

Changes in Extended Unemployment Benefit eligibility age: evidence from Finnish register data

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Non-technical summary

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We show that the composition of the long-term unemployed changed over time: whilst most remained low-educated former manual workers, later cohorts included larger shares of tertiary-educated former professionals. Moreover, we find earlier reforms affected a broad group of unemployed individuals, whereas later reforms disproportionately affected highly educated professional employees. Our findings highlight the need to pay particular attention to heterogeneity in response behaviour when assessing reforms to early retirement pathways and to consider their cohort-specific distributional consequences.

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Abstract

We examine how changes to Extended Unemployment Benefit, an early retirement pathway for long-term unemployed workers in Finland affects labour market outcomes, using three reforms for identification. In 2003, minimum eligibility age was raised from 57 to 59, in 2010 to age 60 and in 2014 to age 61. We show that among individuals previously employed in the private sector the 2003 reform had the largest effect: cumulative employment by age 63 increased by 10 months, unemployment declined correspondingly, and earnings increased by €39,700 (in 2024 prices). While the 2014 reform increased cumulative employment by 3.2 months and earnings by €14,500, we find only limited evidence that the 2010 reform increased employment and earnings. Among individuals previously employed in the public sector, only the 2003 reform had an effect, increasing employment by 2.7 months but having no impact on earnings. We show that the composition of the long-term unemployed changed over time: whilst most remained low-educated former manual workers, later cohorts included larger shares of tertiary-educated former professionals. Moreover, we find earlier reforms affected a broad group of unemployed individuals, whereas later reforms disproportionately affected highly educated professional employees. Our findings highlight the need to pay particular attention to heterogeneity in response behaviour when assessing reforms to early retirement pathways and to consider their cohort-specific distributional consequences.

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1. Introduction

Reducing extended periods of unemployment and inactivity has come to the forefront of the policy agenda across Western economies (Arranz & García-Serrano, 2023; Dlugosz, Stephan & Wilke, 2014). Across OECD countries, long term unemployment defined as being out of the labour market for at least one year accounted for 25.5% of total unemployment in 2023 (Dromundo, Luske and Tuccio, 2023). The problem is particularly acute for older individuals closer to pension eligibility age who are more likely to have outdated skills, less incentive to retrain and the availability of programmes which provide a bridge to early retirement (Lalive, 2008).

At same time, ageing populations have contributed to fiscal pressures in developed countries and led to governments implementing measures in the attempt to extend working lives (Léime, 2019). Crucially, typical reforms such as raising the normal (first pillar) retirement age are more effective if individuals are engaged in the labour market close to or at eligibility age. Therefore, understanding how reforms to early retirement pathways particularly those targeting older unemployed individuals impact labour market outcomes is critical to informing coordinated approaches to policymaking and ensuring programmes achieve their objectives.

Finland serves as a typical case in point. During the 1990s and 2000s several routes existed by which individuals could exit the labour market prior to normal retirement age. One of the main pathways was the ‘unemployment tunnel’, combining the Extended Unemployment Benefit (EUB), which extended earnings-related unemployment benefits beyond the typical two-year period for older long-term unemployed individuals, with the subsequent Unemployment Pension (UP). In practice, the unemployment tunnel provided individuals with a direct route from their initial unemployment spell – which up until the mid-2000s could begin at age 55 – to retirement. The institutional rules provided an incentive for the employers to lay off older employees, which resulted in excessive unemployment at minimum eligibility age for EUB (Kyyrä et al., 2017). By 1999, the widespread use of such practices contributed to a gap of over 5 years between the effective and normal retirement age (Nivalainen et al. 2020).

In response, successive Finnish governments have sought to reform the unemployment tunnel. A series of laws passed in 2003, 2010 and 2014 increased the EUB minimum eligibility age. Yet only the first of these, which increased the age limit from 57 to 59 and affected all birth

cohorts born post 1949, has been studied systematically, focusing on private sector employees (Kyyrä and Pesola, 2020).¹ The authors show individuals belonging to the 1950 cohort spent on average 7.5 months longer in employment and earned on average €22,300 (2013 prices) more by the time they reached age 63 than their 1949 counterparts.

Using rich population registers, we extend the analysis by evaluating two subsequent increases in eligibility age to 60 and 61 and also examine the effect of reforms on public sector workers. Moreover, we document how the *type* of EUB claimants has changed across successively younger birth cohorts and highlight the importance of understanding the extent to which treatment effects differ by socioeconomic group in this context. Our findings have implications for the design and targeting of long-term unemployment programmes for older workers as well as for understanding reform impacts on different societal groups. Separately, in the context of ageing populations and reforms to normal retirement age, our research underlines the need for policymakers to better understand the labour market situation of individuals in the period just prior to reaching normal retirement age.

Our paper extends the literature in a number of ways. First, we provide new evidence on the long-term labour market effects of *successive* increases to age eligibility criteria in the context of a single long-term unemployment programme aimed at older workers. Our findings complement previous research, which typically evaluates one-shot reforms and shows raising minimum eligibility ages tends to raise employment among affected cohorts (Kyyrä & Wilke, 2007; Müller, Wilke & Zahn, 2007). Second, we show that affected cohorts respond to reforms at higher age thresholds than has been previously studied. For example, Arranz & García-Serrano (2023) find the probability of exiting unemployment (at ages 52-54) increased by 83%, following an increase in minimum eligibility age from 52 to 55 for long term unemployment assistance in Spain.

The EUB reforms we study impacted groups in their late 50s and early 60s which is arguably more important for determining the effectiveness of broad based initiatives such as reforming first pillar pension age, which have become widespread (Atalay & Barrett, 2015; Staubli and Zweimüller, 2013). Indeed, much of the existing research is limited to exploiting reforms to

¹ Kyyrä and Wilke (2007) investigate an earlier reform implemented in 1997 which raised the EUB eligibility age from 53 to 55 for all cohorts born post 1943 and find significant reduction (increases) in unemployment inflows (outflows) following the reform.

early and normal retirement pathways open to broad groups which typically involve only incremental increases in eligibility age or only measure short term labour market outcomes (Arranz & García-Serrano, 2023; Atalay & Barrett, 2015; Ardito, 2021; Cribb, Emmerson & Tetlow, 2016; Staubli and Zweimüller, 2013; Frimmel, 2021; Riphahn et al., 2023; Geyer and Welteke, 2021). Whilst our findings show the effect of successive age-eligibility hikes on long-term labour market outcomes tends to diminish in magnitude, even at the highest age considered in this study, 61, we nevertheless document an increase in cumulative employment of 3 months among affected individuals previously employed in the private sector.

Third, we contribute to an important literature regarding the design of long-term unemployment programmes. A long line of research shows changes in unemployment benefit duration strongly influence unemployment transitions (Dlugosz, Stephan & Wilke (2014), Inderbitzin, Staubli & Zweimüller (2016); Lalive (2008); Winter-Ebmer (2003)).² Moreover, Røed and Westlie (2012) note the importance of distinguishing between so-called “hard” and “soft” constraints in the context of benefit duration, defined as complete exhaustion versus some form of follow-on benefit, respectively. We contribute to this scant literature but focus on reforms to age eligibility criteria rather than benefit duration (which was unchanged in all reforms), in a Nordic system with soft constraints i.e. which provided ongoing benefits at a lower level following the exhaustion of earnings-related Unemployment Insurance (UI).

Fourth, we contribute to a small but growing literature analysing heterogeneity in treatment behaviour in the context of long term UI programmes (see inter-alia Felder, Frings and Mittag (2024); Kyrrä & Pesola (2020), Nekoei and Weber (2017); Wunsch and Zabrodina (2023)). Importantly, the series of reforms we study are, at least notionally, very similar. Yet we find the extent to which groups responded varied at increasingly higher ages. Such findings have important implications for informing the design of UI programmes, in particular the capacity for certain types of individuals to extend their working lives.

We show successive increases to EUB minimum eligibility age led to significant increases in long term cumulative employment and earnings however the magnitude of treatment effects varied substantially by reform. Among individuals previously working in the private sector, treatment effects range from 10 months of additional employment and €39,700 (2024 prices)

² Evidence also shows the timing of benefit withdrawal matters (see Card, Chetty and Weber, (2007)).

in earnings in the case of the 2003 reform, which raised eligibility age from 57 to 59, to 1.9 months and €7,000 in the case of the 2010 reform and 3.2 months and €14,500 in the case of the 2014 reform, which raised eligibility age from 60 to 61. Among individuals previously employed in the public sector, only the 2003 reform increased employment, by 2.7 months, with no discernible effect on earnings.

We separately observe differences in response behaviour by occupation, education and gender. Response behaviour also changed over time: whereas earlier reforms affected a broad group of unemployed individuals, later reforms disproportionately affected highly educated professional employees. Finally, a key finding and contribution of the study is to show that the composition of the long-term unemployed in Finland has changed: although most remain low-educated former manual workers, later cohorts include a larger share of tertiary-educated former professionals.

