As individuals age, however, and draw down wealth, the ratio falls: the 90/10 ratio for families 70+ in 2019 was 113.

Table 2. Net worth of economic families, 2019

	25-54	55-69	70+
P10	1466	7929	14067
P90	1181243	1975818	1594143
P90/10	806	249	113
Mean	466453	850756	703851
Median	192977	522346	393682

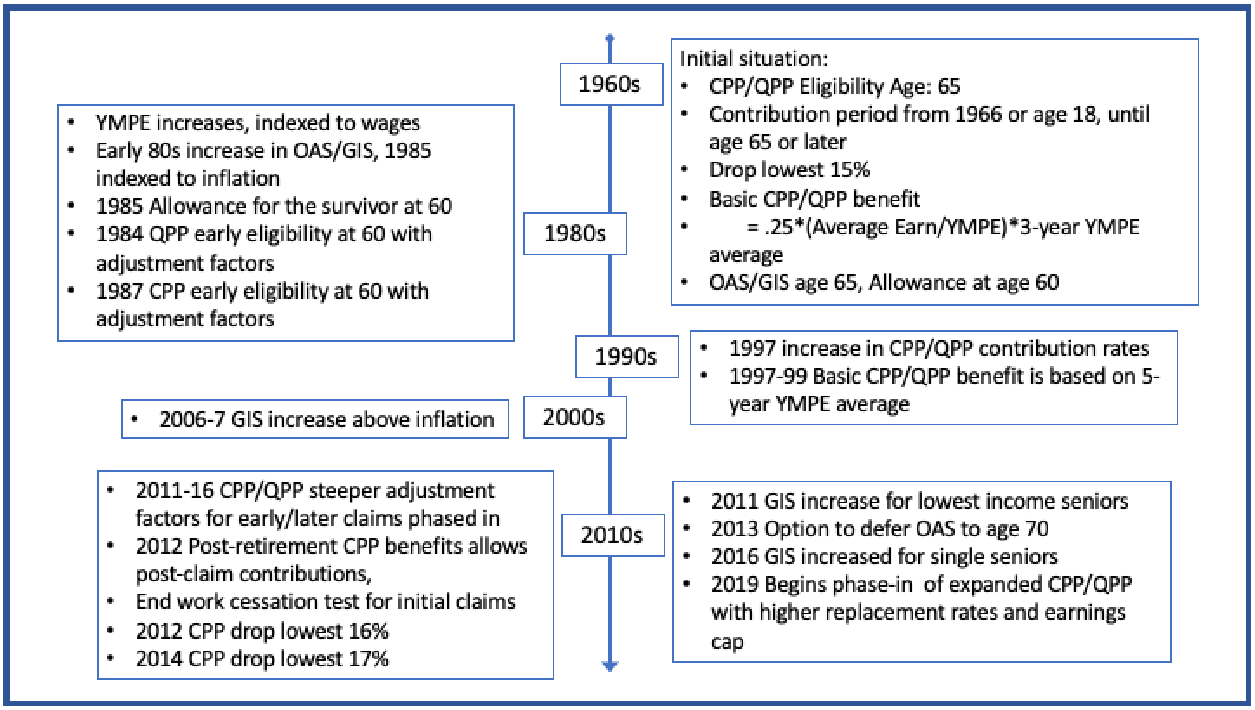
Source: Authors' tabulations using the Survey of Financial Security, 2019. Age of the major income earner in the economic family is used. Net worth includes pensions valued on ongoing concern basis, presented in 2023 Euros.

To summarize, Canadian incomes overall grew more unequal in the 1990s but stabilized somewhat by the 2010s. For seniors, there were absolute gains in income for those at the bottom of the income distribution, but more modest gains relative to workers. An important element of the Canadian system is that those who are the lowest earners at working ages see an increase in their incomes at retirement resulting in lower poverty levels among seniors than most working-age families.

2.2 Canada's social security programs

Canada's retirement income system and social security programs are designed in a way that treats Canadians with different earnings histories very differently. A detailed review of Canada's social security programs is offered in Milligan and Schirle (2016, 2020). Here, we provide a brief overview of key programs and reforms (highlighted in Figure 4), while emphasizing program parameters and reforms that may have heterogeneous effects on benefits and work across the income distribution.

Figure 4: Reforms of Canada's social security programs



There are two major components of Canada's social security programs considered in this study. The first component represents a set of programs that offer older Canadians a guaranteed minimum income. The main program, Old Age Security (OAS), offers a near-universal old age pension to Canadians over age 65. The program is near-universal in that benefits are clawed back for high (individual) income seniors.[2] As structured, the program is not expected to alter work incentives of seniors expecting modest incomes in retirement. OAS benefits are taxable, potentially affecting those seniors whose incomes are high enough that their income tax payable

[2] For 2023, seniors with (individual) income (including OAS) over CAD$86,912 would face the OAS clawback of 15% for income over the threshold. Eligiblity and benefits are also based on residency: one must have 10 years residency to be eligible and benefits are reduced in proportion to years of residency less than 40 years.

is positive. In addition to OAS, the Guaranteed Income Supplement offers a top-up to seniors over age 65 whose (couple) income is low.[3] The benefit is not taxable but is clawed back by 50 cents (or more) for every dollar of income above exempt amounts. Similarly structured clawbacks are applied to the Allowance offered to age 60-64 spouses of OAS pensioners, and the Survivor's Allowance available to widows between ages 60 and 64. As structured, low-income seniors receiving GIS benefits face very different incentives to work than middle-income seniors, and those incentives will depend on their marital status. While the benefits from this set of programs have become more generous over time, there are only minor reforms over the period studied here.[4]

The second major component of Canada's social security programs considered in this study are the Canada and Quebec Pension Plans (CPP and QPP).[5] The CPP applies to all Canadians outside the province of Quebec while the QPP covers residents of Quebec. The structure of the CPP and QPP is very similar. Both offer a contributions-based pension that largely depends on an individual's earnings history after age 18 (or since 1966) and provide a benefit designed to replace up to 25% of average earnings. Important for incentives to continue working at older ages, the average earnings for the purposes of the CPP/QPP benefit calculation allows for dropping out some years of low earnings. Until 2011, 15% of low-earnings months could be

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[3] For 2023, a single person (couple) with income below CAD$20,952 ($27,648) is eligible for the GIS benefit. Exempt from clawbacks are OAS, the first $5,000 of self/employment income and 50% of self-employment income between $5,000 and $15,000.

[4] There is one exception, as since 2012 Canadians may delay take-up of their OAS benefits with an actuarial adjustment applied to benefits. The main benefit in delaying benefits is for individuals with high income, who may delay take-up until such a time that their employment income is low enough that clawbacks are not applied.

[5] We do not account for recent reforms that provide an 'additional' CPP/QPP, covering more earnings and offering a higher replacement rate (an additional 8%). The additional premiums and coverage are being phased in 2019-2025, and additional benefits will be provided in proportion to the years of additional contributions 2019 and later (fully phased in after 40 years).

dropped in this calculation. This was increased to 16% in 2012 and 2013 and 17% in 2014 or later. In effect, these drop-out provisions create greater incentives for continued work among individuals with low earnings or gaps in their work history. This will benefit a range of individuals—including those with unemployment spells, and those who spent time away from the labour force while pursuing postsecondary education.

Important for this study, there is a cap (known as the Year's Maximum Pensionable Earnings, or YMPE) on earnings covered by the CPP and QPP, the level of which is close to the average earnings of Canadian workers each year. As such, while the CPP/QPP is designed to replace 25% of earnings for someone in the middle of the income distribution, it will replace less than 25% of earnings for anyone with higher income. Moreover, whereas additional years of high earnings may result in higher benefits for individuals with lower earnings (or gaps) in their history (by raising the average pensionable earnings for benefit calculation), additional years will not improve benefits for some individuals with high lifetime earnings.

The cap on pensionable earnings is also important to consider alongside the mortality-income gradient present in Canada. For example, it is possible for a middle- and a high-income senior to be eligible for the same maximum CPP pension. We can expect, however, that a high-income senior will live substantially longer (for men, by 8 years after age 50 according to Milligan and Schirle 2021) and thus enjoy higher lifetime benefits from this program.

Another consideration with CPP/QPP is the actuarial adjustment factors applied when beneficiaries initiate benefits before or after age 65 (the 'standard' retirement age for CPP/QPP).[6] Until 2011, benefits were adjusted by 6% per year for early or later take-up. For 2012 and later, the CPP and QPP adjustment factors were gradually increased (and the CPP provisions no longer aligned with the QPP). By 2016, CPP reduced benefits by 7.2% per year of early take-up and increased benefits by 8.4% per year of later take-up. QPP changes to adjustment factors were smaller, with larger early take-up reductions applied to higher benefits.

Finally, CPP and QPP benefits are taxable income. Importantly, CPP/QPP is not exempt when determining eligibility for the GIS (and the Allowances). As such, the GIS interacts with CPP and QPP to alter incentives to work among lower-income seniors. This interaction happens because any actuarial adjustment that is gained by delaying retirement for a year is reduced by 50 cents on the dollar through the clawback of the GIS. This interaction attenuates the actuarial impact of the adjustment, leading to a heightened implicit tax on continued work for future GIS recipients. These interactions are shown to be important in our benefit simulations later in the paper.

The programs described thus far are most important for understanding seniors' incomes in retirement and related work incentives. Various tax provisions may also be important to consider. For instance, there is a sizeable age-based tax credit, allowing a larger share of income to effectively be exempt from income taxation once an individual is over the age of 65. Also, for seniors receiving income from a pension (including annuities or employer-based registered

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[6] The early pension take-up provisions were introduced in 1987 for CPP and 1984 for QPP, allowing one to initiate pensions as early as age 60 and as late as age 70.

pension plans), couples may split the income for tax purposes, reducing the marginal tax rate on income for the higher income spouse but potentially increasing it for the other. There is also a non-refundable tax credit for the first $2,000 of pension income.

2. Empirical Approach

We seek to estimate the extent to which the provisions of Canada's social security system differentially affect the retirement decisions of individuals across the income distribution. This work complements Milligan and Schirle (2023) which focused on average responses. Here, we pay most attention to the impact across the earnings distribution. In what follows, our modelling considers only a single path into retirement: one in which a person works, enters retirement, and initiates their public pension benefits as soon as possible. We situate individuals in the income distribution based on their earnings as an individual at age 54. In this section, we describe the data used, how we measure income and one's position in the income distribution, how we measure incentives to enter retirement, and how we estimate the effect of incentives on retirement behaviour.

3.1 Data

We rely on data from the Longitudinal Administrative Databank (LAD). The first year available is 1982, at which time a 20% sample of tax filers from the T1 Family File were drawn. Information for these individuals is updated each year thereafter (with data used up to 2020), and each year a sample of new taxfilers are added so that the LAD represents a 20% sample of Canadian tax filers each year. The dataset offers detailed information on individual sources of income (reported for tax purposes) but is more limited with respect to demographic information. We can observe an individual's sex, age, marital status and information for their spouse each year. We observe whether and what year an individual dies. We are limited to information provided on tax forms, so that we have very little information regarding other individual or job characteristics.

To situate a person in the income distribution, we estimate thresholds for income deciles using a sample of individuals based on their average lifetime earnings (ALTE). The ALTE averages earnings from age 18 to age 54, but only with earnings from 1966 forward as that was the first year used by the Canada/Quebec Pension Plan. For earlier cohorts, this means the ALTE covers less of their lifetime but within any year-of-birth cohort the age coverage is identical. Decile thresholds are estimated within year-of-birth cohorts, for men and women separately. To be consistent with our analysis sample, the sample used to define income deciles only includes individuals with positive earnings (more than $1,000 in 2021 dollars) at age 54.

We focus on men and women aged 55-69 and their retirement behaviour over the period 1983-2019. We use the 2020 files to ascertain whether each person has retired, as described below. To be in the sample, we require the individual to have positive labour market earnings at age 54. As LAD files we use cover 1982-2019, our sample then includes anyone born between 1928 (turning 54 in 1982) and 1964 (turning 54 in 2018 and potentially retiring in 2019 at age 55).

We characterize a person as entering retirement when we observe that a year of positive employment earnings is followed by a year of zero earnings after age 55. For example, if a person in our 1963 birth cohort (being age 55 in 2018) has positive earnings in 2018 and zero earnings in 2019, they are characterized as having retired in 2018 at the age of 55. Individuals are dropped from the sample after they have entered retirement. We do not account for multiple retirements.

In Table 3, we provide some descriptive statistics for our sample, representing men and women in the bottom (1st), middle (5th) and top (10th) deciles. The sample includes a large number of individuals within each decile; in total our sample is comprised of 774,295 women and 891,710 men. Note that the number of individuals within a decile is not identical, as decile thresholds were based on a broader sample (which only conditioned on positive earnings (>=$1,000) at age 54, whereas our analysis sample further excluded individuals based on missing information (such as marital status or a spouse's age. These further exclusions resulted in smaller samples for lower deciles.

Table 3. Sample Characteristics

	Males			Females		
Decile	1st	5th	10th	1st	5th	10th
Number of individuals	92,130	94,295	95,820	80,945	82,570	82,350
Earnings Average	10,000	46,300	145,300	4,300	23,000	78,100
Lifetime YMPE ratio	0.234	0.847	0.964	0.109	0.525	0.925
Employer Pension	0.115	0.492	0.554	0.114	0.444	0.743
Married	0.747	0.827	0.904	0.747	0.750	0.713
Spouse age gap	1.99	1.77	1.68	1.44	1.35	1.20

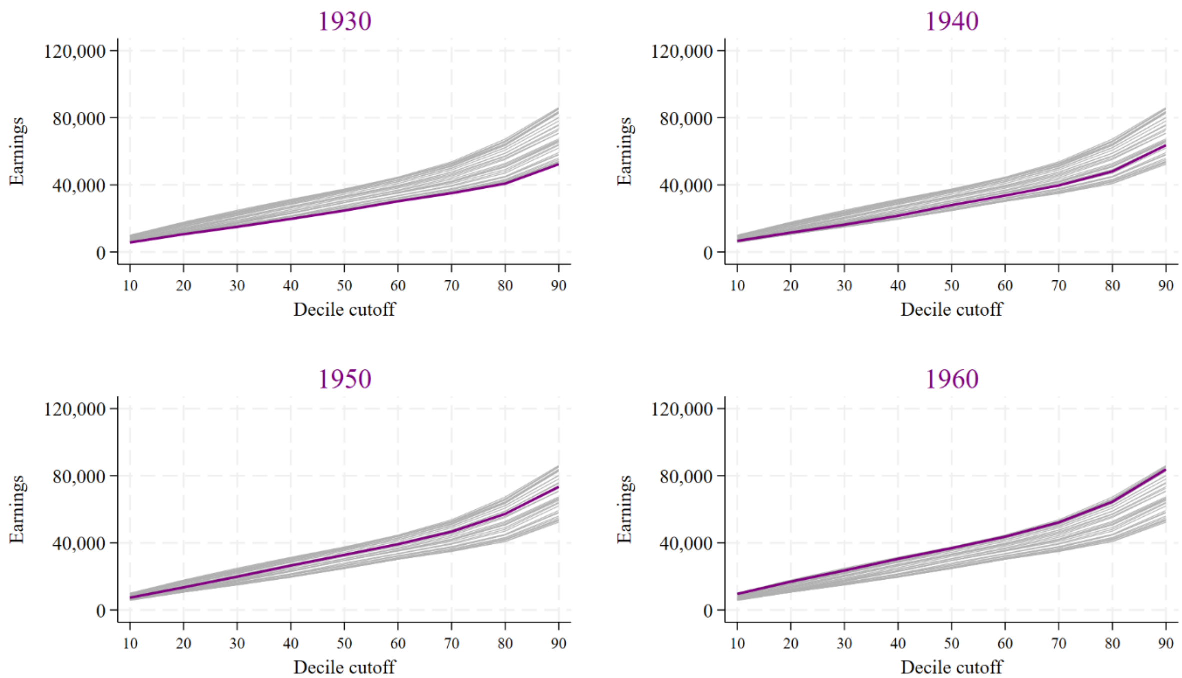
Source: Authors' tabulations using the Longitudinal Administrative Databank. Reported are means. Currency values are 2023 Euros.

Average lifetime earnings is shown in 2023 Euros, with men out-earning women at all points of the distribution. In the first and fifth deciles, men's earnings are over two times that of women's; in the top decile men's earnings are a bit less than twice that of women's. Their earnings each year (from ages 18 to 54) relative to the cap on pensionable earnings (YMPE) exhibit a similar pattern: in the first and fifth deciles, the women's earnings/YMPE ratio (set to have a maximum value at 1.0) is substantially lower than men's. For the top decile, however, the gap narrows as the earnings cap is binding for more individuals.

We document whether men and women in each decile have access to an employer-based pension (using information about the respondent on pension coverage available only after 1995). Both men and women in the lowest decile are unlikely to have an employer pension. We see only a small difference between men and women in the middle of their earnings distribution, with 48% and 43%, respectively, having an employer pension. There are large differences for men and women at the top of the distribution, however, as 75% of women and only 58% of men here have employer pension. This reflects gender differences in occupational attainment, as women in this sample are more likely to work in public sector positions (like teaching or nursing) that are more likely to offer pensions.

Other differences in characteristics across samples in Table 3 offer important insights. For example, men are more likely married in the top deciles, compared to lower-income men or any women. This reflects in part a lower likelihood of being widowed when compared to women. While women are likely to have husbands who earn more than they do, their location in the women's income distribution does not appear to be closely related to their husbands' location in the men’s. However, men with higher incomes are most likely to be married, while men with the lower incomes are as likely as women to be married.

