Financial Incentives and Labor Force Participation of Older Workers: Evidence from France

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Abstract

This paper estimates the impact of financial incentives on retirement decision in France for cohorts of men retiring between 1994 to 2012. During these two decades, a number of pension reforms took place, all aiming to achieve financial balance in the context of increasing life expectancy. These reforms strengthened incentives to retire later, either by offering increased pension benefit for later retirement—becoming close to actuarial fairness—or by increasing early and normal retirement ages. This paper aims to assess how much these financial incentives and age references did contribute to the recent increase in employment rates of older workers.

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1 Introduction

From the late 1970s to the early 1990s, French public policies towards older workers were characterised by reforms providing incentives for earlier retirement. In the context of increasing unemployment, policymakers chose to expand early retirement schemes and provide incentives for earlier retirement through pension schemes. From the mid-1990s to the most recent period, the concern shifted towards the financial sustainability of the pension system. Continuously increasing life expectancy led to large increases in projected old-age dependency ratio, implying large deficits, unless reforms were to be implemented.

The main pension reforms, which were carried out in France over that period, are the 1993, 2003, 2010 and 2014 reforms—five reforms in 21 years—leaving aside many other changes in second-pillar complementary schemes. Each reform strengthened financial incentives for later retirement but differed in which parameter of the pension formula it chose to modify. The 1993 reform mostly reduced pension rights by changing the computation of the reference wage. The 2003 reform changed accruals for later retirement so as to make the postponement of retirement closer to actuarial fairness. The 2010 reform changed the early and normal retirement ages, with a two-year increase (from 60 to 62, and respectively from 65 to 67). The 2014 reform increased the number of years of contribution to be eligible for a full-rate pension.

In the 1990s and early 2000 policymakers were convinced, influenced by major studies—including some of the NBER International Social Security (ISS) publications—, that financial incentives for later retirement were sufficient to remove most of the issue related to the pension system's sustainability. Given that the French system provided very strong incentives to retire at the full-rate retirement age (age 60 for most workers), with more than actuarially fair penalty before and no gains for later retirement, it seemed natural to shift incentives towards actuarial fairness at the margin. This was achieved mostly with the 2003 reform. Subsequently the debate shifted to the need to increase retirement age, through increases in the early retirement age—perceived as particularly low in an international context—which was realised by the 2010 reform.

The policy debate on which tool to use in order to foster the most efficient and fair increase in average retirement age is matched by academic discussion on the relative impact of retirement age norms versus financial incentives for later retirement. Many studies have indeed shown that financial incentives do matter, even controlling for retirement age references (Benallah 2010, Brinch et al. 2015, Manoli & Weber 2016, Gelber et al. 2016). The impact are nonetheless limited, especially compared to studies exploiting changes to both financial incentives and reference age, as in the French context with changes in the full-rate age (Aubert 2009, Bozio 2011). Other studies have quantified the relative importance of financial incentives compared to norms. Brown (2013) and Seibold (2016) thus confirm earlier studies in showing that financial incentives do matter significantly in retirement decisions, but importantly these studies find that age references seem to matter even more. In the U.S. case, Behaghel & Blau (2012) show that the increase in normal retirement age led to significant postponement of individual decision to retire, with incentives mostly unchanged. The role of reference retirement age has thus become a matter of discussion within academia, and not only among policy circles.

This paper aims to review the evidence on the role of financial incentives as computed along the long tradition of ISS studies—with Social Security wealth (SSW), changes in SSW across ages and other incentives measures. In doing so we exploit administrative data on cohorts of pensioners, and we take into account all the reforms implemented in France since the mid-1990s. It can be seen as the natural follow-up of Blanchet et al. (forthcoming) which documented the marked reversal in older workers' employment trend since the 1990s, and its relation with the change in financial incentives on the basis of several typical cases. In this paper, we consider actual changes in average incentives, and address the following question: how much can these changes to the pension formula be credited for the trend reversal?

Our results show that financial incentives do matter for these recent cohorts, and our estimates suggest that they matter more than what was measured in previous studies. We discuss whether this reflects changes in behaviors, or—our preferred explanation—changes in variations in incentives which facilitate identification of behavioural responses. Second, we introduce retirement age references in our empirical specifications to test the relative role of these norms versus pure financial incentives. We find very significant effects of the former. Although we cannot fully separate out the two effects—in France financial incentives and reaching the full-rate retirement age are closely related—we interpret this evidence as testimony of the importance of reference norms as well as exact incentives formula for guiding individual choices.

The paper is organised as follows: Section 2 presents the French institutional design and reforms since the 1990s. Section 3 describes the data used and the PENSIPP calculators used to computed financial incentives at the individual level. Empirical strategy and results are presented in Section 4. Section 5 concludes.

2 Institutional context and reforms

The French system is particularly complex, and the details of the many different schemes have been described at length in previous ISS volumes (e.g., Blanchet & Pelé (1999); Blanchet et al. (forthcoming)). Here we present a summary presentation of the main pension schemes and the major reforms in order to understand changes in financial incentives which will be documented in the next Section.

2.1 Institutional design of the French pension system

Main scheme for private sector wage earners. The main scheme for private sector wage earners is called the *régime général* as it was the scheme supposed to cover all workers comprehensively in 1945. It is formally known as the *Caisse nationale d'assurance vieillesse* (CNAV), i.e., the National Old-Age Insurance Scheme. The scheme covers earnings up to the Social Security threshold, around average earnings or P70 of the earnings distribution (41 136 euros of gross/posted annual earnings in 2020). Pension is computed by applying the full-rate (50%) to an average of the best 25 years of earnings under one of two conditions: either reaching the normal or full-rate age (65 before 2010, 67 after 2010), or having the required contribution length (originally 37.5 years, and today 41.5 years). A penalty is applied for every quarter missing relative to these conditions.

Formally, the general formula for benefits B for wage earners of the private sector is the following:

$$B = W_{\text{ref}} \times CP \times \tau \tag{1}$$

W_{ref} is the reference wage. CP is the coefficient of proportionality (*coefficient de proratisation*, CP) accounting for the number of years contributed to the pension scheme. It is capped to one, and is computed as $CP = \max(1, D/D_{CP})$, with D the number of years of contribution in the private sector and D_{CP} a reference duration. τ is the pension rate, and can be computed as:

$$\tau = \tau_{\text{ref}} \times \Big[1 - p \times N_{pen} + b \times N_{bon}\Big],$$

where N_{pen} is the number of quarters of penalty and N_{bon} the number of quarters of bonus.

An important feature of the scheme is the fact that earnings used to compute average earnings (W_{ref}) are re-weighted by inflation and not average wage growth. This change in indexation rule started in 1987 and was systematically applied since then. This corresponds to one the most important change in the pension formula even if the change was not advertised by any specific reform. The impact of this change is nonetheless very significant for the financial sustainability and the level of pensions. A number of studies (e.g., Blanchet et al. 2016) have shown that this indexation rule has reduced considerably pension liabilities at the expense of making the sustainability of the system very dependent on the growth rate of the economy—if the average wage growth is sufficient, pension rights lose progressively their value counterbalancing higher life expectancy; if the average wage growth is too small, the system generates deficits as pension rights keeps rising with higher life expectancy.

Complementary schemes for private sector wage earners. In addition to the main scheme, private sector workers are mandated to be affiliated to a complementary pension scheme (AGIRC for executive workers, ARRCO for non-executives, and since 2019 Agirc-Arrco for all private sector employees). These schemes are pay-as-you-go point-based systems. Contributions are converted into points using a shadow price of the point, then points are accumulated during the entire career. At retirement the sum of accumulated points are converted into a monthly annuity based on the selling price of the point (Legros 2006, Bozio et al. 2019). These schemes provide additional coverage below the Social Security threshold (roughly 25% of earnings replacement), and additional coverage for high earners (up to eight times of the main threshold, i.e., annual gross earnings up to 320K euros). These schemes are much closer to actuarial fairness in their design than the main scheme, reflecting that they were originally designed to remain funded schemes.

Main scheme for public sector wage earners. Public sector wage earners are covered by different schemes (*Service des retraites de l'Etat* for State employees, and CNRACL for hospitals and local authority employees). These are annuity pay-as-you-go schemes. The pension is computed based on the last six months earnings, with a full-rate of 75% under the condition to fulfil the required length of career. The apparent generosity of this scheme is reduced by the fact that only the main salary is taken into account in the pension computation, excluding all forms of bonuses which make up around 27% of the total remuneration of public sector employees on average.

2.2 Pension reforms in France since the mid-1990s

We now briefly present the major changes induced by pension reforms since the mid-1990s. These changes were mainly "parametric" in the sense that they modified specific parameters of the system presented above. Table 1 provides the values of the different parameters for cohorts born between 1933 and 1973.

The 1993 pension reform. This reform was the first to aim to reduce pension liabilities in France. It only affected private sector employees in the main scheme, and the objective was mostly to reduce pension rights. First, the reform changed the computation of average earnings from the best 10 years to the best 25 years, thus lowering reference earnings for the pension computation (column 6 in Table 1). Second, it increased the number of years required to obtain the full-rate from 37.5 years to 40 years (column 1 in Table 1). The changes were phased-in progressively by adding one year of the reference year, and one quarter to the required contribution length every cohort (Bozio 2011).

The 2003 pension reform. This reform affected both the public and private sector employees, but it was the former which were more directly affected, as many of the changes from the 1993 reform were then also applied to the public sector workers. For instance a penalty was introduced for every year missing to the new required contribution length of 40 years. After some time allowed for convergence towards the conditions of the private sectors, the required length of contribution was further increased to match increases in life expectancy, thus leading to 41.5 years as of 2019 (column 1 in Table 1). Importantly, the 2003 reform also intended to change the system more generally towards more actuarially fair rules. It introduced a bonus for every year contributed after reaching the full-rate age—which was not the case before—and also reduced the penalty for claiming before the full rate age (columns 4 & 5 in Table 1). Finally the reform created a new scheme for public sector employees in order to take into account their remuneration in the form of bonuses, albeit with low level of contributions and pension rights. A separate provision (known as *carrière longue*, i.e., long career) was also introduced for workers having started working at early ages (14, 15, and 16) allowing early retirement (from 56 onward depending on the exact contribution length) with the full-rate.

Table 1: Summary of the legislation enacted by the 1993 to 2014 reforms, by cohort

Cohort	Required contrib. length	Duration length for CP	Penalty (in % per miss. quarter)	Bonus(in % per add. quarter)	Number of annuities for W_{ref}	Early retirement age	Full retirement age
1933	150	150	2.5	X	10	60	65
1934	151	150	2.5	X	11	60	65
1935	152	150	2.5	X	12	60	65
1935	153	150	2.5	X	13	60	65
1937	154	150	2.5	X	14	60	65
1938	155	150	2.5	X	15	60	65
1939	156	150	2.5	X	16	60	65
1940	157	150	2.5	from 64	17	60	65
1941	158	150	2.5	from 63	18	60	65
1942	159	150	2.5	0.75 to 1.25*	19	60	65
1943	160	150	2.5	0.75 to 1.25*	20	60	65
1944	160	152	2.375	1 to 1.25*	21	60	65
1945	160	154	2.25	1 to 1.25*	22	60	65
1946	160	156	2.125	1 to 1.25*	23	60	65
1947	160	158	2	1.25	24	60	65
1948	160	160	1.875	1.25	25	60	65
1949	161	161	1.75	1.25	25	60	65
1950	162	162	1.625	1.25	25	60	65
06/1951-	163	156	1.5	1.25	25	60	65
07/1951+	163	156	1.5	1.25	25	60y.o. 4m.	65y.o. 4m.
1952	164	164	1.375	1.25	25	60y.o. 9m.	65y.o. 9m.
1953	165	165	1.25	1.25	25	61y.o. 2m.	66y.o. 2m.
1954	165	165	1.25	1.25	25	61y.o. 7m.	66y.o. 7m.
1955	166	166	1.25	1.25	25	62	67
1958	167	167	1.25	1.25	25	62	67
1961	168	168	1.25	1.25	25	62	67
1964	169	169	1.25	1.25	25	62	67
1967	170	170	1.25	1.25	25	62	67
1970	171	171	1.25	1.25	25	62	67
1973	172	172	1.25	1.25	25	62	67

* According to the number of additional quarters.
NOTE: CP stands for coefficient of proportionality and W_{ref} for reference wage (see equation (1)). 06/1951- refers to individual born between January 1st and June 1951, 30th while 07/1951+ refers to individual born between July, 1st and December, 31st.
SOURCE: Legislation, general regime.

The 2010 pension reform. This reform was introduced just after the 2008 financial crisis when the financial sustainability of the system had appeared severely dented. The main change this time concerned the age references: the early retirement age of 60 was increased to 62, while the normal retirement age of 65 was increased to 67 (columns 7 & 8 in Table 1). The reform was phased-in relatively quickly and had a very significant impact on the financial balance of the scheme. It also affected special schemes in the public sector which benefited from early reference ages (e.g., police and active duty employees could retire at 50, increased to 52).

The 2014 pension reform. This reform was more modest in scale than previous ones, but it further increased required length of contribution from 41.5 to 43 years (column 1 in Table 1). It also extended the provision of long careers to workers having started working before 18.

2.3 Alternative pathways

Another important element of the French institutional framework are the alternative routes for the transition from work to retirement.[1] The two main pathways in France have been early retirement schemes and unemployment insurance—disability insurance has only been marginally used in the French case.

Early retirement schemes. The heydays of early retirement in France was the decade from mid-1970s to mid-1980s. During that period of increasing unemployment, early retirement schemes were unanimously approved by unions and policymakers alike. They offered very high replacement rate to workers aged 55 and above—even 50 in some cases—if they left their job, and this until they reached the full-rate age of the pension system. From 1984 onwards, the flow onto early retirement slowed down significantly but the effect of this policy remained important as affected cohorts never returned to the labor market.

