The Long-Run Impact of Early Retirement Programs: Evidence from Canadian Pension Reforms*

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Abstract

Raising the early eligibility age (EEA) for old age pensions is a popular policy to reduce financial pressure on pension systems. While a mature literature has investigated the short-run impact of the EEA on labor supply, evidence on the long-run impacts on economic well-being and poverty is scarce, even though the impact on later-life living standards is crucial to determine the EEA's welfare effect. This paper helps to fill this gap by studying two Canadian pension reforms that reduced the EEA from age 65 to age 60. The reforms took place in the 1980s, enabling us to follow affected individuals for the entire retirement period until they die. Using comprehensive tax records and a variety of research designs, we obtain three main findings. First, a one-year reduction in the EEA lowered the pension claiming age by 0.25 years but had no effect on the labor market exit age. Second, early claiming increased pension and total income early in retirement but these gains were overshadowed by income losses later in retirement. Third, lowering the EEA had important distributional consequences: the losses in lifetime pension and total income were concentrated among retirees with above-median income, while low-income retirees experienced a significant improvement in later-life economic well-being. Overall, the EEA reduction in the 1980s were associated with a significant decline in elderly bankruptcy and poverty rates in Canada.

Keywords: Public pensions, policy reform, early eligibility age, financial well-being and poverty

JEL Classification: H55, J21, J26

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1 Introduction

A main purpose of public pension programs is to protect the elderly from poverty and a decline in living standards. But population aging and falling fertility rates have catalyzed a rapid increase in current and projected program costs and prompted a growing urgency to reform public pension programs. A popular policy to balance the financial stability of pension programs is to raise the Early Eligibility Age (EEA) when public old age pensions first become available. For example, among OECD countries the average EEA in 2018 was 61.2 years; over a year higher than it was in 2004 (OECD, 2019).

Raising the EEA can reduce spending on public pensions and increase tax revenue by boosting employment. At the same time, a higher EEA can reduce overall welfare if income protection during retirement declines and old age poverty increases. While an active literature analyzes the immediate responses of a change in the EEA on pension receipt and labor force participation, the long-run consequences of a change in the EEA on economic well-being and poverty during retirement are unknown.[1] Yet, without knowledge of these effects, assessing the welfare impact of a change in the EEA remains elusive. Credibly estimating the long-run effects has been hampered for two primary reasons: a lack of comprehensive data that captures economic well-being, and a lack of exogenous variation in the EEA that permits following affected individuals over the entire retirement period.

This paper address both challenges in the context of Canada, which is an ideal setting for three reasons. First, Canadian administrative tax data, covering 20 percent of the population over a 35 year period, enable us to go beyond labor supply and characterize the long-run impacts of a change in the EEA on outcomes that are rarely measured: total disposable income and its different components as well as indicators for financial distress such as the probability of a bankruptcy or being poor. Second, we leverage plausibly exogenous variation in the EEA by exploiting the existence of two distinct public pension programs in Canada: the Quebec Pension Plan program (QPP) covers the province of Quebec and the Canada Pension Plan program (CPP) covers the rest of Canada. The EEA is now the same in both programs but that has not always been the case. In 1984, the QPP lowered its EEA from age 65 to age 60 but the CPP implemented the same change only three years later, so that for some birth cohorts the EEA was significantly lower in Quebec than

[1] For a review, see Lumsdaine and Mitchell, 1999; Feldstein and Liebman, 2002; Coile, 2015; Blundell *et al.*, 2016; and Böersch-Supan *et al.*, 2016.

in the rest of Canada. Third, since the reforms took place in the early 1980s, we can follow affected individuals until they die and study the dynamic effects of a change in the EEA over the entire retirement period. Moreover, a simple theoretical model predicts that individuals should claim the pension at the *optimal claiming age* that maximizes the discounted sum of pension benefits. The optimal claiming age is positively correlated with the age at death, and since we observe the age at death in the data, we can calculate each person's optimal claiming age and test whether people effectively claim at this age.

Our empirical analysis leverages the reform-based variation in the EEA using a sharp regression kink design and a cohort difference-in-differences design. The reforms create two kinks in the slope of the EEA by date of birth. At the first kink, the EEA starts to *decline* from age 65 for cohorts born after the kink. At the second kink, the EEA starts to *increase* from age 60 for cohorts born before the kink. The regression kink design identifies a local average treatment effect by relating the slope change in the EEA to the induced slope change in the outcome of interest. Having two kinks offers an opportunity to test whether the effects for an EEA increase and an EEA decrease are symmetric. Moreover, the regression kink design also allows us to implement a complier analysis in order to characterize the attributes of marginal early claimers, who respond to the reforms by claiming earlier.

The cohort difference-in-differences design pools all variation in the EEA across birth cohorts and regions and has more statistical power compared to the regression kink design. Having more power is important to capture the long-run impact of an EEA change on financial outcomes, which tend to be noisy, as well as the distributional effects by pre-retirement income. However, the design relies on a stronger identification assumption compared to the regression kink design by requiring that without the reform the outcome variable would have followed the same trend in Quebec and the rest of Canada. We carefully check the validity of this assumption by examining trends in Quebec and the rest of Canada among control cohorts with the same EEA.

Our analysis yields four main findings. First, lowering the EEA by one year reduces the pension claiming age by 0.25 years but has no effect on the labor market exit age. The complier analysis reveals that, consistent with pension wealth maximizing behavior, early claimers die earlier and have a lower optimal claiming age than individuals who delay claiming. Second, early claiming induces a modest fall in lifetime pension wealth of $500, or about 0.6 percent, and leaves lifetime income roughly unchanged, which may also explain why individuals do not adjust their labor supply. However, these estimates hide important dynamic effects over the retirement period. Early claiming creates a financial gain at the onset of retirement because people can access benefits earlier: pension wealth and total income between the new and the old EEA increase by $1,200 and $2,500. But early claiming creates a significant financial loss later in retirement because early claiming lowers the annual pension permanently: pension wealth and total income after the old EEA drop by $1,700 and $2,700.

Third, a change in the EEA has important distributional consequences. Low-income retirees experience a boost in pension and total income at each age in retirement. In contrast, high-income retirees do enjoy higher pension and total income at the onset retirement, but these gains are overshadowed by losses in pension and total income later in retirement. The differential impact across the income distribution is explained by differences in life expectancy and, consequently, the optimal claiming age. Low-income retirees have shorter life expectancy, and early claiming is optimal for them. High-income retirees have greater life expectancy, and delaying claiming would be optimal for them, but they claim as early as low-income retirees, which could reflect misoptimization or myopia (Diamond and Köszegi, 2003).

Fourth, early claiming lessens financial distress in retirement. Both bankruptcy and poverty rates decline significantly in the short run (between the new and the old EEA) and they even persist even in the long run (after the old EEA). Separate estimates across the income distribution show that the reduction in poverty rates and, to a smaller extent, bankruptcies are entirely driven by low-income households. Overall, these results suggest that a lower EEA is associated with large welfare gains among low-income retirees. Higher-income retirees see a drop in the pension income, but the associated welfare loss is likely small since public pensions account for a small share of their retirement income.

This paper contributes to an active literature on the impacts of public pension programs on labor supply and welfare. One arm of this literature has investigated the labor supply effects of financial incentives associated with changes in pension benefit levels, generally finding modest responses (Burtless, 1986, Baker *et al.*, 2003, Gruber and Wise, 2004, Coile and Gruber, 2007, Krueger and Pischke, 1992, Gelber *et al.*, 2016, Milligan and Schirle, 2020). Another arm of this literature has studied the labor supply and pension claiming effects of changes in the early or full retirement age using structural models (Rust and Phelan, 1997, French, 2005, Bound *et al.*, 2010) or quasi-experimental policy variation (Mastrobuoni, 2009, Behaghel and Blau, 2012, Staubli and Zweimüller, 2013, Atalay and Barrett, 2015, Manoli and Weber, 2016, Deshpande *et al.*, 2020, Geyer and Welteke, 2021, Johnsen *et al.*, 2021, Lalive *et al.*, 2021, Seibold, 2021). In this literature, Baker and Benjamin (1999a) have studied the short-run impact of the same pension reforms on men using survey data. They find that a reduction in the EEA from 65 to 60 increases pension claiming between 60 and 64 but has no effect on employment. Our paper is also related to a more limited literature on the association between public pensions and elderly poverty (Engelhardt and Gruber, 2006, Milligan, 2014, Marchand and Smeeding, 2016, Fonseca and El-Attar, 2020, Jacques *et al.*, 2021).

Our primary contribution to the earlier literature is that the combination of our data and our setting enables us to credibly estimate the *long-run* impact of the EEA over the entire retirement period on economic well-being and poverty. Although the income and poverty impacts of the EEA are crucial determinants for the welfare effects, to our knowledge, the only paper that has attempted to estimate these impacts directly is Engelhardt *et al.* (2020) for the US. Using survey data and variation in the EEA across birth cohorts generated by the introduction of the EEA at age 62, they find that early claiming is associated with a reduction in total income and an increase in poverty. One concern is that their estimates could be biased by cross-cohort variation in other factors that affect pension claiming and total income. Specifically, to account for the impact of rising inflation, US Congress increased pension benefits on an ad hoc basis for all cohorts in the latter half of their sample. Our setting creates variation in the EEA across cohorts *and* regions, enabling us to control for any cohort-specific factors. Our main findings illustrate that a lower EEA can improve total income at the bottom of the income distribution and reduce elderly poverty.

The remainder of this paper is structured as follows. In section 2, we discuss the institutional background and the theoretical predictions on the impact of the reforms. Section 3 presents the data and provides summary statistics of our analysis sample. Section discusses the regression kink and difference-in-differences estimation strategies. Section 5 presents the empirical results. Section 6 concludes.

2 Institutional Background and Theoretical Predictions

2.1 Public Pensions in Canada

For older Canadians, there are two major public pension programs: the Canada and Quebec Pension Plans (C/QPP) and Old Age Security (OAS). C/QPP and OAS together replace around 40 percent of pre-retirement earnings for an individual with average earnings. While OAS has largely been unchanged since the early 1980s, C/QPP has undergone an important change in the Earliest Eligibility Age (EEA), which is the basis of our empirical analysis. Here, we discuss the aspects of C/QPP and OAS that are relevant for our setting. For more details on Canada's social security programs, see, e.g., Baker *et al.* (2004) or Milligan and Schirle (2020).

C/QPP is the largest program of the old-age income security system in Canada. The QPP covers individuals residing in the province of Quebec, while the CPP is for those living in all other areas of the country. The existence of two plans originated from Quebec's desire to retain control over the pension plan reserves and the design of the plan itself. The other provinces also had the option of establishing their own parallel plans, but none did. The two plans are largely identical in the types and amounts of benefits available, and in the rules governing eligibility. Benefits are fully portable for the two plans for individuals who cross province borders during their work live. Benefits are financed by a payroll tax of 10.2 percent (11.1 percent in Quebec) on earnings up to a maximum (C$ 58,700 in 2020).

Eligibility for benefits is conditional on having contributed in at least one calendar year from age 18 onwards.[2] C/QPP benefits replace 25 percent of the average of the real earnings history, up to a maximum. The real earnings history is the average indexed capped earnings over the contributory period, excluding the lowest 17 percent of earnings. The earnings history also excludes times during which a person was receiving a disability pension or rearing small children. In 2020, the maximum C/QPP pension for an individual who claims the pension at age 65, the Normal Retirement Age, is C$1,177 per month.

OAS is financed by general tax revenues and offers an OAS pension for individuals over age 65 who meet a residency requirement.[3] Individuals with 40 years of residence receive a full OAS

[2] An individuals only contributes if the annual earnings exceed C$3,500.

[3] Individuals must have resided in Canada for at least 10 years if in Canada at the time of application or twenty years if outside Canada at the time of application. Since 2013 individuals can delay claiming an OAS pension up to

pension, C$614 per month in 2020. Individuals with less than 40 years of residence receive a partial OAS pension of 1/40th of the full OAS pension for each complete year of residence in Canada after age 18. The OAS pension is earnings-tested and reduced by 15 cents for every dollar the net income exceeds C$79,054. OAS also offers two means-tested benefits. The Guaranteed Income Supplement (GIS) pays up to C$916 per month to OAS beneficiaries with an annual income below a threshold. The Allowance pays up to C$1,165 per month to individuals aged 60 to 64 with a spouse who is eligible for the GIS.