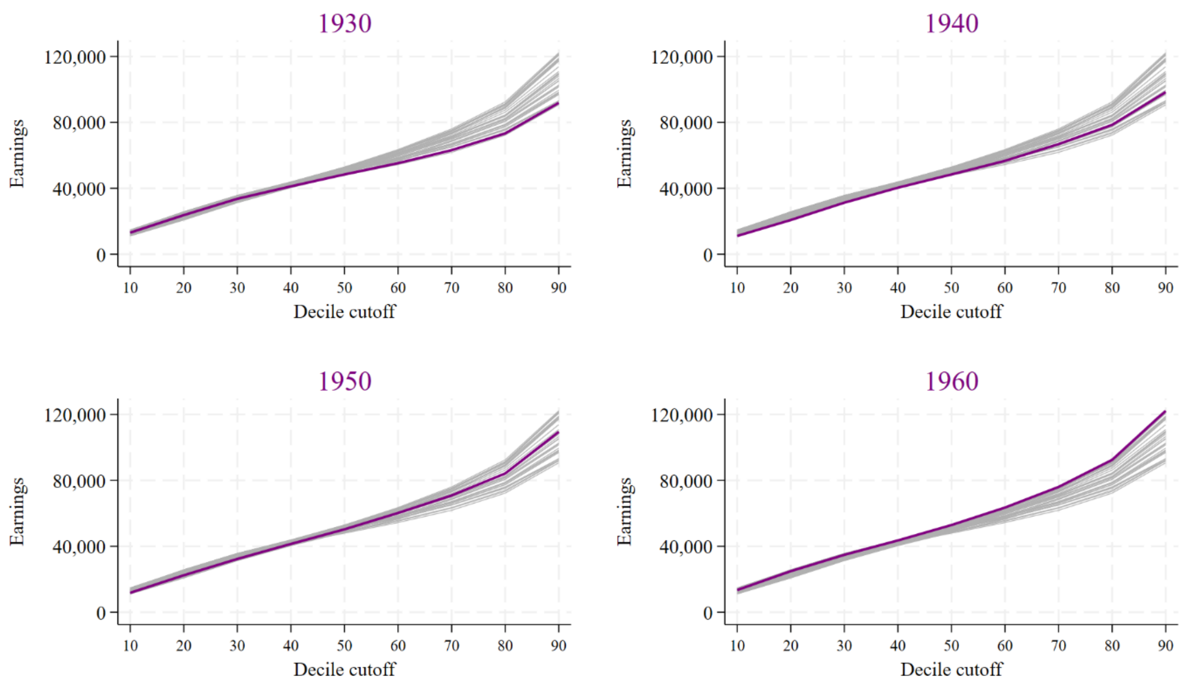
Figure 5: Earnings Distribution for Women



Source: Authors’ tabulations using the Longitudinal Administrative Databank. Reported are decile cutoffs with a separate thin line for each year of birth from 1928-1964. The highlighted year is indicated in each panel. Currency values are 2023 Euros.

Figure 5 and Figure 6 illustrate the differences between earnings at each decile (for women and men, respectively) across birth cohorts. Each line in these graphs shows the decile cutoffs for a different single year of birth for the years 1928-1964. One particular year is highlighted in each panel in order to see the evolution. Because the coverage for the ALTE earnings measure varies by cohort, we use earnings at a comparable age for all cohorts—age 54. For both men and women, we observe earnings increasing over time (with each successive birth cohort). However, the cohort differences are most clear for those in upper deciles. For example, across cohorts of men, the 10th percentile of earnings (at age 54) increased by only 6% while the 90th percentile increased by 32%. As such the 90/10 ratio increased across these cohorts, from 7.0 to 8.7. Most increases in income appear for the top half of the earnings distribution for men. In contrast, for women we can see broader increases in earnings, such that earnings at all deciles increased across birth cohorts.

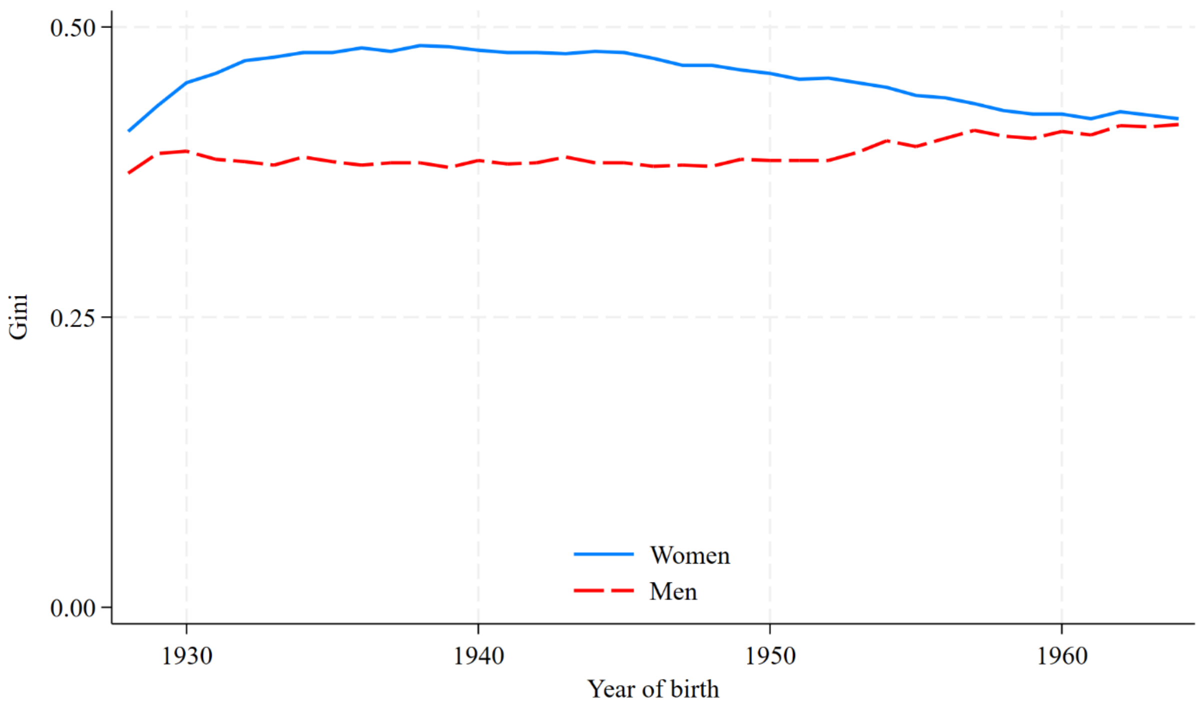
Figure 6: Earnings Distribution for Men



Source: Authors' tabulations using the Longitudinal Administrative Databank. Reported are decile cutoffs with a separate thin line for each year of birth from 1928-1964. The highlighted year is indicated in each panel. Currency values are 2023 Euros.

Another way to look at the changes in earnings over time is to go to our measure of lifetime earnings, ALTE. If we take the ALTE for every year of birth cohort and calculate the gini coefficient, we can observe how much earnings inequality has changed over time.

Figure 7: Gini of average lifetime earnings by year of birth



Source: Authors' tabulations using the Longitudinal Administrative Databank. We plot the gini coefficient on average lifetime earnings (ALTE) by year of birth and by sex.

In Figure 7, we plot these gini coefficients for the years of birth from 1928 to 1964 separately by sex. For these gini coefficients, we use only observations with positive earnings. For women, the composition of those in our sample changes over time as for older cohorts there were fewer women in the workforce. The gini coefficient measured on this sample of working women rises through the mid 1930s birth cohorts before dropping toward the 1960s. For men, the gini coefficient for ALTE is mostly flat until after 1950 when it begins to rise.

The changes in earnings that we observe translate into pension income in several ways. First, because of the YMPE earnings cap the growth in earnings at the high end of the earnings distribution won't translate directly into higher pensions because the YMPE is set at a measure of median earnings, meaning strong growth above the median won't result in higher pensions. Second, to the extent earnings growth leads to higher retirement income (both from public and private sources) there may be less reliance on the income-tested parts of the program, like the GIS and the Allowance. Third, earnings increases in the middle of the distribution have a direct link to pensions through the setting of the YMPE earnings cap. Higher median earnings growth post-2005 led to sizeable gains in the YMPE, which meant larger retirement incomes for those retiring.

3.2 Life expectancy

Milligan and Schirle (2021) found sizeable gaps in life expectancy between high- and low-income Canadians. Evidence in that study (based on a sample consisting of the universe of contributors to the Canada Pension Plan) suggests Canadian men in the top mid-career earnings ventile (top 5%) live eight years longer than men in the bottom ventile. With this in mind, we believe accounting for the income gradient in mortality is important when determining lifetime benefits from social security programs.

In this study, we account for the differential in life expectancy across the income distribution, and across birth cohorts. To do so, we must construct cohort mortality trajectories that allow us to estimate mortality and life expectancy from age 55 to age 100. Our LAD data covers 1982 to

2019. This span of 38 years by itself is insufficient to measure mortality to age 100. We proceed by leveraging these available data to create estimates of mortality that span the necessary 55-100 age range for each year of birth cohort. Our methods are similar to what was used by Milligan and Schirle (2021) and are described below.

We start with our sample of individuals who are alive and in the workforce at age 54. These individuals are sorted into earnings deciles for each year of birth and both sexes. We aim to calculate their survival rates for ages 55 to 100 conditional on survival to age 54. With data from 1982 to 2019 we can observe survival directly from age 55 to 91 for the 1928 birth cohort, but only to age 56 for the 1963 cohort. To fill in the entire mortality trajectory for each cohort, sex, and earnings decile we use three strategies.

First, we use the observed survival rates (whenever available) to age 75. This is done by taking observed sex-specific deaths at each age and dividing by the surviving population of that birth cohort. Second, we make projections based on available data for survival rates and use these projections from age 75 (or whatever age observed rates are not available) up to age 89. We explain more about these projections below. Third, we use the population life tables for each year for ages after age 90 to ensure that cohorts aren't projected to live excessively long. This method was implemented in Milligan and Schirle (2021) based on similar methods used in Chetty et al. (2016). The resulting vector provides a complete set of survival rates for ages 55 to 100 for each sex/year of birth/decile.

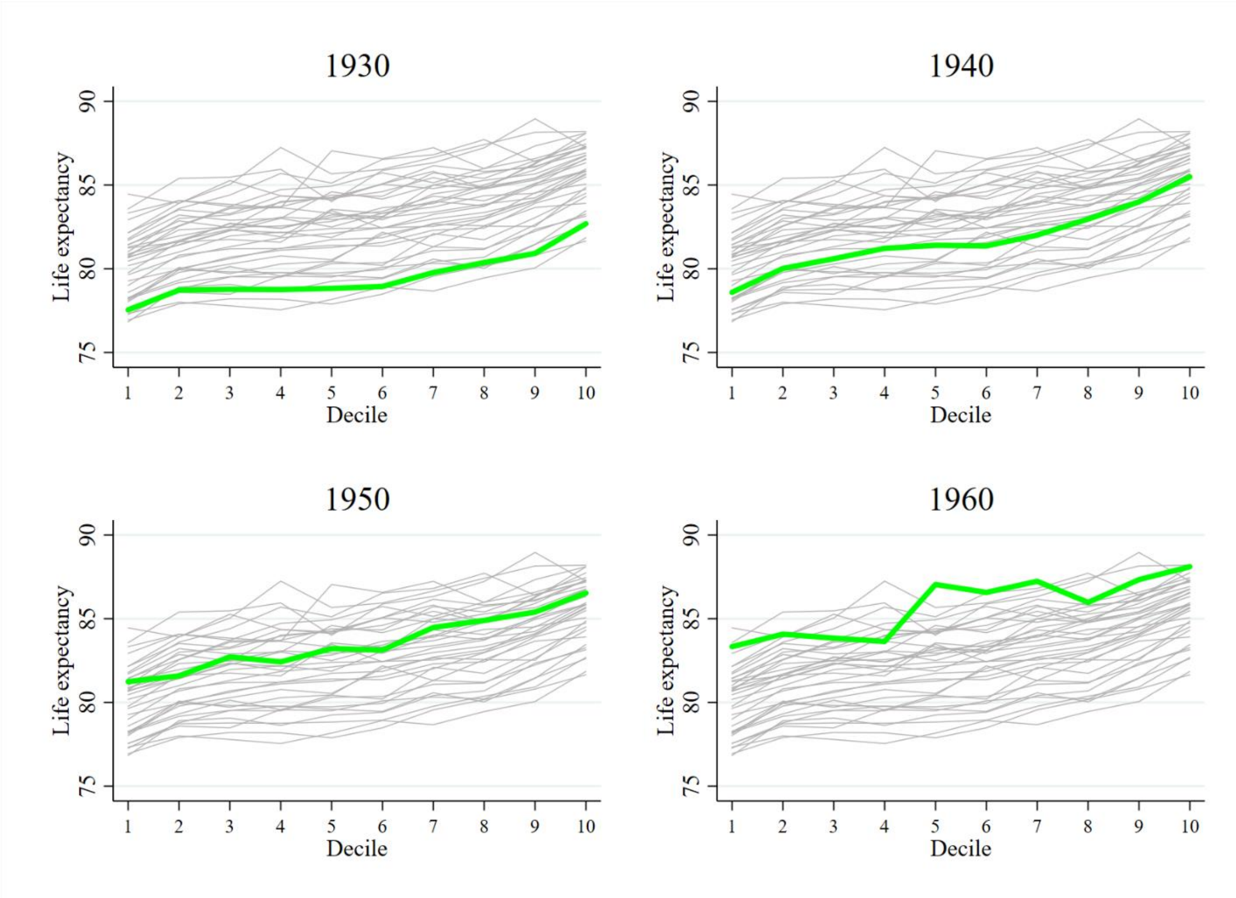
The projections for ages up to 89 are based on the empirical regularity known as Gompertz's Law, which posits a log-linear relationship between mortality and age.[7] We implement the Gompertz regressions on samples defined by decile and sex. Given small samples and limited observations within some cohorts, we pool our samples across years of birth and include a year of birth fixed effect. This effectively assumes the same slope relationship between age and mortality within a decile for all cohorts but allows for the intercept to shift for each birth cohort to reflect general improvements in mortality over time. We can do this for each decile separately, or for the whole sample (of a given sex and year of birth) together to produce a population-wide cohort measure.

Using these assembled survival rate blocks up to age 100 we can calculate life expectancies conditional on working and being alive and working at age 54. We can do this separately by sex, year of birth, and earnings decile.

We illustrate the relationship between life expectancy and earnings deciles and across cohorts in Figure 8 and Figure 9, for men and women respectively. The figures show a separate line for each year of birth cohort which records the life expectancy for each earnings decile. The four panels in each figure highlight four specific birth years. A few things stand out. First, consistent with Milligan and Schirle (2021), there is a clear longevity gradient for men across all cohorts, with high earners outliving low earners. For the cohort born in 1960, there is a four-year difference in life expectancy between men in the bottom and top deciles.

[7] See Gompertz (1825). The established findings are that Gompertz's Law fits the data well up to around age 90.

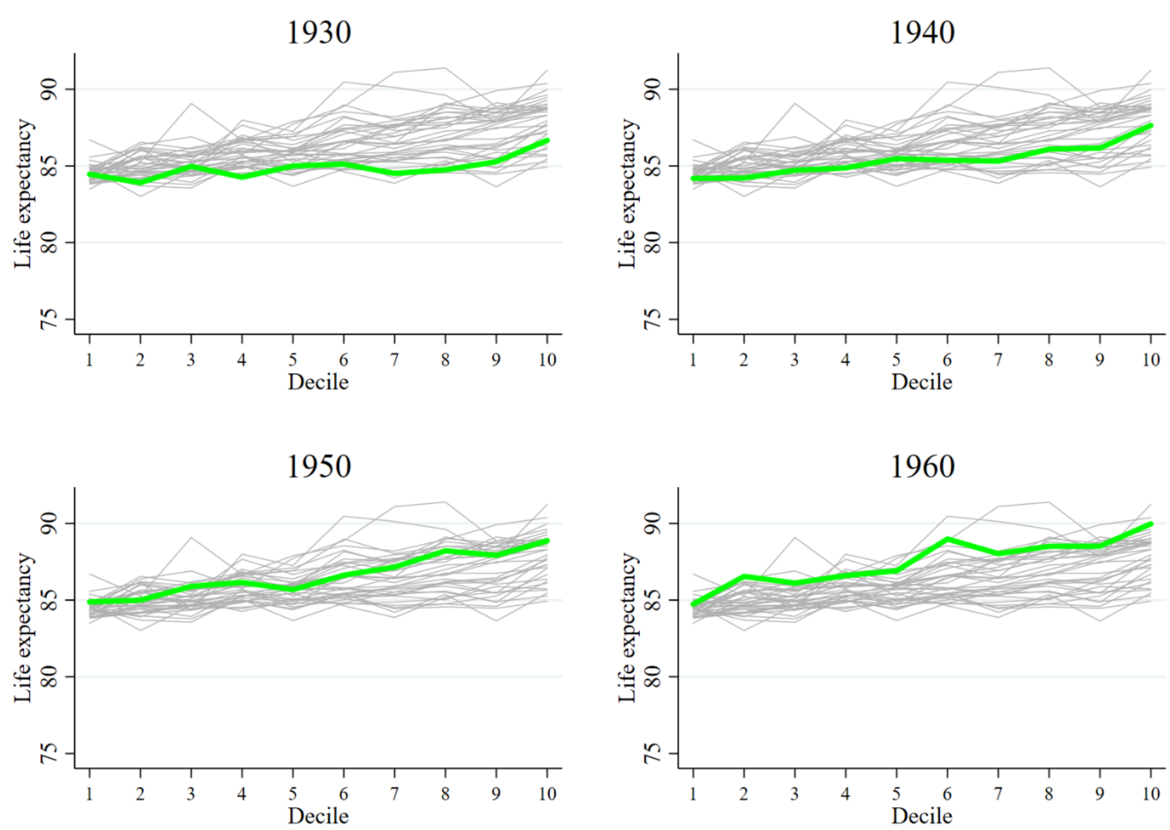
Figure 8: Life Expectancy for Men



Source: Authors' tabulations using the Longitudinal Administrative Databank. We show life expectancy conditional on being alive at age 54. The x-axis is sorted into deciles of lifetime earnings up to age 54; non-workers are excluded.