Unemployment insurance. Early retirement schemes were somehow closed in spirit to unemployment benefits, and often they were funded by the unemployment insurance scheme. When early retirement pathways were closed, another transition emerged within the unemployment insurance scheme. Job search constraints were removed for unemployed workers older than 56 years old, and thus unemployment benefit became another pathway towards retirement. Importantly, unemployed periods provided quarters of contribution to validate full-rate age conditions of the main pension scheme. This route started to be closed down in the mid-1990 when the government progressively increased eligibility age for such schemes. Nevertheless, the unemployment insurance pathway remains today the main alternative route towards retirement.

[1] See Behaghel et al. (2016) for a more detailed description of the alternative pathways existing in the French system.

3 Computation of financial incentives

3.1 Data

The data used for our analysis is administrative data collected from most French pension schemes. More specifically we combine two datasets: the *Échantillon Interrégime des Cotisants* (EIC) 2013 and the *Échantillon Interrégime des Retraités* (EIR) 2012. We also add additional observations from previous waves of the EIC (2001, 2005, 2009, 2013), and from the EIR (2001, 2004, 2008, 2012).[2] The EIC gathers information about career contributions to the pension system, following all earnings and other periods leading to some pension rights (e.g., unemployment periods). The EIR provides details about the population of retirees, their pension level, date of pension claim, etc.

All individuals born in representative days of 1934, 1938, 1942, and 1946 who contributed to the Social Security system, are included in the sample of the EIC, and those who eventually claimed their pension are observed in the EIR. Thus, these combined datasets provide us with a representative sample of the 1934, 1938, 1942, and 1946 cohorts, and their transition from work to retirement.

Given the specificity of the pension formula in the public sector, we restrict our analysis to the private sector workers in the current version of the paper.[3] We also restrict our sample to individuals who are employed at age 54.

3.2 Retirement and claiming age

We define retirement as the last period of observation individuals are receiving positive labor earnings—it thus differs from claiming age, also observed in the data. We observe in our data several pathways from work to retirement: as pointed out by Table 2, about half of the population claim their pension at the moment they leave the labour market, which we call the "normal" route.

The second half of the population is taking an alternative route. These alternative pathways cover a variety of different situations, but we group these situations in terms of modelling. The reason for this choice is that all alternative routes actually convey the same financial incentive: they offer a replacement rate of about 60% of the last earnings.

[2] The EIR and EIC, as administrative data, have restricted access. Researchers need to apply to the DREES at the French ministry of health and social affairs to be granted access.

[3] In 2018, out of 16.3 thousands retirees of a basic pension plan, 13.6 of them (83 %) receive benefits from the general regime, 8.4 thousands (52 %) exclusively (Drees 2020).

This rate is the legal one for unemployment, disability and sickness. Replacement rate are more heterogeneous for early retirement schemes, but the figure is close, and these schemes cannot be disentangled from unemployment in our data.

Only 47 % of the 1934 cohort retire through the normal route (Table 2). There are even fewer in the 1938 cohort, as early retirement schemes were still present at that time. They start declining from 1994, which explains the drop in the proportion of individuals taking this alternative route and the increase in the normal route for the following cohorts.

3.3 The PENSIPP calculator

The computation of financial incentives requires the knowledge of potential pensions at all ages. We compute these pensions using the PENSIPP calculator developed at the Institut des politiques publiques (IPP) applied to the EIR-EIC data described before (for a short description, see Blanchet et al. 2016).[4] For private sector workers, the PENSIPP calculator accounts for both pension schemes: the basic pension (CNAV) and the complementary ones (Agirc-Arrco). Any private sector worker has to contribute to both schemes. The CNAV pension scheme corresponds to the historical public pension system initiated in 1945. Complementary schemes appeared in the 1950s and became compulsory in the 1970s. The earnings' base for these complementary schemes is different from the one of the CNAV system as they apply above the Social Security threshold, and the formula that determines the pension is also different (see above Section 2.1). The PENSIPP calculator accounts for these differences by following closely the legislation. It also includes all the major changes in the pension legislation since the 1980s, which makes it possible to assess the evolution of the incentives over time.

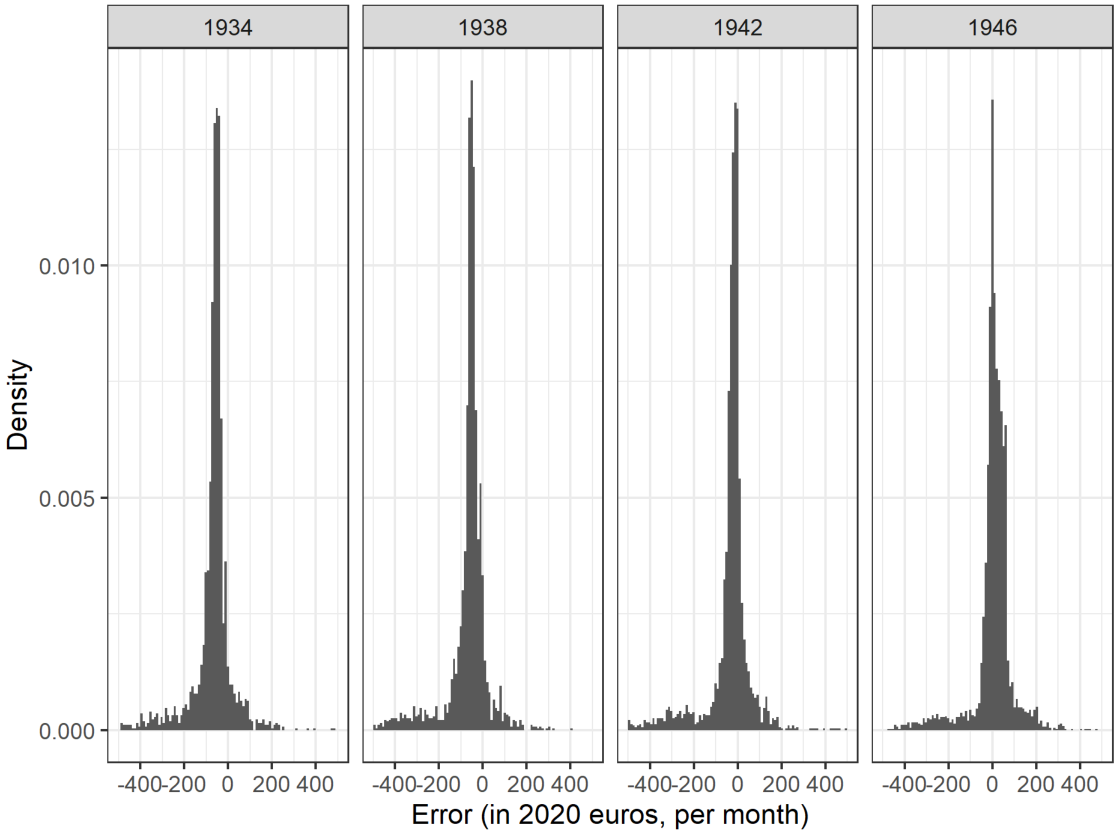
3.4 Assessment of the calculator

As we observe actual pensions at the time individuals claim their pension, we are able to assess the quality of the PENSIPP calculator by comparing simulated pensions to actual ones. Figure 1 shows these differences expressed in 2020 euros. The results show that most of the differences between simulated and actual monthly pensions ranges between -200 and 200 euros. The quality of the prediction is better for the youngest cohort (1946) with a large majority of prediction errors comprised between -100 and 100 euros. When

[4] Pension legislation underlying PENSIPP can be found in IPP Tax and Benefit tables, `https://www.ipp.eu/en/ipp-tax-and-benefit-tables/pension/`.

considering older cohorts, the PENSIPP calculator seems to underestimate pension benefits. One reason for this may be that PENSIPP uses yearly data, while pensions are computed from quarterly data. Moreover, the quality of earnings data is likely to be lower for older cohorts. As a result, the career from which pension benefits are computed maybe incomplete, leading to an underestimation of the pension level.

Figure 1: Difference between simulated and actual pension benefits



SOURCE: EIC, EIR, PENSIPP.

Table 2: Descriptive Statistics

	1934		1938		1942		1946	
	Women	Men	Women	Men	Women	Men	Women	Men
Retirement age	58.8	59.25	58.7	59.41	59.33	59.75	59.63	59.76
Claiming age	60.73	61.33	60.95	61.6	61.18	61.66	61.11	61.31
Situation at retirement								
Retired at full rate by age (in %)	1.59	4.56	1.83	5.83	2.5	4.13	1.16	3.31
Retired at full rate by duration (in %)	29.53	22.58	20.15	20.39	29.46	26.39	33.38	31.29
Retired at early age (in %)	31.79	31.46	24.99	26.79	31.6	30.84	33.42	34.2
Number of validated years:								
Average	38.72	36.79	37.99	37.7	39.18	39.2	40.24	41.17
q25	37	32	36	33	38	35	39	39
q50	40	38	39	39	40	40	41	42
q75	42	43	41	43	42	44	43	45
Missing years for full rate:								
Average	-2.06	-2.59	-2.52	-2.5	-1.98	-1.99	-1.28	-1.4
q25	-4	-5	-4	-5	-4	-4.75	-3	-4
q50	-2	-2	-2	-2	-1	-1	0	0
q75	0	0	0	0	0	0	0	0
Reference Wage (k euros):								
Average	1.8	1.45	1.91	1.51	2.13	1.64	2.36	1.82
q25	1.62	1.1	1.68	1.1	1.85	1.13	2.04	1.28
q50	1.62	1.1	1.68	1.1	1.85	1.13	2.04	1.28
q75	2.02	1.86	2.16	1.99	2.46	2.2	2.75	2.42
Pension rate (in %):								
Average	46.22	43.05	44.35	43.42	45.11	44.66	47.75	47.88
q25	46.25	32.5	41.25	36.25	41.25	37.5	45.75	48.41
q50	46.25	32.5	41.25	36.25	41.25	37.5	45.75	48.41
q75	50	50	50	50	50	50	51.5	51.5
Pension (k euros):								
Average	11.66	8.48	12.27	9.26	14.35	10.73	17.05	12.88
q25	9.94	4.94	9.83	5.89	11.34	7.27	13.38	9.08
q50	12.46	8.4	12.94	8.88	14.86	9.94	17.17	12.13
q75	13.96	12.06	15.12	12.91	17.5	14.81	20.63	17.23
Financial Incentives at retirement age								
SSW (100 000 euros)	1.87	1.55	1.95	1.69	2.3	1.97	2.76	2.38
Accrual (1 000 euros)	-5.45	-1.2	-2.64	-0.96	-1.92	-0.38	-5.84	-3.15
ITAX (in %)	0.22	-0.16	0.06	-0.34	0.01	-0.29	0.17	-0.09
Peak Value (100 000 euros)	1.44	1.43	1.35	1.34	1.27	1.26	1.19	1.19
Pathway (in %):								
Normal	45.45	49.06	41.25	48.87	52.21	55.56	60.09	59.93
Unemployment, Early Retirement	49.67	43.68	51.86	43.98	40.03	37.44	33.81	33
Sickness/disability	4.88	7.25	6.89	7.14	7.76	7	6.1	7.07
Q3/Q1 career earnings above the median (in %)	66.72	82.23	38.3	70.49	32.33	63.83	21.61	54.31
Situation at age 55:								
Cumulated earnings (1 000 000 euros)	0.62	0.41	0.67	0.44	0.73	0.49	0.84	0.57
Ever been unemployed (in %)	26.3	26	34.41	35.71	36.8	40.54	40.21	44.08
Ever validated sickness quarters (in %)	34.1	42.71	36.24	42.95	40.19	52.07	40.94	62.89
Ever validated disability quarters (in %)	0.15	1.06	1.71	2.54	1.51	1.99	1.63	2.71
Has 3 or more kids (in %)	34.93	29.67	41.43	38.25	42.43	39.11	33.81	34.5
N	1947	1227	1697	1064	1921	1258	2328	1994

Note: Median for Q3/Q1 career earnings ratio are computed on the overall sample. All monetary variables are in 2020 euros.

Source: EIR-EIC.

3.5 Financial incentives

Computation. We compute several financial incentives from the pensions computed with PENSIPP. We first obtain the Social Security Wealth (SSW) as the sum of expected flows of pensions. After claiming, pension benefits are indexed on prices, so the only source of uncertainty that we need to account for is life expectancy. If an individual i in period t can claim a pension P_{it}, then the SSW corresponding to this level of pension is:

$$SSW_{it} = \sum_{\tau=t}^{T} \beta^{\tau-t} P_{it} S(t,\tau)$$

where $S(t,\tau)$ corresponds to the probability of being alive in period τ conditional on being alive in t, and β accounts for time preferences. We use gender specific survival tables computed by the French national institute of statistic (*Insee*) and a discount rate β equals to 97%.

Pensions are only positive from the early retirement age, which is equal to 60 for all the individuals we consider. For any retirement before this age, we consider that individuals get a benefit that equals to 60% of the last observed income until the claiming age (60). As explained before, this corresponds to the replacement rate of unemployment benefit and disability schemes. From age 60, P_{it} corresponds to the pension corresponding the career of the individual taking into account the fact that he left the labour market earlier.

From the SSW, we compute the *accrual* as the first difference between the SSW at the date $t+1$ and t:

$$ACC_{it} = \beta S(t+1,t) SSW_{it+1} - SSW_{it}$$

The accrual simply accounts for the financial incentives associated to delaying retirement by one year. Computing SSW_{it+1} requires some assumption of the pension level associated to claiming one year later ($P_{i,t+1}$). We make the following assumption: the last observed workstate (in year t) is extended one additional year, with the same real earnings if the individual is working in t. We then compute the pension level associated to this extended career and calculate the accrual.