2.2 Reduction of Early Eligibility Age

Since the 1970s the EEA for C/QPP benefits was set at age 65. Individuals could delay claiming up to age 70 but without any actuarial adjustment of benefits. With the intent of introducing more flexible claiming options, Quebec passed a law in June 1983 which lowered the EEA from age 65 to age 60, effective January 1, 1984. Individuals, who wanted to claim a pension before age 65, needed to have reduced work substantially. Specifically, projected earnings over a 12 months period, based on the monthly earnings at the time of applying, could not exceed 25 percent of the maximum annual pension (C$7,000 in annual earnings in 1987). The test on earnings applied only at the time of applying but not after benefit receipt had been initiated.[4]

In the same law, the Quebec government also introduced an actuarial adjustment of benefits. Benefits were reduced by 0.5 percent for each month of pension receipt before age 65. Thus, an individual who claimed a pension at age 60 would receive 70 percent of the pension she would have received at age 65. The law also introduced a bonus for delaying claiming: Each month of delaying the start of the pension claim past age 65 and as late as age 70 would increase the pension by 0.5 percent.

As Baker and Benjamin (1999a) discuss, the reduction in the EEA in Quebec was not well publicized prior to the introduction, because most of the discussion focussed on other parts of the legislation. The law granted easier access to disability benefits for 60-64 year old individuals. Under the new rules, they would already qualify for disability benefits if their health status prevented them from working in their last job, while under the old rules they would only qualify if their health

age 70 with an increase in benefits of 0.6% for each month of delaying.

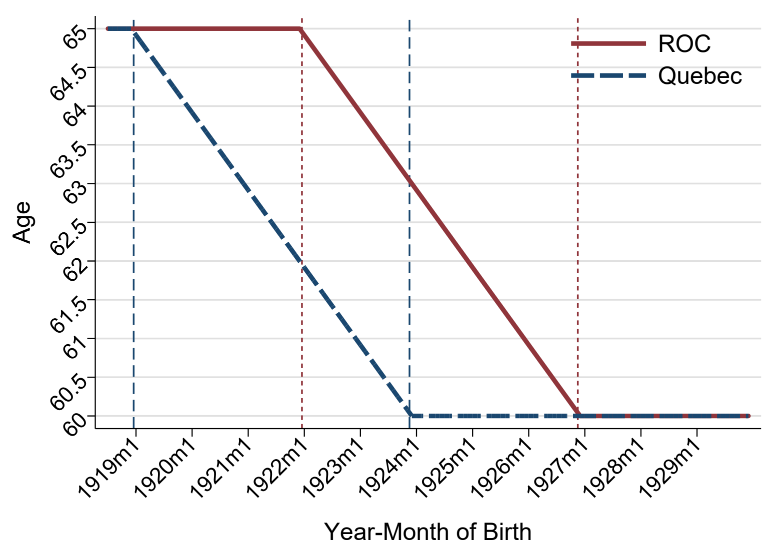
[4]The CPP and QPP abolished the earnings test above age 65 in 1975 and 1977, respectively. Baker and Benjamin (1999b) find that the abolishment of the earnings test above age 65 led to a shift from part time to full time work.

status prevented them from working in any job in the economy. The law also increased surviving spouse pensions by about 35 percent.

At the time Quebec reduced the EEA, it seemed unlikely that the CPP would enact a similar set of rules, because of the strong opposition from the province of Ontario (which had veto power). Yet, in December 1985 the other provinces agreed to adopt the same EEA and actuarial adjustment of benefits in the CPP as in the QPP. The corresponding legislation was passed in June 1986 and enacted on January 1, 1987.

The changes in law create variation in the EEA by date of birth and region of residence, since Quebec and the Rest of Canada (ROC) implemented the legislation in different years. Figure 1 illustrates this variation for monthly birth cohorts in Quebec and ROC. The figure illustrates two important features, which form the basis for our empirical estimation strategy. First, the slope of the EEA exhibits two sharp kinks, one when the EEA starts to decline from age 65 and one when the EEA reaches the new level of age 60. Second, because of the differential timing of the laws, for some birth cohorts the EEA is up to 3.5 years higher in ROC than in Quebec while other birth cohorts have the same EEA in both regions.

Figure 1: Earliest Eligibility Age in Quebec and ROC by Year-Month of Birth



2.3 Theoretical Predictions

The theoretical impacts of a change in the EEA can be analyzed using a simple lifetime model of consumption, retirement, and pension claiming. We treat pension claiming and retiring as two separate choices, since they respond very differently to the EEA changes, which is also consistent with the weak institutional link between the two choices. Individuals only need to lower earnings at the timing of applying for a pension, but can otherwise work and receive a pension simultaneously. The period utility function is $u_t = v(c_t) - \phi \cdot l_t$, where c_t is consumption, l_t is one if an individual works and zero otherwise, and ϕ captures disutility of work. If $v(c_t)$ is concave, then individuals want to perfectly smooth consumption, and we can rewrite $c_t = C/T$, where C is lifetime consumption and T is the life expectancy. Individuals know T with certainty and let the interest and discount rate equal zero. Then we can write the lifetime utility as $U_t = T \cdot v(C/T) - \phi \cdot R$, where R denotes the retirement age. An individual's lifetime budget constraint is the sum of labor income $w \cdot R$ and social security wealth, which is the sum of annual pension income $b(P)$ between the claiming age P and T. Because of the actuarial adjustment of benefits, the pension $b(P)$ is a function of the claiming age P.[5] Hence, the lifetime budget constraint can be written as $C = w \cdot R + (T - P) \cdot b(P)$.

We obtain the following optimality condition for the claiming age P^*:

$$v'(C/T) \cdot ((T - P^*) \cdot b' - b) = 0 \quad \longrightarrow \quad \frac{d\text{SSW}}{dP} = (T - P^*)b' - b = 0, \tag{1}$$

which shows that the *optimal claiming age* P^* maximizes social security wealth (SSW). Intuitively, delaying claiming means one year less of benefits, $-b$, but offers higher benefits in all future years, $(T - P^*)b'$. At the optimum, the two effects offset each other, otherwise people could increase SSW, and total utility by changing their claiming age. Note that the condition $(T - P^*)b' = b$ is the same as the one for *actuarial fairness* of a pension system. If the condition holds at each age, then individuals will receive the same SSW independent of when they claim. But with heterogeneity in life expectancy T, it is impossible to have a pension system that is actuarially fair for all. Individuals with a short life expectancy should claim early ($b > (T - P)b'$), while individuals with a long life

[5]The pension $b(P)$ is also a function of wR, because benefits replace 25 percent of average lifetime earnings (up to a maximum). However, the impact of delaying retirement by one year on pension benefits is negligible for two reasons. First, an additional year of earnings moves average lifetime earnings only by a small amount. Second, when calculating average lifetime earnings the 17 percent lowest earnings are dropped, which often includes earnings close to retirement.

expectancy should delay ($b < (T - P)b'$).

A key advantage of our setting is the ability to calculate each individual's optimal claiming age, because we can observe the exact date of death of 80 percent of individuals in our sample.[6] Figure 2 shows the distribution of the optimal claiming age using the post-reform pension parameters. The pre-reform optimal claiming age is always 65—the pre-reform EEA—since there is no actuarial adjustment for delaying ($b' = 0$). Overall, the figure shows that for many individuals the post-reform pension system is actuarially unfair and incentivizes early claiming. The peak in the optimal claiming age is at 60—almost 25% of people should claim at this age. However, the figure also shows that for long-lived individuals delaying claiming beyond 65, and as late as age 68, is optimal.

In our empirical analysis, we can test how well the optimal claiming age predicts the actual claiming age. Several factors may prevent individuals from claiming at the optimal claiming age. First, the age of death is uncertain and individuals may have biased beliefs on how long they life. Hurd and McGarry (2002) investigate this question in the US and find that subjective survival probabilities predict effective survival probabilities fairly well. Second, liquidity constraints may limit individuals' capability to delay claiming until the optimal claiming age. If liquidity constraints matter, we would expect than an EEA decrease should have a stronger impact on low-wealth individuals. Since we cannot observe wealth, we investigate the importance of liquidity constraints by estimating the effects separately across the income distribution. Third, recent evidence suggests that behavioral factors may influence when people claim a pension and when they retire (Behaghel and Blau, 2012; Seibold, 2021; Lalive *et al.*, 2021).

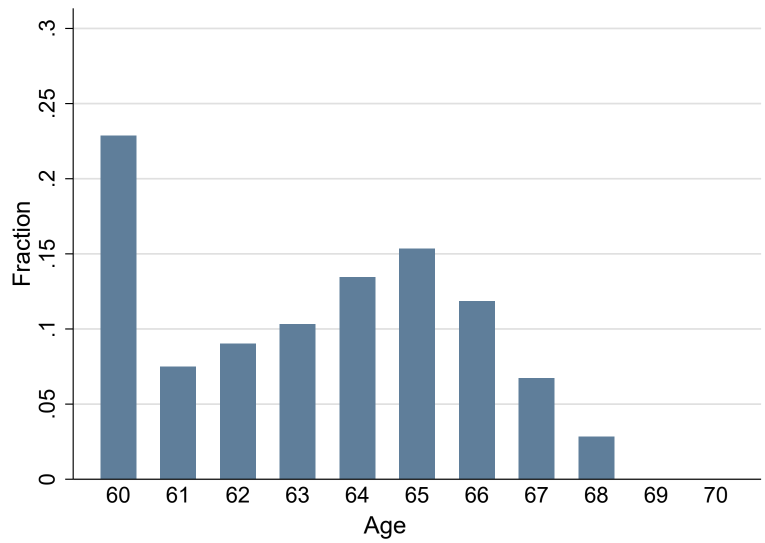
From the optimality condition for the retirement age R^* and the implicit function theorem, we can assess how a change in the SSW affects R:

$$v'(C/T) \cdot w = \phi \quad \longrightarrow \quad \frac{dR}{d\text{SSW}} = -1/w < 0. \tag{2}$$

Equation (2) shows that an increase in SSW induces individuals to retire early through an income effect. Changes in the claiming and retirement age directly affect financial well-being in retirement through their effect on pension wealth and total wage income, but they may also affect financial

[6]We observe individuals at least until age 87 and up to age 99. For the 20 percent of individuals who are still alive at the end of our sample period, we randomly assign a future age of death using gender-specific population mortality rates.

Figure 2: Distribution of Optimal Claiming Age



Notes: The figure shows the distribution of the optimal claiming age—the age that maximizes social security wealth—using post-reform pension parameters for post-reform birth cohorts (born in 1927 or 1928). Social security wealth is calculated using a discount rate of 3.5% and the individual-specific age of death.

well-being indirectly through other channels. First, a change in pension wealth may affect how much people save in retirement and taxable accounts. Second, an increase in pension wealth may crowd out other government transfers such as means-tested welfare benefits. In the empirical analysis, we will estimate the direct effects of an EEA change on claiming and retiring, but also the indirect effects on savings and transfers.

3 Data and Sample

Our analysis relies on individual tax returns from the Longitudinal Administrative Database (LAD), a 20 percent representative sample of Canadian income tax filers. Individuals in the LAD are followed each year and can be linked across years using an anonymous identifier. Our analysis below is based on the years 1982 to 2017, the available time period in the most recent version of LAD.

The LAD offers three key advantages for the purpose of our analysis. First, the long period covered by the LAD allows us to follow individuals over the entire retirement period. We observe individuals in our sample at least until age 87 and up to age 99. Observing the entire retirement period is important to capture the dynamic effects of a decrease in the EEA. Individuals who respond by claiming their pension earlier, i.e. before age 65, will receive more pension benefits between age 60 and age 65. But they will receive less pension benefits after age 65 because of the actuarial adjustment of benefits. The varying impact of an EEA change on the age profile of benefits may also change the age profile of other outcomes.

A second advantage is the possibility to study whether ex-post individuals claimed their pension at the optimal claiming age. The most important determinant of the optimal claiming age is the age at death. Since we observe the age of death for over 80 percent of individuals in our sample, we can calculate each individual's optimal claiming age and contrast it with the effective claiming age. Previous studies calculate the optimal claiming age based on expected survival rates from population statistics. This approach misses important heterogeneity in life expectancies, and optimal claiming ages, across individuals socio-economic characteristics.