The rest of this paper is set out as follows, section 2 provides an overview of the Finnish institutional context with respect to unemployment and early retirement pathways. Section 3 discusses the data and methodological approach. Section 4 presents our main findings and sensitivity analysis. Section 5 concludes.

2. Institutional context

2.1. Unemployment insurance and Reforms to EUB

Unemployment insurance in Finland can take one of two forms, earnings or non-earnings related, where the latter is provided by the state and is typically less generous in terms of its replacement rate (see Kyyrä et al., (2017) for a detailed review). For working age individuals, unemployment insurance is available for the first 500 days of unemployment.³ Following this period if an individual is not eligible for an extended unemployment pathway, they are automatically transferred onto a non-earnings related benefit known as Labour Market Support Days (LMS).⁴

For older individuals, until 2003 special rules applied such that after 500 days of unemployment, Extended Unemployment Benefit (EUB) was available at age 57 until age 60

³ The 500 days exclude weekends.

⁴ LMS is available for an indefinite period however claimants are encouraged to seek employment during the claim period.

at which point individuals automatically transferred onto Unemployment Pension (UP).⁵ ⁶ Eligibility for EUB (irrespective of reform) is based on two employment conditions (i) prior to their initial period of unemployment individuals worked 10 out to the previous 28 months and (ii) individuals should have worked at least 5 out of the previous 15 years prior to their initial EUB claim.

Individuals then claimed UP until reaching Ordinary Pension (OP) eligibility age (i.e. first pillar pension available at age 65 in 2003). In 2003 UP was abolished for individuals born after 1949 and those claiming unemployment benefits were granted Additional Days of unemployment Allowance (ADA) between age 60 and OP age, noting the level of the benefit was unchanged and identical to that available under UP.⁷ Collectively, this pathway was referred to as the ‘unemployment tunnel’ and a common route to early retirement (Kyyrä and Pesola, 2020).⁸

As part of an effort to extend working lives and reduce the prevalence of early retirement behaviour Finnish policymakers enacted a series of reforms in 2003, 2010 and 2014 to increase the minimum eligibility age for EUB.

The first reform, announced in 2002 and becoming law later the same year took effect on 1st January 2003 and increased the minimum eligibility age to 59 for cohorts born 1950 and onwards, in effect individuals who were born in 1950 and intended to claim EUB could begin their initial spell of unemployment at age 57 in 2007. Whereas individuals born in 1949 could enter unemployment at age 55 in 2004.

The second reform, announced in 2009 and becoming law later the same year, came into effect on the 1st January 2010 and raised the minimum eligibility age by 1 year and affected all cohorts born in 1955 and onwards. In practice, this implied an individual could transition to unemployment at age 58 in 2013 and claim EUB at age 60 in 2015.

⁵ For individuals to be eligible for UP they must have exhausted their unemployment benefit entitlement period and worked 5 out of the previous 15 years prior to their initial UP claim.

⁶ Subject to meeting the age and recent working history criteria, EUB is available to individuals who are members of their unemployment fund and non-members (but the latter receive a lower rate of benefit known as basic unemployment allowance). In practice most workers are members (see Kyyrä et al., 2017) for further details.

⁷ Following the 2003 reform individuals claiming EUB could claim OP at age 62 without penalty.

⁸ Evidence suggests eligibility ages acted as a signal to both individuals and employers in terms of a means to exit the labour market either by choice or due to being laid off.

The final reform, announced in 2012, becoming law in 2013 and effective from 1st January 2014 raised the minimum eligibility age for EUB to 61. For individuals born in 1957 and onwards and who intended to claim EUB, the first spell of unemployment could start at age 59 in 2016.

2.2. Ordinary Pension and alternative early retirement pathways

As part of a wider effort to increase the effective retirement age in Finland a major reform to the pension system took effect in 2005. This included a flexible retirement age between 63 and 68, in effect the minimum eligibility age to receive full OP was reduced from 65 to 63 and became the default retirement age (Gruber et al., 2022). At the time, it was possible to claim OP early at age 62 subject to a permanent reduction in benefit level.⁹ In 2013, legislation abolished the early old-age pension for all cohorts born in 1952 or later.

In 2017 OP eligibility age was gradually increased stepwise by three additional months for each single year birth cohort starting 1955. The 2017 reform was first announced at the end of 2014 and passed into law in Autumn 2015. Nevertheless, as part of our robustness checks we provide evidence which suggests that the 2017 OP reform did not influence our main findings.

A myriad of early retirement pathways each with their own eligibility conditions existed in Finland during the 1990s and early 2000s and have since been reformed or abolished over time. Older individuals with health conditions could retire from work subject to particular criteria via Ordinary Disability Pension (ODP) or Individual Early Retirement (IER), the latter having relatively more lenient eligibility criteria.¹⁰ Starting in 2004 IER was abolished and ODP criteria were relaxed (in line with the previous IER rules) such that so-called ‘relaxed’ ODP was available at age 60 to all cohorts born in 1944 and onwards.¹¹ This reform did not have

⁹ Prior to 2005, individuals could claim the Early Old Age Pension (EOAP) from age 60, subject to a permanent 0.4% reduction in benefits for each month claimed before age 65. Conversely, delaying retirement increased benefits by 0.6% per month beyond the eligibility age. Following the 2005 reform, the earliest claiming age was raised to 62, and the early retirement deduction increased to 0.6% per month. Postponing retirement after age 63 no longer generated a delayed retirement credit, but work was rewarded through a higher pension accrual rate of 4.5% per year based on earnings.

¹⁰ The minimum age criteria for IER was 58. ODP is available to all adult individuals as it is the main disability benefit.

¹¹ Kanabar et al. (2024) evaluate the 2004 reform to IER and ODP and show the relabelling effects to ‘relaxed’ ODP led to a sharp reduction in applications and successful awards, though the effects were disproportionately concentrated among lower educated individuals and those with stronger lifetime labour force attachment.

systematically different effects across the birth cohorts affected by the EUB reforms. Kyyrä (2015) shows that an earlier increase in the age limit of EUB from 55 to 57 which took effect in 1997 (for all cohorts born 1943 onwards) did not change the likelihood of transitioning to disability pension at ages 53 or 54, or the cumulative incidence of claiming disability pension by age 63. More generally, previous research shows that EUB eligibility has no significant spillover effects (positive or negative) on the odds of exiting the labour market via a disability pathway, and vice versa for IER eligibility on the odds of unemployment, implying these disability-related pathways are not substitutes to EUB (Kyyrä, 2015; Uusitalo & Nivalainen, 2013).

Individuals wishing to reduce their working hours but not exit the labour market had the option to transition to Part Time Pension (PTP) until 2016. To be granted PTP individuals and their employer had to jointly agree a work plan, in addition, a successful award was conditional on individual's work history. The eligibility criteria for PTP varied by sector. Private-sector workers must have been employed full-time for at least two-thirds of the 18 months immediately before applying; public-sector workers must have been employed full time for at least three out of the preceding five years. Irrespective of sector, individuals must have been in employment at least five out of the previous 15 years prior to application. The level of benefit paid is equal to 50% of the difference between full and part-time earnings (Kyyrä, 2015).

The eligibility age to claim PTP prior to 1998 was 58-64, in 1998 the minimum eligibility age was reduced to 56 for individuals born between 1942 and 1946 and was subsequently increased to 58 starting 2003 for all cohorts born 1947 and onwards. In 2011, the age limit was increased to 60 for those born in 1953 and later, and in 2013 to 61 for those born 1954 onwards. The last PTPs were granted in 2016. For the birth cohorts used to analyse the 2003 and 2010 EUB reforms (1949-1950 and 1954-1955, respectively), the age limit for PTP was 58 and 61, respectively. We note these ages are above the minimum eligibility age for individuals starting their initial unemployment journey (unemployment tunnel can occur up to two years prior to reaching EUB eligibility age). PTP was only available to individuals employed in full time work at the time of application and therefore cannot be regarded as a substitute to EUB.

Starting from 2017 (and announced in 2014), Partial Old-Age Pension (POAP) replaced PTP for all cohorts born 1949 and later. Under the 2017 system which is still in effect at the time of writing, an individual may claim 25% or 50% of their accrued earnings-related pension as

partial old-age pension with an actuarially fair reduction. The minimum eligibility age to claim POAP is 61 and coincides with the EUB eligibility age following the 2014 reform (affecting those born in 1957 and onwards) but is above the age at which unemployment tunnel could begin. In contrast to PTP, POAP does not condition on individual's labour market status nor does it require formal agreement between an individual and their employer.¹² Moreover, POAP is available to individuals claiming EUB and so can be regarded as a complementary pathway. As part of our sensitivity analysis we analyse POAP claims at ages 61-63 among individuals belonging to 1956 and 1967 birth cohorts to rule out spillover effects biasing our findings.

3. Data and methods

Data

We utilise administrative data compiled from the registers of the Finnish Centre for Pensions (FCP). The sample is restricted to individuals who have accrued social security in Finland, are born between 1949 and 1957 and covers the period 1997-2020. The registers contain a range of economic and sociodemographic information collected on an annual basis (recorded 31st December). Further details regarding the information available can be found in Table 1 in Section 4.2.