The *Implicit Tax Rate* associated to this decision is simply obtained as minus the ratio between the *accrual* and the current earnings:

$$ITAX_{it} = -\frac{ACC_{it}}{y_{i,t-1}}$$

As current earnings y_{it} sometimes correspond to a truncated earnings—e.g., if retirement occurs in the middle of the calendar year—we use previous period's earnings $y_{i,t-1}$ instead to compute the ITAX.

These first two financial incentives only account for the trade off between retiring this year or next year. The *Peak Value* accounts for more sophisticated types of trade off by comparing today's financial value of the retirement to any better future option:

$$PEAK_{it} = \max_{\tau \geq t} \beta^{\tau - t} S(\tau, t) SSW_{i\tau} - SSW_{it}$$

Pattern by age. We then compute the pension incentives for every individual in our dataset, for all possible claiming age between 55 and 67. Figures 2a to 3c present the average of the following incentives variables: pension level, SSW, pension accrual, implicit tax and peak value. We present the average of the financial incentive by year (*(a)* Figures) and by distance to the full rate age (*(b)* Figures). Each line corresponds to a different cohort of birth year, so that we can assess the evolution of the average incentive over time. The differences between the age-based profiles and the ones based on the distance to full rate comes from the fact that the full-rate age can be reached at different ages depending on individual career profiles (see Section 2). The age profile is then the aggregation of many different age profiles, that depend on contribution duration and wage profile. Financial incentives for some case-studies were depicted in Blanchet et al. (forthcoming). The average patterns presented below offer a much more accurate picture of the shape and evolution of financial incentives for a representative sample of the French population.

For all cohorts, the pension level is increasing slowly and smoothly with age. These smooth profiles however hide very different patterns from both sides of the full-rate age. The pension profile is very steep on the left of the full rate, due to high penalty for retirement before the full rate. The slope is maximal from 64 to 65, due to the eligibility to the contributory minimum pension (*minimum contributif*) at age 65, creating a jump in the pension level. At the right of the full rate, the slope is much less dynamic, due to lower increase in the pension rate once the full rate is reached (through both lower *surcote* rate compared to the *decote* and a the saturation of the coefficient of proportionality—see equation 1 in Section 2).

This pattern of the evolution of the pension level directly shapes the patterns of the other financial incentives variables. The SSW by age is relatively flat, with strong differences depending on the distance to the full rate: steep the years before, especially one year before, and flatter afterwards. The accrual being somehow equal to the slope of the SSW, we find similar patterns in Figure 3a: relatively strong accruals before the full rate with a jump in the year before (and at age 64), and smaller afterwards. The shape of the ITAX is similar, which suggests that much of the incentives are driven by the numerator of this ratio. The Peak value is slightly different though, since the spike at the full rate translates into high and decreasing peak value until this point, which often corresponds to the maximum SSW individuals can expect.

Pattern by cohort. Financial incentives are globally increasing with time. On Figure 3a, the level of the accrual is increasing for younger cohort (for a given age or distance to the full rate). How can we explain this evolution and how consistent are they with the results of Blanchet et al. (forthcoming) ?

Changes of incentives over time are the product of two main components: (i) the evolution of the pension legislation and (ii) the evolution of labour market trajectories.

First, the different reforms described in Section 2 can have different effects on the pension accrual, through their effect on each component of the pension formula.

(i) The increase in the number of years taken into account in the reference wage decreases the accrual at every age. A new year of earnings, if it enters the n best ones, will indeed have a relatively stronger (smaller) impact on the average if n is small (big).

(ii) The increase in the number of years of contribution in the coefficient of proportionality decreases the accrual, because one additional year of contribution increases the pension by a factor $1/D_{CP}$, which decreases with D_{CP}.

(iii) The decrease in the penalty for missing years before the full rate age contributes to the decrease in accrual

(iv) The creation of the *surcote*, the bonus for continued work beyond the full rate, explains the increase in the accrual observed on the right of the full rate

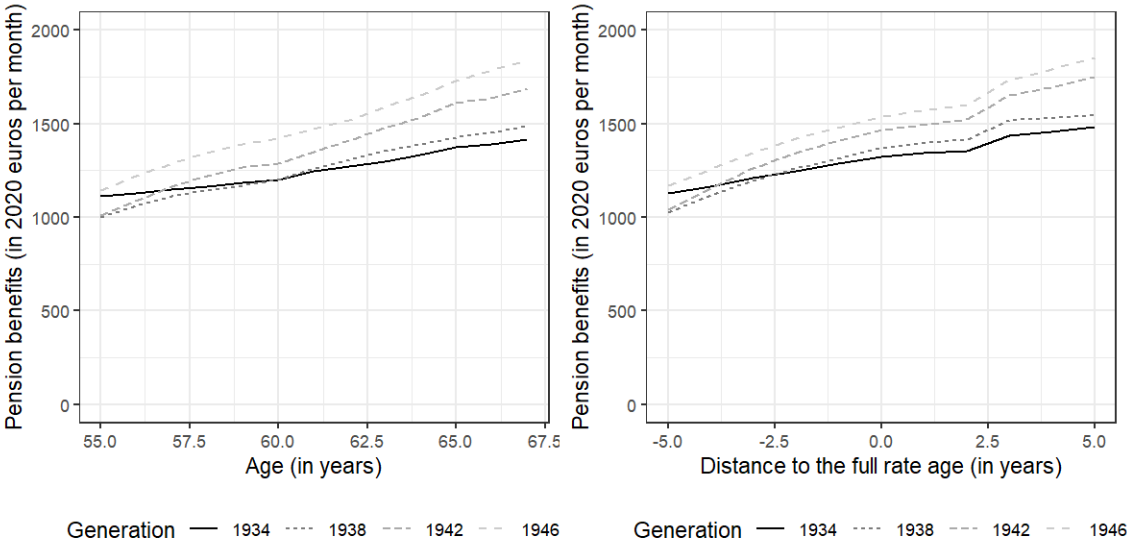
We would then expect the accruals to be stronger over time after the full rate, and lower before the full rate. The first element is observed on the right panel of Figure 3a, with an increase in accrual after the full rate for younger cohort. It is not the case for the second point, as the accruals are also higher for younger cohort. This can be explained by the second determinant of financial incentives.

The evolution of careers indeed goes in the opposite direction at younger age. Blanchet et al. (forthcoming) showed that financial incentives are stronger when work duration is smaller, relative to the reference work duration for full rate. Over time, the reference work duration increases and the average number of years of work at a given age decreases (due to longer education and more difficult insertion on the labour market), so that the average gap between work duration and the reference duration widens. This evolution in the labor market trajectories drives upwards financial incentives over time before the full rate and at younger age. This explains the patterns we observed on 3a (increasing accrual over time before 60 and before the full rate age).

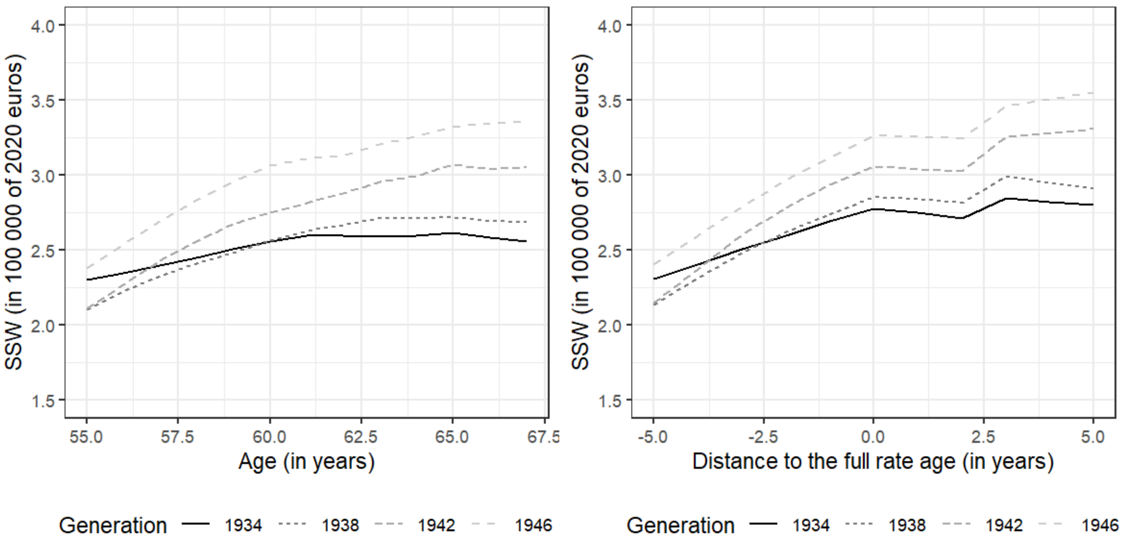
Note that the difference observed in the evolution of the incentives over time between Blanchet et al. (forthcoming) and this paper underlines the importance of using a representative sample rather than typical cases to assess the link between financial incentives and retirement behaviors.

Figure 2: Pension and Social Security Wealth

(a) Average pension benefits, by cohort



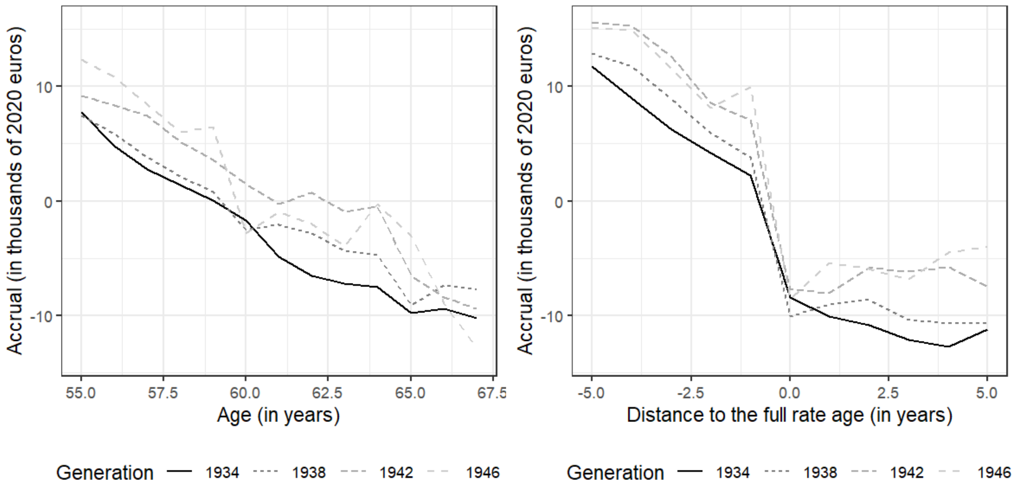
(b) Average Social Security Wealth, by cohort



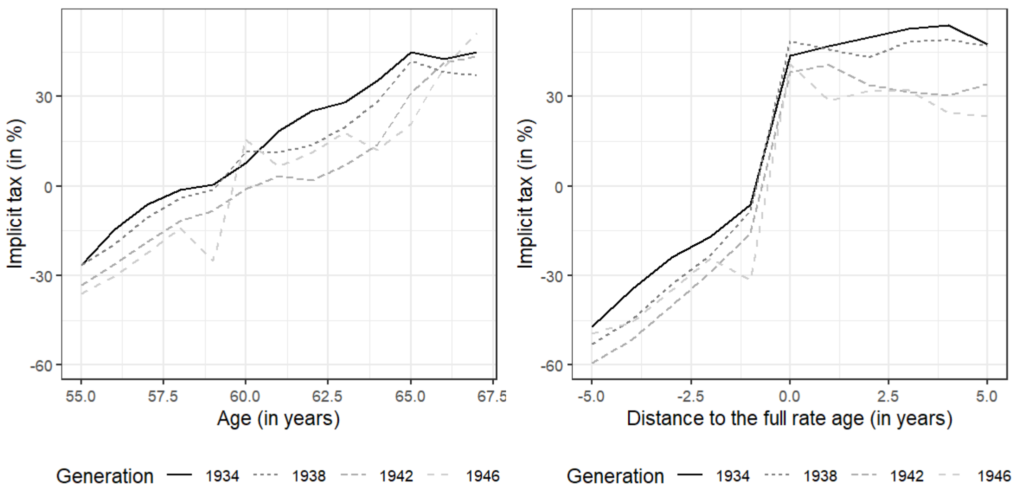
NOTE: The panel is balanced
SOURCE: EIR-EIC

Figure 3: Financial incentives by cohort

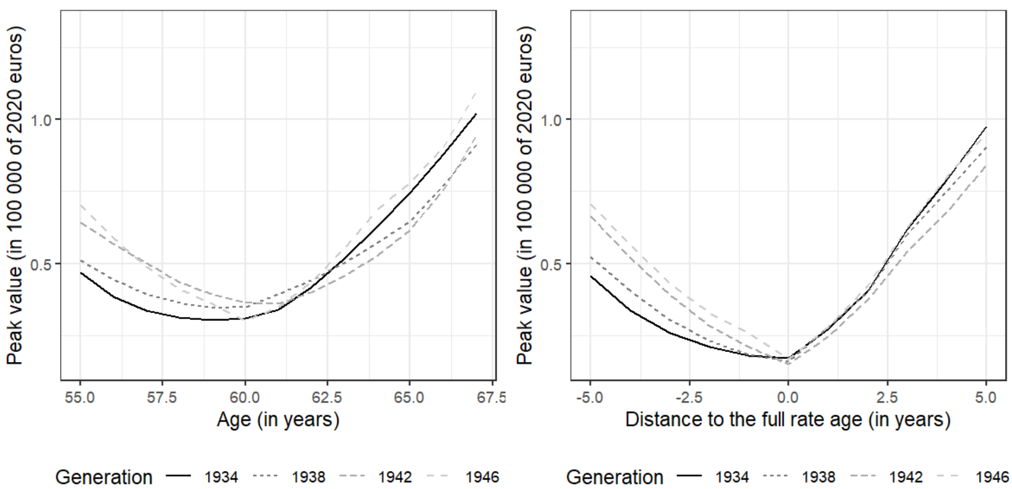
(a) Average accrual



(b) Average implicit tax, by cohort



(c) Average peak value, by cohort



Note: The panel is composed of individuals for which the implicit tax was computable (wage $\neq 0$)
Source: EIR-EIC