Second, this earnings-life expectancy gradient appears fairly constant over time. This is consistent with Milligan-Schirle (2021) but contrasts with the findings of Chetty et al. (2016) who find that longevity improvements have been concentrated in the top part of the earnings distribution only.

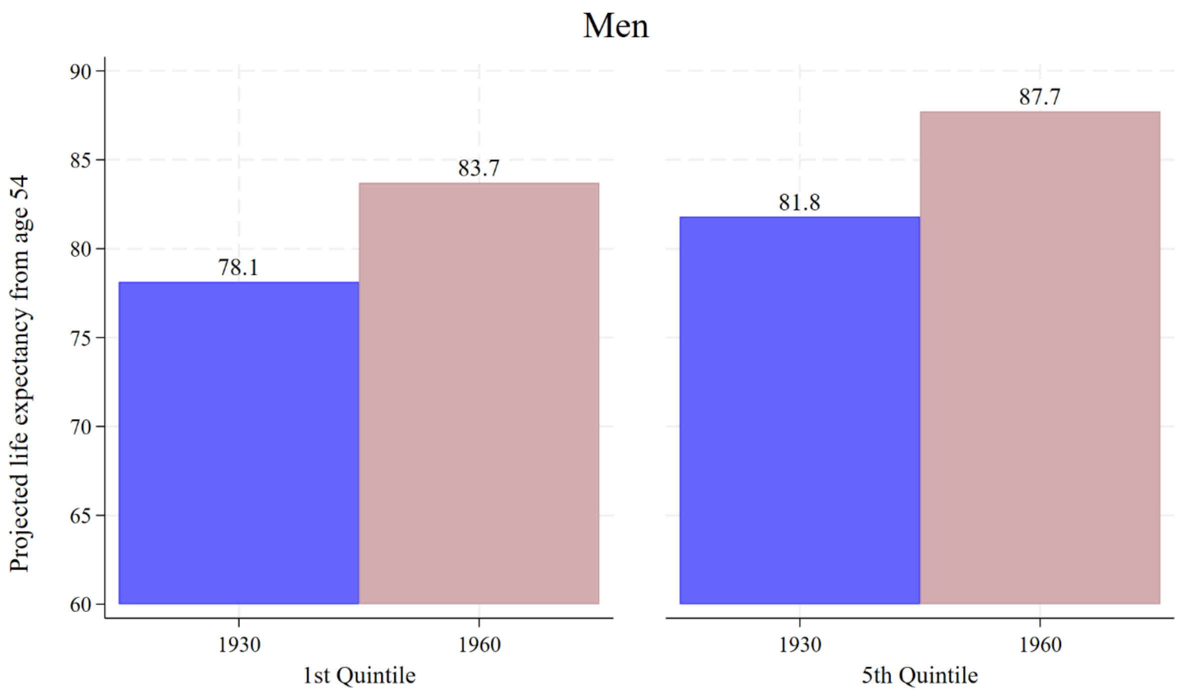
Figure 9: Life Expectancy for Women



Source: Authors' tabulations using the Longitudinal Administrative Databank. We show life expectancy conditional on being alive at age 54. The X-axis is sorted into deciles of lifetime earnings up to age 54; non-workers are excluded.

Third, while there is a longevity gradient for women, there was only a small difference in life expectancy across deciles for early cohorts. This changes over time, however, so that by 1960 the longevity gradient is much steeper: a difference of over five years between the bottom and top deciles. Notice this gradient is different from that in Milligan and Schirle (2021) as our results here reflect a slightly different sample of women. Here, all women must have earnings at age 54 to be a part of this sample. Milligan and Schirle (2021) required positive earnings between ages 45 and 49. While the two studies are based on different data sources, we suspect other selection criteria (in that LAD is based on tax filers and their family members, whereas the earlier study is based on CPP contributors) may also play a role. Given the changing nature of work for women across these cohorts, we are inclined interpret (at least part of) the changing longevity gradient for women as representing a re-sorting of women across deciles.

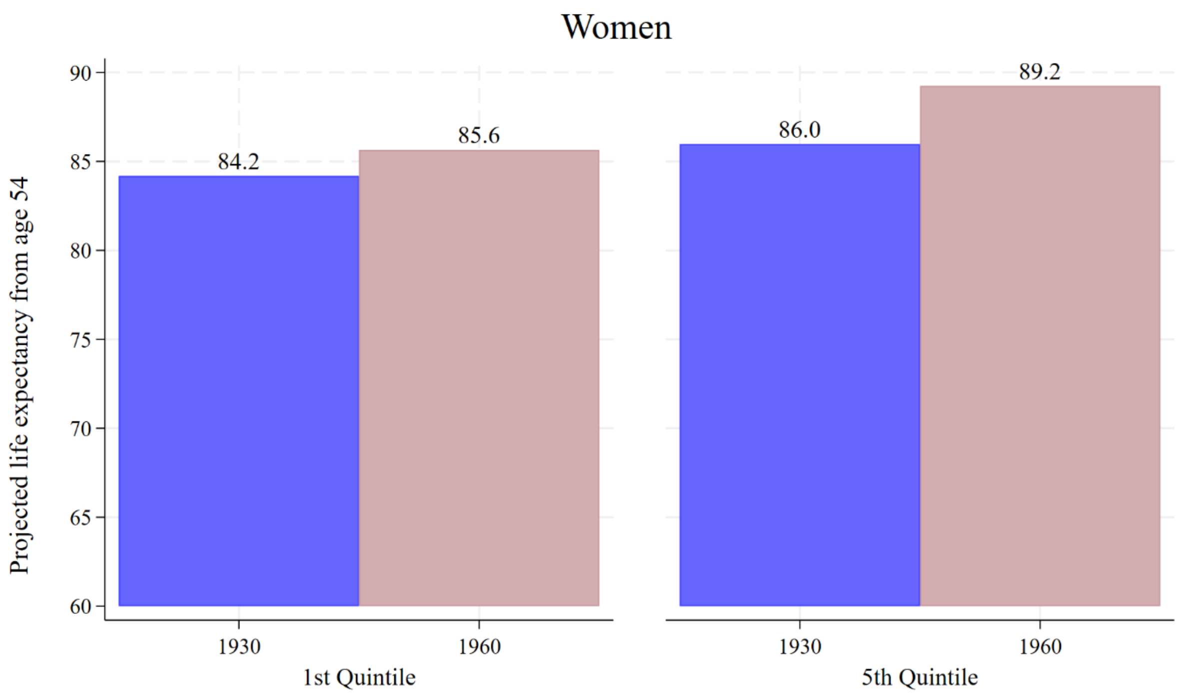
Figure 10: Life expectancy improvements by earnings quintile for men



Source: Authors' tabulations using the Longitudinal Administrative Databank. We show life expectancy conditional on being alive at age 54. Individuals are sorted into quintiles of lifetime earnings up to age 54; non-workers are excluded.

Another way to summarize these life expectancy trends is to compare those born in 1930 to those born in 1960 by quintile, to see where the gains in longevity have arisen. For these calculations, we continue to use the life expectancy conditional on survival to age 54. We plot the results for men in Figure 10. For men in the bottom quintile, life expectancy projected for the 1930 birth cohort is 78.1 years. By 1960, this had grown by 5.6 years to 83.7. In the top quintile, the growth was very similar at 5.9 years.[8]

Figure 11: Life expectancy improvements by earnings quintile for women



Source: Authors' tabulations using the Longitudinal Administrative Databank. We show life expectancy conditional on being alive at age 54. Individuals are sorted into quintiles of lifetime earnings up to age 54; non-workers are excluded.

We repeat this analysis for women in Figure 11, where we find different patterns. The gains in the bottom quintile for women are only 1.4 years across the birth cohorts from 1930 to 1960, while in the top quintile the gains are 3.2 years. The difference between women and men is the

[8] We repeated this analysis conditioning on survival to age 50, which yields results comparable to other papers. For men, the life expectancy gain for the first quintile conditional on survival to age 50 was from 77.3 in the 1930 cohort to 83.2 in the 1960 cohort. For the fifth quintile of earnings for men, the gain was from 80.8 to 87.1 years. For women, the gain in the first earnings quintile conditional on survival to age 50 was from 83.6 for the 1930 cohort to 85.3 for the 1960 cohort. In the fifth quintile, the gain for women was from 85.4 years for 1930 to 88.8 years for the 1960 cohort.

condition that you must be working at age 54 to be in our sample. Because many fewer women worked in the 1930 birth cohort, it is a very different sample of women when comparing the 1930 to the 1960 birth cohorts. These gender patterns are consistent with the findings in Milligan and Schirle (2021).

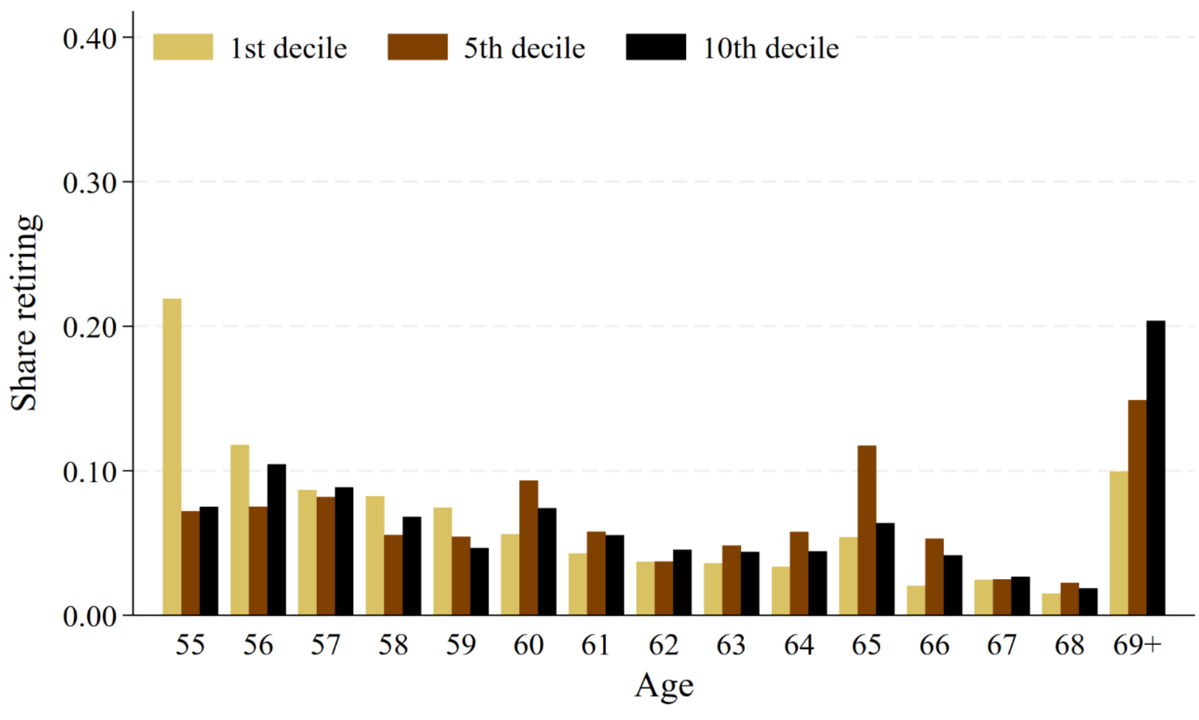
These differences in mortality matter for the lifetime total benefit of public pension income. When we think of seniors' benefits offered as a demogrant (such as the OAS), the importance of these longevity gradients is clear. Given the same benefit level, with benefits initiated at the same age, those from higher earnings deciles can expect receive more in lifetime benefits than those from lower deciles. Similar concerns arise when considering caps on benefits—such as the maximum benefit for CPP—that result in the same monthly amount available to both middle- and high-income Canadians. This will be considered further, while also accounting for the differences in benefit amounts across deciles, in later sections.

To close the discussion of differential mortality, we summarize the three different measures of survival and mortality that we use in the analysis in the rest of the paper. First is the usual population-wide measure produced by national statistical agencies—mortality rates by age and sex for a particular year. This is what we have used in previous work (Milligan and Schirle 2016, 2020, 2023). We call this the 'cross-sectional' measure. Second, using our method outlined above, we can produce a measure that follows the actual (and Gompertz-projected) mortality trajectory of a particular birth-year cohort, for each sex. We call this the 'cohort' measure. Finally, we can repeat the cohort measure separately for each decile of age-54 earnings to produce differential mortality by earnings decile for each year of birth and sex. We call this the 'cohort-differential' measure.

3.3 Retirement patterns

In this section we describe retirement patterns observed in our sample, focussing on differences between earnings deciles of men and women. We first look at the distribution of retirement ages. Following that we show hazard rates—the percent retiring among those remaining in the workforce at a given age.

Figure 12: Retirement age distribution for women born in 1940

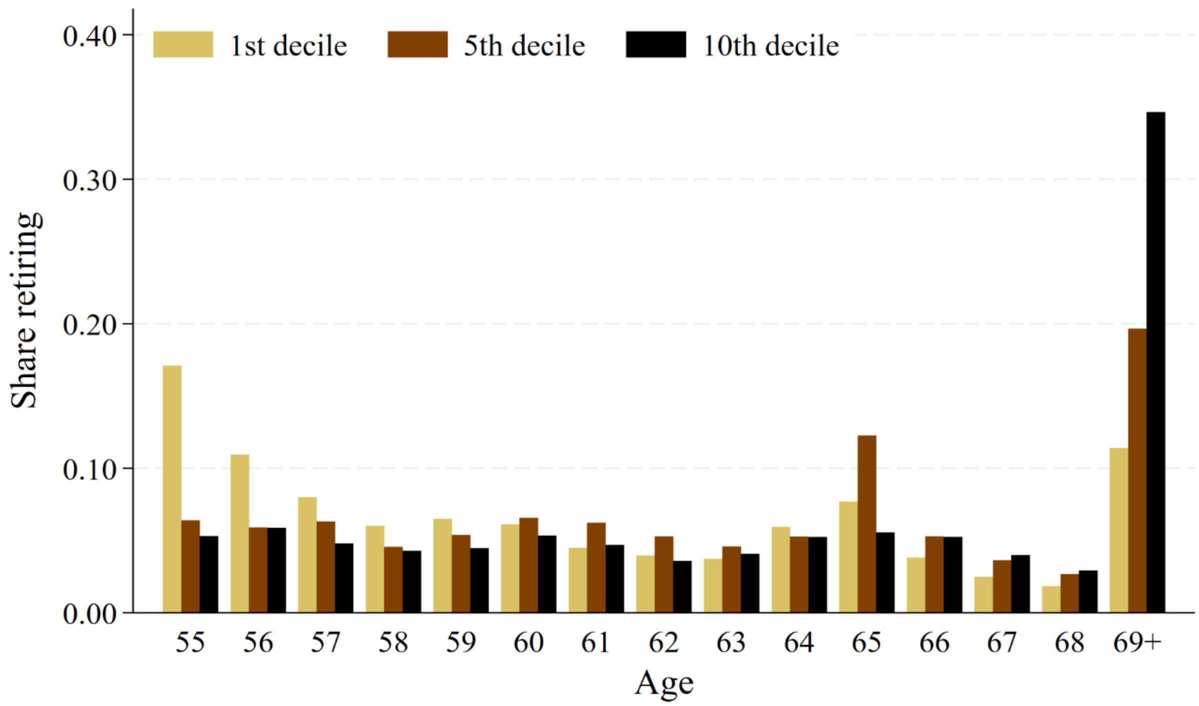


Source: Authors' tabulations using the Longitudinal Administrative Databank. We show the proportion of the workforce retiring at each age for the 1940 birth cohort. Each bar shows a different decile of earnings as indicated.

The labour force retirement age distributions for the 1940 birth cohort is depicted in Figure 12 and Figure 13 for women and for men. This 1940 cohort reaches age 60 in 2000, about the middle of our sample range. The changes over time are interesting, but we present the time series changes later in this section with the hazard analysis. The figures show the first, fifth, and tenth deciles of the lifetime earnings distribution. At age 54, all observations are still working because that is the selection criterion to be in our dataset. We group all retirements from ages 69 and higher together.

For women in Figure 12, there are large differences across earnings deciles, with the lowest earning decile heavily retiring at ages in the 50s. In contrast, for the highest earners in the tenth decile, the survival rate in the labour force to age 69 is strong, with 20 percent retiring at ages 69 or higher. For the middle earners in the fifth percentile, there is a noteworthy spike at the normal retirement age of 65. There is also a noticeable bump at age 60, which is the early retirement entitlement age under the C/QPP as well as for the Allowance. This might result from those in the middle of the income distribution being more sensitive to the parameters of the public retirement system like the early and normal retirement ages. In Figure 13 we repeat the analysis for men. The pattern is very similar, but with an even stronger residual left retiring at ages 69 and higher for the top earning tenth decile.