Crucially, the data includes information relating to individuals' work history, including sector of work, employment earnings and periods of employment and unemployment. Both days worked and annual earnings is available from 1997 whereas unemployment is recorded from 2005 onwards. The data includes information on educational attainment and socioeconomic status available via registers provided by Statistics Finland. Spousal information is unavailable. Due to the lag between policy announcement and implementation, following Kyrrä and Pesola (2020) we specify individuals' sector of work one year prior to the year in which each EUB reform was announced. This implies that all individuals in the sample were working at the end of 2001, 2008 and 2011, respectively. We restrict attention to individuals working in the private

¹² Individuals could claim either 25% or 50% POAP. Claimants could initially claim 25% and subsequently increase this to 50% but not vice-versa. In practice, all POAP claims are approved conditional on individuals meeting the minimum age requirements. If POAP is claimed prior to the age of 61, the part taken out is permanently reduced by 0.4 per cent per month from the time of taking out the pension to the time of reaching the OP age. If POAP is deferred following retirement age, the part taken out is permanently increased by 0.4 per cent per month from the month in which the retirement age is reached to the month that the pension is taken out. There are no restrictions regarding how much an individual can work while drawing a partial old-age pension (ETK, 2025).

and public sector for analysis purposes for whom eligibility criteria for EUB are identical (the self-employed are ineligible).

In order to proxy the recent employment condition, we restrict our analysis sample to individuals who have worked at least 35% in the two years prior to the age at which the initial period of unemployment could begin given EUB eligibility rules at the time. This is computed at the eligibility age relevant for the control cohort used to evaluate each respective reform. For example, in the case of the 2003 (2010) reform the recent employment condition is measured based on individuals employment history at 53-55 (55-57), given their initial spell of employment could begin at 55 (57) and eligibility for EUB was 57 (59).¹³ Given our register data capture complete labour market history starting from 2005 it is not possible to assess whether individuals' meet the long term employment condition (i.e. whether an individual has worked 5 out of the previous 15 years) in the case of birth cohorts used to evaluate the 2003 reform.¹⁴ As part of the robustness checks we show that in the case of the 2010 and 2014 reforms imposing this condition does not change the qualitative nature of the findings.

Methods

Individuals' minimum eligibility age for EUB is conditional on their full date of birth which is available in FCP registers. Therefore, it is possible to compare differences in labour market outcomes between birth cohorts born just before and after the reform cutoff date allowing us to identify treatment effects using a sharp Regression Discontinuity Design (RDD).

Regression Discontinuity (RDD) exploits exogenous policy changes and allows us to circumnavigate the endogeneity problem under certain assumptions. In the context of EUB, if an individual's observable and unobservable characteristics are correlated with the decision to take up benefits and is not controlled for this will bias our findings. RDD addresses this issue by exploiting exogenous variation in otherwise similar individuals who only differ in their date

¹³ Alternatively, one can define eligibility using prorated age. However, because employment histories are observed only at the annual level, such a measure is mechanically dependent on individual's date of birth and assumptions regarding the timing of employment within the reference years. We therefore prefer the simple eligibility rule, which is calendar-neutral and avoids an additional layer of constructed variation and so provides a more transparent and robust basis for identification.

¹⁴ For the same reason we assess cumulative labour market outcomes between ages 56-63 in the case of the 2003 reform.

of birth. In each of the three reforms we aim to isolate the effect of the increase in minimum eligibility age on three cumulative outcomes: employment, earnings and unemployment.

Our register data allows us to analyse the effect of reforms on long-term labour market outcomes, which are arguably more relevant in terms of their policy implications compared to short term outcomes. We compare outcomes between ages 56-63, 57-63 and 58-63 for the 2003, 2010 and 2014 reforms, respectively. Due to the register data recording labour market information on an annual basis, we prorate outcomes within calendar years using individuals' full dates of birth. We assume that the labour market outcome of interest is distributed evenly within each relevant age-calendar window. Our cumulative outcomes are then derived by summing these windows over the age range of interest.

A typical concern in identifying reform effects in a RDD setting is manipulation of the treatment assignment variable, which in our case is individual's date of birth. We deem it unlikely that individuals or their parents were able to manipulate individual's date of birth in anticipation of the reforms which took place around five decades following birth. Separately, we are not aware of any discontinuous changes in the incentive to give birth just prior to or following December, in each of the adjacent birth cohorts used to determine allocation to treatment and control groups.¹⁵

Our main regression specification is specified in equation 1:

$$y_i = \alpha + \delta \mathbf{1}[c_i \geq c_0] + \beta_1(c_i - c_0) + \beta_2(c_i - c_0)\mathbf{1}[c_i \geq c_0] + \varepsilon_i \quad (1)$$

where y_i refers to our cumulative labour market outcome of interest, c_i refers to individual's date of birth, c_0 refers to a reform cutoff date (1st January 1950, 1st January 1955 and 1st January 1957) and $\mathbf{1}[c_i \geq c_0]$ is an indicator which determines whether an individual is born after a particular reform cutoff. The third term refers to the trend change in a particular outcome which is naturally occurring across successive cohorts, finally the fourth term allows the relationship

¹⁵ The Child Allowance Act came into effect in July 1948 (announced 1947) which included a universal maternity grant (previously only available for low-income families), universal child allowance and free maternal and child healthcare services. This reform predates the birth cohorts used for the analysis (potentially with the exception of those born in the early part of 1949). We use a narrow bandwidth around the 1st January 1950 and so these observations do not affect the estimation results, separately, using observations born 6 months either side of the cutoff does not change the qualitative nature of the findings.

between this trend and the outcome to vary each side of the cutoff (i.e. for each cohort). We assume there is no discontinuity in the error term, ε_i , at the respective cutoff c_0 . Under these conditions, δ provides an estimate of the Local Average Treatment Effect (LATE) on a given outcome of interest for belonging to the treatment versus control group. For the purpose of identifying a treatment effect we do not require additional covariates, however these can improve the precision of estimates (Lee and Lemieux, 2010; Calonico et al., 2020).

Our main analysis is based on the packages developed by Calonico et al. (2017) and Calonico et al. (2025). These estimation routines estimate non-parametric local RDD estimates using observations close to the relevant cutoff to estimate LATEs and conditional LATEs, respectively. We use a rectangular (uniform) kernel to weight observations each side of the cutoff equally, the optimal bandwidth is data driven such that the point estimator for the estimate is mean squared error optimal and derived by the programme. We present robust estimates which correct for potential bias in conventional local polynomial RDD and associated standard errors (Calonico et al., 2017, 2025). For the purpose of the heterogeneity analysis, we stratify our sample by pretreatment characteristics to determine whether there is variation in response behaviour across groups.

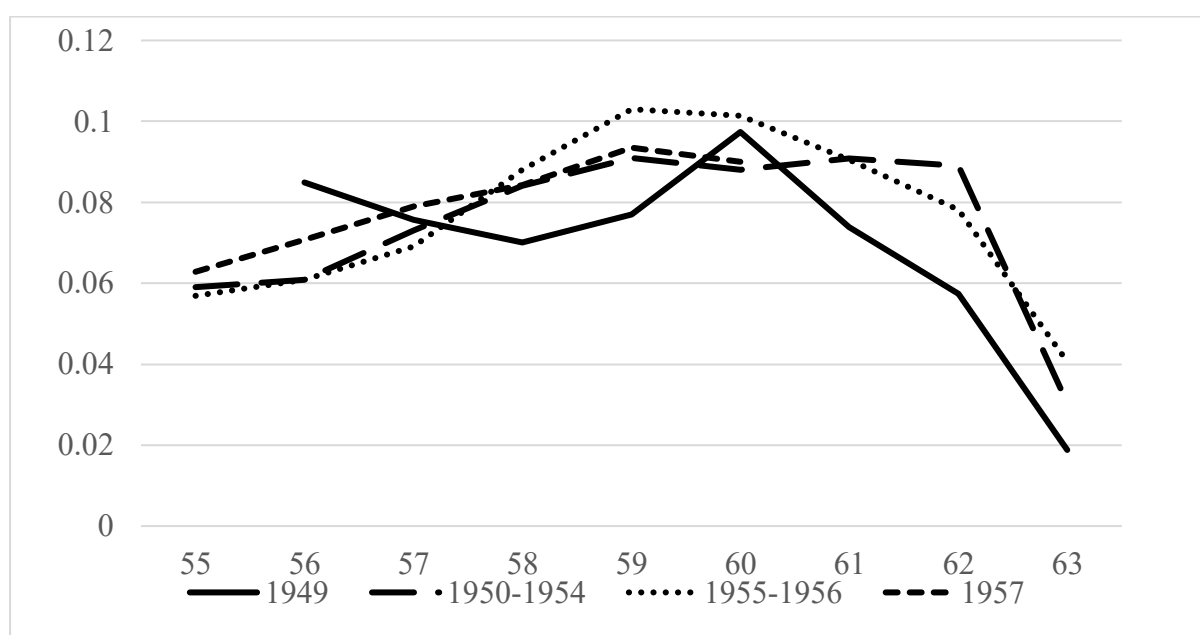
4. Findings

4.1. Unemployment risk by age

Figure 1 shows the risk of unemployment by age for selected birth cohorts.¹⁶ Clear differences appear between adjacent cohorts at ages 55, 57, and 58, corresponding to the minimum ages at which the first unemployment spell had to begin to qualify for EUB after 500 days of earnings-related unemployment benefits. We separately note the clear spike in unemployment due to the 2008/09 Global Financial Crisis. Appendix A reports the aggregate unemployment rate by age for the same birth cohorts and consistent with Figure 1 shows increases in the proportion of individuals unemployed at minimum EUB eligibility ages.