4 Empirical analysis

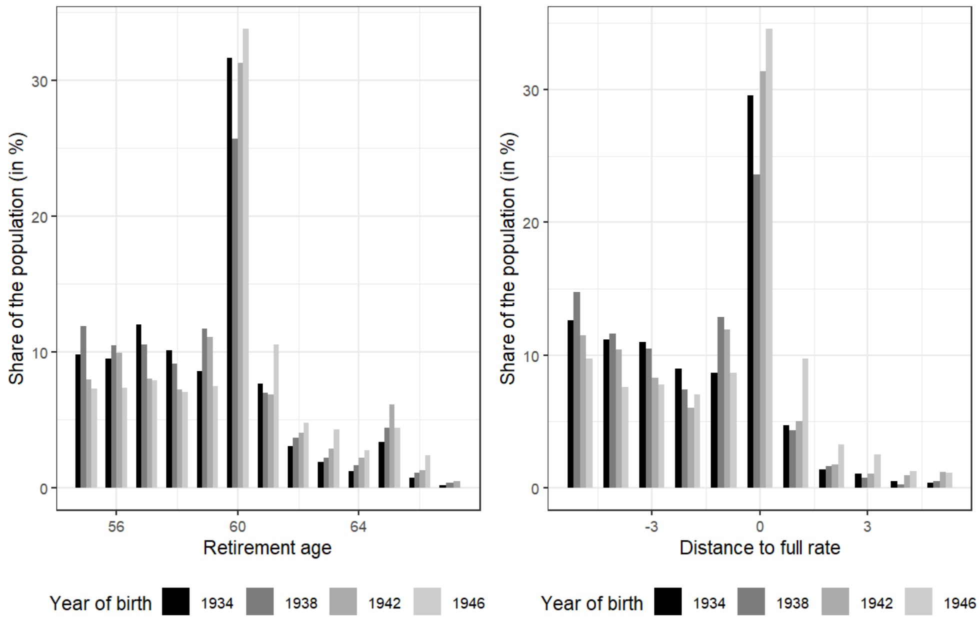
In this section we present the main evidence of the effect of financial incentives over retirement behavior. We first produce graphical evidence of the correlation between claiming behavior and pension accrual, and then present estimation results.

4.1 Graphical evidence

Figures 5 and 6 (repeating Figure 3a) compare retirement behavior by age and distance to the full rate age to the associated financial incentives. We can see a clear correlation between the bunching in retirement at the full rate age (around 60% of the population) and the strong incentive to postpone retirement until the full rate the the system gives (very high accruals on the left of the full rate). This cross-sectional correlation does not necessarily reveal a causal effect of the accrual over retirement behavior. The full-rate age embeds both the financial incentives and the norm effect. Both dimensions can drive the observed pattern of pension claiming.

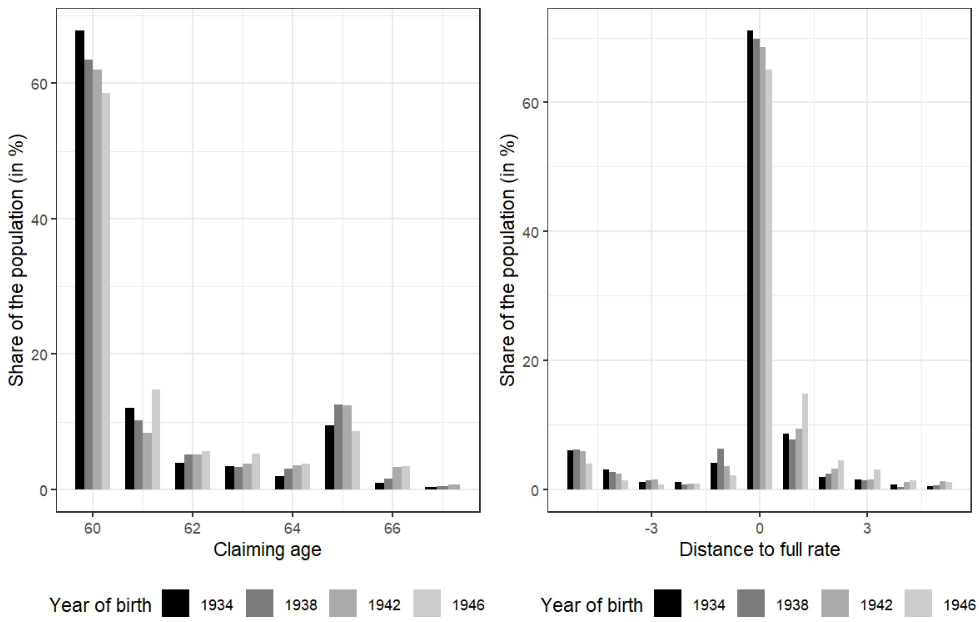
More compelling is the evolution of the distribution of retirement, which is also consistent with the evolution of the accrual. We observe, for the last cohort, a shift in the proportion of individuals retirement beyond the full rate, and a reduction in the bunching a the full rate age. This can be linked to the increase in the accrual after the full rate. This suggests a causal effect of pension incentives over retirement behaviour, even though some other mechanisms could be considered, such as changes in the employment protection at the full rate age (Rabaté, 2019).

Figure 4: Retirement behaviour, by cohort



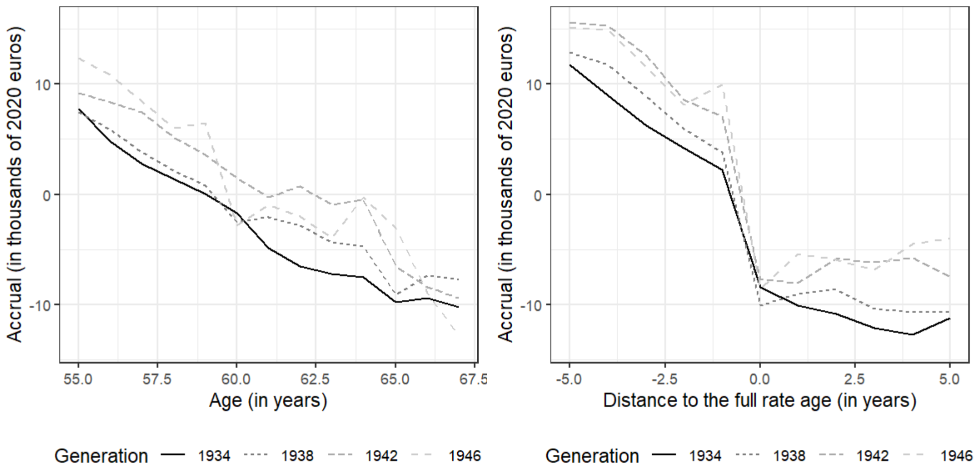
Source: EIR-EIC

Figure 5: Claiming behaviour, by cohort



Source: EIR-EIC

Figure 6: Average accrual, by cohort



SOURCE: EIR-EIC

4.2 Estimation results

For each individual i, we model retirement decision at period t, Y_{it} as a function of individual characteristics X_{it} (age, gender, last wages), financial incentives FI_{it} (either accrual, peak value or implicit tax rate), and some time varying unobserved heterogeneity term ε_{it}. We make the assumption that decisions are independent over time conditional on observed characteristics. At each period, the likelihood of pension claiming is given by:

$$P(Y_{it} = 1 | SSW_{it}, FI_{it}, X_{it}) = P(SSW_{it}\beta_1 + FI_{it}\beta_2 + X_{it}\beta_3 < \varepsilon_{it}) \quad (2)$$

As previously mentioned, the French pension system also includes a full-rate age, that can be reached between 60 and 65 depending on the contribution length. As the full rate can have a direct effect on retirement behaviors, through norms or framing effects (Behaghel & Blau (2012)), we include it in some specifications:

$$P(Y_{it} = 1 | SSW_{it}, FI_{it}, FR_{it}, X_{it}) = P(SSW_{it}\alpha_1 + FI_{it}\alpha_2 + FR_{it}\alpha_3 + X_{it}\alpha_4 < \xi_{it}) \quad (3)$$

Given the independence of the claiming decisions, the individual contribution to the likelihood is given by:

$$\ell_i(Y_i, Z_i) = P(Y_{iT_i} = 1 | Z_{iT_i}) \prod_{t=t_0}^{T_i - 1} P(Y_{it} = 0 | Z_{it}) \quad (4)$$

where t_0 is the minimum legal retirement age, and T_i is the observed claiming age for individual i, and Z_{it} is the chosen set of explanatory variables. Unobserved heterogeneity terms are supposed to follow a normal distribution leading to a *logit* model.

We further add controls in the specification. Three dummies assess whether individuals have had a period of unemployment, sickness or disability in their careers. We classify individuals into two groups whether they have had a flat or an dynamic career. Focusing on the interquartile ratio of career earnings, we consider any individual as having a dynamic career if his interquartile ratio is above the median of ratios (this median is equal 1.27 over the total population). Finally we control for the number of kids people have: less than three children or three children or more. Table 2 present descriptive statistics of the retirement incentives and all control variables, by gender and cohort of birth.

Main estimates

The main estimation results are shown in Table 3 for accrual. The first column corresponds to equation (2). Specific age dummies, duration cutoffs and age controls corresponding to specification (3) are sequentially included in columns 2 to 6.

Table 3: Logit estimation results for Accrual

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	−1.79	−1.643	−1.749	−1.768	−4.191	−3.407
	(0.0201)	(0.0208)	(0.0221)	(0.023)	(0.128)	(0.1332)
Accrual	−7.401	−6.774	−5.416	−5.452	−6.339	−6.8
	(0.2378)	(0.2413)	(0.2352)	(0.2374)	(0.2516)	(0.27)
SSW	0.23	0.605	0.432	0.427	0.098	0.142
	(0.0079)	(0.0217)	(0.021)	(0.021)	(0.0239)	(0.0248)
Cumulated earning at 55		−1.897	−1.409	−1.353	0.084	0.029
		(0.0898)	(0.0875)	(0.0888)	(0.1011)	(0.1041)
Full Rate			1.8			
			(0.0432)			
Full rate by age				2.256	1.126	1.051
				(0.1046)	(0.1117)	(0.1122)
Full rate by duration				1.748	1.224	0.082
				(0.0454)	(0.049)	(0.0718)
Age					3.758	1.691
					(0.2711)	(0.2915)
Age^2					−0.821	0.211
					(0.1343)	(0.1488)
Early retirement age						1.439
						(0.0504)
Log Likelihood	-29197.6	-28928.13	-27361.63	-27349.82	-26323.35	-25839.05
N	71601	71601	71601	71601	71601	71601

NOTE: Robust standard error clustered at the individual level are given in parentheses.
SOURCE: EIR-EIC.

As we do not explicitly model alternative pathways at this stage, the ITAX variable is defined only for a subcategory of individuals who are employed when reaching the eligibility age for retirement (60 for the cohorts we study). We then use the accrual variable as the main financial incentive variable, and present most of the results of the estimations for this variable.[5]

The first important result appearing in this table is that the coefficients for the financial incentives are significantly different from 0, and of expected sign. On the one hand, an increase in the SSW increases the probability of claiming (income effect). On the other hand an increase in the accrual decreases the probability to claim (substitution effect). This finding differs from previous studies on French data (e.g Mahieu & Blanchet (2004)) who found a negative effect of the SSW on retirement behaviour. This was likely to be driven by a positive correlation between SSW and unobserved factors, such as disutility for work. Using more variations from pension reforms, we may be able to better identify the direct effect of financial incentives.

These results are robust throughout the different specifications. We find qualitatively similar results for the implicit tax variable (see Table 5 in appendix A), when estimating the model separately for men and women (see Table 4) and using different regression specifications (see Tables 7 and 8 in appendix A). The sign of coefficients for peak value variable are nevertheless counter-intuitive (see Tables 6 and 9 in appendix A).[6]

From column 3, we include a dummy variable that equals one when the worker reaches the full rate. Reaching the full rate is associated to a strong increase in the claiming probability. As the full rate can be obtained through different ways, we distinguish two different cases: first we consider the full rate irrespective of the way it is obtained (column 3). From the fourth specification, we distinguish between full rate obtained because of the contribution duration (Full rate by age), or because the worker reached the age limit (Full rate by age). It shows that normative or reference age in the system can be an important driver of retirement decisions, alongside financial incentives.

Interestingly, adding the full rate variable—e.g., from column (2) to (3) of Table 3—decreases a lot the effect of the accrual: the point estimate is divided by two when we include the full rate variables. It is consistent with the description of the financial incentive presented above, as the pension formula gives strong incentive to postpone retirement until the full rate age. Financial and normative incentives then coincide in the system,

[5] Additional results for implicit tax rate and peak value are given in appendix A. Results are qualitatively similar.

[6] But differentiating the impact of financial incentives by cohort of birth restore expected sign (see next paragraph).