A third advantage is that, because the LAD is based on tax returns, we can go beyond labor supply and estimate the effect of a change in the EEA on rarely-studied financial outcomes, such as retirement saving plan contributions, capital and dividend income, bankruptcy, government transfers, and total disposable income among others. Studying the overall impact of an EEA change on financial well-being is key to gauge its welfare effects. The rich information in the LAD also allows us to implement a complier analysis and describe the average characteristics of individuals who adjust their claiming age when the EEA changes, which is important when thinking about the policy implications.

Sample and Summary Statistics. Our main analysis file consists of men and women born between 1918 and 1929 who live in one of the ten Canadian provinces. We impose three sample restrictions. First, we exclude temporary workers who are not eligible for C/QPP benefits. Second, we exclude individuals who die or claim a disability pension before age 60; the EEA for a C/QPP retirement pension after the reform. Third, we exclude individuals who move between Quebec and ROC, as it is unclear whether they would receive a pension from the CPP or the QPP.

Table 1 reports summary statistics for our analysis sample by region. The claiming age is the age an individual first receives a C/QPP pension. The retirement age is the first age somebody earns less then \$3,500; the threshold above which somebody is insured by the C/QPP.[7] The next set of outcomes we consider are discounted sums of pension benefits, labor income, savings plan contributions, means-tested transfers, capital income, and total taxable income in different age windows. Capital income is the sum of dividends and interest, capital gains, rental income, and other investment income. They are informative on the short-run (age 60-64) and long-run (age 65-87) financial effects of an EEA change.

We consider two additional outcomes to capture financial well-being, we can observe in the data: the probability of a bankruptcy and the probability of the low income measure being one. The low income measure is commonly used to measure poverty (see, e.g., Baker *et al.*, 2021). It is defined as having household income less than half of the median after-tax income among all Canadian households, adjusted for household size. Overall, individuals in ROC, compared to Quebec, are financially better off and less likely to be bankrupt or considered low income. Panel B of Table 1 report summary statistics for background characteristics. Individuals in ROC tend to die later, are more likely to be female, are more likely to be married, and have less children that individuals in Quebec, but the differences are small.

4 Empirical Strategy

We apply two complementary empirical strategies: a sharp regression kink design (RKD) and a cohort difference-in-differences design (DiD). As Figure 1 shows, the pension reforms create discontinuous changes in the slope of the EEA at certain thresholds of birth date, the assignment variable. The RKD identifies a local average treatment effect by relating the slope change in the EEA to the induced slope change in an outcome of interest, for example the pension claiming age.[8]

Our analysis focuses on the two birth date thresholds in ROC, because the sample for ROC is four times larger than for Quebec. The first threshold is December 1922, where the EEA starts to decline for individuals born *after* December 1922, as such we label this kink *EEA decline.* The second threshold is December 1926, where the EEA starts to increase for all individuals born *before* December 1926, as such we label this kink *EEA increase.* Having two kinks allows us to test

[7]The results are similar when we define the retirement age as the last age somebody earns more than \$3,500, but the first age that somebody earns less than \$3,5000 better captures retirements from career jobs.

[8]The RKD has been applied to study a diverse set of topics. See Ganong and Jäger (2018) for a review of the recent studies using an RKD.

Table 1: Summary Statistics

	ROC		Quebec	
	Mean	S.D.	Mean	S.D.
	(1)	(2)	(3)	(4)
A. Outcome Variables				
Claiming age	64.15	(1.99)	63.61	(2.31)
Retirement age	63.36	(4.3)	62.63	(3.71)
Pension benefits 60-64	8,200	(11,600)	11,500	(13,400)
Pension benefits 65-87	79,000	(46,600)	71,700	(44,400)
Labor income 60-64	94,600	(108,800)	75,500	(95,900)
Labor income 65-87	21,000	(57,200)	15,500	(50,200)
Savings plan contributions 60-64	11,100	(19,600)	8,300	(16,300)
Savings plan contributions 65-87	6,800	(17,100)	4,300	(13,800)
Means-tested transfers 60-64	1,200	(5,300)	2,100	(7,400)
Means-tested transfers 65-87	12,000	(24,100)	15,200	(23,200)
Capital income 60-64	38,000	(57,500)	30,800	(51,200)
Capital income 65-87	71,800	(125,500)	53,800	(105,600)
Total income 60-64	165,800	(167,000)	139,800	(145,000)
Total income 65-87	287,200	(263,100)	245,600	(223,700)
Bankruptcy 60-64 in%	0.079		0.131	
Bankruptcy 65-87 in %	0.146		0.236	
Low income measure 60-64 (in%)	10.92		13.02	
Low income measure 65-87 (in%)	2.9		3.44	
B. Background Characteristics				
Age at death	81.10	(6.9)	80.58	(7.2)
Female	0.414		0.375	
Married	0.797		0.758	
Family size	2.03	(0.76)	2.01	(0.82)
No. of children	0.24	(0.59)	0.28	(0.62)
No. individuals	256,477		78,240	

Notes: The table reports summary statistics of the analysis sample, separately for ROC and Quebec. Discounted sums are calculated using an interest rate of 3.5%.

whether the effects of an EEA decrease and an EEA increase are symmetric. A second advantage of the RKD is the possibility to identify the average characteristics of individuals who change their claiming age when the EEA changes, which is important when thinking about policy implications.

We are interested in the marginal effect of a change in the EEA on an outcome y, which corresponds to the change in the slope of y at the kink divided by the change in the slope of the EEA. Since the relationship between EEA on the basis of the date of birth is deterministic and given by the 1987 reform, empirically we only need to estimate the change in the slope of y based on the following regression:

$$y_i = \alpha + \beta_0 f(BD_i - BD_0) + \beta_1 D_i f(BD_i - BD_0) + X_i'\gamma + \varepsilon_i, \text{ where } |BD_i - BD_0| \leq h, \tag{3}$$

where i is individual, BD_0 is the date of birth at the kink, f is a function of the difference between an individual's date of birth and the date of birth where the EEA starts to change, and h is the bandwidth in months. D_i is a dummy that is equal to 1 if an individual is affected by the EEA change. For the EEA-decline kink, we set D_i equal to 1 for individuals born *after* December 1921, so that β_1 measures the change in the slope when the EEA decreases. For the EEA-increase kink, we set D_i equal to 1 for individuals born *before* December 1926, so that β_1 measures the change in the slope when the EEA increases. Clearly, if the effects are symmetric, we have $\beta_1^{\text{decline}} = -\beta_1^{\text{increase}}$. As our main specification, we use a linear specification for f and a bandwidth h of 18 months, but we explore the robustness of our estimates for different modelling choices. Following Card *et al.* (2015), we use robust standard errors.

Two assumptions need to be satisfied for the RKD to identify a causal effect (Card *et al.*, 2015). First, the slope of the direct effect of the assignment variable, date of birth, on the outcome shows no discontinuity in the neighborhood of the kinks. Second, conditional on unobservable determinants of the outcome variable, the density of the assignment variable is smooth at the kink point. These assumptions are likely satisfied in our context, because it is impossible for individuals to manipulate the date of birth in anticipation of the policy change. Yet, seasonality in births could still create sorting around the kink points.

Appendix Figure A.1 shows that the number of observations and its slope are smooth around the kinks where the EEA decreases and increases. Similarly, Appendix Figure A.1 shows that the distribution of pre-determined covariates we observe in our data (fraction female, fraction married, family size, and number of kids) is also smooth around both kinks. Appendix Table A.1 presents the corresponding RK-estimates; out of ten estimates seven are statistically insignificant, including the number of observations, and the remaining three estimates are only statistically significant at the 10%-level. Overall, these checks confirm the validity of the RKD.

The cohort DiD exploits the differential variation in the EEA by date of birth in ROC and Quebec. Since Quebec lowered the EEA three years earlier than ROC, an individual with the same birth date could claim a pension up to three years earlier when living in Quebec compared to ROC. The cohort DiD, by pooling all variation in the EEA across region and birth cohorts, has more statistical power relative to the RKD, but it relies on a stronger identification assumption. It requires that, in the absence of the policy reform, trends in an outcome variable would have been the same in ROC and Quebec. Having more statistical power is crucial for examining the effect on financial outcomes, which tend to be noisy, as well as for studying heterogenous effects across the income distribution.

We implement the cohort DiD by estimating regressions of the following form:

$$y_{icp} = \alpha + \beta \ \mathrm{EEA}_{icp} + \lambda_c + \theta_p + \mathbf{X'_{icp}}\gamma + \varepsilon_{icp}, \tag{4}$$

where y_{icp} is an outcome of interest for individual i, born in year-month c, and living in province p, EEA_{icp} is the earliest pension eligibility age, and ε_{icp} is an error term. We include birth year-month (λ_c) and province fixed effects (θ_p) to capture any level difference across birth cohorts and provinces. Finally, $\mathbf{X_{icp}}$ represents individual specific characteristics to control for any observable differences that might confound the analysis.

The main parameter of interest is β, which captures the causal effect of one-year increase in the EEA on y under the assumption that trends in y in the absence of the reforms would have been the same in Quebec and the rest of Canada. Below we provide evidence for the validity of this assumption by showing that trends in y among cohorts with the same EEA do not differ between Quebec and the rest of Canada.

5 Results

5.1 Effects on Claiming and Retirement Age

We start by presenting the impact of an EEA change on the claiming and retirement age. Figure 3(a) shows the average claiming age by year-month of birth for cohorts born between 1918 and 1929 in Quebec (blue diamonds) and ROC (red circles). The long-dashed lines indicate the kink locations in Quebec where the EEA starts to decline from age 65 (first long-dashed line) and where the EEA reaches age 60 (second long-dashed line). Similarly, the short-dashed lines indicate the kink locations in ROC where the slope of the EEA changes. The average claiming age is identical in both regions for cohorts born before Quebec reduces its EEA. The claiming age for these cohorts is close to their EEA of 65, indicating that most individuals claim benefits when they become available. The slope of the average claiming age changes sharply at each kink and since the kinks in Quebec occur at an earlier birth date than in ROC, the average claiming age is temporarily lower in Quebec but the gap disappears once the EEA in ROC reaches 60.[9]

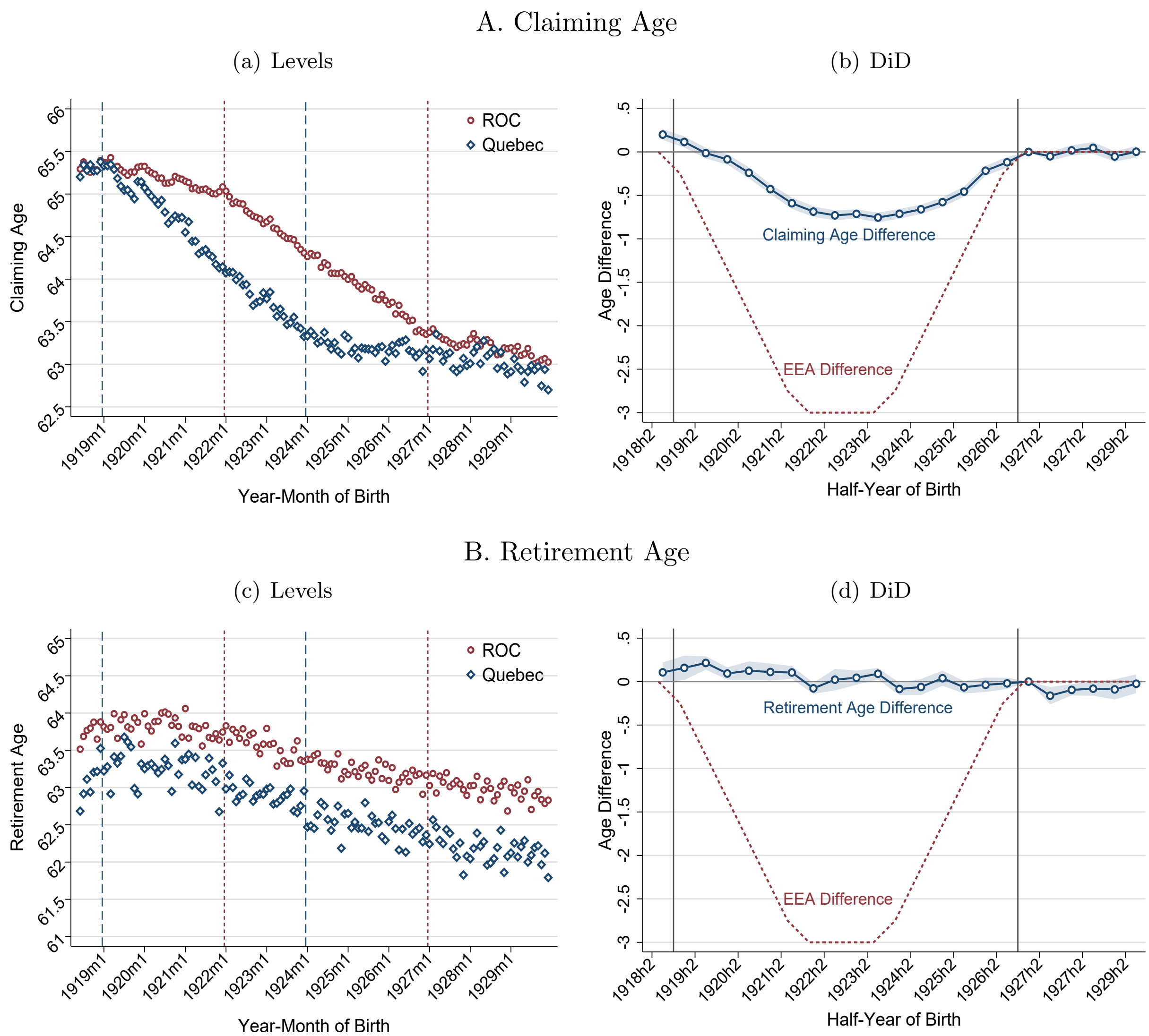
Figure 3(b) shows the difference the average claiming age between ROC and Quebec by half-year of birth. We obtain these estimates from equation 4 when we replace EEA_{icp} with a set of interaction terms of half-year of birth and a dummy for living in Quebec. For illustration, we also include the difference in the EEA between Quebec and ROC (red-dashed line). The figure shows that the effective claiming age traces the EEA closely. The difference in the claiming age between Quebec and ROC is not statistically different for birth cohorts with the same EEA (except for those born in the second half of 1918), providing supporting evidence for parallel trends. In contrast, the difference in claiming ages is negative and statistically significant for cohorts with a lower EEA in Quebec than in ROC, and the difference is larger when the difference in the EEA is larger.