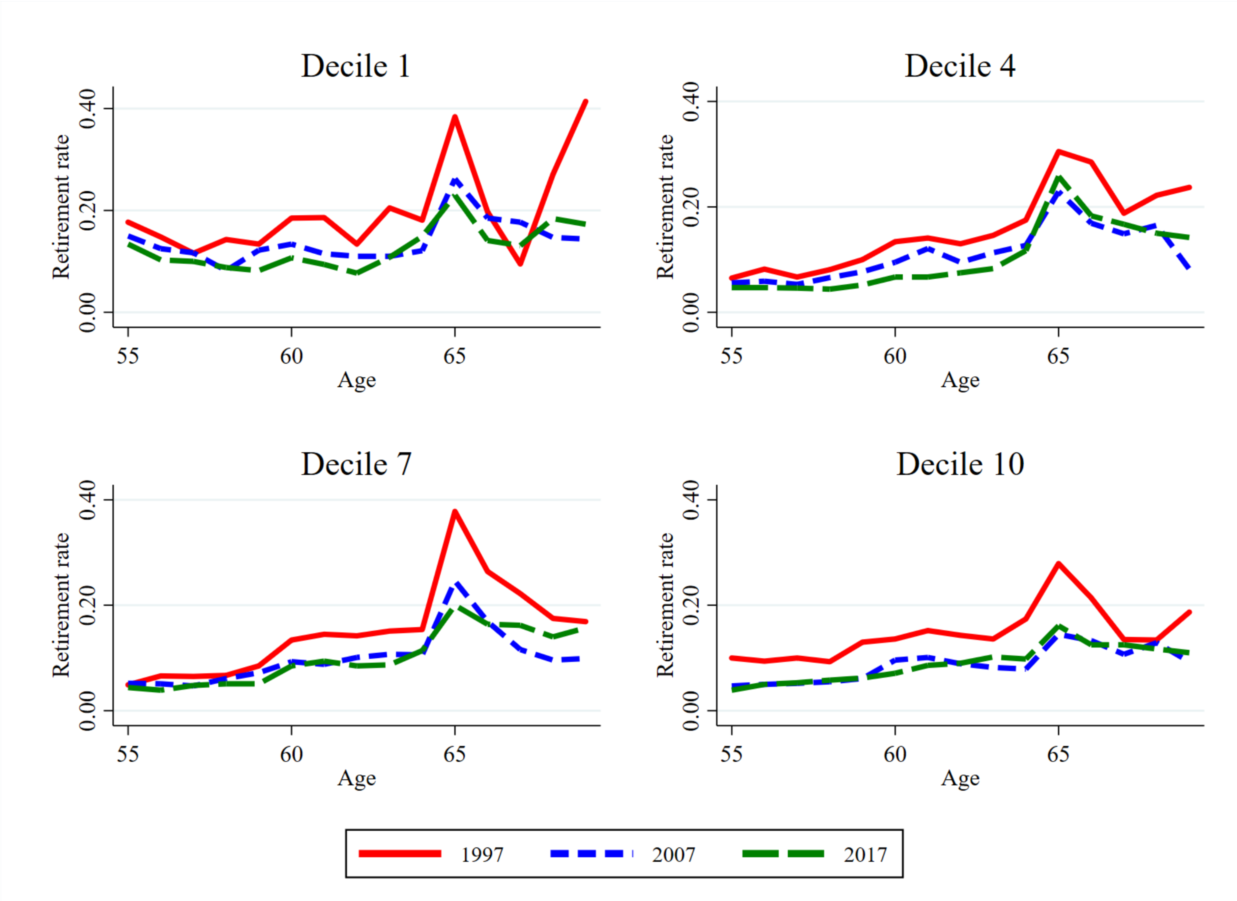
Figure 13: Retirement age distribution for men born in 1940



Source: Authors' tabulations using the Longitudinal Administrative Databank. We show the proportion of the workforce retiring at each age for the 1940 birth cohort. Each bar shows a different decile of earnings as indicated.

We now turn to retirement hazard rates, representing the probability of entering retirement at each age among those who were still working. The results are presented in Figure 14 for women and Figure 15 for men. We show the results separately for four deciles in the four panels of each figure. We also show the evolution of the hazard rates over time graphing the hazard for three different years to bring attention to the change in retirement behaviour.

Figure 14: Retirement Rates for Women



Source: Authors' tabulations using the Longitudinal Administrative Databank. We show the conditional retirement rate at each age. Each quadrant shows a different decile, sorted on lifetime earnings. The three lines in each quadrant show the retirement rates in the indicated year.

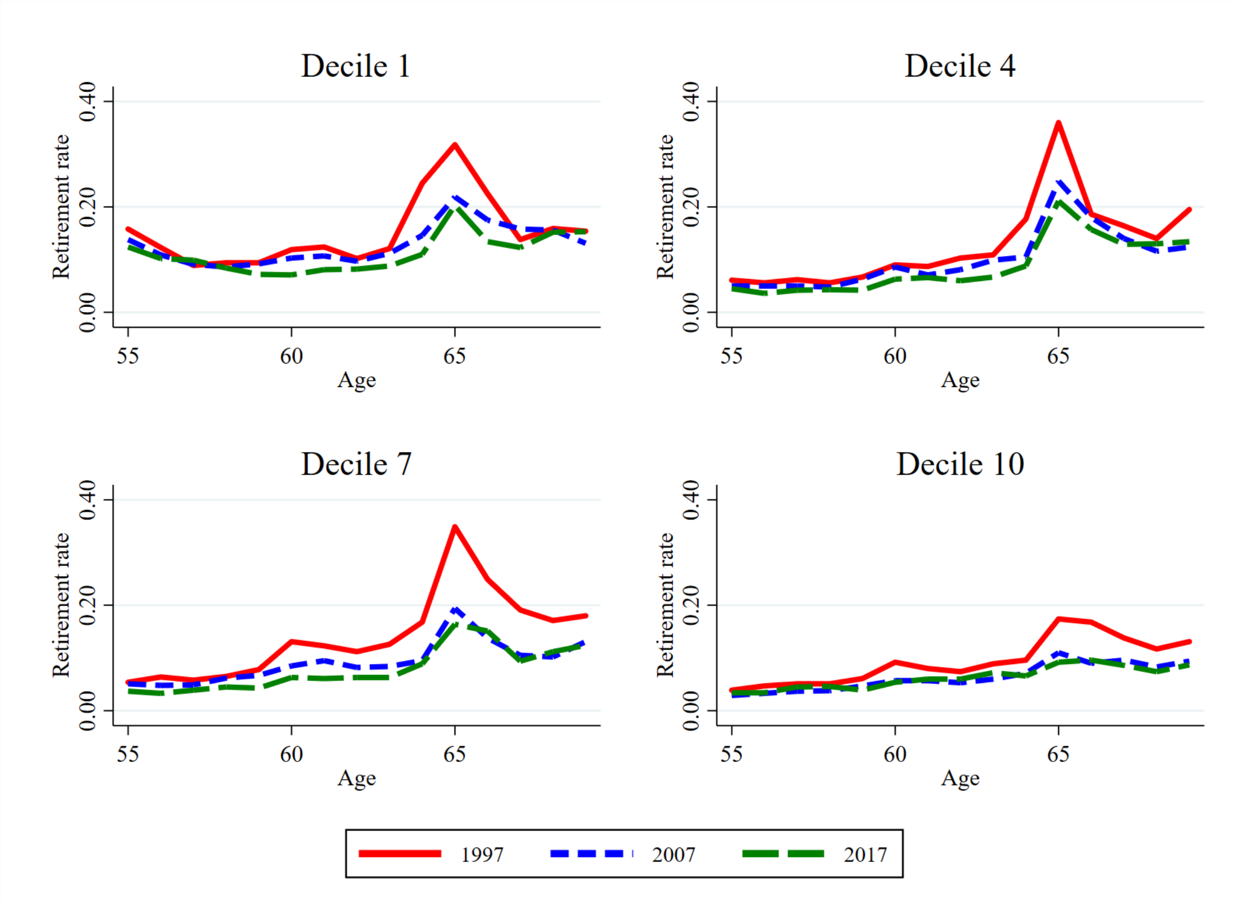
Across all deciles, there is a positive relationship between the hazard rate and age, but the nature of that relationship varies across deciles and by gender. For women in Figure 14, there is a clear spike in the hazard rate at age 65, although the spike is noticeably smaller for the top decile. Decile 1 women are also more likely to enter retirement at younger ages (55-60) than in other deciles, which may reflect their attachment to the labour force.[9] Most noticeable is the reduction in the retirement rate across ages over time, falling substantially between 1997 and 2007.

From these cross-sectional hazard rates one can calculate the amount of work after age 54 implied by the hazards for someone in the workforce at age 54 and facing this set of age-specific hazard rates. For women in the 1st decile, the implied amount of work after age 54 is 4.2 years in 1995 and that grows by 2.7 years to 6.9 years by 2018. At the 10th decile, the growth is a similar 2.4 years, from 6.2 in 1995 to 8.6 in 2018. So, there is a large increase in work after age 54 for women over time, and the increase is fairly uniform across earnings deciles.

Patterns are similar for men in Figure 15. One difference across the male deciles lies in the retirement rates for men in the first decile, where there is first a higher likelihood of entering retirement close to age 55, and then again after age 66, with a relatively low spike at age 65. At the 10th decile, the hazard rate for men is much flatter with much less pronounced spikes at ages 60 and 65 than other deciles. With respect to gender differences, the top and bottom decile retirement rates are much lower at all ages for men, especially in 1997. By 2017 these gender differences are less pronounced. Overall, there is a large drop in hazard rates between 1997 and 2017 across ages and earnings deciles.

[9] The large spike at age 68 and 69 in 1997 for the 1st decile in Figure 14 results from very small samples—very few women survive in the labour force to that age and so the large hazard rate actually represents very few women.

Figure 15: Retirement Rates for Men



Source: Authors' tabulations using the Longitudinal Administrative Databank. We show the conditional retirement rate at each age. Each quadrant shows a different decile, sorted on lifetime earnings. The three lines in each quadrant show the retirement rates in the indicated year.

These hazard rates can be combined to form a cross-sectional measure of workforce survival from age 54, and from that the implied years of work after age 54. This allows us to quantify the magnitude of the drop in hazard rates in an intuitive way. For men in the 1st earnings decile, the implied years of work after age 54 grew from 5.2 in 1995 to 7.2 in 2018. For the 10th decile, the growth was from 7.9 years in 1995 to 9.8 years in 2018. As with women, the shift to longer work lives is fairly uniform across the earnings distribution.

To summarize the patterns of retirement, we have three main findings. First, high earners exhibit sharply different retirement behaviour than low earners. They work longer and are less likely to exit at target ages like 60 and 65. Second, there has been a large increase of work over time, with women working about 2.5 years more and men 2 years more in 2018 than in 1995. These increases in work are quite uniform across the earnings deciles. Third, the gender differences in retirement rates and changes in work after age 54 are present but they are subdued. Rates of retirement and how work at older ages has evolved are more different across earnings deciles than across genders.

3.4 Incentive measures

We now describe the three pension incentive measures used in the analysis. We construct these incentive measures using available information in the LAD and pension program rules. We closely follow the methods described in Milligan and Schirle (2023), so we provide only a brief overview of these measures here.[10]

The first measure is known as social security wealth (*SSW*), given by:

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

SSW represents the value of benefits (B) after tax, received from social security programs over ones' lifetime (from retirement age R until their last age T), given they are planning from the point of view of a person at age S with policy rules (legal environment) in the year l. The

[10] The benefit calculator, including necessary imputations, and the use of the Canadian Tax and Credit Simulator (CTaCS) are detailed in Milligan and Schirle (2023).

measure accounts for social security contributions made if the individual keeps working from ages S to R-1, as a proportion c of their earnings Y, and discounts future benefits using $r = 3\%$ discount rate, where $\beta = \left({}^{1}/_{1+r}\right)$. In our calculations, future benefits and contributions are also discounted for their probability of survival to age t, conditional on having lived until age S. For these survival rates, we use one of the three different methods described above (cross-section, cohort, cohort differential).

The second measure is the one-year accrual (*ACC*). *ACC* is used to describe the extent to which *SSW* increases or decreases by delaying retirement by one year, from age R to $R+1$:

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

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

For our third measure, we construct an implicit tax (*ITAX*) on continued work for one more year after age R, to reflect what may be lost by delaying retirement in terms of the *ACC* relative to the income that would be earned if retirement is delayed (Y^{Net}):

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

We note that in Milligan and Schirle (2023), we evaluated the benefit calculator used here by comparing the simulated benefits received at age 70 to the actual benefits we observe in the LAD, separately for each component (OAS, GIS and the CPP/QPP). Our benefit calculator is very accurate with respect to OAS benefits, and fairly accurate for the CPP (although we tend to overestimate C/QPP retirement benefits for earlier retirements by up to 10%, suggesting there are more years of low earnings in individuals' true histories than we have imputed). For GIS, we tend to overestimate benefits among those retiring early, especially at age 60 or earlier.

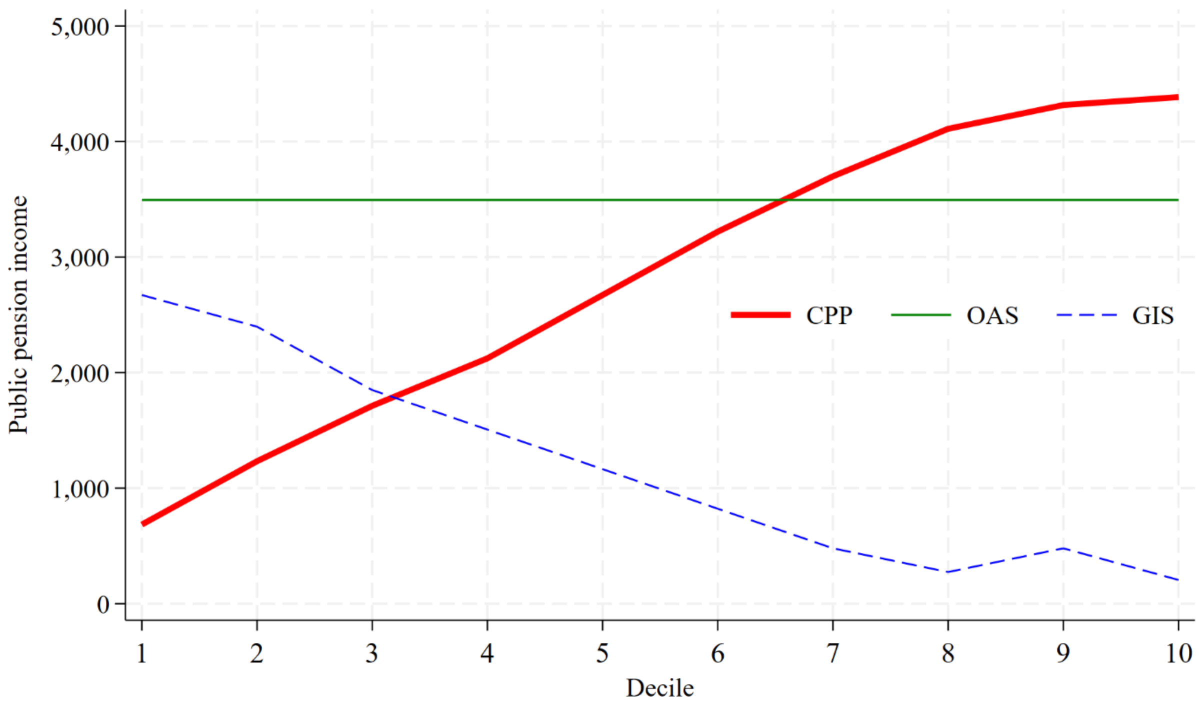
3.5 Patterns of benefits and incentives

How do benefits vary across the earnings distribution? And how do the incentive measures change from low to high earners? In this section we build the intuition on what to expect as we focus on the distribution of benefits and incentives. We start with how the basic benefits change across earnings levels, and then proceed to *SSW* and *ITAX*, looking across time, deciles, sex, and ages.

In Figure 16 and Figure 17 we present the average annual estimated benefits for women and men. The benefits are the average across of individual (not couple) benefits taken at age 71 among those of a particular sex, earnings decile, and year of birth. We choose age 71 because at that age almost everyone has taken up their CPP/QPP and retirement income is fairly stable. As before, the earnings deciles are those assigned by lifetime earnings. There is not much difference in the patterns across years of birth so we choose only the 1940 birth cohort to emphasize the differences across lifetime earnings groups.

The relationship between each component's benefit level and income deciles takes the expected shape. For CPP and QPP, benefits are closely tied to the earnings a person earned over their lifetime so that upper deciles will receive more benefits than lower deciles. This earnings-benefit relationship is constrained, however, by the YMPE earnings cap, which is legislatively set around median annual earnings. For men in Figure 17 we can see that benefits reflect this earnings around the 5th or 6th decile, which aligns with the location of the earnings cap at median earnings. For women, only those in top deciles reach this maximum benefit.