Table 4: Logit estimation results for all financial incentives, by gender

	Accrual		ITAX		Peak Value	
	Women	Men	Women	Men	Women	Men
Intercept	−3.541 (0.2028)	−4.104 (0.1819)	−2.809 (0.1861)	−3.358 (0.1663)	−4.799 (0.3798)	−4.901 (0.4092)
SSW	0.171 (0.0635)	0.31 (0.0448)	0.832 (0.0517)	1.096 (0.0558)	0.784 (0.0545)	1.064 (0.0598)
Financial incentive	−7.87 (0.3318)	−6.042 (0.3446)	0.641 (0.1248)	0.756 (0.0982)	1.219 (0.2007)	0.871 (0.2038)
Year dummies:						
Full rate by age	1.054 (0.141)	1.138 (0.1962)	1.351 (0.1441)	1.615 (0.2008)	1.366 (0.145)	1.642 (0.2009)
Full rate by duration	−0.169 (0.0909)	0.215 (0.0992)	0.968 (0.0742)	1.194 (0.0663)	1.02 (0.0744)	1.231 (0.0666)
Early retirement age	1.75 (0.0736)	1.254 (0.0674)	1.332 (0.0645)	0.929 (0.0578)	1.307 (0.0646)	0.912 (0.058)
Age	0.772 (0.4356)	2.801 (0.3867)	−1.295 (0.3942)	1.308 (0.3388)	−0.825 (0.4004)	1.641 (0.3475)
Age^2	0.742 (0.2209)	−0.401 (0.2015)	1.368 (0.1981)	−0.027 (0.1751)	1.303 (0.1984)	−0.065 (0.1751)
High Q3/Q1 career earnings ratio	0.067 (0.0425)	−0.013 (0.0389)	−0.031 (0.04)	−0.118 (0.0372)	−0.057 (0.0403)	−0.146 (0.0366)
Career before age 55:						
Cumulated earnings	−0.076 (0.3266)	−0.659 (0.1992)	−3.096 (0.2657)	−3.99 (0.2463)	−2.762 (0.2868)	−3.684 (0.2856)
Ever been unemployed	0.366 (0.0376)	0.332 (0.0347)	0.362 (0.0368)	0.336 (0.033)	0.409 (0.0385)	0.379 (0.0341)
Ever validated sickness quarters	0.179 (0.0359)	0.294 (0.0305)	0.199 (0.0347)	0.357 (0.0292)	0.226 (0.0351)	0.374 (0.0296)
Ever validated disability quarters	0.653 (0.1686)	0.989 (0.1735)	0.648 (0.144)	0.919 (0.167)	0.66 (0.1464)	0.952 (0.1657)
Number of Children:						
Less than 3 (ref)						
3 or more	0.196 (0.0427)	0.112 (0.032)	0.412 (0.0407)	0.265 (0.0309)	0.379 (0.0422)	0.259 (0.0313)
Log Likelihood	-10829.89	-14707.15	-11776.13	-15869.35	-11765.95	-15877.83
N	30919	40682	30919	40682	30919	40682

NOTE: Robust standard error clustered at the individual level are given in parentheses. The financial incentive used in the specification is indicated in columns.
SOURCE: EIR-EIC.

and are both associated with an increase in the claiming probability. It makes it difficult to disentangle between the two types of mechanisms. One solution to do so is to compare the relative evolution of the two channels over time.

The impact of financial incentives by cohort

In order to assess the relative impact of financial incentives and norms, as well as their evolution over time, we interact the main explanatory variables with cohort dummies (*slope effect*), add cohort dummies (*level effect*) and estimate the following model:

$$
\begin{aligned}
& P(Y_{it}=1|SSW_{it},FI_{it},FR_{it},EEA_{it},X_{it}) \\
= \quad & P\left(\sum_c D_{ic}\left(SSW_{it}\alpha_{1c}+FI_{it}\alpha_{2c}+FR_{it}\alpha_{3c}+EEA_{it}\alpha_{4c}+\alpha_{0c}\right)+X_{it}\alpha_5<\xi_{it}\right)
\end{aligned}
$$

where $P(Y_{it}=1)$ is the probability of individual i to retire at time t, D_{ic} equals 1 if individual i belongs to cohort c. Coefficients of interest are thus α_{1c}, α_{1c} and α_{1c}, that respectively measure the interaction between retirement incentives and cohorts.

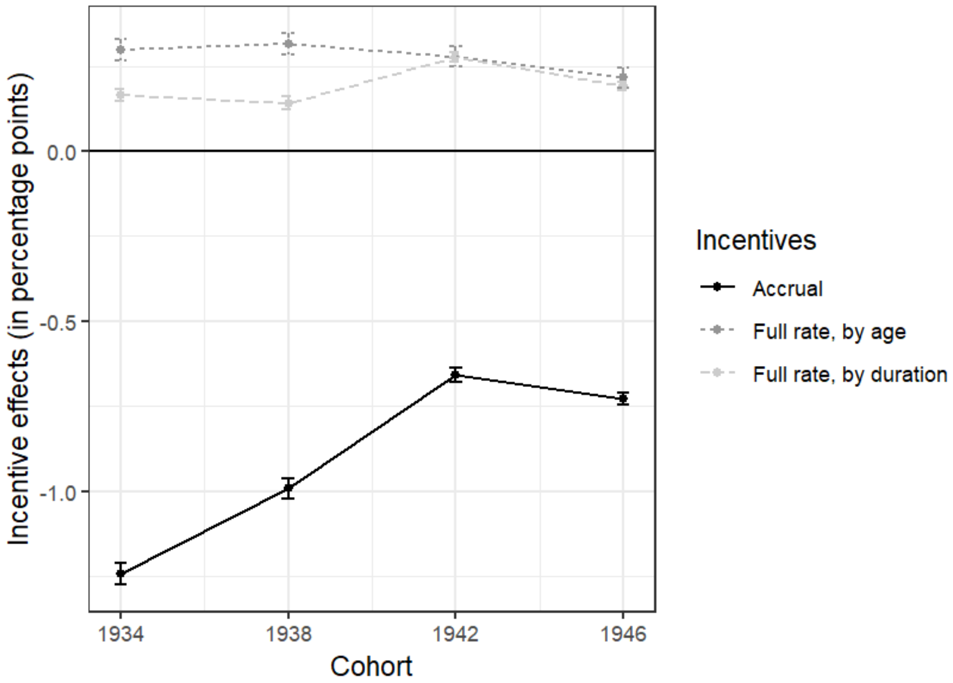
Figure 7 shows the marginal effect of variables of interest for each cohort.[7].

Although it is difficult to compare the coefficients associated to different variables, it is interesting to see their evolution over cohorts. The effect of the financial incentives tends to decrease in absolute value from cohort 1934 to 1946. The major change intervenes between cohort 1934 and cohort 1938. This change in parameters seems to compensate the observed increase in financial incentives described in section 4.1.

The pattern in coefficients associated to full rate dummy variables is less clear: reaching the full retirement age, or getting the required number of years of contributions to get the full rate does seem to have an effect that change over time.

[7]The full table of coefficient is given in appendix A, for the different incentive variables (Table 10). The marginal effect of implicit tax and peak value variables are given in Tables 12 and 13

Figure 7: Marginal effects for financial (accrual) and full rate incentives, by cohort



SOURCE: EIR-EIC

4.3 Counter-factual analysis

In order to assess the role of pension system reforms on the increase in employment rates of older workers, we simulate a scenario in which reforms would have not taken place. Then, we compare individuals' departure decision in two scenarios: one where current legislation is in force and one where reforms have not taken place. In France, the pension reforms that aimed at delaying the retirement age are the 1993, 2003, 2010 and 2014 reforms.[8] We thus build a counterfactual scenario, in which the 1992 context is preserved.

We distinguish two aspects of the 1992 context: the pension system legislation and the opening of alternative pathways.

As far as the legislation is concerned, it is easy to neutralise the changes in the pension legislation linked to the implementation of the reforms. We replicate the pension legislation in force in 1992 for all cohorts in our sample. Conversely, the data do not allow us to explain who goes through each alternative pathway. In particular, early retirement schemes opportunities are offered by firms, and workers are free to join or not. We do not have information on firms nor on workers' decisions towards early retirement opportunities. As

[8] The way different cohorts were affected by these reform can be seen in Table 1.

early retirement schemes are generous, we consider that all individuals who have been offered early retirement have accepted it. In order to build a counterfactual scenario without pension reforms, we thus replicate the proportion of individuals observed to go through the unemployment/early retirement route observed for the 1934 cohort. Indeed, the 1934 cohort is the one which has not been impacted by the recent pension reforms. We therefore make the assumption that, in the absence of reforms, the share of workers who were offered to withdraw from the labour market prior to claiming would have remained the same as the one observed level for the 1934 cohort.

Although the changes in legislation have an effect on the proportion of individuals taking the sickness/disability pathway (Rabaté & Rochut 2020), this is a second-order effect: as individuals stay longer on the labour market, they have more chances to take an alternative route to retirement. We thus decide to maintain the individuals observed in the sickness/disability pathway in our counterfactual scenario.

Finally, the adjustment of the number of people in each pathway is done by switching individuals from the normal pathway to the unemployment/early retirement pathway or vice versa, so as to replicate the proportions observed for the 1934 cohort, by gender. As we do not have information on the firms giving these opportunities to their salaries, we randomly reassign individuals from the normal to the counterfactual route, up to the 1934 observed proportions.

For each type of financial incentive (accrual, implicit tax and peak value), we estimate a logit model of retirement decision with cohort interaction (Table 10 in Appendix A). We use the coefficients to predict the average probability of retirement for the original dataset and for two counterfactual datasets: one in which the incentives have been recomputed with the 1992 pension legislation, and one in which the incentives have been recomputed in the global 1992 context (1992 legislation and alternative routes).[9] The effects of simulations are essentially a product of the change in incentives with and without the reforms (see Tables 14 and 15 in Appendix A).

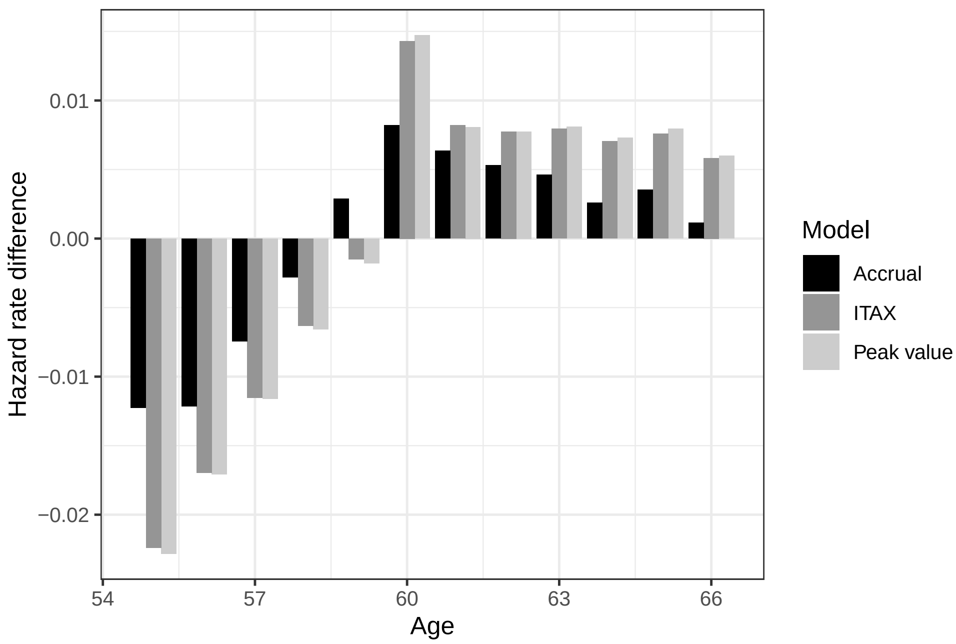
The pension system reforms since 1992 have delayed withdrawal from the labour force. Figure 8 shows the difference in claiming hazard rates predictions between 1992 counterfactual legislation and actual legislation. We observe a shift in the hazard rates by age, which are lower before early retirement age and higher after compared to a situation

[9] We also carry out the counterfactual analysis using the specification (3) coefficients (figures 16 to 19). Although with a not-so-good fit to the data, this specification leads to similar conclusions on the role of public policies and financial incentive on French labour force participation over cohorts.

in which legislation would have remained the same as in 1992. The further away the individuals were from the early retirement age, the stronger the effect.

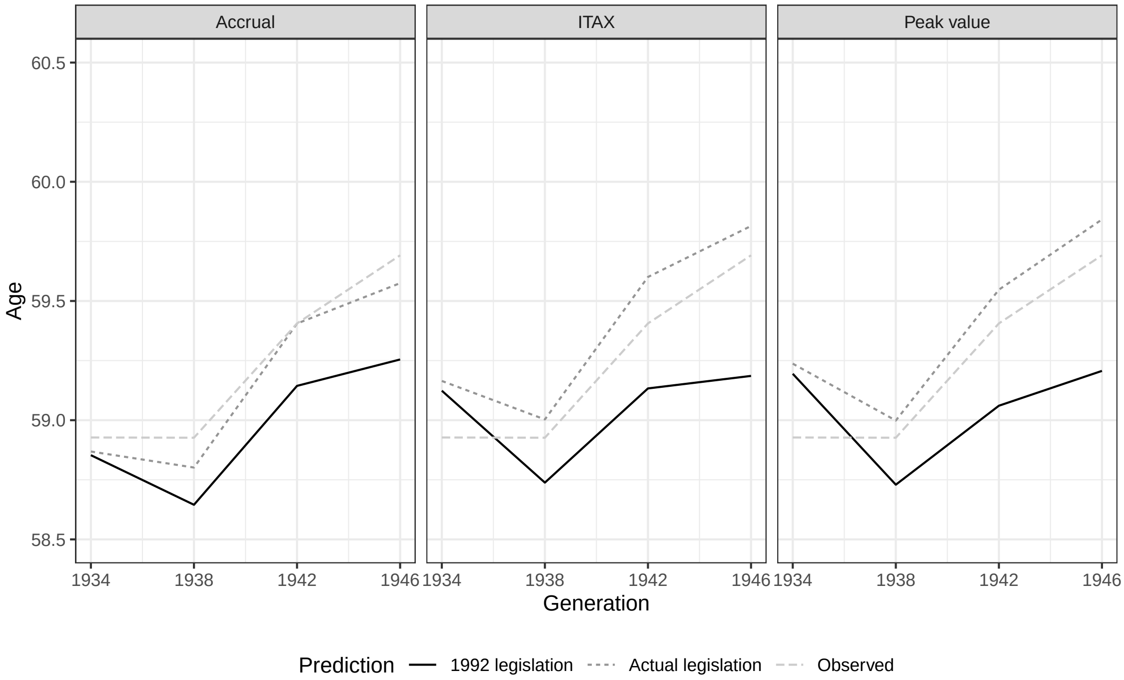
In terms of average age at retirement, it translates into an increase of almost half a year for the 1946 cohort compared to a situation in which the reforms would not have been enacted (the increases reaches four to six months according to the financial incentive used in the specification, see Figure 9). This observation is even stronger when we take into account the change in alternative pathways policies: the decline of early retirement schemes has resulted in a higher labour force participation, increasing the average age of retirement of three additional month (for the accrual specification, see Figure 10).