Panel B of Figure 3 provides analogous evidence for the average retirement age. The average retirement age is noisier than the average claiming age, because the retirement age distribution is more dispersed than the claiming age distribution. In contrast to the claiming age, we see no visible changes in the slope of the retirement age at any of the kink points (Figure 3c). The local distribution of retirement ages around the ROC-kinks also shows no visible change in slope (Appendix Figures c and d). The DiD estimates of the difference in retirement ages in Figure 3(d) confirm this finding. The differences are either insignificant or small in size relative to the difference in the EEA.

Table 2 shows the corresponding claiming age (panel A) and retirement age (panel B) estimates using the RKD and the DiD. The RKD estimates are multiplied by twelve, so that they measure the effect of a one-year decrease, or increase, in the EEA. Consistent with the graphical evidence, we find large and statistically significant claiming age effects. A one-year decrease in the EEA reduces the effective claiming age by about 0.23 years and this estimate is robust to controlling for additional covariates. The RKD estimate for a one-year increase in the EEA is slightly larger (0.28 years), but a Wald test cannot reject the hypothesis that the estimates of an increase and a decrease in the EEA are identical. The DiD estimates in columns 5-6 are similar in magnitude to the RDK estimates: a one-year increase in the EEA raises the effective claiming age by 0.25 years.

[9] Appendix Figures (a) and (b) plot the claiming age distribution locally around the kinks in ROC, documenting sharp changes in the slope of the claiming age at the kink points.

Figure 3: Trends in Claiming and Retirement Ages in ROC and Quebec by Birth Date



Notes: The figure plots the average claiming and retirement age by year-month of birth in ROC and Quebec (panels a and c) as well as the half-yearly average difference in the claiming and the retirement age, obtained from equation (4) when replacing EEA_{icp} with a set of interaction terms of half-year of birth and a dummy for living in Quebec. Shaded area denotes a 95 percent confidence interval.

Extrapolating these estimates over five years, we conclude that the reform reduced the effective claiming age by about 1.25 years. In contrast, panel B shows that the reform has no impact on the retirement age; both the RKD and the DiD estimates are small in magnitude and statistically insignificant or only marginally significant.

Table 2: Effects on Claiming and Retirement Age

	RKD Estimates				DiD Estimates	
	EEA Decrease		EEA Increase			
	(1)	(2)	(3)	(4)	(5)	(6)
A. Claiming Age						
Coefficient	-0.226***	-0.224***	0.285***	0.275***	0.260***	0.252***
	(0.026)	(0.026)	(0.041)	(0.041)	(0.010)	(0.010)
Mean	65.1	65.1	63.3	63.3	64.0	64.0
Equality test (p-value)			0.230	0.288		
Covariates	No	Yes	No	Yes	No	Yes
Observations	72,370	72,370	82,600	82,600	334,717	334,717
B. Retirement Age						
Coefficient	-0.045	-0.065	0.014	0.028	-0.028*	-0.015
	(0.085)	(0.083)	(0.078)	(0.076)	(0.015)	(0.014)
Mean	64.6	64.6	63.0	63.0	63.2	63.2
Equality test (p-value)			0.499	0.443		
Covariates	No	Yes	No	Yes	No	Yes
No. observations	72,370	72,370	82,600	82,600	334,717	334,717

Notes: Columns 2-4 and 5-6 report estimates obtained from regression specifications (3 and (4), respectively. ***, **, * denotes statistical significance at the 1%, 5%, and 10% level, respectively.

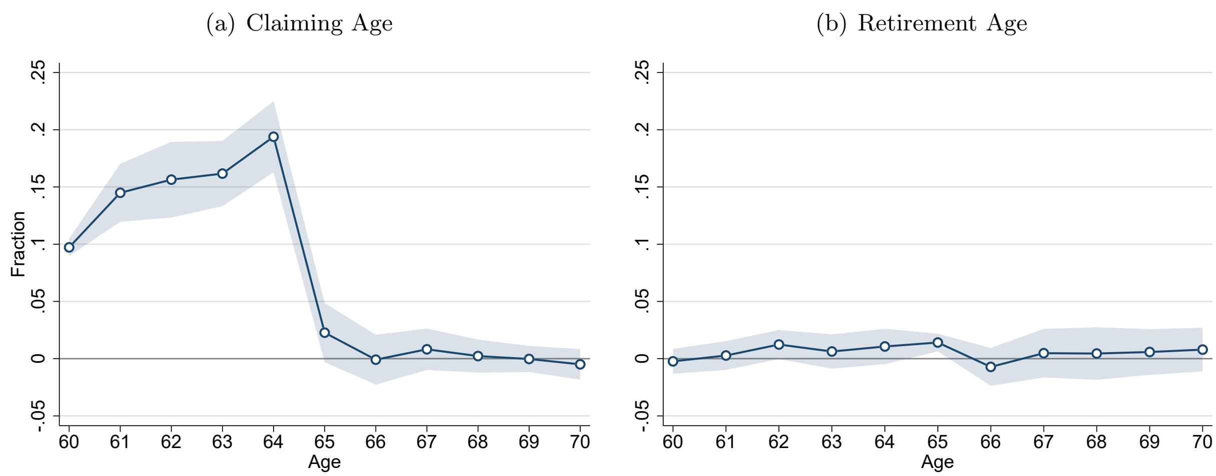
Robustness. Several robustness checks corroborate our findings. Appendix Figure A.4 shows that the RKD estimates are robust for bandwidths from 12 to 24 months; we always find large and significant claiming age responses and small and insignificant retirement age responses. The RKD estimates are relatively stable, although less precise for the EEA increase, when we include a quadratic instead of a linear trend on either side of the cutoff (Appendix Table). In the spirit of Ganong and Jäger (2018), Appendix Figure A.5 shows RKD estimates for the true kinks and placebo kinks located within 15 months of the true kinks. The claiming age estimates for the EEA increase reach a maximum at the true kink and the claiming age estimates for the EEA decrease are close to a maximum. In contrast, the RDK estimates for the retirement age are insignificant at the true kink and almost all placebo kinks.

We also decompose the claiming and retirement age responses by estimating the effect at each age from 60 to 70 using a triple-differences approach that exploits the variation in the EEA across calendar time, ROC versus Quebec, and age.[10] Figure 4 shows that lowering the EEA from 65

[10] The regression we estimate is $y_{iapt} = \alpha + \sum_{s=60}^{70} \beta_s (I_s \times \text{QUE} \times I_{1984 \leq \text{Y} \leq 1986}) + \lambda_{at} + \theta_{pt} + \pi_{ap} + \mu_a + \rho_t + \eta_p + \varepsilon_{iapt}$, where y_{iapt} is one if individual i in province p and year t claims a pension (or retires) at age a, I_s is an indicator for age s, QUE is an indicator for living in Quebec, $I_{1984 \leq \text{Y} \leq 1986}$ is an indicator for the year being between 1984 and 1986, and λ_{at}, θ_{pt}, π_{ap}, μ_a, ρ_t, and θ_p are fixed effects for age times year, province times year, age times province, age, year, and province. The coefficients of interest are β_s, measuring the effect of lowering the EEA in Quebec (relative to ROC) on claiming or retiring at age s (relative to age 55-59) between 1984 to 1986 (relative to before 1984 and

to 60 increases claiming at each age between 60 and 65, but has no impact on claiming after age 65 even though the reform introduced a bonus for delaying claiming beyond 65. In contrast, the retirement response is small and statistically insignificant at each single age between 60 to 70.

Figure 4: Incidence of Claiming and Retirement by Age

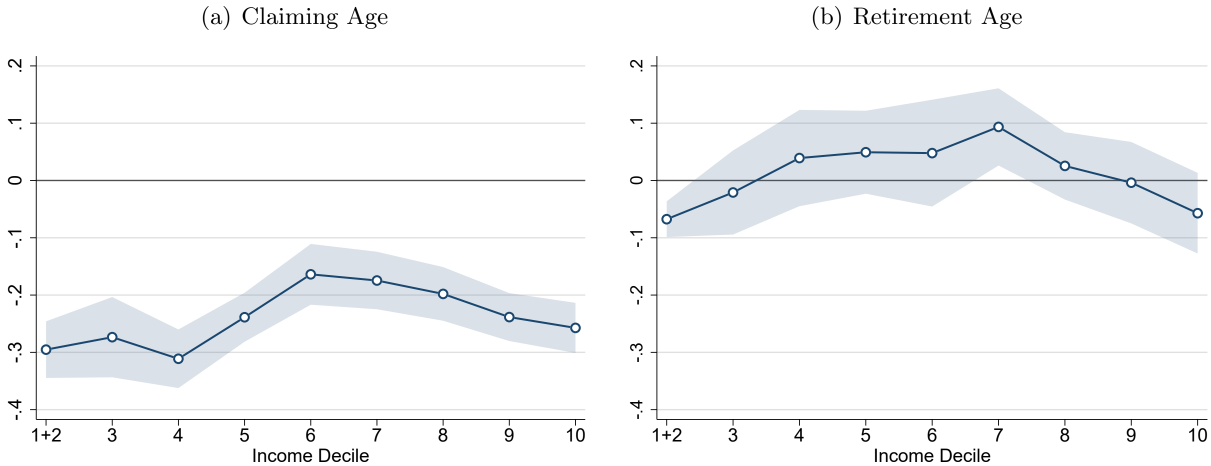


Notes: The figure plots the average difference the incidence of claiming (panel a) and retirement (panel b) by age, obtained from the regression specification shown in footnote 10. Shaded area denotes a 95 percent confidence interval.

Heterogeneity by Income Deciles. Raising the EEA can have important distributional effects. Absent sufficient savings and job opportunities, individuals at the lower end of the income distribution may face more financial hardship than those at the upper end of the income distribution. We explore effect heterogeneity along the income distribution by splitting our sample into deciles based on the total taxable income at age 59. We then estimate equation (4) for each decile separately (we pool the bottom two deciles, because more than 10 percent report zero taxable income). Figure 5 reports the corresponding point estimates and 95 percent confidence interval. The claiming age drops significantly in all income deciles. A one year decrease in the EEA reduces the claiming age by about 0.3 years in the bottom three income deciles and slightly less in the higher deciles. The retirement age response is much smaller and in most cases statistically insignificant.

after 1986).