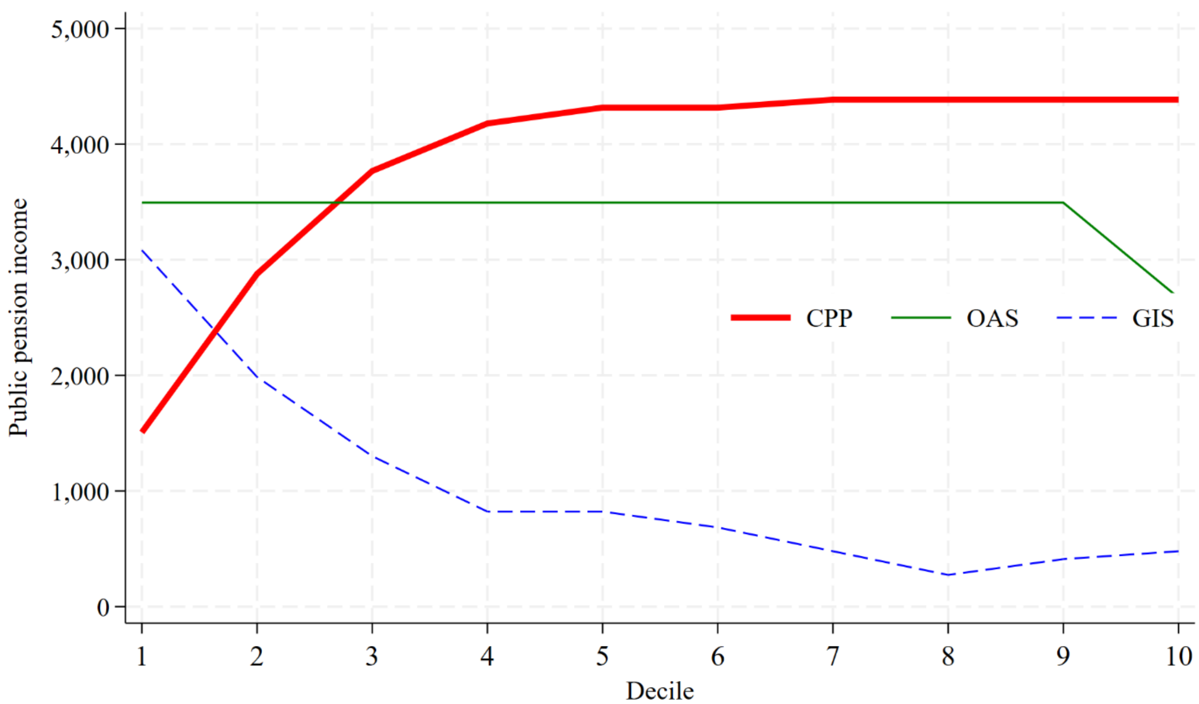
Figure 16: Pension income across earnings groups for women



Source: Authors' tabulations using the Longitudinal Administrative Databank. Reported are average public pension income by decile for the 1940 birth cohort. Currency values are 2023 Euros.

The OAS benefit is nearly the same for men and women across all deciles. Since the OAS pension is (mostly) a flat demogrant paid equally on the basis of residence, this is to be expected. The only legislative exceptions to receiving a full OAS pension are for those with less than 40 years of Canadian residence and those above the income-test threshold. We do not observe lifetime Canadian residence so our estimates do not reflect differences in lifetime residence. We do implement the income threshold clawback, which is set at a level that affects approximately the top 10 percent of income earners in retirement. In Figure 16 and Figure 17 we see little impact of the clawback for women, but some impact for the highest decile of earners for men.

Figure 17: Pension income across earnings groups for men



Source: Authors' tabulations using the Longitudinal Administrative Databank. Reported are average public pension income by decile for the 1940 birth cohort. Currency values are 2023 Euros.

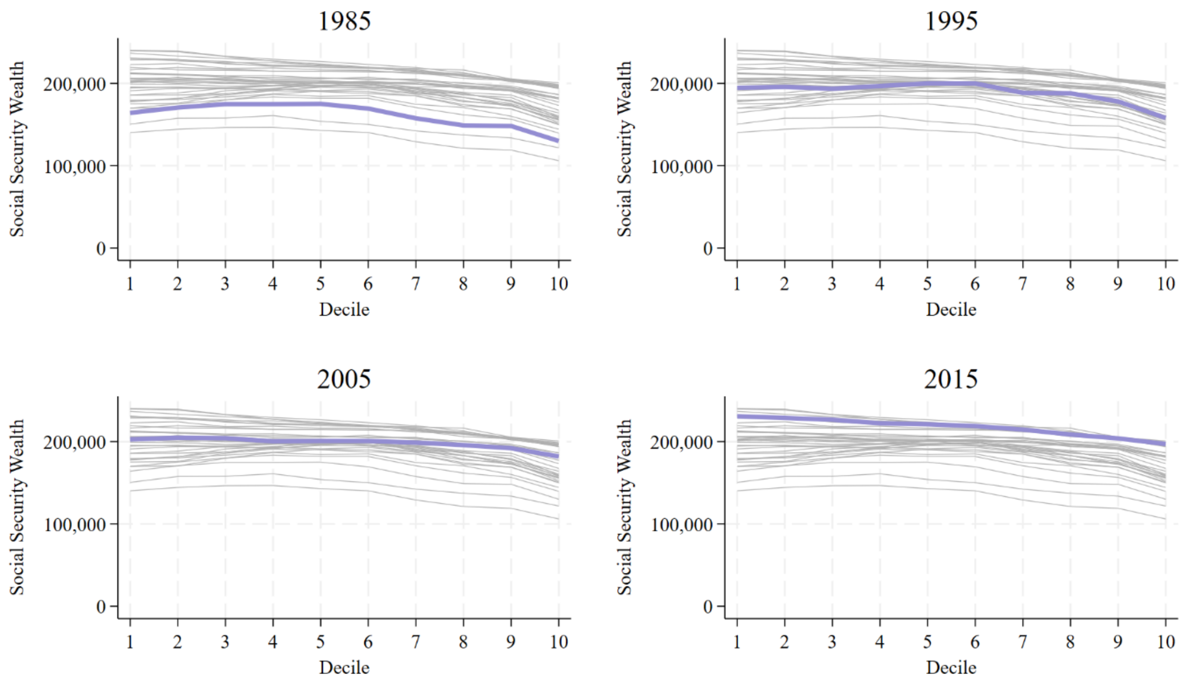
Finally, the GIS benefit that tops up incomes for low-income seniors tends to fall across earnings deciles. Those who had the lowest earnings while working (and the lowest CPP benefits as a result) receive the highest GIS benefit, while those from top deciles are less likely to be eligible.

Women appear to receive more GIS benefits across the middle deciles than men, which will in part reflect the experience of single women (as GIS is couple-income tested).

Taken together, the flow of benefits adds up to more benefits going to those in low-earning deciles than middle- or high-earning deciles because of the GIS. Comparing the middle to the top however, the importance of the GIS recedes but CPP/QPP does not grow much more because of the YMPE earnings cap. To note, these benefit flows do not account for income taxes which are progressive and so favour the lower earners in retirement.

We now present the full *SSW* calculation. To move from these individual benefit flows to the full *SSW* calculation we aggregate the benefit flows for the couple and apply income taxes for each future age. Then we discount for time preference and adjust for survival to arrive at the sum used for *SSW*. We explore how *SSW* is distributed across the earnings distribution for women and men in Figure 18 and Figure 19. To note, we use the cross-section survival rates here, so the results here are comparable to the calculations in Milligan and Schirle (2023). We present the SSW for retirement at age 55. At older ages *SSW* will grow as Canada/Quebec Pension Plan benefits will be larger with more years of work. But, showing the results at one common age can highlight the patterns across time and earnings decile.

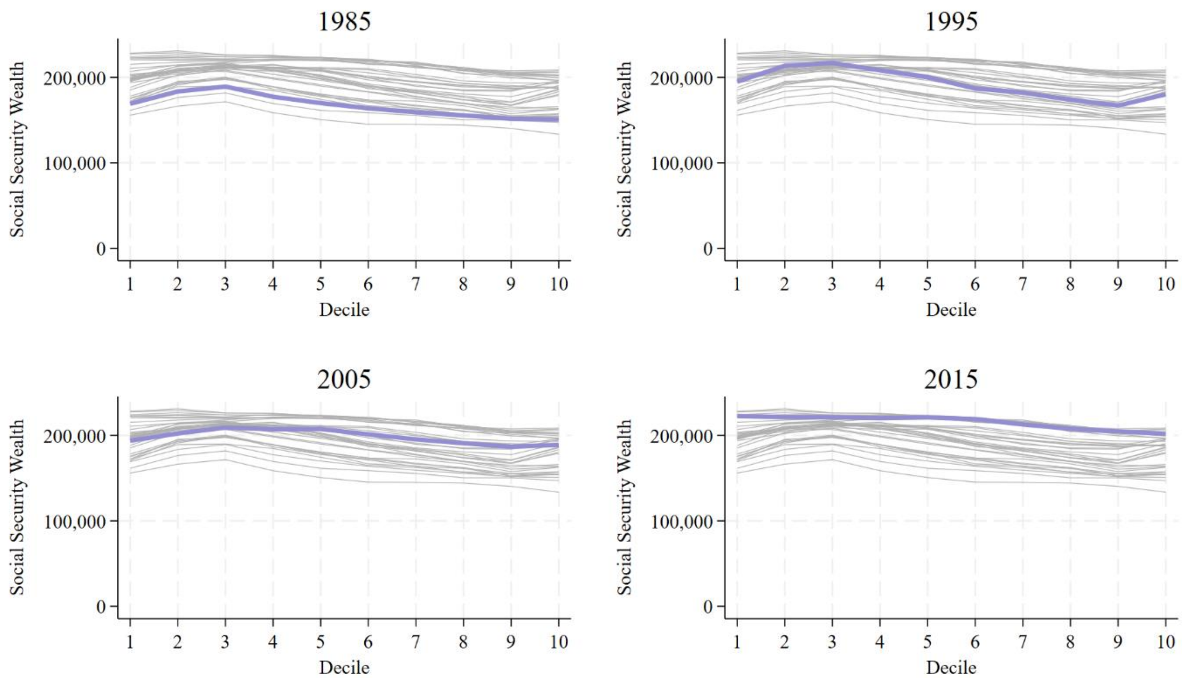
Figure 18: SSW at Age 55 by Decile and Year for Women



Source: Authors' tabulations using the Longitudinal Administrative Databank. We show the Social Security Wealth (in 2023 Euros) at age 55 separately by lifetime earnings decile. Each grey line is a different year between 1982 and 2019. Each quadrant highlights the indicated year.

The overwhelming trend observable in the figures is a flatness of benefits with lifetime earnings. In fact, the slope is slightly negative. As individuals from lower-earning deciles are likely eligible for more income-tested benefits, their *SSW* tends to be higher than individuals from top deciles. These differences in benefit eligibility across deciles result in a negative relationship between social security wealth and earnings deciles. When averaged across cohorts, men expect a *SSW* of 199,600 Euros in the first earnings decile, 201,500 in the fifth, and 182,100 in the top decile. Women (whose career earnings are generally lower than men) expect *SSW* of 201,700 Euros in the first decile, 201,400 in the fifth, and 171,000 in the top decile. Over time, we can see general increases in benefit generosity as *SSW* is higher for each successive cohort. Notably, the jump between 1985 (highlighted in the top left quadrant of Figure 18 and Figure 19) and later years reflects the introduction of early CPP/QPP benefit take-up in 1987/1984.

Figure 19: SSW at Age 55 by Decile and Year for Men

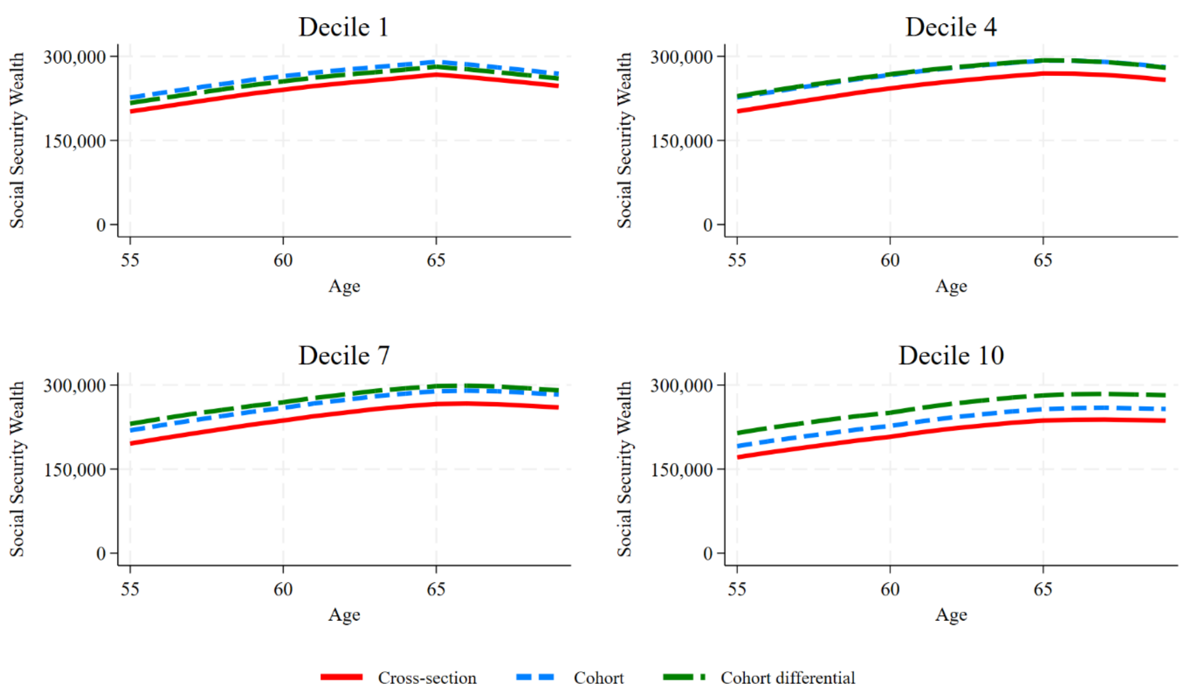


Source: Authors' tabulations using the Longitudinal Administrative Databank. We show the Social Security Wealth (in 2023 Euros) at age 55 separately by lifetime earnings decile. Each grey line is a different year between 1983 and 2019. Each quadrant highlights the indicated year.

We now turn to an exploration of the impact of differential mortality on the *SSW* calculation. This exploration is novel and a key addition to the analysis presented here compared to what appears in Milligan and Schirle (2023). We show results using the three different survival calculations described earlier: cross-sectional, cohort, and cohort-differential.

The results are graphed for women and men in Figure 20 and Figure 21. We plot *SSW* at each age using each of the three survival calculations. For these figures, we average over all years of birth in our sample. The four panels display what the patterns look like at four different earnings deciles. The overall pattern has *SSW* rising until around age 65, especially at lower-earning deciles. The upward trajectory reflects that delayed retirement increases CPP/QPP entitlement.

Figure 20: SSW with Differential Mortality for Women



Source: Authors' tabulations using the Longitudinal Administrative Databank. Social Security Wealth is shown using three different mortality assumptions. Currency is 2023 Euros. Each quadrant shows a different decile, sorted on average lifetime earnings. We average over all years of birth for this figure.

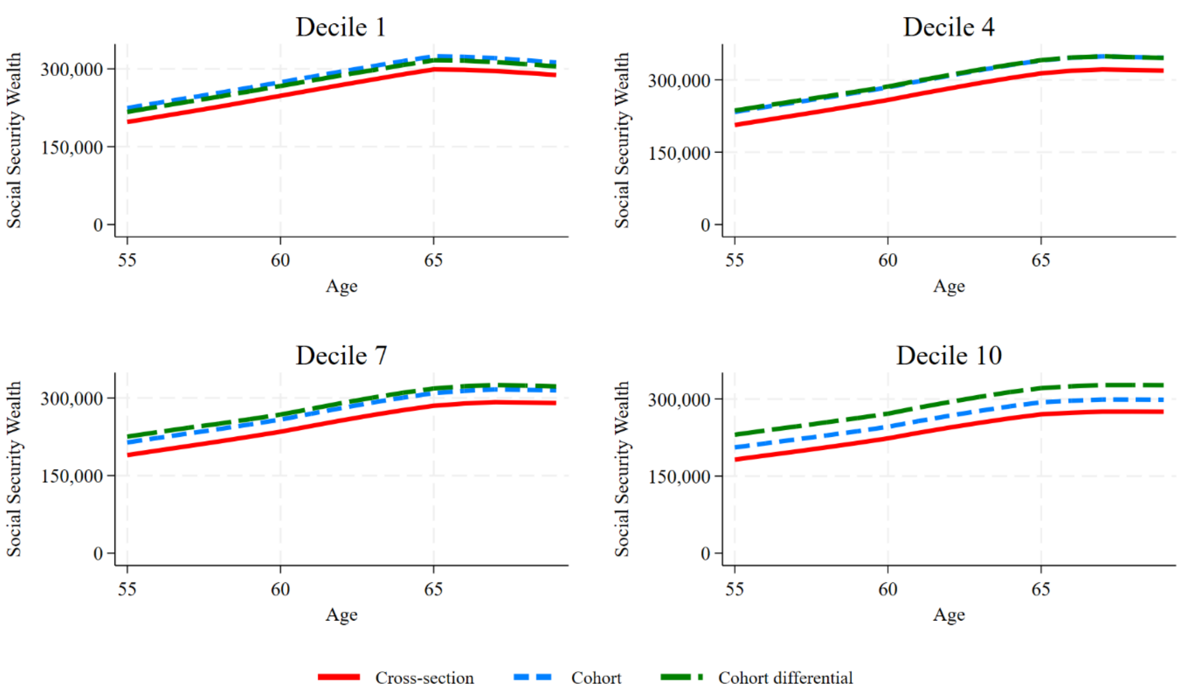
Acting counter to this, once a lower earner hits eligibility for the income-tested GIS at age 65, further work directly claws back GIS entitlement at a rate of 50 cents on the dollar. This means that after age 65, extra work is taxed at a high rate because earned income leads to foregone GIS benefits. This has little impact on high-earning deciles though, since GIS benefits are much less important there.