¹⁶ We define unemployment as a transition from employment in $t-1$ to unemployment in t .

Figure 1: Unemployment risk by age



Notes: Unemployment risk by age for selected birth cohorts. N= 2.915M time-person observations. Activity status defined at 31st December of each calendar year. Source: FCP registers (2005-2017).

We separately report unemployment risk by sector in Appendix B. Figures B1-B2 show in the case of the 1949 cohort among private sector workers the risk rises and then falls from age 60 whereas for public sector workers it declines across successively higher ages. In the case of the 1950-54, 1955-56 and 1957 birth cohorts, in general the trends in unemployment risk do not differ systematically by sector and age; though we note the unemployment risk is higher at ages 61-62 among those previously employed in the private sector. However, Figures B1-B2 highlight clear level differences by sector which reflect differences in characteristics among eligible individuals (see Appendix C) as well as Finland's strong employment protection laws, particularly in the public sector. This is consistent with EUB claimant data, for example FCP registers show that among the 1949 birth cohort who at age 57, 87% were previously employed in the private sector in 2001 (Table 1 shows this pattern remains broadly similar across successively younger cohorts).

4.2. Programme eligibility and EUB claimant characteristics

We next consider the socioeconomic and demographic characteristics of individuals (i) eligible for EUB and (ii) who claimed EUB at minimum eligibility age.

Appendix C shows clear differences in the characteristics of EUB-eligible individuals by sector. Individuals previously employed in the public sector were much more likely to be female, educated to tertiary level and occupy a higher socioeconomic position. The gap with respect to those previously employed in the private sector was large: over 30 percentage points in the case of gender, between 15 and 20 percentage points in the case of tertiary education and around 15 percentage points in the case of highest socioeconomic group classification. These differences persist across the birth cohorts used to evaluate each of the reforms.

In terms of claimant characteristics column 2 of Table 1 shows in 2006 EUB claimants were more likely to be men and married. We note only 1 in 6 claimants were educated to degree level, the majority of individuals were previously employed in the private sector and their job involved manual work or administrative and clerical duties.

A notable trend across successively younger birth cohorts (who faced higher eligibility ages) is the composition of the claimant group changes. In particular, Table 1 shows in the case of the 1956 cohort, an even larger share of EUB claimants are men, and the proportion of degree educated claimants is over 10 percentage points higher compared to 1949 counterparts at the minimum eligibility age. Consistent with this, the proportion of claimants in the highest socioeconomic occupation group is double the level when compared with the 1949 cohort. Similarly, inflation adjusted annual earnings among claimants born in 1956 is 20% higher than counterparts born in 1949. Nevertheless, the majority of EUB claimants are relatively low educated manual workers and the proportion of time spent in employment in the period just before becoming eligible for EUB does not change across cohorts.

Table 1: EUB claimant characteristics at minimum eligibility age

Characteristic	Proportion of EUB claims among eligible sample at age 57 (cohort 1949)	Proportion of EUB claims among eligible sample at age 59 (cohort 1954)	Proportion of EUB claims among eligible sample at age 60 (cohort 1956)
Male	0.55	0.55	0.60
<i>Marital status</i>			
Single	0.08	0.1	0.08

Married	0.76	0.71	0.71
Divorced	0.14	0.18	0.18
Other	0.02	0.01	0.02
<i>Education level</i>			
Tertiary education (minimum 13 years FT education)	0.17	0.23	0.29
Below tertiary education (9–12 years FT education)	0.83	0.77	0.71
<i>Sector (in 2001, 2008 and 2011, respectively)</i>			
Private	0.88	0.88	0.84
Public	0.12	0.12	0.16
<i>Socioeconomic status (in 2001, 2008 and 2011, respectively)</i>			
Upper-level employees with administrative, managerial, professional and related occupations	0.08	0.12	0.16
Lower-level employees with administrative and clerical occupations	0.31	0.30	0.29
Manual workers	0.50	0.50	0.46
Other (unemployed, students, pensioners)	0.11	0.07	0.09
<i>Annual earnings (euro 000's in 2001, 2008 and 2011, respectively)</i>	38,150	44,667	46,343
<i>Employment history</i>			
Proportion of time spent in employment between age 48 and 54	91%	91%	91%
N	1563	895	1294

Notes: Sample refers to individuals who made a claim for EUB in 2006 (born 1949, age 57), 2013 (born 1954, age 59) and 2016 (born 1956, age 60). Earnings reported in 2024 prices and adjusting using CPI. Source: FCP registers.

Comparing Appendix C and Table 1 we note the following observations. First, in level terms the proportion of individuals with tertiary education is considerably higher among eligible

individuals (34% and 53% among those previously working in private and public sector, respectively in 2014) compared to claimants overall (29% in 2016). However, in relative terms the increase in individuals with such characteristics between 2003 and 2014 is substantially higher among the latter group.¹⁷

Separately, we observe a notable increase in the share of the claimant population who previously occupied high socioeconomic positions. Finally, the proportion of manual workers in the claimant group stood at 46% in 2014, a substantially higher share than that reported among eligible individuals (36% and 15% among those previously working in private and public sector, respectively).

4.3. Discontinuity plots and reform effects

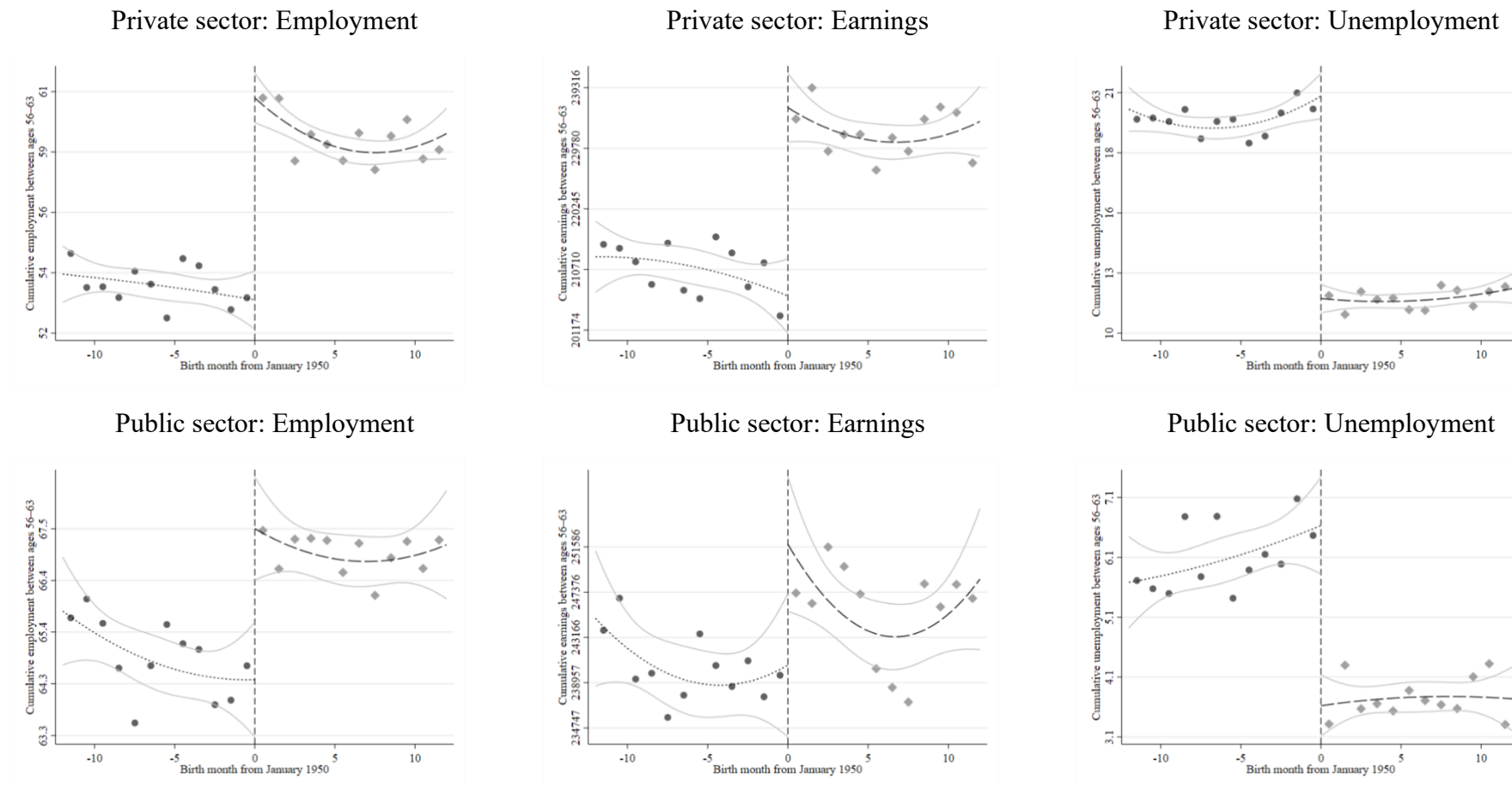
We first consider differences in cumulative labour market outcomes, by sector, between ages 56-63, 57-63 and 58-63 for the 2003, 2010 and 2014 reforms, respectively.