Figure 5: Claiming and Retirement Age by Income Decile



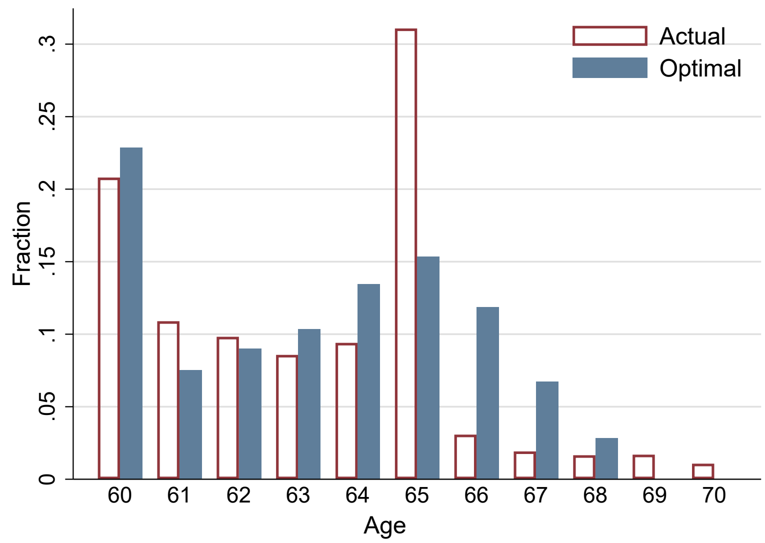
Notes: The figure plots estimates of β for different income deciles, obtained from equation (4). Shaded area denotes a 95 percent confidence interval.

5.2 Optimal Claiming Age and Complier Analysis

The reduction in the EEA from age 65 to 60 induces many people to claim their pension earlier. Is this behavior consistent with individuals maximizing their pension wealth? To answer this question, in Figure 6 we contrast the *effective* claiming age for birth cohorts 1927 and 1928, who have an EEA of 60, with the *optimal* claiming age—the claiming age that maximizes pension wealth. Two findings emerge from the figure. First, for each age below 65 the actual claiming age matches the optimal claiming age quite well, on average. Second, about twice as many individuals claim their pension at age 65 relative to what would be optimal; many of them would benefit from delaying claiming to age 66 or later. In Canada, age 65 is the "full retirement age" because individuals qualify for full retirement benefits, and claiming before age 65 is framed as a loss in benefits relative to the full retirement age, while claiming after age 65 is framed as a gain in benefits.[11] This loss-gain framing creates a claiming spike at the full retirement age if people have reference-dependent preferences with loss aversion (Behaghel and Blau, 2012; Seibold, 2021; Lalive *et al.*, 2021).

[11]The wording for early claiming is (using today's pension adjustment factors) "if you start before age 65, payments will decrease by 0.6% each month (or by 7.2% per year), up to a maximum reduction of 36% if you start at age 60." The wording for late claiming is "if you start after age 65, payments will increase by 0.7% each month (or by 8.4% per year), up to a maximum increase of 42% if you start at age 70.

Figure 6: Distribution of Effective and Optimal Claiming Ages



Notes: The figure compares the distribution of the optimal and effective claiming ages for the 1927 and 1928 birth cohorts.

Complier Analysis. To better understand who are the individuals on the margin of early claiming, we perform a complier analysis (Imbens and Rubin, 1997; Abadie, 2003). The RKD estimates capture a local average treatment effect for compliers. For the EEA decrease kink, compliers are those who claim before age 65 when the EEA is reduced. In contrast, always takers claim early regardless of the EEA (relying on a disability pension) and never takers always claim at age 65 or after. For the EEA increase, compliers are those who delay claiming, i.e. after age 60, when the EEA increases, always-takers always delay claiming after age 60, and never-takers continue to claim at age 60. While we cannot identify who is a complier (or an always or never taker), we can describe their observable characteristics.

The complier analysis in the RKD follows the same logic as for the regression discontinuity design (see, e.g., Almond and Doyle, 2011). The binary variable Z denotes whether an individuals is born after a kink ($Z = 1$) or before ($Z = 0$). When studying the EEA decrease, we define a binary variable D that captures whether an individual claims before 65 ($D = 1$) or not ($D = 0$) (for the EEA increase, $D = 1$ if an individual claims after 60 and 0 otherwise). Finally, the binary variable D_Z denotes the value D would take if Z were either 0 or 1. We can now distinguish compliers ($D_1 = 1$ and $D_0 = 1$), always takers ($D_1 = D_0 = 1$), and never takers ($D_1 = D_0 = 0$).

Under monotonicity ($D_1 - D_0 \geq 0$) and independence of Z from D, we can write the expected characteristics of compliers as follows:

$$E(X|D_1 = 1, D_0 = 0) = \frac{\pi_C + \pi_A}{\pi_C} \left[E(X|D = 1, Z = 1) - \frac{\pi_A}{\pi_C + \pi_A} E(X|D = 1, Z = 0) \right], \qquad (5)$$

where π_C and π_A are the population shares of compliers and always takers.[12] We estimate each term on the right-hand side of equation 5 using the corresponding sample mean and a bandwidth of 12 months around the kink.

Table 3 reports the estimates from the complier analysis for the EEA decrease (panel A) and the EEA increase (panel B). The last two columns show the p-value of a hypothesis tests whether complier characteristics are equal to always taker and never taker characteristics. Overall, we find evidence consistent with pension wealth maximization. The first row in each panel shows that the optimal claiming age varies across groups in the way we would expect if individuals maximize pension wealth. It is lowest among individuals who always claim early independent of the EEA (always takers for EEA decrease and never takers for the EEA increase) and highest among those who never claim early (never takers for the EEA decrease and always takers for the EEA increase). The optimal claiming age of compliers lies in between that of always and never takers. An important determinant of the optimal claiming age is the age of death, since early claiming is financially more attractive for people who expect to die sooner. The second row in each panel shows that the age of death follows the same qualitative patterns as the optimal claiming age.

The complier analysis also offers some evidence why the reform triggered no retirement age response. The third row in each panel shows that the probability to have stopped working at age 60 is significantly higher among compliers compared to those who always delay claiming (and lower compared to those who always claim early). This suggests that many compliers cannot adjust their retirement age in response to reform, as they have retired several years before becoming eligible for a pension.

[12] To derive equation 5, note that $E(X|D_1 = 1)$ is comprised of always takers and compliers: $E(X|D_1 = 1) = E(X|D_1 = 1, D_0 = 0)P(D_0 = 1|D_1 = 1) + E(X|D_1 = 1, D_0 = 0)P(D_0 = 0|D_1 = 1)$. Monotonicity implies that $E(X|D_1 = 1, D_0 = 1) = E(X|D_0 = 1)$. Independence implies that $\pi_A = P(D_0 = 1)$ and $\pi_N = P(D_1 = 0)$, and because of monotonicity there are no defiers, so that $\pi_C = 1 - \pi_A - \pi_N$. Equation 5 then follows from rearranging the expression for $E(X|D_1 = 1)$. Using the definition of conditional probabilities, we can replace $P(D_0 = 1|D_1 = 1) = \pi_A/(\pi_A + \pi_C)$ and $P(D_0 = 0|D_1 = 1) = \pi_C/(\pi_A + \pi_C)$. Moreover, independence implies that $E(X|D_1 = 1) = E(X|D = 1, Z = 1)$ and $E(X|D_1 = 1, D_0 = 1) = E(X|D = 1, Z = 0)$.

Table 3: Characteristics by Response to Treatment

	Mean			P-values	
	Compliers (C) (1)	Always Takers (A) (2)	Never Takers (N) (3)	Pr(C=A) (4)	Pr(C=N) (5)
A. EEA Decrease					
Optimal claiming age	62.47	61.79	62.59	0.000	0.002
Age of death	81.51	77.71	82.28	0.000	0.000
Working at age 60	0.630	0.535	0.695	0.000	0.000
Fraction married	0.788	0.619	0.824	0.000	0.000
Fraction female	0.384	0.442	0.416	0.000	0.002
Population share	0.220	0.137	0.643		
B. EEA Increase					
Optimal claiming age	62.14	62.56	61.97	0.000	0.392
Age at death	79.36	81.77	78.56	0.000	0.378
Working at age 60	0.372	0.664	0.354	0.000	0.718
Fraction married	0.826	0.797	0.581	0.316	0.000
Fraction female	0.389	0.434	0.434	0.260	0.408
Population share	0.110	0.885	0.004		

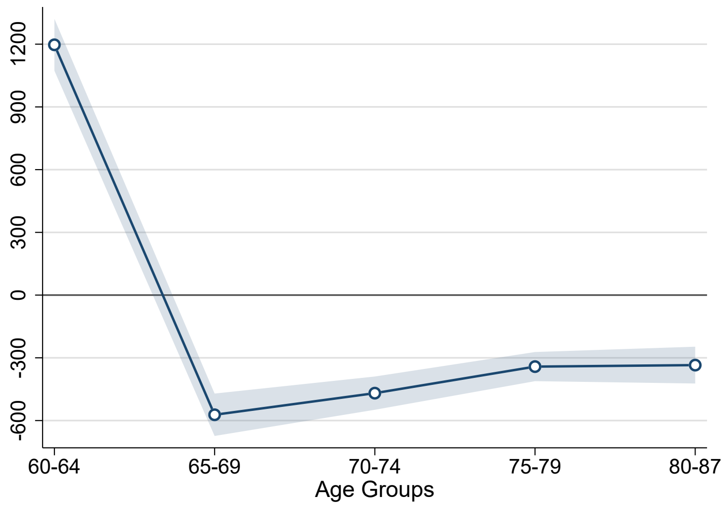
Notes: The table reports average characteristics of compliers, always takers and never takers (columns 2-4) and p-value of associated hypothesis tests (columns 5-6) ***, **, * denotes statistical significance at the 1%, 5%, and 10% level, respectively. Bootstrapped standard errors using 500 replications.

5.3 Effects over the Life-cycle and across the Income Distribution

An advantage of our setting is the ability to follow people until they die, allowing us to estimate the financial impact of an EEA change over an individual's entire retirement period. We start our analysis by exploring the impact on social security wealth (the discounted sum of pension benefits). Figure 7 plots the coefficient estimates of EEA_{icp} from equation (4) when the outcome variable is the social security wealth in different age intervals. Consistent with the decline in the claiming age, we find a large increase social security wealth between age 60 and 64 of about \$1,200. Since lowering the EEA by one year decreases the claiming age by 0.25 years (Table 2), the estimate implies that someone who claims at the new EEA of 60 instead of 65 experiences an increase in pension wealth of \$24,000 (=5*1200/0.25) between 60 and 65.

While early claiming creates a fiscal boon before age 65, it reduces social security wealth after age 65 due to the actuarial adjustment of benefits. We estimate that social security wealth between age 65 and 69 declines by about \$600, equivalent to a \$12,000 loss in benefits for someone who claims five years earlier. The loss in benefits is smaller at higher ages, presumably because individuals who are still alive at higher ages are less likely to have claimed early. Consequently, they lose less in benefits later in life is smaller, but social security wealth between age 80 and age 87 still drops

Figure 7: Effects on Social Security Wealth in Different Age Intervals



Notes: The figure plots estimates of β, obtained from equation (4), when the outcome variable are discounted pension benefits in different age intervals. Shaded area denotes a 95 percent confidence interval.

by about $300, on average.

We next explore how the change in social security wealth affects other financial outcomes as well as low income status and bankruptcy. Table 4 presents DiD-estimates for these outcomes in three age intervals, capturing the short-run (age 60 to 64), long-run (age 65 to 87), and total effect (age 60 to 87). The first row summarizes the effect on social security wealth and shows that the losses after age 65 outweigh the gains before age 65, so that individuals lose $521 in social security wealth over the entire retirement period. One way to respond to the change in social security wealth is by adjusting labor supply, but the second row shows that the estimates for total labor income are always small and statistically insignificant, consistent with evidence that the retirement age did not change.

In addition to labor supply, individuals may also respond by adjusting their savings behavior. Consistent with this idea, we find that individuals contribute more to a registered savings plan between age 60 and 64 where social security wealth increases, and less after age 65 where social security wealth decreases. These responses are in part driven by an income effect, but also because registered saving plan contributions are tax-deductible, helping to offset the additional tax burden from an increase in income. Additional pension income may also crowd-out other means-tested government transfers. We find that total means-tested transfer decline by $300 between 60 and 64 and increase by about \$100 between age 65 and 87 (not statistically significant). Finally, we find no effect on total capital income between 60 and 64 and a decrease between 65 and 87, which may be driven by dissaving. Overall, total income follows the same pattern as social security wealth; it increases between 60 and 64 and decreases between 65 to 87.