Figure 8: Difference in claiming hazard rates predictions, between 1992 counterfactual legislation and actual legislation



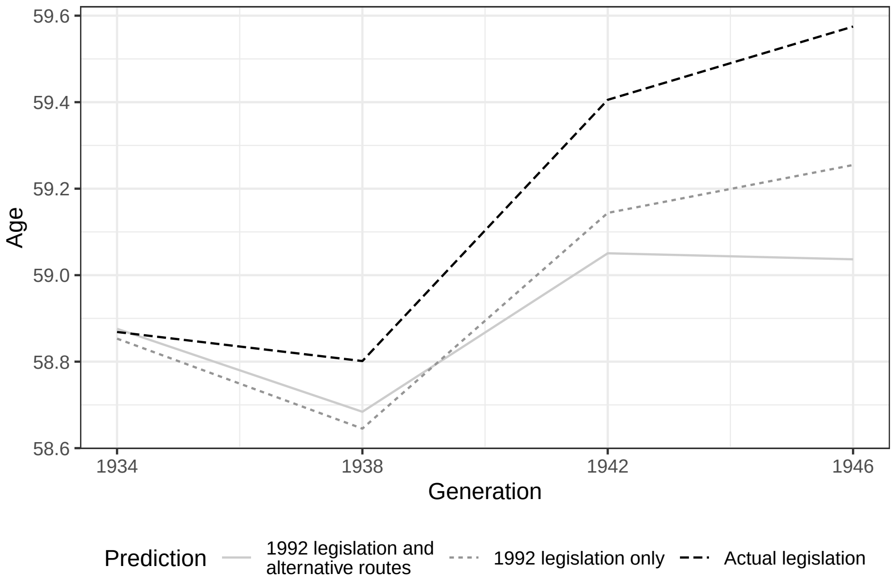
Source: EIR-EIC

Figure 9: Predictions of the average age at which is claimed a pension



SOURCE: EIR-EIC

Figure 10: Predictions of the average age at which is claimed a pension



NOTE: Financial incentive is accrual in the specification
SOURCE: EIR-EIC

Additionally to our conterfactual-analysis, we implement the NBER methodology (see

Introduction chapter). Contrary to ours, that consider retirement probabilities conditional on being on the labour force, the NBER methodology consists in computing unconditional retirement probabilities and using life table to make comparable working life expectancies between years.[10]

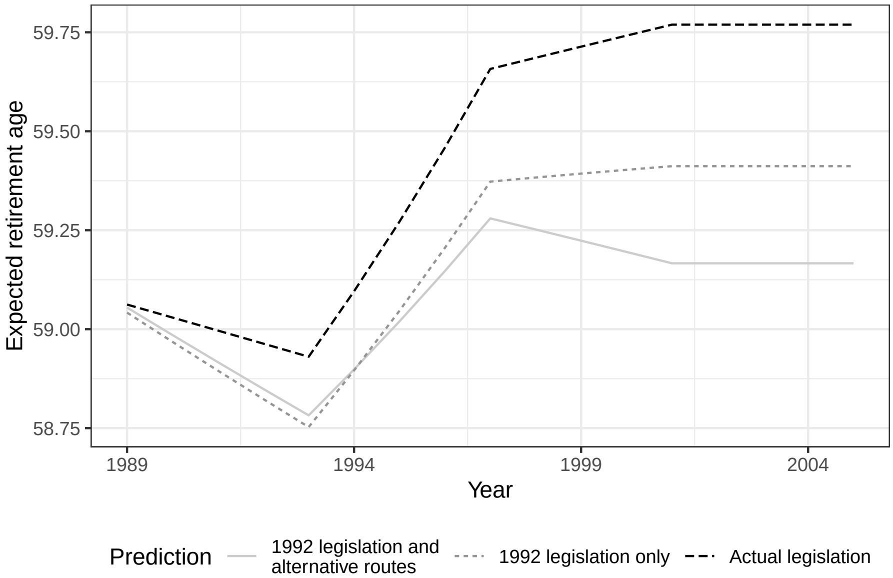
Because of our data structure—we only observe 1934, 1938, 1942 and 1946 cohorts over the years 1989 to 2012—we have to make assumptions on the retirement probabilities we do not observe a given year for a given age. For example, we cannot compute the retirement probability of individuals aged 55 from 1990 to 1992. We thus compute the missing probabilities using a linear interpolation of the two nearest values we have in hand (probability of individuals aged 55 from 1989 and in 1993 in the example). We set out of range probabilities equal to the closest known value.[11] For example, the probability of individuals aged 56 in 1989 are set equal to the probability of individuals aged 56 in 1990 (1934 cohort).

Using the specification with the accrual financial incentive, the methodology leads to similar results: in 2005, the expected retirement age at 55 years old is four months higher than it would have been in case of no reform since 1992 (Figure 11). Taking into account the decline of early retirement schemes increases the retirement age differential of three additional months. The actual relative change in the expected retirement age at 55 between 1989 and 2005 is 1.2 % (59.8 *vs.* 59.1) while the counterfactual relative change in the 1992 legislation scenario is 0.6 % (59.4 *vs.* 59). Then, our model explains almost half of the actual change as driven by the reforms. Taking into account the shift in early retirement scheme policy, we find that 84 % of the actual change in expected retirement age at 55 is explained by the reforms: the counterfactual relative change without reforms is 0.2 % (59.2 *vs.* 59.1).

[10] More precisely, the retirement probabilities are conditional on work at 55.

[11] The linear interpolation technique would alternatively lead to probabilities greater than 1.

Figure 11: Expected retirement age at 55



Note: Financial incentive is accrual in the specification
Source: EIR-EIC

5 Conclusion

We have computed financial incentives using microsimulation techniques for a sample of French retirees from different cohorts progressively affected by pension reforms since the 1990s. We show that these incentives do matter in explaining retirement decisions in addition to the impact captured by dummies for retirement age references. The relative impact of normative and financial incentives is hard to disentangle with the approach we adopt in this paper, as both types of incentives largely coincide in the French pension system. We nevertheless show that the importance of financial incentives increases over time, as normative and financial incentives are less and less aligned. This evidence of an effect of financial incentives over retirement behaviour suggests that they played a part in the reversal of employment of older workers observed over the last decades.

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A Additional results

Table 5: Logit estimation results for implicit tax rate

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	−2.52 (0.0238)	−2.078 (0.0248)	−2.134 (0.0258)	−2.137 (0.0265)	−3.461 (0.1126)	−2.822 (0.1176)
ITAX	1.095 (0.0822)	0.919 (0.0823)	0.573 (0.0713)	0.573 (0.0713)	0.734 (0.0789)	0.788 (0.0813)
SSW	0.404 (0.0085)	1.115 (0.0236)	0.824 (0.022)	0.824 (0.022)	0.623 (0.0244)	0.682 (0.0253)
Cumulated earning at 55		−3.747 (0.0888)	−2.865 (0.0865)	−2.86 (0.0873)	−1.917 (0.0998)	−2.052 (0.1019)
Full Rate			2.285 (0.0354)			
Full rate by age				2.345 (0.1068)	1.443 (0.1145)	1.411 (0.1142)
Full rate by duration				2.279 (0.0369)	2 (0.038)	1.204 (0.0476)
Age					1.594 (0.2359)	−0.088 (0.2557)
Age^2					−0.021 (0.1168)	0.798 (0.129)
Early retirement age						1.043 (0.0418)
Log Likelihood	-33323.27	-31854.07	-29100.86	-29100.67	-28541.83	-28254.14
N	71601	71601	71601	71601	71601	71601

NOTE: Robust standard error clustered at the individual level are given in parentheses.
SOURCE: EIR-EIC.

Table 6: Logit estimation results for peak value

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.245	0.931	−0.736	−0.732	−5.489	−4.738
	(0.093)	(0.1073)	(0.1113)	(0.113)	(0.2283)	(0.23)
Peak Value	−2.048	−2.237	−1.037	−1.039	1.222	1.149
	(0.0694)	(0.0789)	(0.08)	(0.0807)	(0.1158)	(0.1157)
SSW	0.373	1.108	0.828	0.828	0.597	0.658
	(0.0088)	(0.0245)	(0.0224)	(0.0224)	(0.0248)	(0.0258)
Cumulated earning at 55		−3.834	−2.927	−2.929	−1.687	−1.836
		(0.0923)	(0.088)	(0.0888)	(0.1059)	(0.1086)
Full Rate			2.225			
			(0.0358)			
Full rate by age				2.198	1.457	1.426
				(0.1089)	(0.115)	(0.1147)
Full rate by duration				2.228	2.024	1.244
				(0.0371)	(0.0379)	(0.0476)
Age					2.052	0.363
					(0.2417)	(0.2612)
Age^2					−0.084	0.728
					(0.1178)	(0.13)
Early retirement age						1.023
						(0.0419)
Log Likelihood	-33141.12	-31580.68	-29058.82	-29058.78	-28517.65	-28240.19
N	71601	71601	71601	71601	71601	71601

NOTE: Robust standard error clustered at the individual level are given in parentheses.
SOURCE: EIR-EIC.

Table 7: Accrual regressions specifications

	LPM	LPM FE	LPM RE	Probit	Probit RE
Intercept	0.105		0.105	−1.84	−3.568
	(0.0149)		(0.0149)	(0.079)	(0.1352)
SSW	0.025	−0.256	0.025	0.131	0.24
	(0.0031)	(0.0068)	(0.0031)	(0.0294)	(0.0261)
Accrual	−0.591	−0.724	−0.591	−3.052	−6.646
	(0.0183)	(0.0157)	(0.0183)	(0.26)	(0.1137)
Year dummies:					
Full rate by age	0.284	0.253	0.284	0.682	1.119
	(0.0217)	(0.0214)	(0.0217)	(0.068)	(0.112)
Full rate by duration	0.217	0.232	0.217	0.241	0.057
	(0.0109)	(0.0103)	(0.0109)	(0.0704)	(0.0519)
Early retirement age	0.197	0.154	0.197	0.798	1.467
	(0.0081)	(0.0076)	(0.0081)	(0.0367)	(0.0444)
Age	−0.229	0.798	−0.229	0.449	1.819
	(0.0331)	(0.0347)	(0.0331)	(0.1661)	(0.2794)
Age^2	0.276	0.156	0.276	0.39	0.155
	(0.0186)	(0.0196)	(0.0186)	(0.089)	(0.145)
Woman	−0.021		−0.021	−0.125	−0.222
	(0.003)		(0.003)	(0.0199)	(0.029)
High Q3/Q1 career earnings ratio	0.006		0.006	0.021	0.024
	(0.003)		(0.003)	(0.0199)	(0.0258)
Career before age 55:					
Cumulated earnings	0.023		0.023	−0.193	−0.401
	(0.0129)		(0.0129)	(0.1343)	(0.1285)
Ever been unemployed	0.037		0.037	0.205	0.348
	(0.0028)		(0.0028)	(0.0149)	(0.0244)
Ever validated sickness quarters	0.022		0.022	0.137	0.24
	(0.0025)		(0.0025)	(0.0129)	(0.0235)
Ever validated disability quarters	0.105		0.105	0.467	0.786
	(0.0166)		(0.0166)	(0.0679)	(0.0937)
Number of Children:					
Less than 3 (ref)					
3 or more	−0.015		−0.015	−0.083	−0.151
	(0.0026)		(0.0026)	(0.015)	(0.0245)
R^2	0.26	0.43	0.26		
adj-R^2	0.26	0.3	0.26		
Log Likelihood	-23444.93			-25792.28	-25589.18
N	71601	71601	71601	71601	71601

NOTE: Robust standard error clustered at the individual level are given in parentheses.
SOURCE: EIR-EIC.