In line with Kyrrä and Pesola (2020) Figure 2 shows that in the case of the 2005 reform, among those previously employed in the private sector there is a clear discontinuity in cumulative labour market outcomes when comparing control and treated cohorts. Figure 2 and Table 2 show individuals born in late 1949 and eligible for EUB at age 57 (i.e. who first enter unemployment at age 55) spend on average 10 months less in employment than their counterparts born in early 1950. Mirroring these findings, we observe the same group spent on average 9.5 fewer months in unemployment. We note that the average cumulative period spent in unemployment between ages 56-63 among private sector workers born to the 1949 cohort and meeting the EUB eligibility criteria was 19.41 months, thus, in proportionate terms the reform led to a relative reduction in unemployment of 49%. Finally, in terms of cumulative labour market earnings we observe those individuals belonging to the 1949 cohorts earned around 39,684 euros less by the time they reached OP age.¹⁸

¹⁷ In 2003 45% of eligible individuals were educated to tertiary level, compared to only 17% of claimants.

¹⁸ In practice once individuals reach OP eligibility age their labour market earnings fall significantly, for those on unemployment pension or additional days of unemployment it is zero. Separately, we note there is no change in earnings disregard at the time UP was abolished (i.e. no change in incentives to work across the control and treated cohorts).

Figure 2: Changes in cumulative employment, earnings and unemployment between ages 56-63 among private and public sectors workers due to the 2003 EUB reform.



Notes: estimates based on individuals belonging to birth cohorts 1949 and 1950 and who meet the EUB eligibility criteria. $N_{private} = 57,722$ and $N_{public} = 37,674$. Trend refers to quadratic polynomial on binned data. Solid grey line refers to 95% confidence interval. Source: FCP registers.

Table 2: Changes in cumulative employment, earnings and unemployment among private sector workers due to the 2003, 2010 and 2014 EUB reforms

	Months employed	Cumulative earnings	Months unemployed	N
EUB reform				
2003	9.96*** [1.17]	39,082*** [7,659]	-9.50*** [0.96]	57,722
<i>Bandwidth</i>	2.89	2.47	3.11	
2010	2.44*** [0.83]	4,326 [5,931]	-0.96 [0.76]	52,805
<i>Bandwidth</i>	3.75	3.23	2.89	
2014	3.21*** [0.82]	14,540*** [4,792]	-1.97*** [0.57]	49,491
<i>Bandwidth</i>	2.77	4.02	3.61	

Notes: outcome variables measured over ages 56-63, 57-63 and 58-63 in the case of the 2003, 2010 and 2014 reform to EUB, respectively. Estimates based on package developed by Calonico et al. (2017), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Table 3: Changes in cumulative employment, earnings and unemployment among public sector workers due to the 2003, 2010 and 2014 EUB reforms

	Months employed	Cumulative earnings	Months unemployed	N
EUB reform				
2003	2.70** [1.39]	5,862 [8780]	-3.53*** [0.83]	37,674
<i>Bandwidth</i>	2.85	2.63	2.68	
2010	1.51* [0.93]	1,718 [6454]	-0.59 [0.55]	36,512
<i>Bandwidth</i>	2.42	3.16	3.03	
2014	1.14 [0.79]	8,238 [5684]	-0.71 [0.45]	36,633
<i>Bandwidth</i>	2.57	2.67	3.30	

Notes: outcome variables measured over ages 56-63, 57-63 and 58-63 in the case of the 2003, 2010 and 2014 reform to EUB, respectively. Estimates based on package developed by Calonico et al. (2017), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

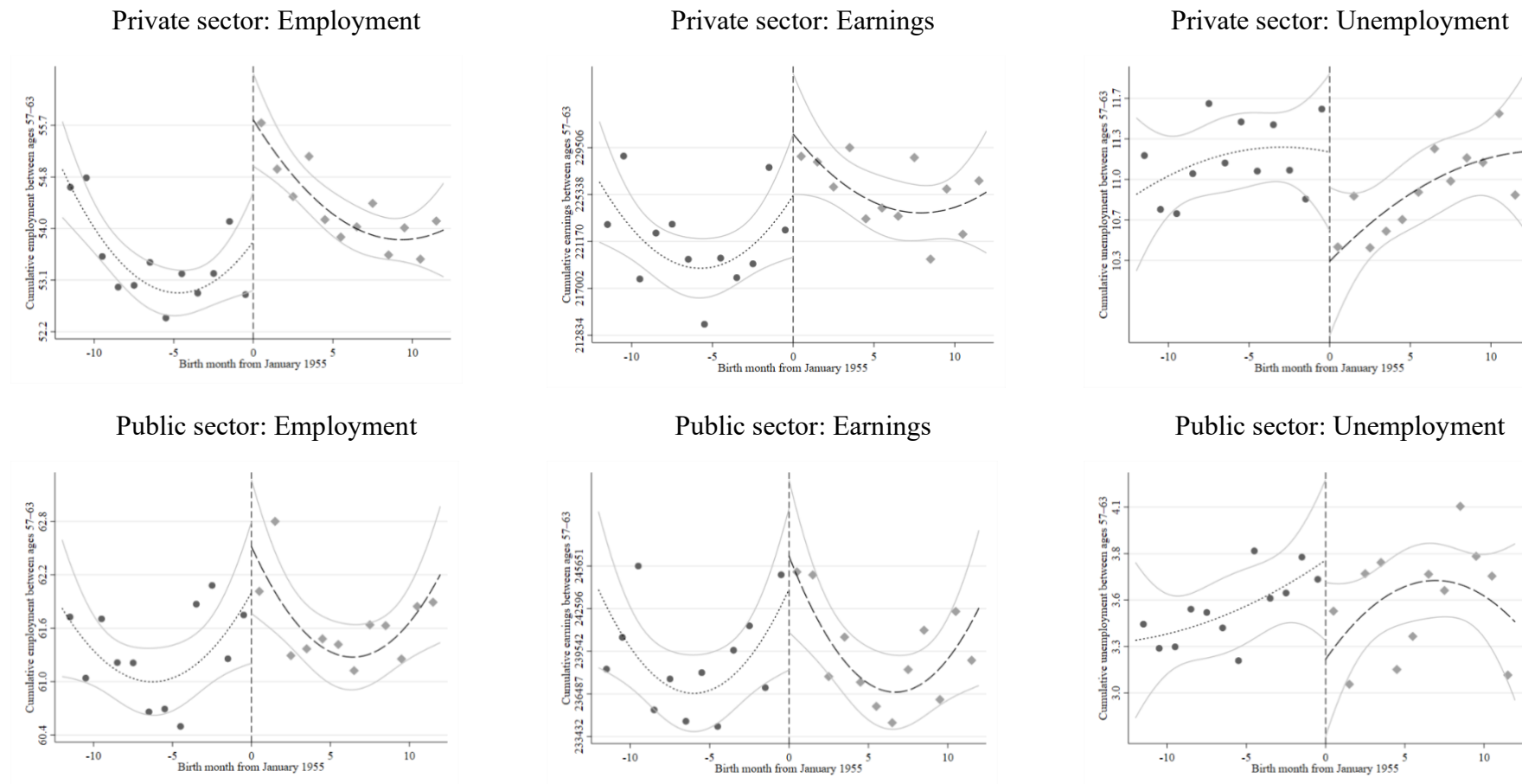
The qualitative nature of the findings is similar for individuals previously employed in the public sector; however, the discontinuity is smaller in magnitude across all outcomes. Starting with the 2003 reform, comparing the cohorts born two months either side of the cutoff, the

average difference in cumulative months of employment is 2.7 months. Mirroring the employment effects, we observe public sector workers in treated cohorts spent on average 3.5 months less in unemployment by age 63. These results are consistent with the findings reported in Appendices B and C, namely that those individuals eligible for EUB who previously worked in the public sector were more likely to be female, higher educated and occupy higher socioeconomics positions i.e. worked in occupations which had a lower unemployment risk. . This also leads to shorter cumulative durations among individuals working in the public sector, for example among the 1949 birth cohort, the average cumulative period spent in unemployment between ages 56-63 was 6.01 months, thus in proportionate terms, the reform reduced the time spent in unemployment by almost 59%. Finally, Figure 2 shows no significant difference in cumulative earnings between control and treated cohorts for workers in this sector.