The other important element of this analysis is the impact of incorporating differential mortality. We move from the standard cross-sectional mortality to differential mortality in two stages. First, we introduce cohort-based mortality; then we allow the cohort-based mortality to vary by earnings decile.

In principle, comparing cross-sectional to cohort mortality we expect that using cohort-based mortality results in *SSW* that is everywhere above the cross-sectional measures, for both men and women. This results from two factors. First, cohort-based mortality measures the future mortality based on the actual experience of a given cohort. In contrast, cross-sectional mortality assumes that future mortality of people of a given age will be exactly like the current mortality of past cohorts who are at those future ages right now. Because survival has improved over time, using cross-sectional mortality systematically under estimates survival and downward biases *SSW*. The second factor is the selection into our sample. We only consider those who were working at age 54, so if non-workers have systematically worse health they will likely have worse survival rates using the cross-sectional method (which includes the whole population) than with our cohort method (which includes only those who worked at age 54).

Moving further to differential mortality by earnings decile, we expect that the *SSW* of lower earners will shrink because they have fewer years to receive benefits. Similarly, we expect the *SSW* of higher earners to grow because they have more years to receive benefits. The magnitudes of these shifts, however, are hard to gauge as they involve the interaction of the timing of benefits and the timing of the survival differences across earnings deciles.

Figure 21: SSW with Differential Mortality for Men



Source: Authors' tabulations using the Longitudinal Administrative Databank. Social Security Wealth is shown using three different mortality assumptions. Currency is 2023 Euros. Each quadrant shows a different decile, sorted on average lifetime earnings. We average over all years of birth for this figure.

In Figure 20 and Figure 21 cross-sectional mortality has a solid line, cohort mortality has a short-dashed line, and cohort differential mortality has a long-dashed line. As expected, *SSW* when calculated using cohort survival probabilities instead of cross-sectional survival probabilities is everywhere higher. When moving from cohort survival to cohort-differential survival, the differences align with our expectations but the magnitudes are perhaps surprising. For low-earning deciles, cohort-differential mortality shifts *SSW* slightly downward. As we move up to the higher-earning deciles, cohort-differential mortality shifts *SSW* up compared to the averaged cohort mortality.

This result is perhaps surprising. We saw in the analysis of differential survival in Figure 8 and Figure 9 that there are large differences in survival across earning deciles. Why doesn't this have a large impact on the total *SSW* of lower-earning deciles? The answer may lie in the timing of benefits and the timing of survival differences. From the point of view of a 60 year old, benefits in 20 years at age 80 are discounted by 45% using our 3% per year real discount rate assumption. However, more than half of the life expectancy differences between the 1st and 10th decile occurs after age 80, when the benefit flow is heavily discounted from the point of view of the 60 year old. So, the difference in survival probabilities doesn't matter as much when the benefits at those ages are already fairly heavily discounted.

We now look at how the implicit tax *ITAX* measure of retirement incentives varies by earnings decile across ages, years, and gender. We begin by discussing how we expect the implicit tax to vary across these dimensions.

At ages before 60, stopping work means that an extra zero-earnings year may potentially be in the benefit formula calculation, since benefits under the CPP/QPP cannot be taken up until age 60. Some years within the earnings average are set aside under the formula, so for some people the extra ‘zero’ won’t matter because it won’t be used in the earnings average. However, for others who have more spotty labour market histories with several zero-earnings years, stopping work before 60 means an extra zero in the average earnings calculation and would lower benefits. So, people for whom that extra year of work would displace a meaningful zero in their average earnings will find that the extra year of work is valuable for their future CPP/QPP benefits. For these people, there is an implicit subsidy to work (meaning that *ITAX* is negative) as more work adds to their eventual pension.

For whom is this negative *ITAX* most likely? Those in the lower deciles of earnings are more likely to have irregular attachment to the labour market over their career and so more work between ages 55 and 59 will be valuable since it displaces a zero (or generally low) earnings year. It also applies most likely to women who for these birth cohorts may have had a role as a secondary earner in the couple over these years, moving in and out of work.

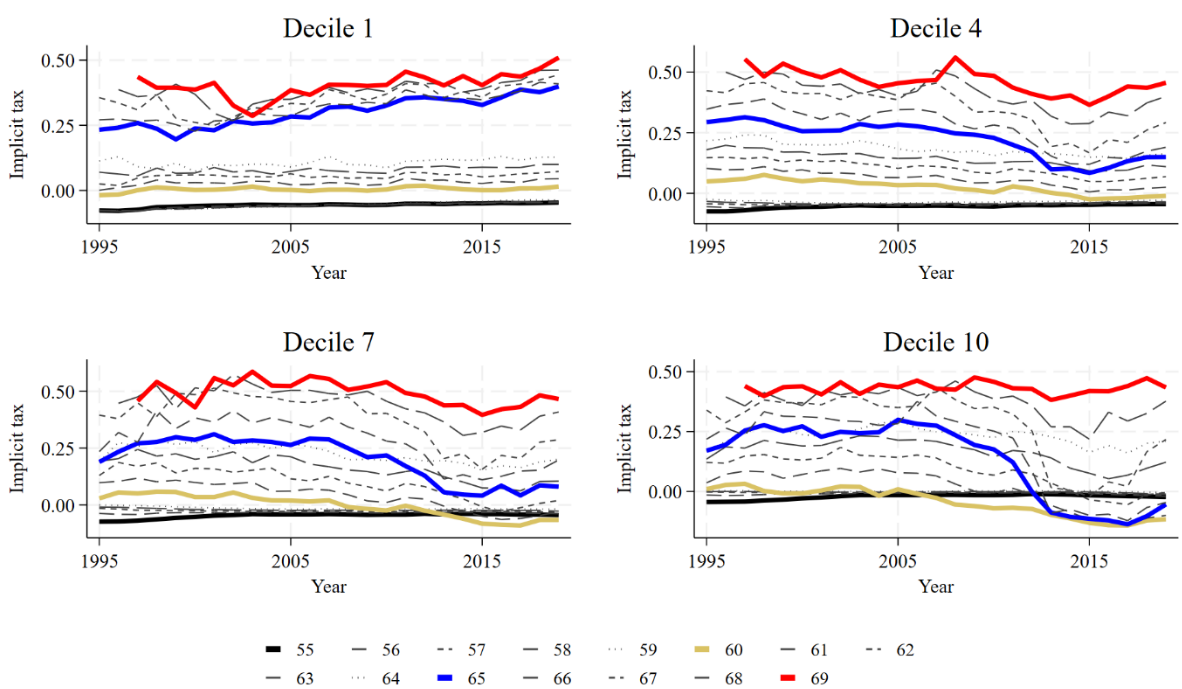
After age 60, the dynamic changes substantially. An extra year of work after age 60 no longer displaces a ‘zero’ in the calculation because if work stops at 60 and the CPP/QPP pension is claimed then there won’t be a ‘zero’ at age 61 in the benefit formula since the benefit would already be locked in. The extra year of work may still be valuable though, since it may displace an earlier low earnings year. In addition, waiting a year increases the eventual CPP/QPP pension through the actuarial adjustment to benefits. On the downside, after age 60 an extra year of non-claiming means that a year of pension benefit flows is foregone.

Ideally, the actuarial adjustment would be set to perfectly offset the gain in lifetime benefits with the foregone year of pension receipt. This ideal may not hold for two main reasons. First, the actuarial adjustment is set with some average survival rate schedule in mind, and as we've seen in this paper mortality varies not only by gender but also strongly by earnings decile. So, low earners may not be compensated enough through the actuarial adjustment because they don't live long enough to reap the long-term flow of higher benefits. High earners may correspondingly be overcompensated by the actuarial adjustment for the parallel reason—they live much longer and get the higher benefits for longer than the average person might. The second reason the actuarial adjustment might not align perfectly is the income-tested GIS. For those who receive the GIS in retirement, every dollar of CPP/QPP actuarial adjustment results in a drop of 50 cents in their GIS entitlement, creating a very high implicit tax on extra work. For those over 60 we therefore expect a higher implicit tax on work for those in low-earning deciles both because of their shortened lifespan and because of the GIS/CPP interaction.

Finally, there are some other differences for those over age 65. First, in the CPP/QPP benefit formula, work after age 65 is counted in a way that more favourably displaces earlier low-earnings years. This should tend to decrease *ITAX*, as more work is translated into higher CPP/QPP benefits. On the other hand, for those with potential retirement income in the GIS clawback range, employment earnings will decrease their GIS directly by 50 cents on the dollar. This is in addition to the long-term impact on CPP/QPP actuarial adjustments discussed above.

We graph the implicit tax on work *ITAX* in Figure 22 and Figure 23. We plot separate lines for each age, with the X-axis running time from 1995 to 2018. We then replicate our analysis for four different deciles in the four panels of each figure. It is easiest to explore the findings by looking at age; from the bottom of each panel up.

Figure 22: Implicit Tax Rates for Women



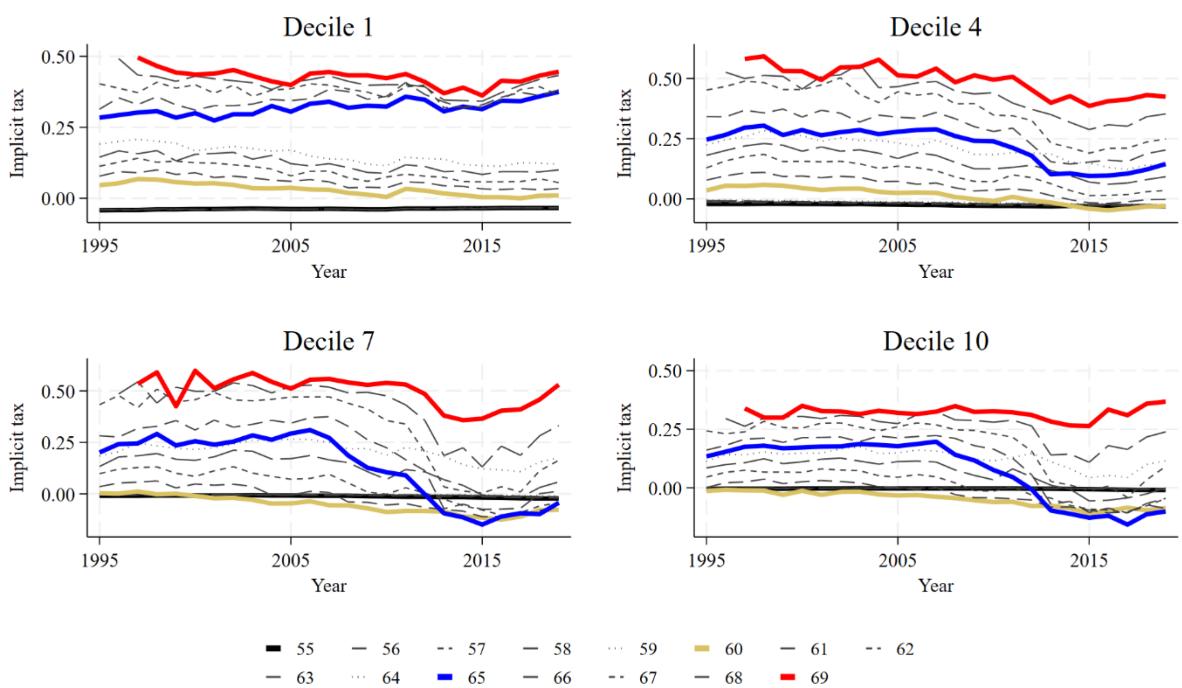
Source: Authors' tabulations using the Longitudinal Administrative Databank. The implicit tax (ITAX) across time with a separate line for each age. Each quadrant shows a different decile, sorted on average lifetime earnings.

The lines for ages 55-59 are very similar and therefore can't easily be distinguished in these figures. At these ages younger than 60 *ITAX* is generally negative, reflecting the gain in lifetime

SSW that results from extra work through the CPP/QPP benefit formula as discussed above. As expected, this is more true for women and for low-earnings workers who have a higher likelihood of interrupted work histories for whom an extra year of work in the earnings average is most valuable. For high-decile earners, the YMPE earnings cap means that an extra year of work is unlikely to improve their average much because the cap means that even if it is their highest earning year ever it still doesn't improve the average earnings. Moreover, because they are more likely to have fairly complete earnings histories, a 'zero' year they would experience if they stopped working would likely be excluded from the average earnings calculation through the low-earnings throwout provisions. This means that extra work at 55-59 has almost zero impact on their eventual future pension flows and explains why the lines are very close to zero for higher earners. There is no strong time series trend across years at these ages.

At ages 60 to 69, the implicit tax on work shifts up in most cases. For low earners who will eventually receive the GIS, the actuarial adjustment they receive results in a diminished GIS so they face quite a large *ITAX*. Most notable is the time-series drop after 2011. This aligns with the increase in the actuarial adjustments phased in between 2012-2016, which makes delayed retirement more valuable because the eventual CPP/QPP benefits will be even higher with the increased actuarial adjustment. In addition, the number of 'throw out' months expanded from 15% to 17% over this time period. Again, this would increase the likelihood that an extra year of work would not matter for the lifetime earnings calculation and tend to push the *ITAX* toward zero. For middle and higher deciles for both men and women, the *ITAX* at age 60-65 is lower than at ages 55-59. When contemplating continued work at ages 55-59, there was in most cases little change in their eventual CPP/QPP pension. In contrast, from age 60 onward delaying retirement means that they benefit from the CPP/QPP actuarial adjustment. This adjustment is more generous compared to mortality risk at age 60 than at age 69, so many workers actually gain in *SSW* because of the extra year of work; moreso when they are closer to 60. As they get closer to 69, the actuarial adjustment becomes increasingly inadequate compared to the cost of delaying CPP/QPP receipt for a year, and *ITAX* rises.

Figure 23: Implicit Tax Rates for Men



Source: Authors' tabulations using the Longitudinal Administrative Databank. The implicit tax (ITAX) across time with a separate line for each age. Each quadrant shows a different decile, sorted on average lifetime earnings.

To summarize this discussion of the retirement incentives embedded in Canada's pension, we have several new findings here compared to our work in earlier papers that did not focus on differences across earnings groups. First, in Canada social security wealth is tipped toward lower earners. The earnings-related components of CPP/QPP are complemented by the income-tested components like GIS to deliver higher SSW to low earners than high earners. Second, consideration of differential mortality by lifetime earnings groups matters in the direction expected (higher SSW for high earners and lower SSW for low earners). However, the magnitude is not as much as might have been expected since many of the extra years of life experienced by high earners are quite distant in time and therefore those benefits are fairly heavily discounted by the assumed interest rate in the SSW net present value calculation. Third, fairly esoteric parameters like the actuarial adjustments and throw-out year provisions matter a lot for work incentives.

4. Regression Results

We now proceed to put the incentive measures developed in the previous section into action to see how they impact retirement decisions in our regression analysis.

4.1 Estimating equation

We closely follow Milligan and Schirle (2023) in estimating the following equation using a linear probability model:

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

where entry to retirement (R_{it}) 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 (SSW_{it}) and the implicit tax ($ITAX_{it}$) 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

RPP pension status 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 earnings cap.

We estimate this equation separately for subsamples from each decile of the earnings distribution, and separately for men and women. We also show results using three different mortality projection measures.

4.2 Main results

We present our main results in Table 4. The sample here is pooled with men and women and includes observations from 1995 to 2019. We begin in 1995 as we can only observe RPP eligibility after 1995, noting that RPP income is important in predicting eligibility for GIS benefits. All together, there are over 11 million person-year observations. Across the three columns in the table are three different regression specifications which use three different sets of control variables. In the 'base' model we include the control variables described above, but for the key age and year controls we include them as linear (for year) and quadratic (for age) controls. In the 'dummies' model, we remove the linear year and quadratic age controls and replace them with a full set of dummy variables for each year and age. Finally, in the 'full' model we replace the linear terms for earnings at age 54 and the lifetime YMPE ratio (measuring lifetime earnings) with cubic terms, to more richly control for variation in lifetime earnings.

Table 4: Main Regression Results

	(1)	(2)	(3)
	Base	Dummies	Full
N	11,481,540	11,481,540	11,481,540
R-Squared	0.0167	0.0236	0.0245
	OLS	OLS	OLS
Social Security Wealth	0.0029***	0.0007***	0.0007***
(100,000 Euros)	(0.0002)	(0.0002)	(0.0002)
ITAX	0.0295***	0.0389***	0.0401***
	(0.0005)	(0.0005)	(0.0005)
Male	-0.0048***	-0.0058***	-0.0068***
	(0.0002)	(0.0002)	(0.0002)
Married	-0.0119***	-0.0077***	-0.0062***
	(0.0004)	(0.0004)	(0.0004)
Spouse age gap	-0.0005***	-0.0006***	-0.0005***
	(0.0000)	(0.0000)	(0.0000)
Employer pension (RPP)	-2.6477***	-0.0078***	-0.0071***
	(0.0468)	(0.0004)	(0.0004)
Spouse RPP	0.0037***	0.0032***	0.0028***
	(0.0002)	(0.0002)	(0.0002)
Earnings at age 54	-0.0035***	-0.0037***	cubic
	(0.0001)	(0.0001)	
Spouse earnings at age 54	0.0007***	0.0006***	-0.3361***
	(0.0002)	(0.0002)	(0.0057)
Lifetime YMPE ratio	-0.0426***	-0.0388***	cubic
	(0.0004)	(0.0004)	
Age	Quadratic	Dummies	Dummies
Year	Linear	Dummies	Dummies
Province dummies	Y	Y	Y
Age*RPP	Y	Y	Y

Source: Regressions using the Longitudinal Administrative Databank on a pooled sample of men and women from 1995 to 2019. The dependent variable in each case is a binary indicator for being retired. Each column shows a different specification. Three stars indicates significance at the 1% level of confidence; two stars is 5%; one star is 10%. Robust standard errors are reported below in parentheses.