Table 8: Implicit tax rate regressions specifications

	LPM	LPM FE	LPM RE	Probit	Probit RE
Intercept	0.184 (0.0187)		0.184 (0.0187)	−1.387 (0.0763)	−2.462 (0.1278)
SSW	0.093 (0.0055)	−0.149 (0.006)	0.093 (0.0055)	0.523 (0.0273)	0.965 (0.0238)
ITAX	0.08 (0.0067)	0.108 (0.0093)	0.08 (0.0067)	0.417 (0.042)	0.715 (0.0964)
Year dummies:					
Full rate by age	0.325 (0.0223)	0.291 (0.0222)	0.325 (0.0223)	0.867 (0.0694)	1.458 (0.1103)
Full rate by duration	0.324 (0.0097)	0.396 (0.0096)	0.324 (0.0097)	0.691 (0.0304)	1.083 (0.0477)
Early retirement age	0.173 (0.008)	0.112 (0.0075)	0.173 (0.008)	0.641 (0.0257)	1.114 (0.0422)
Age	−0.343 (0.0322)	0.705 (0.0326)	−0.343 (0.0322)	−0.086 (0.1407)	0.141 (0.2644)
Age^2	0.3 (0.0179)	0.149 (0.0181)	0.3 (0.0179)	0.45 (0.0729)	0.616 (0.1378)
Woman	−0.061 (0.0047)		−0.061 (0.0047)	−0.345 (0.0201)	−0.64 (0.0277)
High Q3/Q1 career earnings ratio	−0.003 (0.0041)		−0.003 (0.0041)	−0.041 (0.0172)	−0.074 (0.0251)
Career before age 55:					
Cumulated earnings	−0.309 (0.0298)		−0.309 (0.0298)	−1.954 (0.1321)	−3.618 (0.1184)
Ever been unemployed	0.041 (0.0029)		0.041 (0.0029)	0.204 (0.0135)	0.342 (0.0236)
Ever validated sickness quarters	0.029 (0.0025)		0.029 (0.0025)	0.151 (0.0122)	0.273 (0.0227)
Ever validated disability quarters	0.105 (0.0163)		0.105 (0.0163)	0.436 (0.062)	0.756 (0.0908)
Number of Children:					
Less than 3 (ref)					
3 or more	−0.032 (0.003)		−0.032 (0.003)	−0.181 (0.0145)	−0.344 (0.0237)
R^2	0.22	0.39	0.22		
adj-R^2	0.22	0.25	0.22		
Log Likelihood	-25380.56			-27659.86	-27707.34
N	71601	71601	71601	71601	71601

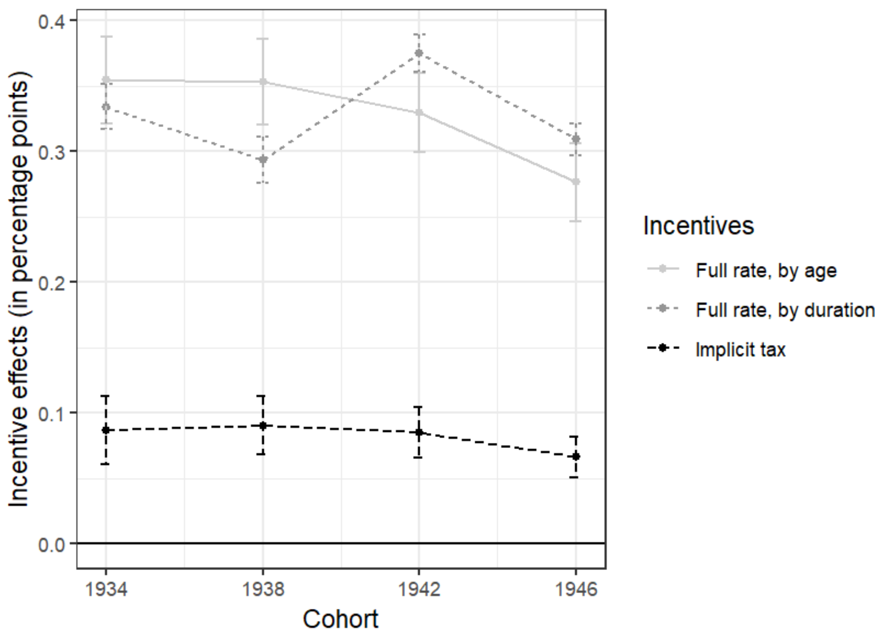
Note: Robust standard error clustered at the individual level are given in parentheses.
Source: EIR-EIC.

Table 9: Peak Value regressions specifications

	LPM	LPM FE	LPM RE	Probit	Probit RE
Intercept	−0.039		−0.039	−2.357	−4.227
	(0.0434)		(0.0434)	(0.1844)	(0.2657)
SSW	0.089	−0.146	0.089	0.505	0.926
	(0.0055)	(0.0062)	(0.0055)	(0.0284)	(0.0246)
Peak Value	0.131	−0.175	0.131	0.559	1.01
	(0.0195)	(0.0653)	(0.0195)	(0.0857)	(0.1316)
Year dummies:					
Full rate by age	0.327	0.295	0.327	0.878	1.477
	(0.0223)	(0.0223)	(0.0223)	(0.0697)	(0.1104)
Full rate by duration	0.329	0.4	0.329	0.715	1.127
	(0.0097)	(0.0096)	(0.0097)	(0.0305)	(0.0478)
Early retirement age	0.171	0.111	0.171	0.63	1.093
	(0.0081)	(0.0076)	(0.0081)	(0.0258)	(0.0422)
Age	−0.296	0.638	−0.296	0.13	0.539
	(0.033)	(0.0423)	(0.033)	(0.1452)	(0.2706)
Age^2	0.294	0.162	0.294	0.42	0.562
	(0.0179)	(0.0189)	(0.0179)	(0.0727)	(0.1381)
Woman	−0.053		−0.053	−0.309	−0.571
	(0.0052)		(0.0052)	(0.0226)	(0.0292)
High Q3/Q1 career earnings ratio	−0.008		−0.008	−0.058	−0.102
	(0.0037)		(0.0037)	(0.0163)	(0.0253)
Career before age 55:					
Cumulated earnings	−0.276		−0.276	−1.796	−3.301
	(0.0308)		(0.0308)	(0.1435)	(0.1272)
Ever been unemployed	0.046		0.046	0.226	0.385
	(0.0031)		(0.0031)	(0.0141)	(0.0243)
Ever validated sickness quarters	0.031		0.031	0.161	0.29
	(0.0026)		(0.0026)	(0.0123)	(0.0228)
Ever validated disability quarters	0.106		0.106	0.445	0.779
	(0.0165)		(0.0165)	(0.0622)	(0.0906)
Number of Children:					
Less than 3 (ref)					
3 or more	−0.03		−0.03	−0.173	−0.328
	(0.0031)		(0.0031)	(0.0149)	(0.0239)
R^2	0.22	0.39	0.22		
adj-R^2	0.26	0.3	0.26		
Log Likelihood	-25375.68			-27662.54	-27707.58
N	71601	71601	71601	71601	71601

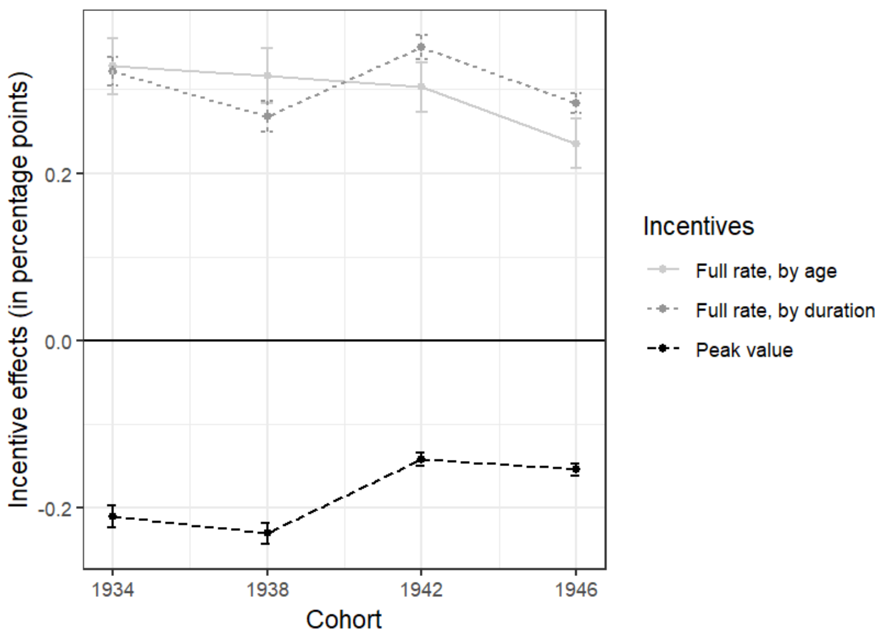
NOTE: Robust standard error clustered at the individual level are given in parentheses.
SOURCE: EIR-EIC.

Figure 12: Marginal effects for financial (implicit tax) and full rate incentives, by cohort



Source: EIR-EIC

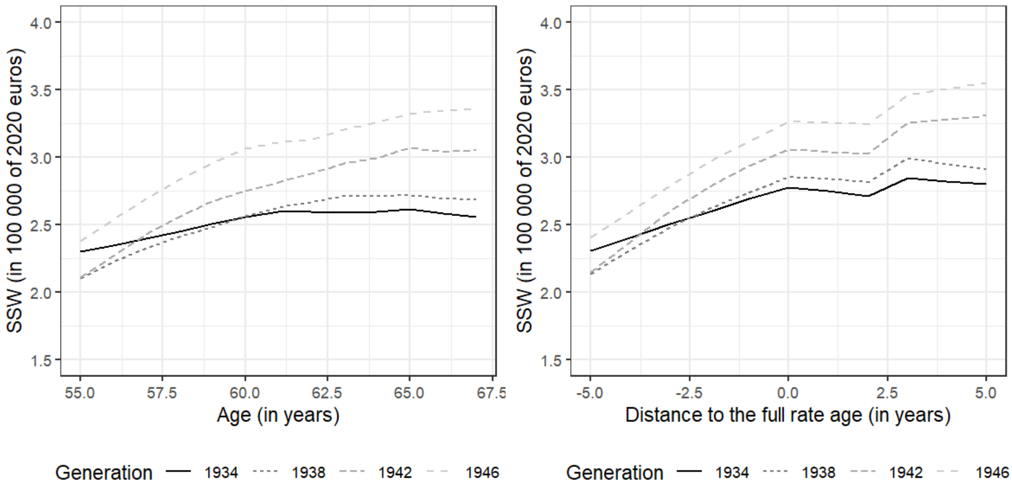
Figure 13: Marginal effects for financial (peak value) and full rate incentives, by cohort