Figure 3 and Table 2 show that in the case of the 2010 reform, which raised the minimum EUB eligibility age from 59 to 60 we observe a 2.44 month increase in the months of cumulative employment between ages 57 and 63 among treated individuals previously working in the private sector. However, our estimates imply no equivalent discontinuities with respect to cumulative earnings or unemployment. In the case of public sector workers, Table 3 shows only marginal differences in cumulative employment among the treated cohort. Visual inspection of Figure 3 highlights clear evidence of within birth year trends in labour market outcomes which could be attributable to the general macroeconomic conditions prevailing at the time the reform came into effect and the immediately following period. We further investigate the inconclusive findings with respect to the 2010 reform as part of the sensitivity analysis.

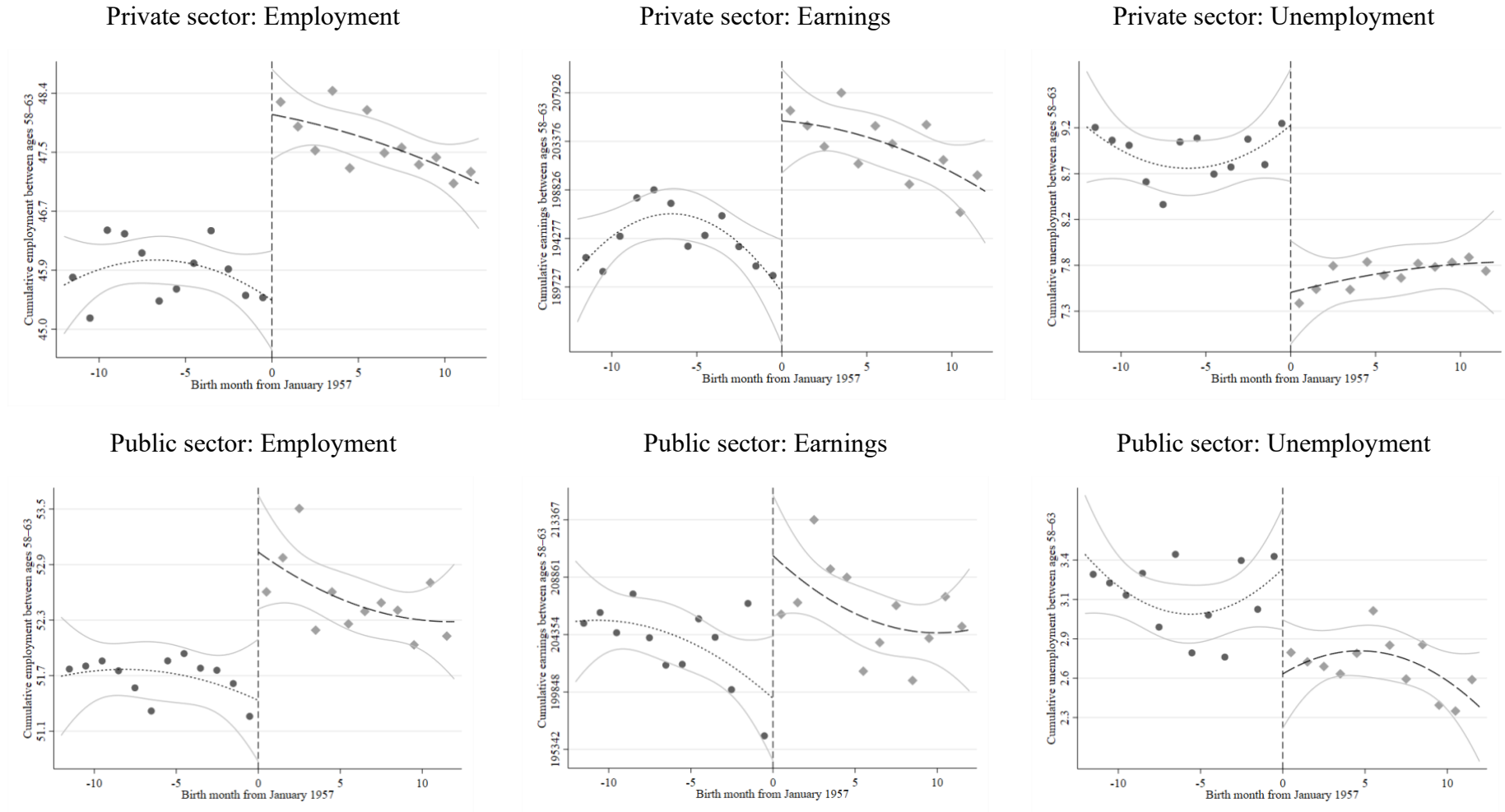
Finally, in the case of the 2014 reform which raised the minimum EUB eligibility age from 60 to 61, Figure 4 shows a clear discontinuity in terms of cumulative employment and unemployment outcomes among individuals who were working in the private sector in 2011. Individuals born in 1957 spent around 3.2 months longer in employment and around 2 months less in unemployment between ages 58-63. Table 2 shows average cumulative earnings among individuals born in 1957 were approximately €14,539 higher than counterparts born in 1956. Table 3 shows long term unemployed individuals who previously worked in the public sector did not respond to the reform.

Figure 3: Changes in cumulative employment, earnings and unemployment between ages 57-63 among private and public sectors workers due to the 2010 EUB reform.



Notes: estimates based on individuals belonging to birth cohorts 1954 and 1955 and who meet the EUB eligibility criteria. $N_{private} = 52,805$ and $N_{public} = 36,512$. Trend refers to quadratic polynomial on binned data. Solid grey line refers to 95% confidence interval. Source: FCP registers.

Figure 4: Changes in cumulative employment, earnings and unemployment between ages 58-63 among private and public sectors workers due to the 2014 EUB reform.



Notes: estimates based on individuals belonging to birth cohorts 1956 and 1957 and who meet the EUB eligibility criteria. $N_{private} = 49,491$ and $N_{public} = 36,633$. Trend refers to quadratic polynomial on binned data. Solid grey line refers to 95% confidence interval. Source: FCP registers.

Heterogeneity in treatment effects

Cross-country evidence shows that responses to changes in early and normal retirement eligibility ages varies systematically by socioeconomic characteristics, implying that reforms have important distributional consequences (Geyer and Welteke, 2021; Giusta and Longhi, 2021; Kanabar et al., 2024; Kanabar and Kalwij, 2026). For Finland, Kyyrä and Pesola (2020) find that the 2003 EUB reform generated larger behavioural responses among men and workers in industries undergoing structural change, while finding no evidence of household spillovers. Building on this evidence, we examine whether the effects of later EUB reforms, implemented at increasingly higher eligibility ages, differ across claimant characteristics and by sector.

This focus is particularly relevant in the Finnish context because EUB claimants are disproportionately drawn from groups with weaker labour-market prospects. As shown in Table 1, they are more likely than the general population to have low or intermediate education and to have worked in manual occupations before claiming long term unemployment benefit. More generally, individuals with weaker labour-market attachment are more likely to experience unemployment during working life and, conditional on entry, to remain unemployed for longer (Lallukka et al., 2019). Consistent with this, our register-based calculations show that among cohorts born between 1949 and 1957, individuals without tertiary education were both more likely to experience unemployment between ages 51 and 55 and more likely to remain unemployed in the following year. It is therefore important to assess whether reforms to EUB had a differential impact on a group of individuals already at greater risk of labour-market disadvantage as they approached retirement.

Tables D1 and D2 in Appendix D report treatment effects by sector and reform for selected characteristics.¹⁹ Table D1 shows that in the case of the 2003 reform irrespective of sector behavioural responses were concentrated among two groups. The first were lower educated, low-middle earning married and divorced/separated men. Such individuals were more likely to previously work in a lower level administrative/clerical position or in a manual occupation. The second were tertiary educated, higher earners who previously worked in professional occupations.

¹⁹ Treatment effects are estimated using the rdhte STATA package developed by Calonico et al. (2025).

In the case of 2010 EUB reform, the findings for individuals previously employed in the private sector partially mirror those reported for the 2003 reform, though we no longer observe a reform impact among divorcees nor higher educated higher-earning individuals previously employed in a professional occupation. We do not observe consistent reform effects across our outcomes of interest among individuals previously working in the public sector.

Finally, in line with the findings reported in Table 1, in particular that among individuals belonging to younger birth cohorts a higher proportion of EUB claimants have tertiary level education compared to their predecessors, Table D1 shows the impact of the 2014 EUB reform was disproportionately concentrated among higher educated males and (to an extent) female middle-higher earners who previously worked in professional occupations in the private sector. Separately, irrespective of sector, married individuals were more likely to respond to the reform.

Lag and lead effects

We next consider whether individuals exhibit lag and lead effects with respect to the EUB reforms. The period between announcement and implementation date varies by reform but is generally small: less than one year in the case of the 2003 and 2010 reforms and around one year in the case of the 2014 reform. However, the period between announcement date and the relevant treated birth cohort being eligible to begin their 500-day spell of unemployment is between 4-5 years depending on the reform considered.²⁰ Therefore individuals belonging to affected cohorts may adjust their behaviour due to the reform announcement itself, consistent with research evaluating changes in statutory retirement age (Bucher-Koenen, T, Ferrari, I and Pettinicchi, Y, 2019).