The results in Table 4 show a mixed set of results for the impact of *SSW*. In the base specification, each 100,000 euros of *SSW* is expected to increase the probability of retirement by

0.0029 percentage points. So, for someone with 300,000 of *SSW* that would increase the retirement rate by about 1.2 percentage points. Compared to the hazard rates into retirement shown in Figure 14 and Figure 15 where the typical retirement rate is about 20 percent across ages, this is a fairly small impact. Moreover, depending on the way that we control for earnings, age, and year, the coefficient on *SSW* becomes insignificant (dummies specification) or flips sign to negative (full specification). However, whether positive, zero, or negative, the impact of *SSW* on retirement remains fairly small. These results are consistent with our findings in Milligan and Schirle (2023).

The impact of the implicit tax on work, *ITAX*, comes through consistently and strong in Table 4. Across the three specifications, the coefficient estimate ranges between 0.0295 and 0.0401, and strongly significant. These estimates align very closely with those reported in Table 3 of Milligan and Schirle (2023) which used an almost-identical sample and methodology. To put these estimates in context, the difference in *ITAX* seen in Figure 22 and Figure 23 between decile 1 earners and decile 10 earners is approximately 0.50. Using a coefficient estimate of 0.0389 from the 'dummies' specification, this means that there is a change in retirement of 0.50*0.0389= 1.95 percentage points in the retirement rate associated with the change in *ITAX* across these two earnings groups.

We now break down our results by gender and by earnings decile, using the 'dummies' specification. The earnings decile breakdowns are new to the analysis in this paper. The results are reported in Table 5 and Table 6. The first column shows the results for the whole sample, while the next three columns report the coefficients for three different earnings deciles.

Table 5: Regressions by Decile for Women

	(1)	(2)	(3)	(4)
	All	1st decile	5th decile	10^{th} decile
N	5,163,945	450,480	538,175	503,975
R-Squared	0.0239	0.0236	0.0349	0.0162
Social Security Wealth	-0.0015***	-0.0106***	0.0011	0.0142***
	(0.0003)	(0.0015)	(0.0010)	(0.0010)
ITAX	0.0480***	0.1475***	0.0647***	-0.0006
	(0.0009)	(0.0064)	(0.0036)	(0.0021)

Source: Regressions using the Longitudinal Administrative Databank on a sample of women from 1995 to 2019. The dependent variable in each case is a binary indicator for being retired. Each column shows a different sample. The specification is the Dummies specification from Table 4. Three stars indicates significance at the 1% level of confidence; two stars is 5%; one star is 10%. Robust standard errors are reported below in parentheses.

For women in Table 5, the coefficient on *SSW* is inconsistent in sign, but remains fairly small. For *ITAX*, the average impact is 0.0480, but the impact at low and middle deciles appears much stronger than at high deciles. Why might there be a stronger response to public pension incentives at lower earnings deciles? One possible reason is that public pensions are a larger share of the income basket in retirement for lower and middle earners, while high earners may be more concerned with the return of their stock portfolio or the details of how their employment-based pension delivers retirement income than the incentives in the public pension system.

We repeat the analysis for men in Table 6. Again, the *SSW* coefficients are inconsistent and relatively small. In contrast the *ITAX* coefficient is much larger at low and middle deciles than at the highest 10^{th} decile.

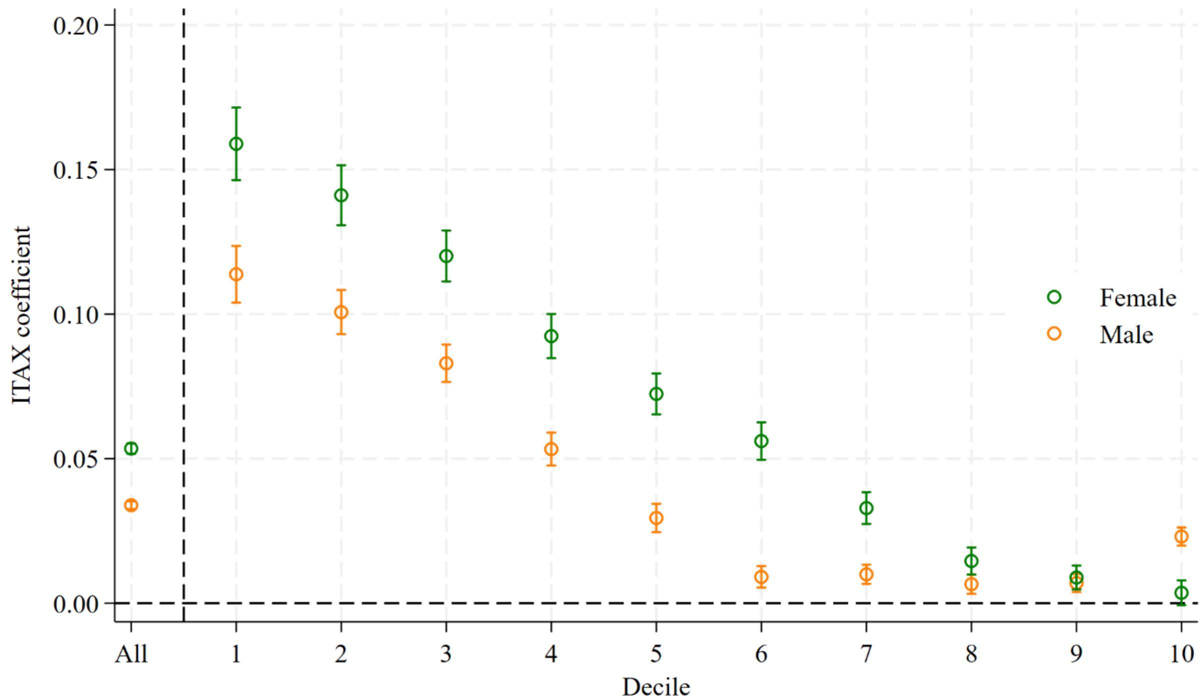
Table 6: Regressions by Decile for Men

	(1)	(2)	(3)	(4)
	All	1st decile	5th decile	10^{th} decile
N	6,317,595	553,800	638,900	697,730
R-Squared	0.0241	0.0287	0.0357	0.0100
Social Security Wealth	0.0031***	-0.0015	0.0047***	0.0079***
	(0.0003)	(0.0013)	(0.0010)	(0.0006)
ITAX	0.0296***	0.1010***	0.0230***	0.0198***
	(0.0007)	(0.0051)	(0.0024)	(0.0016)

Source: Regressions using the Longitudinal Administrative Databank on a sample of men from 1995 to 2019. The dependent variable in each case is a binary indicator for being retired. Each column shows a different sample. The specification is the Dummies specification from Table 4. Three stars indicates significance at the 1% level of confidence; two stars is 5%; one star is 10%. Robust standard errors are reported below in parentheses.

Because of the intriguing result by earnings decile in the above tables for *ITAX*, we expand our reporting to all 10 deciles in Figure 24. The results show an almost-monotonic pattern of coefficients, decreasing as lifetime earnings gets larger. The same path is seen for men and for women; although the coefficient for men gets higher in the 10^{th} earnings decile. Most notably, the response to the *ITAX* incentive hits close to zero by the 6^{th} decile for men and the 9^{th} decile for women. These results suggest that for low-middle earners, the retirement decision is much more sensitive than for high earners. Taking 0.10 as a central estimate for *ITAX* among the lower half of earners, this now implies that a 50 point change in *ITAX* has an impact of 5 percentage points on retirement decisions. That is a large impact.

Figure 24: Regression Coefficients by Decile



Notes: Regressions using the Longitudinal Administrative Databank on samples of men and women from 1995 to 2019. The dependent variable in each case is a binary indicator for being retired. We graph here the coefficient and 95% confidence interval for ITAX, using the specification from Table 4, dummies specification. The first estimate on the left is for the whole sample. The next 10 are for each lifetime earnings decile sample run as a separate regression.

The final regression analysis we present looks at the impact of incorporating differential mortality in the calculation of our incentive variables. Table 7 reports the coefficients on *SSW* and *ITAX* using the 'dummy' specification with a pooled male-female sample. The results show some difference in the estimate of *SSW*, but little change in the estimates of *ITAX*. As we saw earlier in Figure 20 and Figure 21, the incentives are not strongly different across the various mortality calculation methods. We suspect this is because the largest impact of the differential mortality implementation is on later-life pension flows, and these later-life pension flows were already strongly discounted by the chosen interest rate.

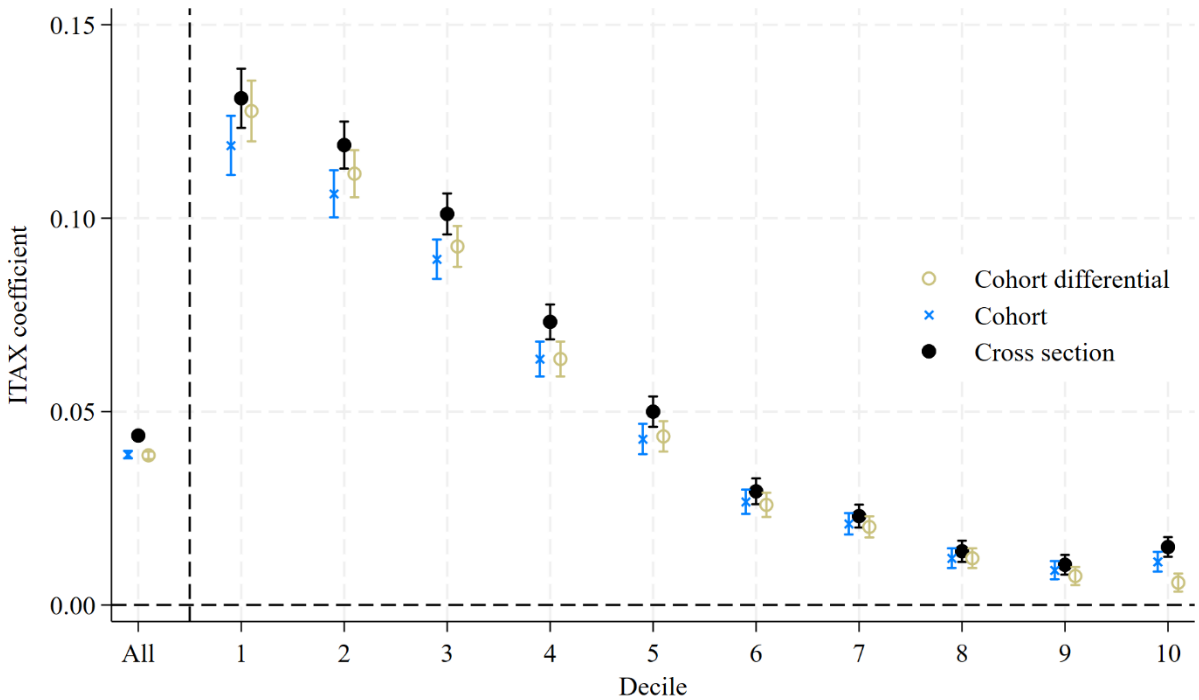
Table 7: Regressions with Differential Mortality

	(1)	(2)	(3)
	Cross-section	Cohort	Cohort Differential
N	11,481,540	11,481,540	11,481,540
R-Squared	0.0238	0.0236	0.0237
Social Security Wealth	0.0004	0.0007***	-0.0020***
	(0.0002)	(0.0002)	(0.0002)
ITAX	0.0438***	0.0389***	0.0387***
	(0.0005)	(0.0005)	(0.0005)

Notes: Regressions using the Longitudinal Administrative Databank on a pooled sample of men and women from 1995 to 2019. The dependent variable in each case is a binary indicator for being retired. Each column shows a different sample. The specification is the Dummies specification from Table 4. Three stars indicates significance at the 1% level of confidence; two stars is 5%; one star is 10%. Robust standard errors are reported below in parentheses.

We plot these coefficients from the differential mortality regressions across decile in Figure 25. Again, we used the pooled male-female sample and the dummies specification. The difference in coefficients is largest between the cross-section method and either the cohort or cohort-differential methods. Overall, the differences in the sensitivity of our estimates for using different kinds of mortality assumptions appears to be minimal. Our estimates are robust to different ways of discounting future pension flows for mortality that may be correlated with lifetime earnings.

Figure 25: Regression Coefficients with Differential Mortality



Notes: Regressions using the Longitudinal Administrative Databank on a pooled sample of men and women from 1995 to 2019. The dependent variable in each case is a binary indicator for being retired. We graph here the coefficient and 95% confidence interval for ITAX, using the specification from Table 4, dummies specification. The first estimate on the left is for the whole sample. The next 10 are for each lifetime earnings decile sample run as a separate regression. The three coefficients for each sample are using different mortality measures.

We summarize the regression results by pointing out three main findings. First, the *ITAX* incentive measure has a larger impact on retirement and is estimated more reliably than *SSW*. Second, the estimates of the impact of *ITAX* on retirement are many multiples larger in low-mid deciles of earnings than for high earners. This suggests that retirement sensitivity for middle-earnings workers may be more important for understanding the impact of public pensions on retirement. Third, the introduction of differential mortality does not substantially change the conclusions of our analysis.

5. Simulations

We pursue in this section simulations about the reforms in the CPP and QPP implemented after 2011. Until 2011, the actuarial adjustment to benefits was 0.5% per month, or 6% per year, before and after age 65. After the reform, the adjustment for the CPP was changed to 7.2% per year before age 65 and 8.4% per year after age 65. There were also changes to QPP actuarial adjustments, but slightly different than those for the CPP. In addition, the number of low-earning months that could be thrown out of the benefit calculation was 15% up to 2011. For 2012 and 2013 this was increased to 16% and for 2014 forward to 17%.

The goal of our simulation is twofold. First, it allows us to gauge the magnitude of our estimated coefficients on *ITAX* and *SSW*. Did these reforms have a material impact on retirement patterns? Second, we are interested in evaluating the impact of the reforms on distribution, comparing the impact across lifetime earning deciles.

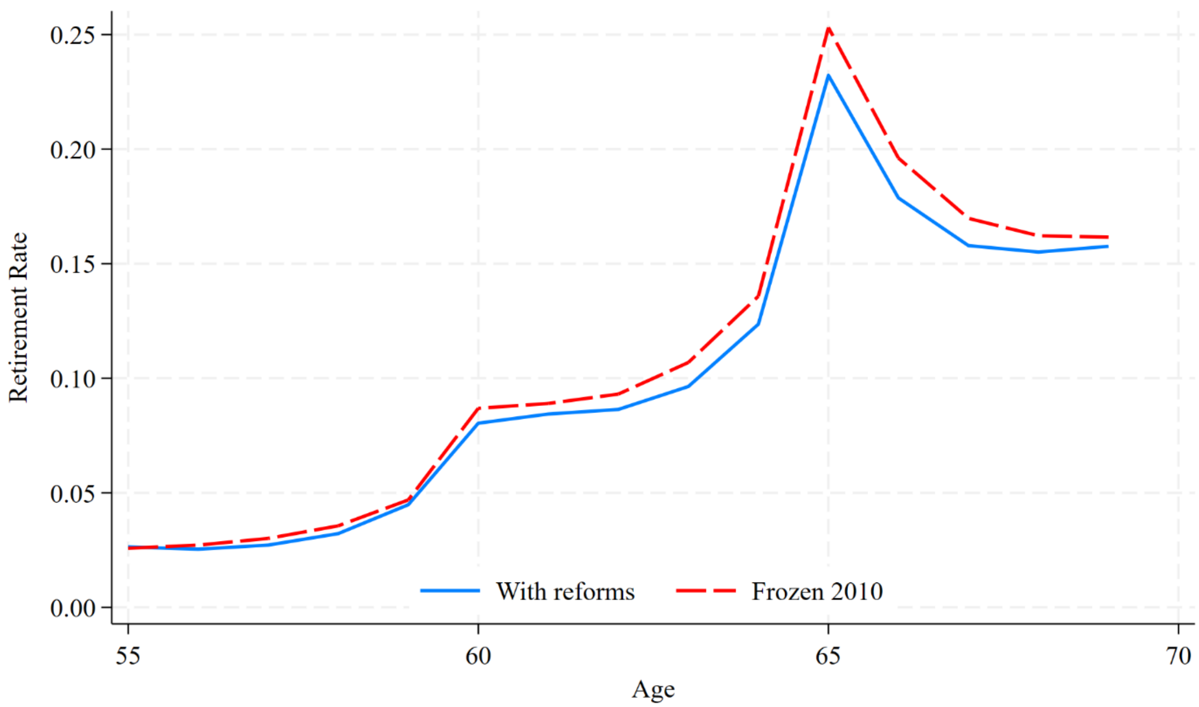
Our method is to calculate the pension incentives for each individual in our sample under the counterfactual assumption that the pension system froze in 2010. That is, we adjust the rules for CPP and QPP only for inflation and do not account for the changes in the actuarial adjustment, the throw-out rules, or other parameters like the YMPE.[11]

We begin the analysis by looking at the impact of freezing the parameters of the system in 2010 on retirement probabilities. We compare the predicted retirement probabilities using our

[11] Over the period from 2010 to 2015 CPI grew by 8.7%. The YMPE grew by 13.6%, reflecting real wage growth over that period.

dummies specification for the base which has the actual reformed system in place to the predicted probabilities for the 2010 frozen system. The major difference here being that the actuarial adjustment changed after 2011. The magnitude of the impact of the change in the *ITAX* measure can be seen in Figure 22 and Figure 23. The biggest changes are at higher lifetime earnings deciles, as the implicit tax on work drops substantially in the years after 2011 because of the improved actuarial adjustment which enhances the return to working one more year.