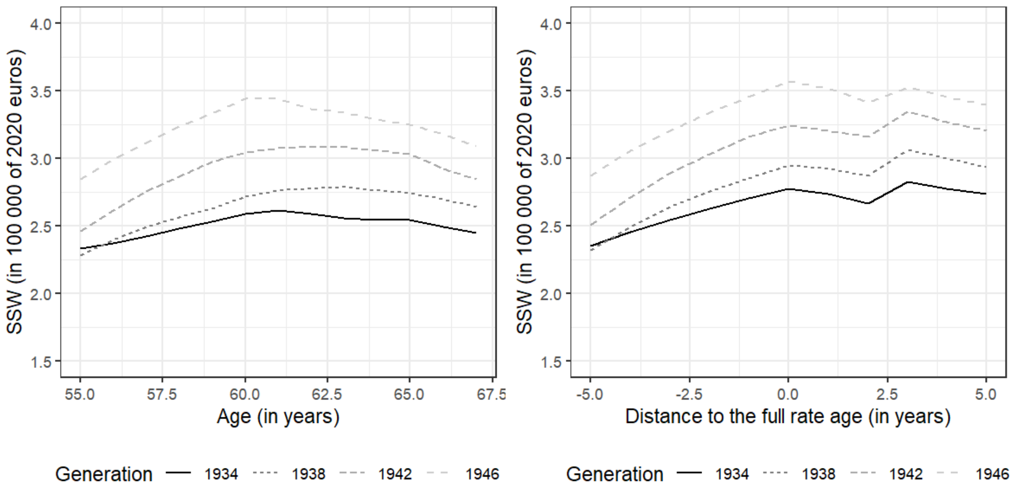
Source: EIR-EIC

Figure 14: Average Social Security wealth by cohort, per scenario

(a) Actual legislation



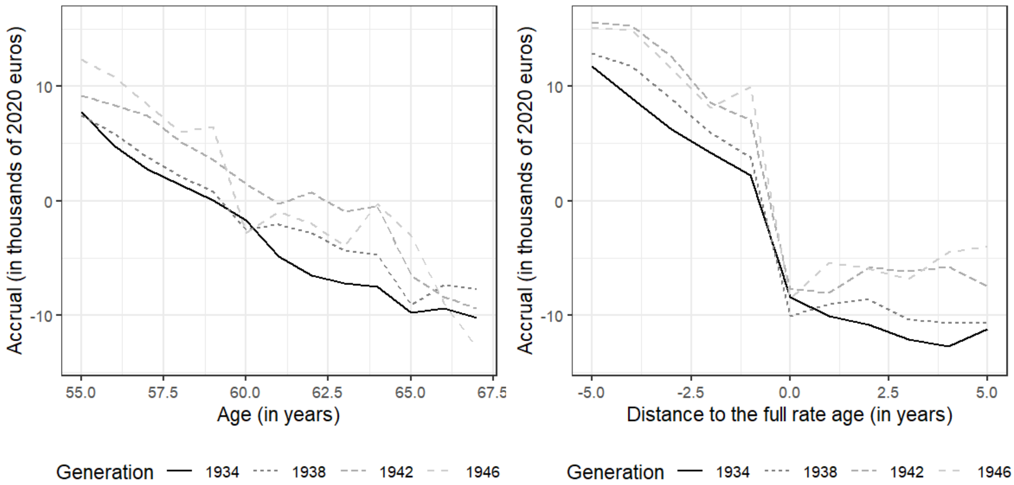
(b) 1992 legislation



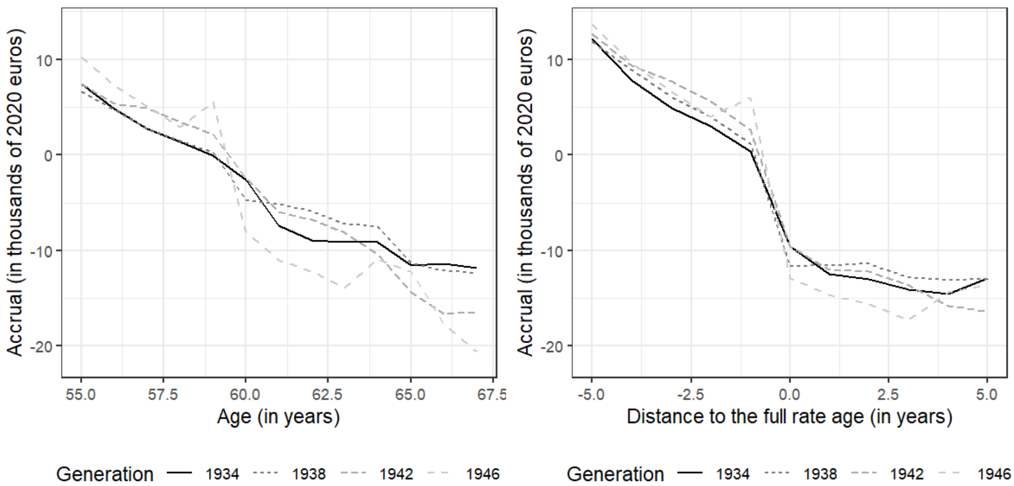
Source: EIR-EIC

Figure 15: Average accrual by cohort, per scenario

(a) Actual legislation

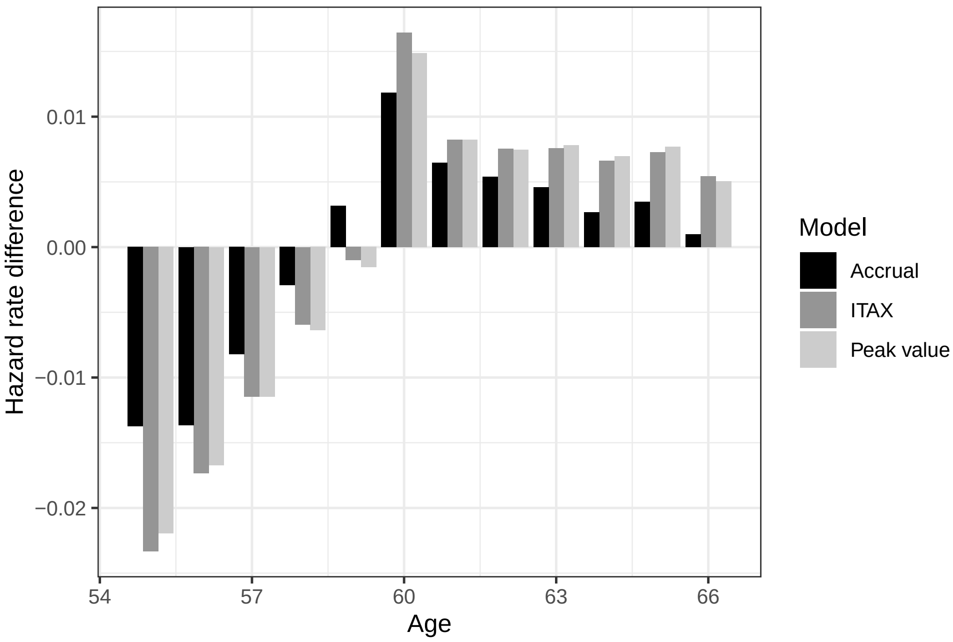


(b) 1992 legislation



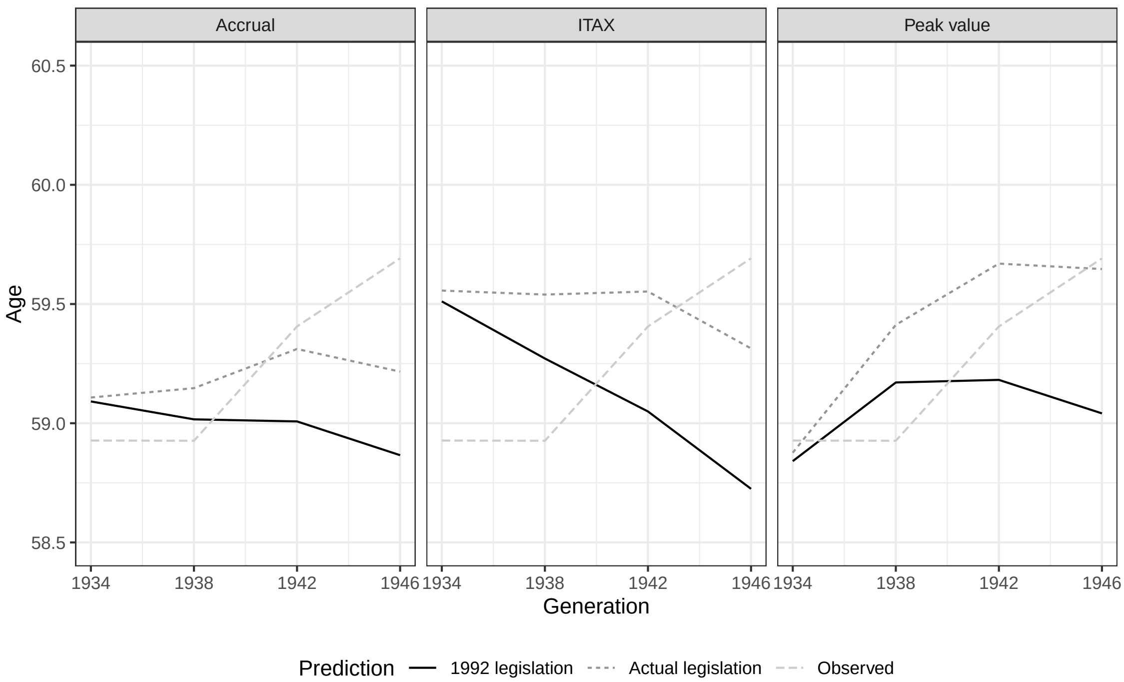
Source: EIR-EIC

Figure 16: Difference in claiming hazard rates predictions, between 1992 counterfactual legislation and actual legislation, specification (3)



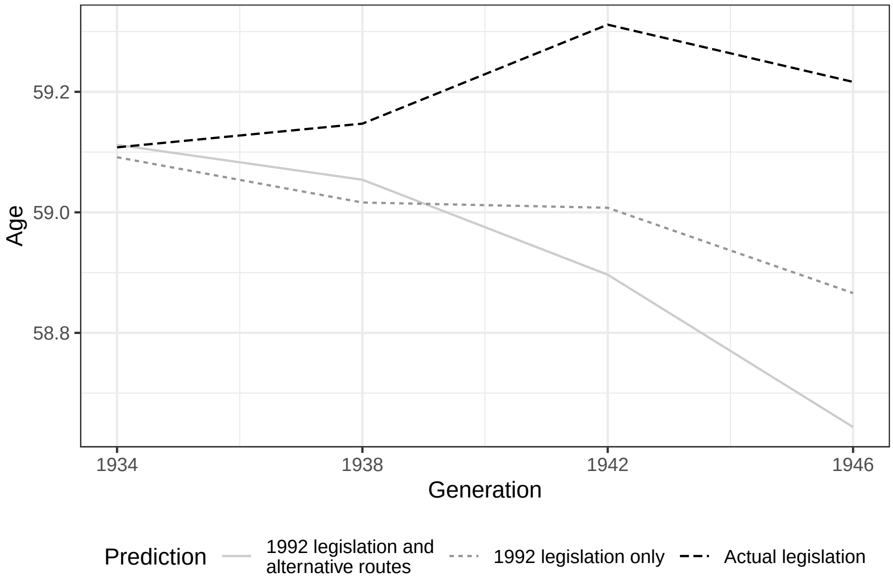
Source: EIR-EIC

Figure 17: Predictions of the average age at which is claimed a pension, specification (3)



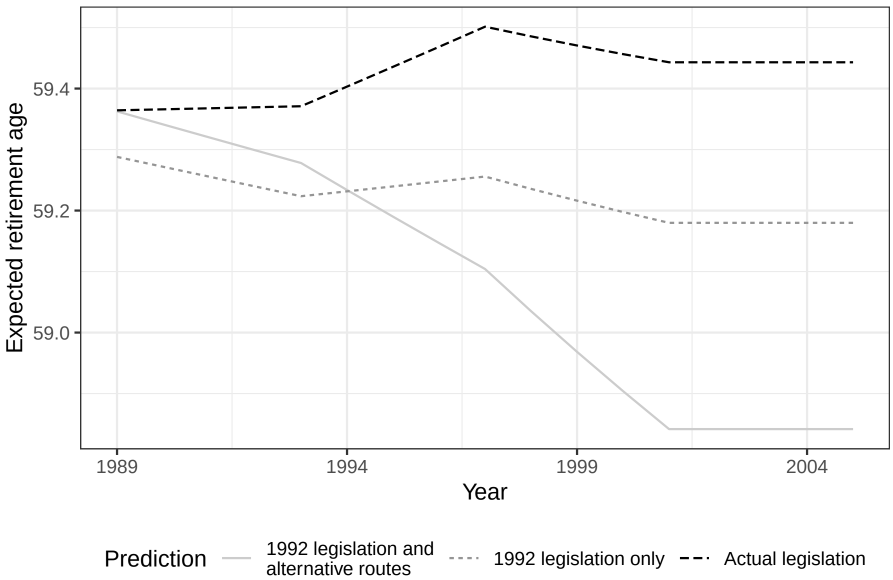
Source: EIR-EIC

Figure 18: Predictions of the average age at which is claimed a pension, specification (3)



Note: Financial incentive is accrual in the specification
Source: EIR-EIC

Figure 19: Expected retirement age at 55, specification (3)



Note: Financial incentive is accrual in the specification
Source: EIR-EIC

Table 10: Cohort random effect logit estimation results for all financial incentives, by gender

	Accrual		ITAX		Peak Value	
	Women	Men	Women	Men	Women	Men
Cohort dummy						
1934 (ref)						
1938	−0.032	−0.055	−0.025	−0.002	−0.117	−0.33
	(0.0123)	(0.0168)	(0.0115)	(0.0158)	(0.2466)	(0.279)
1942	−0.021	−0.066	−0.004	0.04	−0.482	−0.919
	(0.0123)	(0.0157)	(0.0117)	(0.0161)	(0.2441)	(0.2895)
1946	−0.035	−0.04	−0.038	0.008	0.198	−0.065
	(0.011)	(0.0149)	(0.0103)	(0.0145)	(0.1685)	(0.1952)
SSW						
1934	0.024	0.017	0.074	0.109	0.076	0.11
	(0.0051)	(0.0068)	(0.0099)	(0.0069)	(0.0102)	(0.0072)
1938	0.036	0.044	0.089	0.124	0.09	0.127
	(0.0055)	(0.0063)	(0.011)	(0.0064)	(0.0113)	(0.0065)
1942	0.015	0.019	0.066	0.088	0.069	0.094
	(0.0055)	(0.0068)	(0.0109)	(0.0071)	(0.0112)	(0.0074)
1946	0.02	0.01	0.076	0.097	0.078	0.098
	(0.005)	(0.007)	(0.0114)	(0.0073)	(0.0118)	(0.0077)
Financial incentive						
1934	−0.699	−0.87	0.156	0.04	−0.26	−0.253
	(0.0362)	(0.0364)	(0.0259)	(0.0229)	(0.122)	(0.1091)
1938	−0.589	−0.774	0.085	0.09	−0.214	−0.041
	(0.0377)	(0.0336)	(0.0216)	(0.0197)	(0.2616)	(0.2735)
1942	−0.502	−0.459	0.073	0.094	0.071	0.435
	(0.0309)	(0.0561)	(0.0253)	(0.0166)	(0.2768)	(0.3043)
1946	−0.557	−0.579	0.042	0.084	−0.504	−0.249
	(0.0259)	(0.0437)	(0.0167)	(0.0119)	(0.2279)	(0.2405)
Full rate by age						
1934	0.285	0.339	0.342	0.409	0.335	0.364
	(0.0522)	(0.0612)	(0.0535)	(0.0647)	(0.0566)	(0.0667)
1938	0.337	0.306	0.375	0.348	0.381	0.344
	(0.0482)	(0.0691)	(0.0483)	(0.0679)	(0.052)	(0.0699)
1942	0.22	0.375	0.257	0.413	0.3	0.476
	(0.0539)	(0.0533)	(0.0551)	(0.0535)	(0.0571)	(0.0556)
1946	0.251	0.148	0.297	0.192	0.262	0.159
	(0.0501)	(0.0765)	(0.0513)	(0.0775)	(0.0528)	(0.0785)
Full rate by duration						
1934	0.165	0.225	0.283	0.4	0.286	0.397
	(0.0355)	(0.0304)	(0.0347)	(0.0292)	(0.0349)	(0.0291)
1938	0.203	0.129	0.308	0.283	0.314	0.286
	(0.0357)	(0.0322)	(0.0355)	(0.0307)	(0.0356)	(0.0307)
1942	0.254	0.317	0.338	0.396	0.347	0.411
	(0.0299)	(0.0279)	(0.0293)	(0.0223)	(0.0299)	(0.0227)
1946	0.197	0.222	0.291	0.322	0.288	0.319
	(0.0242)	(0.0255)	(0.0239)	(0.0214)	(0.024)	(0.0214)
Early retirement age						
1934	0.31	0.216	0.271	0.153	0.263	0.139
	(0.0275)	(0.026)	(0.0271)	(0.026)	(0.0273)	(0.0264)
1938	0.22	0.218	0.189	0.188	0.193	0.192
	(0.0254)	(0.0248)	(0.0253)	(0.0247)	(0.0257)	(0.0255)
1942	0.218	0.188	0.191	0.159	0.205	0.175
	(0.0231)	(0.0184)	(0.0228)	(0.0182)	(0.0232)	(0.0187)
1946	0.193	0.102	0.181	0.097	0.175	0.095
	(0.0201)	(0.0175)	(0.0197)	(0.0178)	(0.0198)	(0.0182)
Log Likelihood	-9737.52	-13291.13	-10498.6	-14591.29	-10496.16	-14585.49
N	30919	40682	30919	40682	30919	40682

Note: Robust standard error clustered at the individual level are given in parentheses. The financial incentive used in the specification is indicated in columns. All specification include controls for age, career paths and number of children.

Source: EIR-EIC.