Discontinuities in cumulative labour market outcomes between the control and treated birth cohort in the period following announcement and prior to implementation are consistent with individuals exhibiting forward looking behaviour. In contrast, differences in outcomes post minimum eligibility age (conditional on meeting eligibility criteria) allow us to test for lag

²⁰ In the case of the 2003 reform, the reform was first announced in 2002, and the 1950 cohort turn 57 in 2007. The corresponding figures for the 2010 and 2014 reforms for the respective birth cohorts is 4 and 5 years respectively (difference between 1955 cohort turning 58 and 1957 cohort turning 59 given the respective announcement dates). In the case of announcement effects, it is only possible to analyse differences in employment for the 2003 reform due to unemployment and earnings data being available from 2005.

effects. Irrespective of the type of behaviour, we note that the estimand refers to individuals who meet the recent employment criteria, put another way, it reflects a subsample of the population with relatively strong labour market attachment. This is consistent with sharp RDD estimands having a LATE interpretation but in this case among an eligibility-selected subpopulation. To assess the plausibility of the local continuity assumption, we also test for discontinuities in sample composition, as measured by the share of individuals meeting the recent labour-market-history criteria.

Tables E1 and E2 in Appendix E show that in the case of the 2003 reform, irrespective of sector the treated cohort does not exhibit anticipation effects at ages 52-54, instead differences in cumulative employment and unemployment emerge at ages 55-56 compared to individuals with similar characteristics but born in 1949. These differences persist and grow in absolute terms at ages 57-59 and continue until age 62. We note effects are especially large among private sector workers. Finally, Appendix F shows the proportion of individuals who meet the recent employment condition is similar across the reform cutoff.

In the case of the 2010 EUB reform, Table E1 shows individuals previously employed in the private sector and belonging to the 1955 birth cohort work less between ages 54-57 compared to their 1954 counterparts. This difference reflects macro effects given the reference period coinciding with the GFC and the immediately following period over which outcomes are measured. We note the positive employment and negative unemployment effects estimated between ages 58-59 cover a period up to 2013 for the 1954 cohort, put another way, a greater proportion of the outcome period for the control group was during the prolonged economic downturn lasting until 2016. For the same reason the proportion of individuals who meet the recent employment condition is slightly lower among the treated group (we note eligibility declines smoothly across birth cohorts and the reform cutoff, see Figure F3-F4 in Appendix F).²¹

Tables E1 and E2 in Appendix E show that in the case of the 2014 reform cumulative labour market attachment between ages 55-58 is around one-third of a year lower among the 1957 cohort compared to their 1956 counterparts, which again is likely due to macro rather than

²¹ The age at which the recent employment condition is measured corresponds to 2008-2011 (2009-2012) for the 1954 (1955) cohort, respectively.

anticipation effects (see Appendix A). Consistent with this we find a lower proportion of the treated cohort meet the recent employment condition (see Figures F5 and F6 in Appendix F). However, the second half of the decade spanning 2010 and 2020 saw macro conditions generally stabilise in Finland. Table E1 and E2 shows that (irrespective of sector) we observe an increase (decrease) in employment (unemployment) at ages 59-61 consistent with the increase in minimum EUB eligibility age (i.e. when the initial 500-day unemployment spell can begin). Moreover, among individuals previously employed in the private sector Table E1 shows these effects continue to age 61-62 i.e. at ages which correspond with EUB eligibility age and up to the point individuals are eligible to receive OP.

4.4. Sensitivity analysis

Diagnostic tests

A key threat to the causal interpretation of RDD estimates is manipulation of the running variable; in our case, such manipulation is impossible because date of birth determines group assignment and individuals were born at least 50 years before the policies were announced. Moreover, we exploit high quality register data provided by the Finnish Centre for Pensions which has minimal measurement error.

Appendix G plots the number of observations by birth month for the control and treated groups used in the analysis. Whilst there is a clear seasonal pattern across birth cohorts no bunching is observed around relevant cutoffs and visual inspection of non-parametric local polynomial density plots (also reported in Appendix G), show no clear break around the cutoff and confidence intervals largely overlap.²²

A standard diagnostic in RDD setups, including approaches that permit heterogeneity in treatment effects, is ensuring continuity in predetermined covariates (see Calonico et al. 2025). Appendix H reports regression estimates based on an identical specification to that stated in Equation (1), except that the outcome variables refers to a predetermined covariate measured in the year prior to the reform announcement.²³ Appendix H shows, irrespective of reform, no systematic evidence of discontinuities in predetermined covariates at the respective cutoffs,

²² Plots are estimated using the STATA package developed by Cattaneo, Jansson and Ma (2020).

²³ We separately test for differences in a limited set of characteristics (marital status, education level and occupation) 5-8 years prior to reform announcement dates and find no systematic evidence of discontinuities, irrespective of reform considered. Results available on request.

with the exception of selected earnings quartiles and marital groups in the case of the 2010 and 2014 reforms, respectively.

Importantly, such discontinuities do not imply a violation of the RD smoothness assumption in the underlying population. The covariate continuity checks are estimated imposing the same sample restrictions as the main analysis, notably the recent work history eligibility condition. Because our estimand is defined for the subset of individuals meeting the eligibility condition which is correlated with pre-reform labour market attachment and certain characteristics, conditioning on eligibility can generate small differences in covariate distributions across cohorts even when predetermined covariates are smooth in the underlying birth cohort population.²⁴

To assess the extent of differential selection induced by the eligibility criteria (beyond inspection of the visual trends reported in Appendix F), Appendix I reports discontinuity estimates for the proportion of the sample who meet the recent employment eligibility condition and shows in the case of the 2010 and 2014 reforms a discontinuity at the cutoff for individuals previously employed in the private sector. This suggests that the recent work history restriction (which is influenced by the prolonged recession between 2008 and 2015) induces local, sector-specific differential selection into the analysis sample around the cutoff. We note eligibility within birth cohort (as shown in Appendix F) is constant, consistent with a negative macro impact leading to a decline in eligibility given our data are collected on annual basis. Indeed, we do not find selection effects among those previously employed in the public sector who have stronger employment protections. Separately, Appendix C shows no systematic differences in the characteristics of eligible individuals in the birth cohorts which make up the control and treatment group for analysis purposes. Thus, such covariate discontinuities are interpreted as composition effects within the restricted analysis sample rather than evidence of manipulation of the running variable.

²⁴ For example, after imposing the same sample conditions used in the analysis except for the recent working condition, we note 27.7% (27.4%) of individuals belong to the 1956 (1957) birth cohort belong to the 2nd earnings quartile, the equivalent statistic among the 3rd quartile is 29.6% and 29.5%, respectively.

Placebo effects

We next test for placebo effects, first we consider differences in cumulative labour market outcomes 3, 6 and 9 months pre/post the true reform cutoff using a 3-month window.^{25 26}

Appendix J shows, on the whole, the absence of discontinuities and the trend in the size of treatment effect is essentially flat and statistically indistinguishable from zero except for around the true cutoff, irrespective of reform considered. In the few instances where the estimates do differ from zero, predominantly among the birth cohorts used to evaluate the 2010 reform, there is no consistent pattern across sectors, moreover cross examination of the respective discontinuity plot (available on request) shows the broader trend in outcomes (within 3 months of the placebo cutoff) is relatively stable. Put another way, the effects detected reflect the combination of a narrow bandwidth and localised approach. More importantly, the discontinuity at the true reform cutoff reflects changes in institutional rules and is more stable across specifications compared to corresponding placebo estimates.

Changes in unemployment durations

The institutional rules in place during the sample period mean individuals who are below EUB minimum eligibility age after claiming 500 days of (earned or unearned) ordinary unemployment benefit receive a single flat rate unearned benefit called Labour Market Support days (LMS). Individuals may claim LMS indefinitely or until they secure employment and reach an age such that they satisfy EUB criteria.

The 2003, 2010 and 2014 EUB reforms pushed up the minimum eligibility age. In order to rule out treated cohorts continuing to begin their initial unemployment spell according to the pre-reform rules and using LMS as a stop-gap before reaching EUB minimum eligibility age under

²⁵ In the case of the 2003 reform, it is not possible to conduct such tests for the pre-reform period due to availability of labour market outcomes data (i.e. a discontinuity would be mechanical due to monthly birth cohorts who are later born having more data recorded as our measures are pro rata accounting for age).