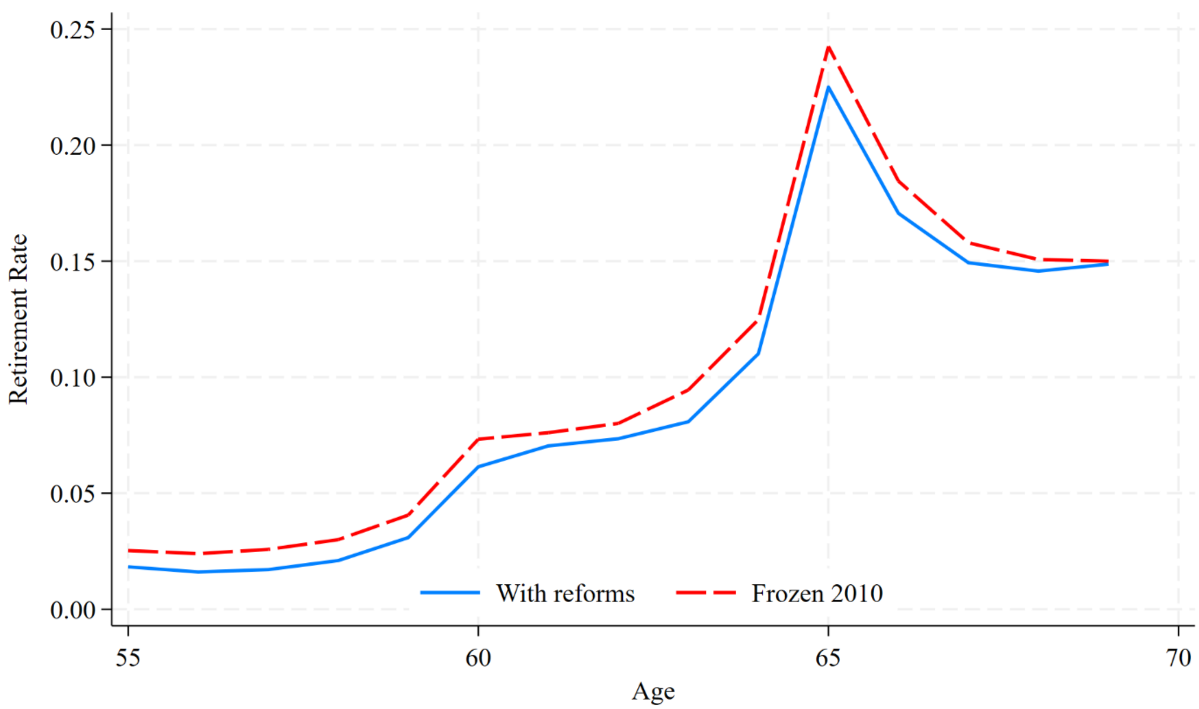
Figure 26: Simulated retirement rates for women



Notes: Simulated retirement rates using the Longitudinal Administrative Databank. The base is the predicted values using the actual 2015 system. The Frozen 2010 predicted values are for a counterfactual with system parameters frozen in 2010.

In Figure 26 we show the predicted retirement rates using the Table 4 dummies specification across ages for females. The solid line shows the predicted rates in 2015 with the actual reformed system in place. The dashed line shows what the predicted retirement rates would be if the 2011 reform had not taken places, given the estimated coefficients. At all ages, the estimated retirement rate is higher with the system frozen in 2010. This arises because the reform lowered the *ITAX* implicit tax on work by making the actuarial adjustments higher. With delayed work, after 2011 there was more of an actuarial bonus. This increases the return to work and given our estimated coefficients it lowers the retirement rate. In Figure 27 we repeat this exercise for men, finding the same pattern—with a larger predicted impact of the reform at lower age ranges than we saw for women.

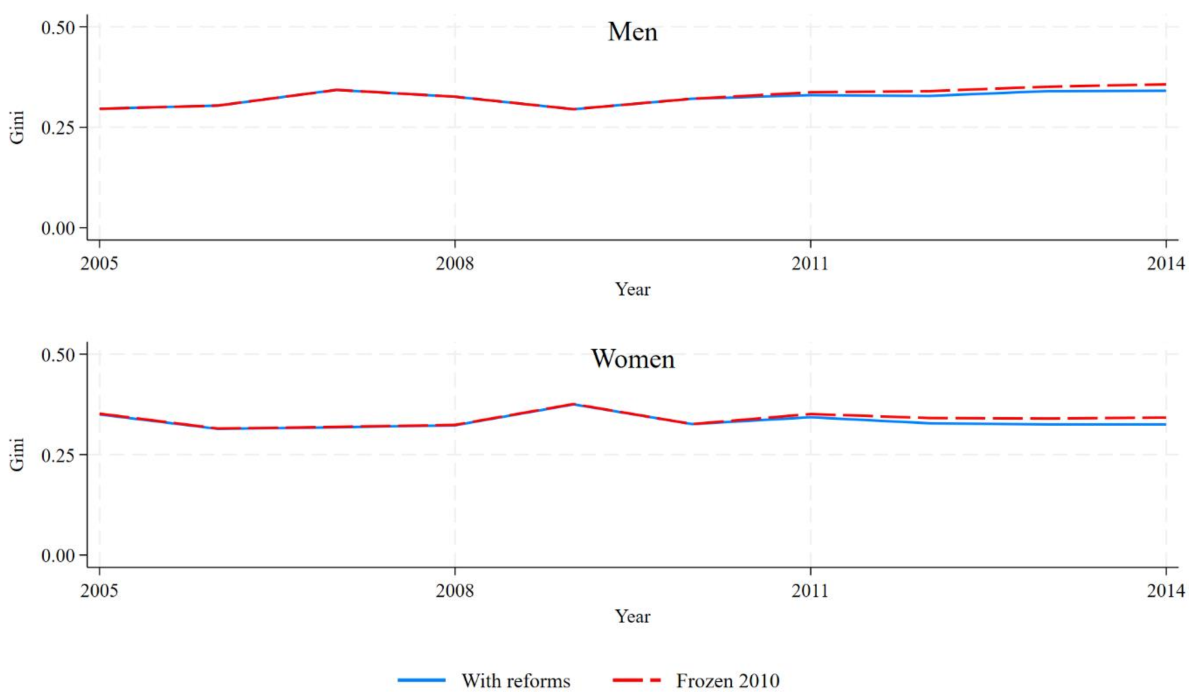
Figure 27: Simulated retirement rates for men



Notes: Simulated retirement rates using the Longitudinal Administrative Databank. The base is the predicted values using the actual 2015 system. The Frozen 2010 predicted values are for a counterfactual with system parameters frozen in 2010.

Another way to examine the impact of the reform is to look at the direct impact on the inequality of retirement income. We do this by calculating the gini goefficient for retirement income observed at age 71 under the base system that had the reforms and the counterfactual system that was frozen in 2010. We graph these gini coefficients in Figure 28 for men and for women separately. Up to 2010, there is no difference in the gini with and without the reform, since the reform hasn't yet taken place. After 2011, the gap between the with and without reform ginis grows as the reform is phased in during the years 2012-2014. The difference in the ginis, however, is small.

Figure 28: Ginis for retirement income before and after reform



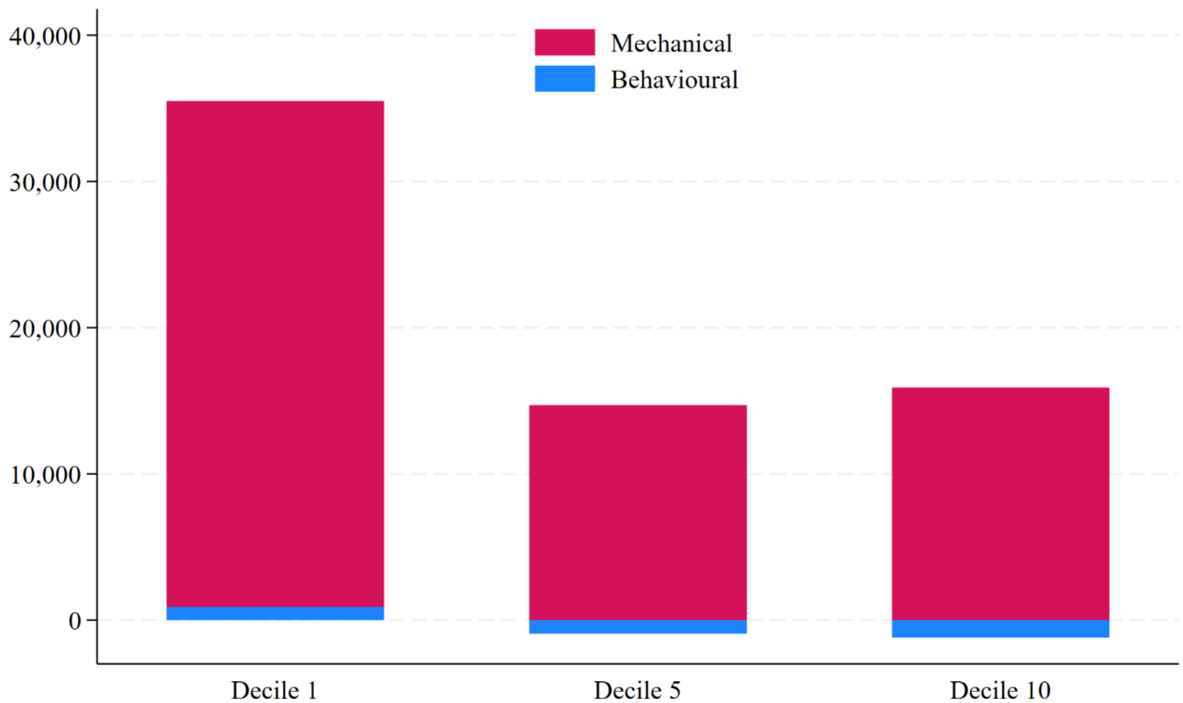
Notes: Gini coefficients for retirement income under the base and under a counterfactual with the retirement system frozen in 2010. The gini is calculated based on retirement income as measured at age 71.

We perform one last calculation to examine the heterogeneous impact of the reform. Looking across lifetime earnings deciles, we look at how the reform affected the total Social Security Wealth. To do this, we take 55 year olds and calculate the *SSW* at every future retirement age up to age 69. We then average these *SSW* values using the estimated probability of retirement at each age as weights. We then compare the *SSW* calculated in this way under the actual observed with-reform system to the *SSW* with the frozen in 2010 unreformed system to get the total impact on *SSW* by earnings decile. This total effect can be further decomposed into two components. The mechanical effect calculates the impact of the reform while holding retirement behaviour constant. The behavioural effect calculates the impact of the induced change in retirement on total *SSW*. We focus on the year 2015 for these calculations, comparing the actual observed *SSW* in 2015 to the *SSW* under the counterfactual 2010-frozen system.

The results are plotted for ALTE deciles 1, 5, and 10 in Figure 29 for women. The calculations show a large gain in *SSW* in the bottom decile, with smaller gains for those in the 5^{th} and 10^{th} deciles of lifetime earnings. The mechanical effect dominates in all cases, with only a small offsetting behavioural effect. The average *SSW* for women is around 200,000 Euros, so these gains should be compared to that value. The major driver of the change in *SSW* here is the increase in the YMPE. Over the time period from 2010 to 2015, the YMPE grew at 13.6% while the CPI inflation was only 8.7%. This means that CPP and QPP benefits became more generous in real terms in 2015 compared to 2010.

The behavioural effect is relatively small here because even though there is less induced retirement, the impact on overall *SSW* received is not large because the actuarial adjustment is now closer to a fair adjustment. With a fair actuarial adjustment, the value of *SSW* will be the same no matter what year one retires.

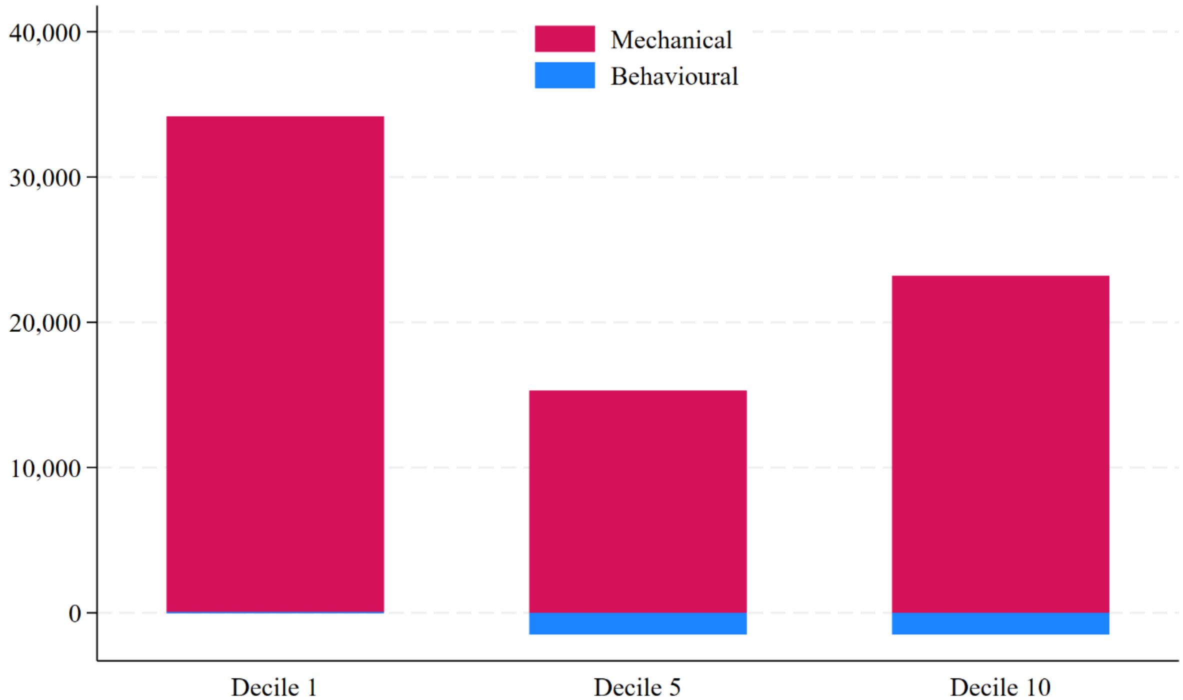
Figure 29: Impact of reform on SSW for women



Notes: Impact of 2011 reform on Social Security Wealth for women by decile of lifetime earnings. The mechanical effect is the impact of the reform holding retirement behaviour constant. The behavioural effect is the impact driven by the change in retirement behaviour. The analysis compares 2015 observed values to values under a system frozen in 2010.

We repeat these mechanical and behavioural effect calculations in Figure 30 for men. Here, the same pattern can be observed as for women. The largest impact is in the first decile, with smaller overall impacts in the fifth and tenth deciles. There is a small offsetting behavioural effect for the upper deciles.

Figure 30: Impact of reform on SSW for men



Notes: Impact of 2011 reform on Social Security Wealth for men by decile of lifetime earnings. The mechanical effect is the impact of the reform holding retirement behaviour constant. The behavioural effect is the impact driven by the change in retirement behaviour. The analysis compares 2015 observed values to values under a system frozen in 2010.

6 Conclusions

In this paper we build on earlier work in Milligan and Schirle (2023) by evaluating the retirement incentives embedded in Canada's retirement income system from the perspective that the system may differentially affect individuals located in different parts of the income distribution. There are several factors that were important to account for in this regard. First, we observe a shifting longevity-earnings gradient, whereby individuals with higher earnings tend to live longer than those with low earnings, and life expectancy has increased over time. Second, we illustrate how benefit eligibility (with some components clearly linked to a person's work history) varies by lifetime earnings decile. These factors may be considered opposing forces—while larger social security benefits are available to individuals with lower earnings in their work history, those from the top of the income distribution tend to enjoy longer lives over which they may receive benefits. Overall, we see greater Social Security Wealth among individuals from lower deciles.

Our results show that the structure of Canada's social security programs leads to very different incentives to continue working at older ages. The implicit tax rates on continued work tend to be higher for workers from lower-earning deciles. Considering changes to actuarial adjustments in the Canada Pension Plan associated with early pension take up, these implicit tax rates on work at older ages fell substantially after 2011. The patterns are slightly different for individuals from lower deciles (for whom incentives to continue work at age 60 improved substantially more than at ages 65 or over) and upper deciles (for whom incentives to continue work after age 65 were most clear). Our regression estimates confirmed the important effects on retirement behaviour, with substantially larger effects for individuals in lower deciles. These effects are greater for women than men, who tended to have lower career earnings. In simulations, we show that changes to the actuarial adjustment after 2010 had some impact on retirement rates by lowering the implicit tax on work. The overall redistributive effect of these induced retirement changes was fairly small, however, as the actuarial adjustments brought the system closer to actuarial fairness.

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