How do the pension wealth shocks affect poverty among seniors? The data include two variables to shed light on this question: bankruptcy filing and the low-income measure, defined as having household income less than half of the median after-tax income for all households in Canada, adjusted for household size. The last two rows of Table 4 show that lowering the EEA reduces bankruptcy rates and the probability to be low income in all age intervals, but the effects are two to four times larger between 60 to 64 than between 65 to 87. The bankruptcy estimates are small in absolute terms, because bankruptcy filing is an infrequent event, but relative to the mean the effects are large. For example, between age 60 and 64 bankruptcy rates drop by about 35%. The low-income measure estimates point to a 10% reduction in poverty rates in all age intervals.

Table 4: Financial Outcomes

	Age Interval 60-64		Age Interval 65-87		Age Interval 60-87	
	Estimate (1)	Mean (2)	Estimate (3)	Mean (4)	Estimate (5)	Mean (6)
Social security wealth	1,197***	8,200	-1,718***	79,000	-521***	87,200
	(63)		(136)		(108)	
Labor income	425	94,600	-126	21,000	299	115,600
	(722)		(144)		(729)	
Saving plan contributions	350***	11,100	-376***	6,800	-26	17,900
	(70)		(118)		(114)	
Means-tested transfers	-300***	1,200	105	12,000	-196***	13,200
	(59)		(70)		(87)	
Capital income	89	38,000	-639**	71,800	-550	109,800
	(215)		(350)		(519)	
Total income	2,517***	165,800	-2,753***	287,200	-237	453,000
	(915)		(618)		(952)	
Bankruptcy (in %)	-0.028***	0.079	-0.018**	0.146	-0.020**	0.134
	(0.009)		(0.009)		(0.009)	
Low income measure (in %)	-1.01***	10.92	-0.235***	2.70	-0.373***	4.33
	(0.111)		(0.031)		(0.041)	

Notes: The table reports estimates obtained from regression specifications (4). ***, **, * denotes statistical significance at the 1%, 5%, and 10% level, respectively.

Distributional Impacts. To better understand why poverty rates drop at all ages, even after age 65 where average social security wealth declines, it is helpful to look at the distributional effects.

Figure shows the impact of the EEA decrease by income decile for four key outcomes: social security wealth, discounted total income, the probability of being bankrupt, and the probability of being low-income. The left column shows the impact on those outcomes between age 60 and 64 and the right column shows the impact between age 60 and 87.

Panel (a) shows that social security wealth between 60 and 64 increases for all income deciles, consistent with individuals claiming benefits earlier. The increase is fairly similar across all deciles, around $1,000 to $1,500. However, as panel (b) shows, once we look all the way up to age 87, we see that social security wealth only increases for individuals at the bottom of the income distribution. Individuals in the third and fourth income decile experience no change in social security wealth, while individuals in the top-half of the income distribution lose about $1,000 to $2,000. Hence, it appears that many individuals in higher income deciles do no claim their benefits at the optimal claiming age, but instead claim too early and effectively lose social security wealth.

Panel (c) and (d) show that total income—the sum of pension benefits, labor income, dividends, capital gains, rental income, and other income (e.g. income from a registered retirement savings plan)—follows the same qualitative patterns as social security wealth. Total income between age 60-64 increases in all deciles, but total income between age 60-87 only increases for individuals at the bottom of the income distribution. However, the estimates are much less precise for total income compare to social security wealth because total income is much noisier.

We next explore the impact on financial distress. As panels (e) and (f) illustrate, bankruptcies tend to decline at the lower end of the income distribution, while they remain largely unchanged at the top of the income distribution, but the point estimates are small and often not statistically significant. A clear pattern emerges for the low income measure. The probability to be low income between age 60 and 64 drops by three percentage points at the bottom of the income distribution and by one percentage point in the third and fourth decile, while poverty rates remain unchanged in the top half of the income distribution. The reduction in poverty rates are long lasting. When we expand the age interval to age 87, we still see a large and significant drop in poverty rates at the bottom of the income distribution, and no significant change in the other income deciles.

In sum, our analysis suggests that the EEA changes have important distributional consequences, specially in the later part of the retirement period. Financial well-being increases among poorer households but declines among their richer counterparts. But we see no change in poverty rates among richer household, since public pensions account for a small share of their retirement income. In contrast, public pension constitute an important lifeline for poorer households.

6 Conclusions

Using administrative tax data, we study responses to pension reforms in Canada in the 1980s, which lowered the Earliest Eligibility Age (EEA) for benefits by five years. Since we can follow treated individuals until they die, we can go beyond labor supply and estimate the impact of an EEA change on financial well-being and poverty over the entire retirement period. Exploiting reform-induced variation in the EEA across regions and cohorts in a regression kink and a difference-in-differences design, we find that a decrease in the EEA by one year causes a 0.25 year reduction in the pension claiming age but has no impact on the labor market exit age. Early claiming raises pension and total income at the beginning of the retirement period but these gains are outweigh by losses in pension wealth and total income later in retirement due to the actuarial adjustment of benefits. The income losses are concentrated among households in the top half of the income distribution, while households at the bottom of the income distribution experience an increase in pension wealth and total income during retirement. The income gains at the bottom of the income distribution are associated with significant decreases in elderly poverty rates.

From a policy perspective, our findings suggest that the EEA is an effective policy lever to improve financial well-being and reduce poverty among low-income retirees who are more likely to be liquidity constrained and have below-average mortality rates, making the pension system actuarially unfair. Lowering the EEA increases their welfare by relaxing liquidity constraints and increasing pension wealth. On the other hand, the welfare of high-income retirees likely decreases. They have below-average mortality rates and would benefit from delaying claiming, but our analysis shows that they claim too early relative to what would be optimal, which could be either due to misoptimization or present-bias preferences (Diamond and Köszegi, 2003). Ultimately, whether lowering the EEA improves overall welfare depends on how much society values redistribution from rich to poor.

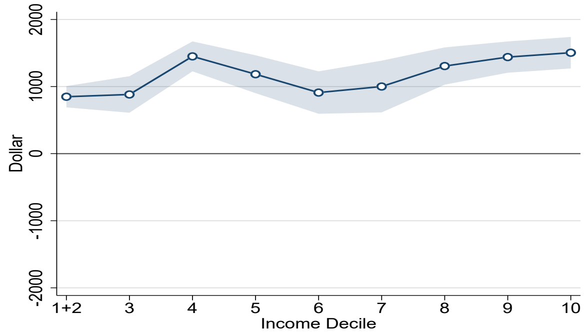
Our findings are derived from the Canadian social security system and two caveats apply when extrapolating them to other countries. First, the impact of the EEA on financial well-being and poverty depends crucially on the financial incentives for early and late claiming. The penalty for early claiming in our setting is low by international standards, making early claiming financially attractive for many low-income retirees. In the US context, where penalties for early claiming are higher, Engelhardt *et al.* (2020) find that a lower EEA has an adverse impact on financial well-being and elderly poverty rates.

Second, income poverty is an important but incomplete measure for welfare. Claiming early may mean consuming more leisure (although in our context we find no effect on labor supply) and individuals may be willing to trade-off less income for more leisure. Moreover, less income does not necessarily mean less consumption, because individuals can self-insure against income shocks through savings or home production (see, e.g. Aguiar and Hurst, 2005). Examining how a change in the EEA affects consumption during retirement is an important open question for a better understanding of the welfare implications.

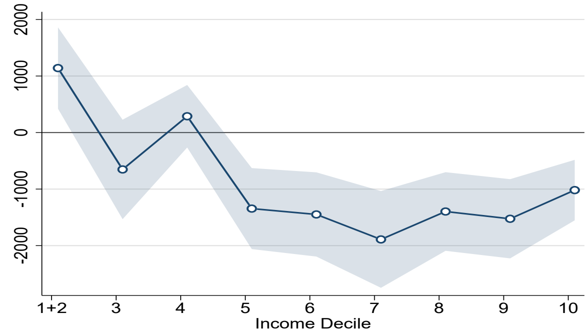
Figure 8: Impact on Financial Outcomes by Income Decile

Pension Benefits

(a) 60-64

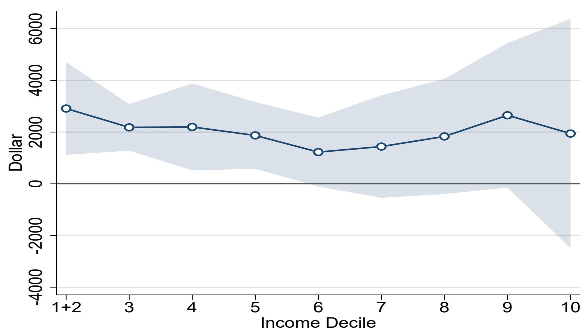


(b) 60-87

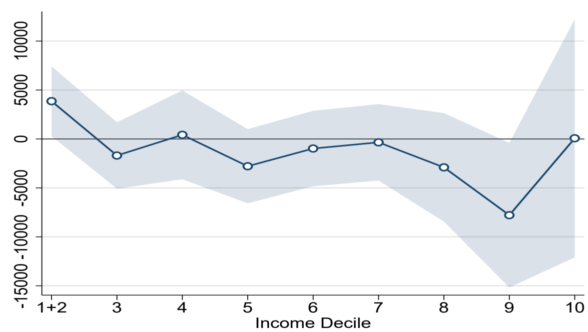


Total Income

(c) 60-64

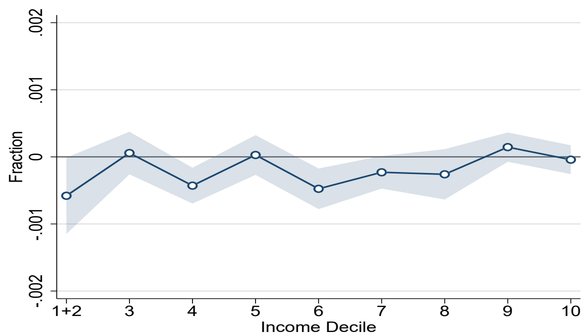


(d) 60-87

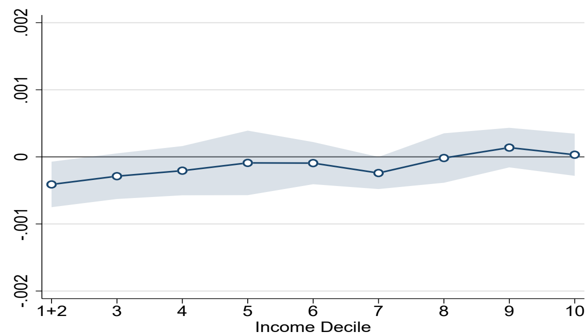


Bankruptcy (in %)

(e) 60-64

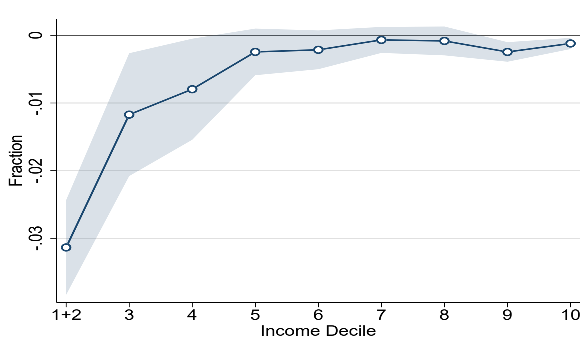


(f) 60-87

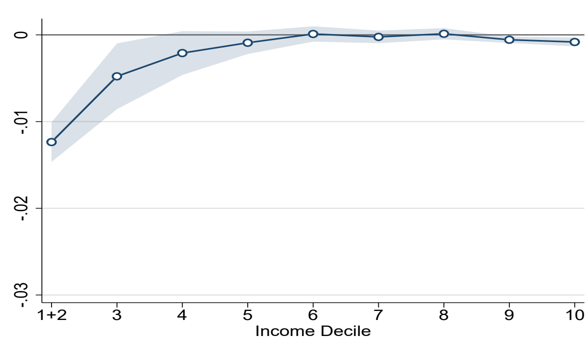


Low Income Measure (in %)

(g) 60-64



(h) 60-87



Notes: The figure plots estimates of β for different income deciles, obtained from equation (4). Shaded area denotes a 95 percent confidence interval.

References

Abadie, A. (2003). Semiparametric instrumental variable estimation of treatment response models. *Journal of Econometrics*, **113**(2), 231 – 263.

Aguiar, M. and Hurst, E. (2005). "consumption versus expenditure". *Journal of political Economy*, **113**(5), 919–948.

Almond, D. and Doyle, J. J. (2011). A regression discontinuity design in length of postpartum hospital stays. *American Economic Journal: Economic Policy*, **3**(3), 1–34.

Atalay, K. and Barrett, G. (2015). The Impact of Age Pension Eligibility Age on Retirement and Program Dependence: Evidence from an Australian Experiment. *The Review of Economics and Statistics*, **97**(1), 71–87.

Baker, M. and Benjamin, D. (1999a). Early Retirement Provisions and the Labor Force Behavior of Older Men: Evidence from Canada. *Journal of Labor Economics*, **17**(4), 724–756.

Baker, M. and Benjamin, D. (1999b). How Do Retirement Tests Affect the Labour Supply of Older Men? *Journal of Public Economics*, **71**(1), 27–51.

Baker, M., Gruber, J., and Milligan, K. (2003). The Retirement Incentive Effects of Canada's Income Security Programs. *Canadian Journal of Economics*, **36**, 261–290.

Baker, M., Gruber, J., and Milligan, K. (2004). *Social Security Programs and Retirement around the World: Micro-Estimation*, chapter Income Security Programs and Retirement in Canada, page 99–152. University of Chicago.

Baker, M., Messacar, D., and Stabile, M. (2021). The effects of child tac benefits on poverty and labor supply: Evidence from the canada child benefit and universal child care benefit. *NBER Working Paper No. 28556*.

Behaghel, L. and Blau, D. M. (2012). Framing Social Security Reform: Behavioral Responses to Changes in the Full Retirement Age. *American Economic Journal: Economic Policy*, **4**(4), 41–67.

Blundell, R., French, E., and Tetlow, G. (2016). Retirement Incentives and Labor Supply. In J. Piggott and A. Woodland, editors, *Handbook of the Economics of Population Aging*, volume 1B, pages 457–566. Elsevier.

Böersch-Supan, A., Härtl, K., and Leite, D. (2016). Social Security and Public Insurance. In J. Piggott and A. Woodland, editors, *Handbook of the Economics of Population Aging*, volume 1B, pages 781–863. Elsevier.

Bound, J., Stinebrickner, T., and Waidmann, T. (2010). Health, economic resources and the work decisions of older men. *Journal of Econometrics*, **156**(1), 106–129.

Burtless, G. (1986). Social security, unanticipated benefit increases, and the timing of retirement. *Review of Economic Studies*, **53**(5), 781–805.

Card, D., Lee, D. S., Pei, Z., and Weber, A. (2015). Inference on causal effects in a generalized regression kink design. *Econometrica*, **83**(6), 2453–2483.

Coile, C. (2015). Economic Determinants of Workers' Retirement Decisions. *Journal of Economic Surveys*, **29**(4), 830–53.

Coile, C. C. and Gruber, J. (2007). Future social security entitlements and the retirement decision. *Review of Economics and Statistics*, **89**(2), 234–246.

Deshpande, M., Fadlon, I., and Gray, C. (2020). How Sticky is Retirement Behavior in the U.S.? Responses to Changes in the Full Retirement Age. *NBER Working Paper No. 27190*.

Diamond, P. A. and Köszegi, B. (2003). Quasi-hyperbolic discounting and retirement. *Journal of Public Economics*, **87**, 1839–1872.

Engelhardt, G. V. and Gruber, J. (2006). "social security and evoluation of elderly poverty". In A. Auerbach, D. Card, and J. Quigley, editors, *Public Policy and the Distribution of Income*, pages 259–287. Russell Sage Press.

Engelhardt, G. V., Gruber, J., and Kumar, A. (2020). "early social security claiming and old-age poverty: Evidence from the introduction of the social security early eligibility age". *Journal of Human Resources*, pages 0119–9973R1.

Feldstein, M. and Liebman, J. B. (2002). Social Security. In A. J. Auerbach and M. Feldstein, editors, *Handbook of Public Economics*, volume 4, pages 2245–2324. Elsevier.

Fonseca, R. and El-Attar, V. M. (2020). Public pensions and low income dynamics in canada. *CIRANO Working Paper*.

French, E. (2005). The effects of health, wealth, and wages on labour supply and retirement beahviour. *The Review of Economic Studies*, **72**(2), 395–427.

Ganong, P. and Jäger, S. (2018). A permutation test for the regression kink design. *Journal of the American Statistical Association*, **113**(522), 494–504.

Gelber, A., Isen, A., and Song, J. (2016). The Effect of Pension Income on Elderly Earnings: Evidence from Social Security and Full Population Data. Working paper, UC Berkeley.

Geyer, J. and Welteke, C. (2021). Closing routes to retirement for women: How do they respond? *The Journal of Human Resources*, **56**(1), 311–341.

Gruber, J. and Wise, D. A., editors (2004). *Social Security Programs and Retirement Around the World: Micro Estimation*. University of Chicago Press.

Hurd, M. D. and McGarry, K. (2002). The predictive validity of subjective probabilities of survival. *The Economic Journal*, **112**(482), 966–985.

Imbens, G. W. and Rubin, D. B. (1997). Estimating outcome distributions for compliers in instrumentalvariables models. *The Review of Economic Studies*, **64**(4), 555–574.

Jacques, P., Leroux, M.-L., and Stevanovic, D. (2021). "poverty among the elderly: The role of public pension systems". *International Tax and Public Finance*, **28**, 24–67.

Johnsen, J. V., Vaage, K., and Willén, A. (2021). Interactions in public policies: Spousal responses and program spillovers of welfare reforms. *The Economic Journal, forthcoming*.

Krueger, A. B. and Pischke, J.-S. (1992). The Effect of Social Security on Labor Supply: A Cohort Analysis of the Notch Generation. *Journal of Labor Economics*, **10**, 412–437.

Lalive, R., Magesan, A., and Staubli, S. (2021). "how social security reform affects retirement and pension claiming". *Working Paper*.

Lumsdaine, R. L. and Mitchell, O. S. (1999). New Developments in the Economic Analysis of Retirement. In O. Ashenfelter and D. Card, editors, *Handbook of Labor Economics*, volume 3, pages 3261–3307. Elsevier.

Manoli, D. and Weber, A. (2016). The Effects of the Early Retirement Age on Retirement Decisions. *NBER Working Paper No. 22561*.

Marchand, J. and Smeeding, T. (2016). Poverty and aging. In J. Piggot and A. Woodland, editors, *Handbook of the Economics of Population Aging*, volume 1B, pages 905–950. Elsevier.

Mastrobuoni, G. (2009). Labor supply effects of the recent social security benefit cuts: Empirical estimates using cohort discontinuities. *Journal of Public Economics*, **93**(11-12), 1224–1233.

Milligan, K. (2014). How is economic hardship avoided by those retiring before the social security entitlement age. *Journal of Pension Economics and Finance*, **13**(4), 420–438.

Milligan, K. and Schirle, T. (2020). *Social Security Programs Around the World: Reforms and Retirement Incentives*, chapter Retirement incentives and Canada's social security programs. Coile, Courtney and Borsch-Supan, Axel.

OECD (2019). *Pensions at a Glance 2019*. Organisation for Economic Cooperation and Development.

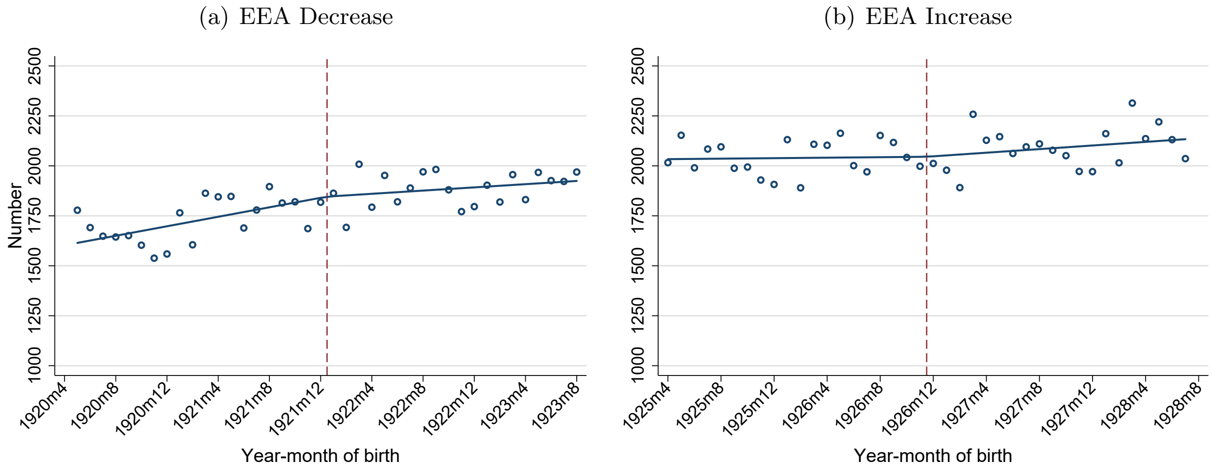
Rust, J. and Phelan, C. (1997). How social security and medicare affect retirement behavior in a world of incomplete markets. *Econometrica*, **65**(4), 781–831.

Seibold, A. (2021). Reference points for retirement behavior: Evidence from german pension discontinuities. *American Economic Review*, **111**(4), 1126–65.

Staubli, S. and Zweimüller, J. (2013). Does raising the early retirement age increase employment of older workers? *Journal of Public Economics*, **108**, 17–32.

A Online Appendix: Additional Figures and Tables

Figure A.1: Number of Observations around Kinks



Notes: The figure plots the distribution of the number of observations in the 20-months interval around the EEA kinks in ROC.

Table A.1: Pre-determined Covariates

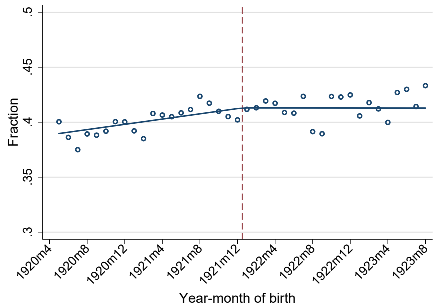
	ROC	
	EEA Decrease	EEA Increase
No. observations	-84.6	39.8
	(79.2)	(73.4)
Fraction female	-0.014	0.012
	(0.010)	(0.009)
Fraction married	0.008	0.009
	(0.008)	(0.008)
Family size	0.026*	0.024*
	(0.015)	(0.014)
Number of kids	0.020*	0.007
	(0.011)	(0.011)

Notes: The table reports estimates obtained from regression specifications (3). ***, **, * denotes statistical significance at the 1%, 5%, and 10% level, respectively.

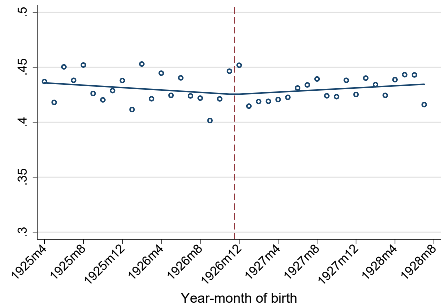
Figure A.2: Distribution of Predetermined Covariates around Kinks

A. Fraction Female

(a) EEA Decrease

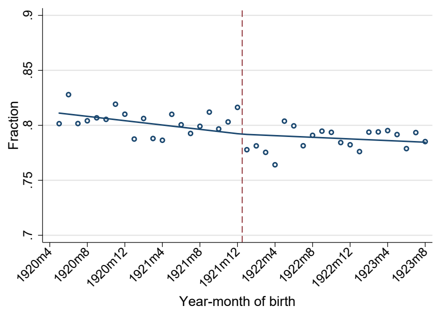


(b) EEA Increase

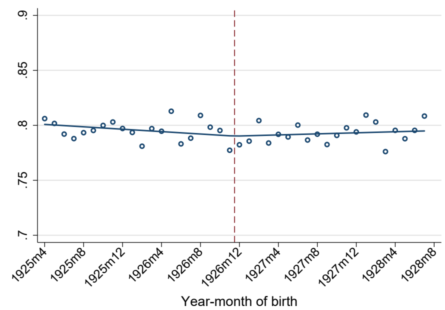


B. Fraction Married

(c) EEA Decrease

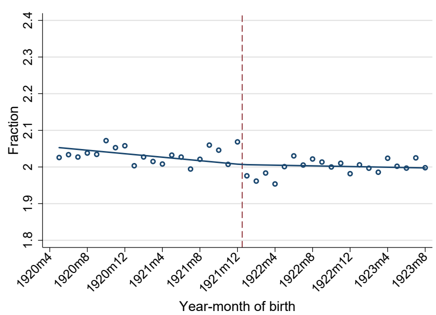


(d) EEA Increase

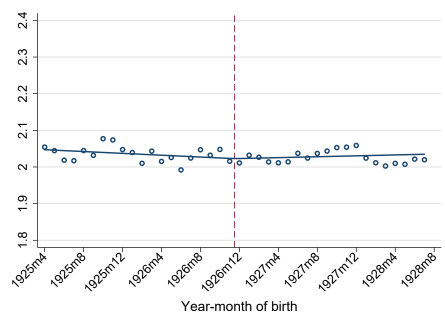


C. Family Size

(e) EEA Decrease

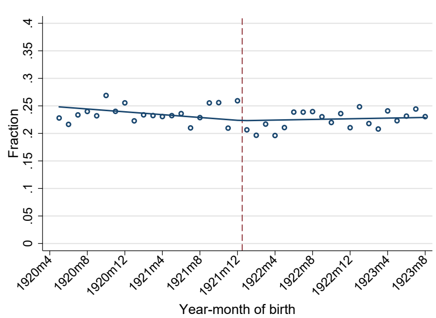


(f) EEA Increase

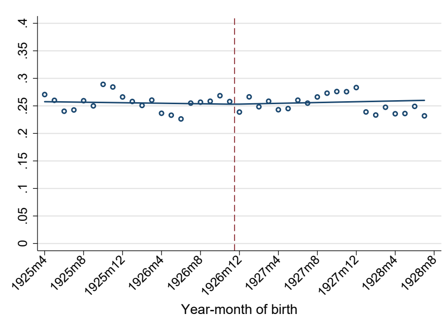


D. Number of Kids

(g) EEA Decrease



(h) EEA Increase

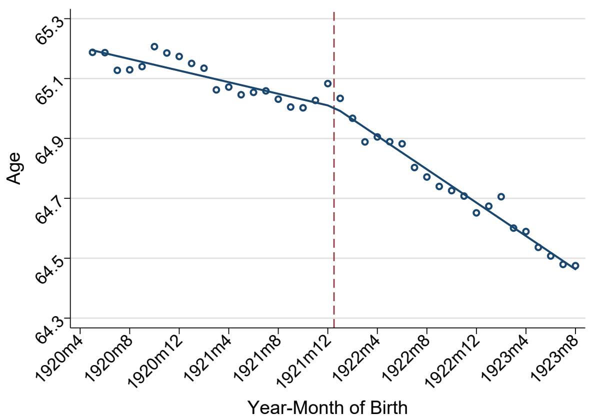


Notes: The figure plots the distribution of pre-determined covariates in the 20-months interval around the EEA kinks in ROC.

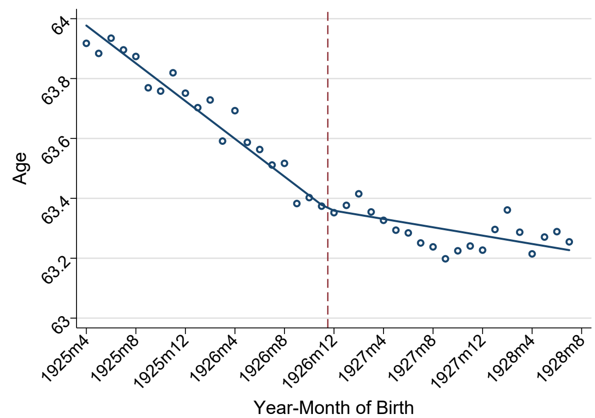
Figure A.3: Distribution of Claiming and Retirement Age around the Kinks

A. Claiming Age

(a) EEA Increase

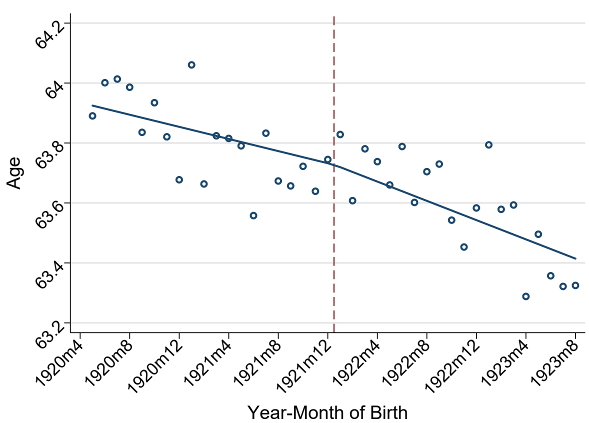


(b) EEA Decrease

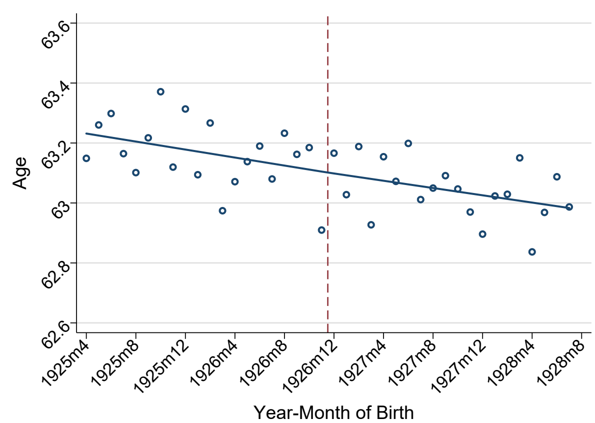


B. Retirement Age

(c) EEA Increase



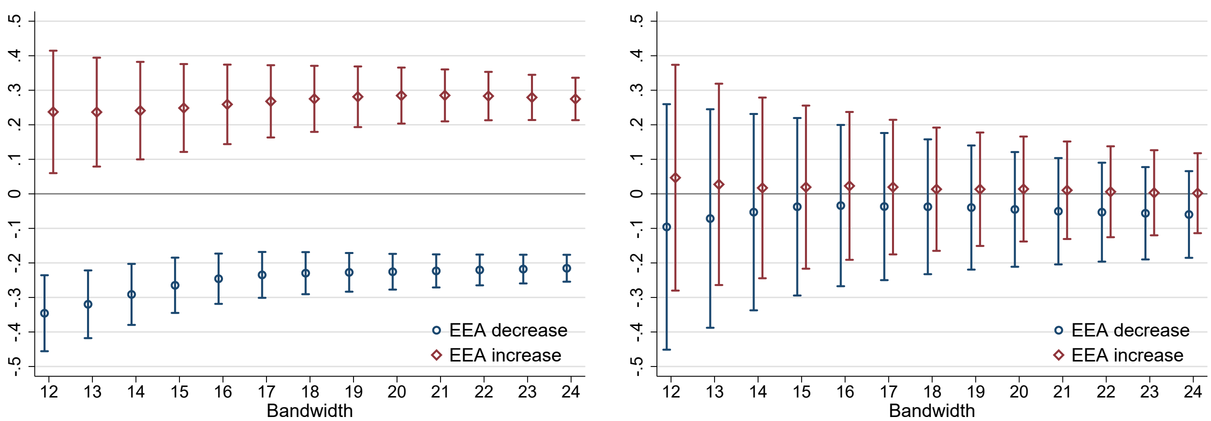
(d) EEA Decrease



Notes: The figure plots the distribution of the claiming age and the retirement age in the 20-months interval around the EEA kinks in ROC.

Figure A.4: Changing the Bandwidth

(a) Claiming Age (b) Retirement Age



Notes: The figure plots RKD-estimates for the claiming age and the retirement age for different bandwidths (in months) around the kinks in ROC.

Table A.2: Effects on Pension Claiming and Retirement Age – Quadratic Specification

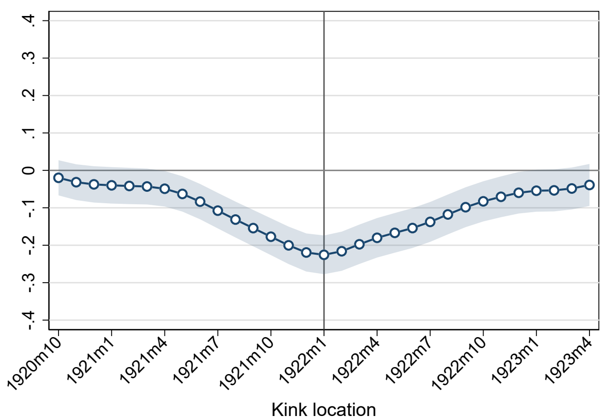
	EEA Decrease		EEA Increase	
	(1)	(2)	(3)	(4)
A. Claiming Age				
Coefficient	-0.418^{***}	-0.413^{***}	0.188	0.189
	(0.099)	(0.096)	(0.159)	(0.158)
Mean	65.1	65.1	63.3	63.3
Equality test (p-value)			0.220	0.230
Observations	72,370	72,370	82,600	82,600
B. Retirement Age				
Coefficient	-0.073	-0.079	0.090	0.062
	(0.320)	(0.314)	(0.294)	(0.290)
Mean	64.6	64.6	63.0	63.0
Equality test (p-value)				
Covariates	No	Yes	No	Yes
Observations	72,370	72,370	82,600	82,600

Notes: The table reports RKD-estimates when using a second-order polynomial in year-month of birth on each side of the kink. ***, **, * denotes statistical significance at the 1%, 5%, and 10% level, respectively.

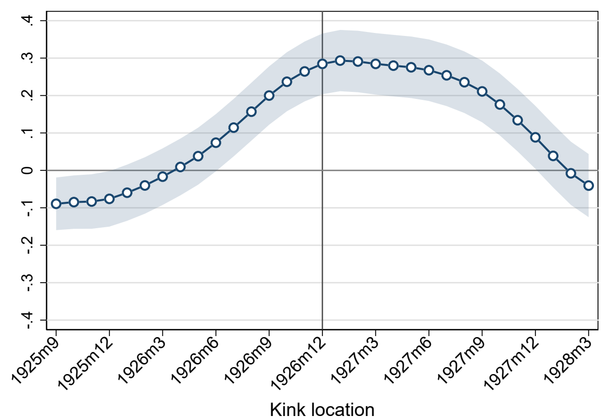
Figure A.5: Claiming and Retirement Age Estimates for Placebo Kink Locations

A. Claiming Age

(a) EEA Increase

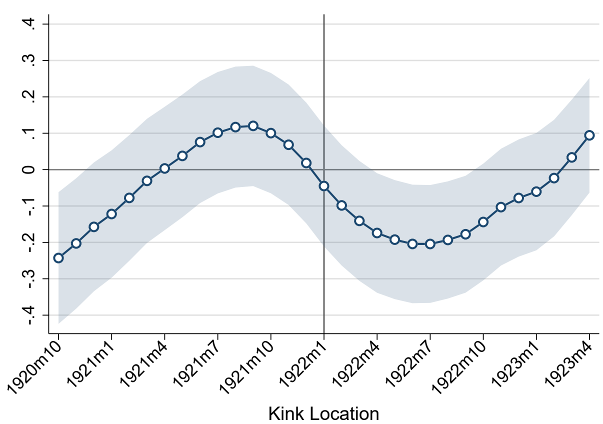


(b) EEA Decrease

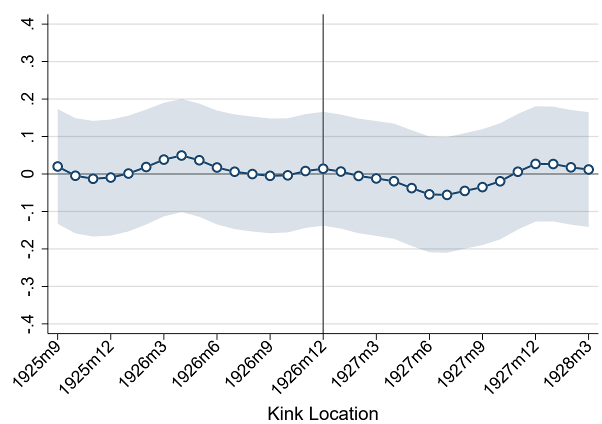


B. Retirement Age

(c) EEA Increase



(d) EEA Decrease



Notes: The figure plots RKD-estimates for the claiming age and the retirement age for the true kinks and placebo kinks located within 15 months of the true kinks in ROC.