²⁶ In the case of the 2010 and 2014 reforms we are restricted to testing placebo effects up to 9 months either side of the respective cutoff. In the case of the 2010 reform this is due to the 1953 and 1954 birth cohorts facing differing PTP eligibility ages (60 and 61, respectively). Whilst PTP is not a competing pathway we nevertheless wish to rule out another reform biasing our estimates. In the case of the 2014 reform, the 1958 cohort turns 63 in 2021 which is beyond the end of our sample period, additionally, individuals born prior to 1958 and in receipt of EUB could claim early OP at age 62 without penalty. For all cohorts born after 1958 this rule was abolished. Such a reform could bias our estimates, in this case at a placebo cutoff 12 months after the cutoff relevant for the 2014 reform.

the post-reform regime, Appendix K plots the distribution of total unemployment days across two successive years at ages 57-59 and 58-60 among individuals who claimed at least one day of unemployment benefit and belong to one of the birth cohorts used to evaluate the reforms.²⁷

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Consistent with the trend in unemployment risk depicted in Figure 1, Figures K1-K4 in Appendix K show that, in the case of the 2010 and 2014 reforms, irrespective of sector considered the distribution of total unemployment days at ages which correspond to the initial unemployment spell remains closely aligned across control and treated birth cohorts. Put another way, treated individual's conditional on being eligible, did not respond to the 2010 and 2014 reforms by spending a longer period of time on LMS, a less generous unemployment benefit, to bridge the gap between initial unemployment and receiving EUB.

Long term employment eligibility criteria

To be eligible for EUB individuals must have worked at least 5 out of the previous 15 years at the point they reach EUB eligibility age, in addition to the recent employment condition which is assessed at the age an individual's initial unemployment spell began. Our register data contain annual employment history information starting from 1997 therefore it is not possible to compute and impose the long-term employment condition on the birth cohorts used to evaluate the 2003 EUB reform. We note however that eligibility conditions for EUB mean it is a programme available to individuals who have (until recently) had a relatively strong attachment to the labour market. For example, among the sample used to evaluate the 2003 reform the average number of years in employment between age 18 and 50 is 26.7 (26.8) among those born in 1949 (1950), hence we do not expect our main findings to change in the event such data were available.

²⁷ We cannot analyse changes in the distribution of unemployment at ages 55-57 in the case of the 2003 reform due to the relevant data preceding our sample period.

²⁸ Whilst our register record total unemployment days on an annual basis, so do not precisely measure continuous spells (which would require start and end dates), they provide crude evidence of the distribution of unemployment spells and importantly, allows us to compare such distributions by birth cohorts (noting individuals who met the eligibility criteria in the control cohorts were permitted to claim EUB after 500 days so depict the counterfactual distribution of interest).

In the case of the birth cohorts affected by the 2010 and 2014 EUB reforms it is possible to calculate and impose the long-term employment eligibility criteria on the samples used to evaluate the reforms. Appendix L reports estimates from an identical regression specification to that used for main analysis and restricted to the same birth cohorts except imposes both the recent and the long-term employment conditions. The results show the qualitative nature of the findings remain unchanged irrespective of the labour market outcome or reform considered.

Global Financial Crisis and turn of year effects

Finland experienced a prolonged downturn following the Global Financial Crisis which lasted until 2016. The unemployment rate rose from 6.4% to 9.4% between 2008 and 2015 (Statistics Finland, 2018). To rule out aggregate macro and turn of year effects biasing the findings we report with respect to the 2010 EUB reform we follow a difference in discontinuity approach.²⁹ We use the discontinuity in cumulative labour market outcomes observed between the 1951 and 1952 birth cohorts as the reference cohorts.³⁰ Appendix M shows that our main finding regarding employment effects among those previously employed in the private sector workers remains, though at 1.9 months, is slightly smaller in magnitude than the effect reported in Table 2 but is more precisely estimated. We note a similar finding with respect to cumulative unemployment. Consistent with both outcomes, the difference in cumulative earnings (approximately €7,000) is significant at conventional levels.³¹

²⁹ Whilst the 2014 reform to EUB was also implemented during an economic downturn, the increase in the unemployment growth rate increased was concentrated in the early part of the 2008-2016 period before slowing down significantly as Finland entered an expansionary phase between 2016 and onset of the pandemic (Kyyrä and Pesola, 2020). We separately note the labour outcomes in the case of the 2014 reform refer to the period 2014-2020 given the birth cohorts affected. Therefore, the likelihood of macro effects biasing our findings is lower compared to the cohorts affected by the 2010 reform. Finally, in the case of the 2014 reform, no suitable counterfactual cohorts are available for the purpose of estimating the difference in discontinuity due to differing EUB and PTP eligibility ages across adjacent birth cohorts.

³⁰ These cohorts faced the same EUB and PTP eligibility age. We do not use the 1952-1953 birth cohorts as the reference cohorts due to a reform to PTP (which came into law in 2009) and meant the 1953 cohort faced a different PTP minimum eligibility age (60) compared to the 1954 and 1955 cohort (61), even if PTP is unlikely to be a competing pathway. Whereas both the 1951 and 1952 birth cohorts were eligible to claim PTP at age 58.

³¹ Using the 1951-1952 birth cohorts may also reflect differential exposure to the GFC, since cumulative outcomes at ages 57-63 are measured over different calendar-year windows across cohorts. Subtracting this placebo discontinuity could therefore mechanically inflate the estimated difference-in-discontinuities effect, especially for cumulative earnings however we find lower estimates in the case cumulative employment and unemployment.

Programme spillovers

We next assess whether reforms to EUB led to programme spillovers. Previous research shows that earlier reforms to EUB in 1997 and 2003 did not lead to individuals selecting onto alternative early retirement pathways related to ill health or disability (Kyyrä and Pesola, (2020); Uusitalo and Nivalainen, (2013)). Programme rules at the time meant individuals aged 60 and below had to demonstrate a 60% reduction in work capacity to satisfy the eligibility criteria for Ordinary Disability Pension.³² Whilst more lenient criteria came into effect in 2003 for individuals aged 60 and over, and born post 1943, research shows individual application and award behaviour actually fell due to relabelling effects (Kanabar et al., 2024). Moreover, EUB was a pathway used by those with relatively strong labour market attachment and the age at which individuals can enter the so-called unemployment tunnel implies programme spillovers are unlikely. Indeed, Figures N1-N4 in Appendix N reports new applications for ODP for selected birth cohorts and ages and generally shows no changes around reform cutoffs.³³

Alongside ODP, individuals could reduce their work intensity via PTP at older ages. However, like ODP substitution to PTP is unlikely for several reasons. First, the eligibility criteria across the two programmes imply the type of individual utilising each pathway differs: eligibility for PTP requires individuals to be working full time in their late 50s and agree to a workplan with their employer *prior* to applying for PTP. Second, the eligibility ages for PTP are higher than the age at which the initial unemployment spell (unemployment tunnel) may begin in the case of EUB, irrespective of reform (the difference can be as large as 4 years).³⁴ ³⁵ Third, the period between announcement and implementation of PTP reforms and how this interacts with announcement and implementation of EUB reforms implies the possibility for individuals to adjust their behaviour in an anticipatory way is limited. The increases in PTP eligibility age to 58, 60 and 61 took effect in 2003, 2011 and 2013, respectively. Yet they were only announced

³² Partial disability pension is also available and requires individuals to demonstrate a 40% reduction in work capacity. Disability is first assessed by an individual's doctor, followed by a subsequent assessment undertaken by a suitably qualified individual working on behalf of the insurer.

³³ Our data include ODP application data up to 2017 and therefore plots are restricted to birth cohorts used to evaluate the 2003 and 2010 reforms.

³⁴ Minimum PTP eligibility age was increased to 58 for those born in 1947 and onwards in 2003. This increased to 60 in 2010 for those born in 1953 and later. This was subsequently raised to 61 in 2013. The gap between initial unemployment age and PTP eligibility ranges between 2-4 years depending on reform.

³⁵ Starting 2013 individuals born in 1953 (conditional on satisfying PTP eligibility criteria) were eligible to claim PTP at age 60. Whereas an individual born in 1953 who satisfies EUB eligibility criteria may initially enter unemployment at age 57, i.e. 3 years earlier in 2010 given rules at the time. Equivalent differences in age range from 2-4 years in the case of control and treated birth cohorts spanning 1954-1957.

in 2001, 2009 and 2012, respectively. These dates closely align with EUB announcement dates rather than precede them. Figures O1-O4 in Appendix O report PTP applications rates for selected birth cohorts and ages and shows no systematic changes in applications rates either side of the EUB reform cutoffs.

As of 2017, PTP was replaced by POAP which unlike PTP had no eligibility criteria and could be claimed irrespective of hours worked from age 61. Figures O5-O8 shows no systematic changes in the proportion of individuals claiming POAP in either the private or public sector among individuals affected by the 2014 EUB reform.

2017 reform to Ordinary Pension

A major reform to OP in 2017 raised minimum eligibility age for all cohorts born post 1954. This is unlikely to affect our findings for several reasons. First, the reform was announced in 2014, 5 years after the 2010 EUB reform was announced. At the time the 1955 birth cohort was age 59 and EUB rules meant an individual's spell of initial unemployment could begin at 58 (i.e. prior to the OP reform being announced). Moreover, the minimum eligibility age for EUB for those born in 1955 was raised to 60, which is more than three years below the newly reformed OP eligibility age (which increased from 63 to 63 and 3 months). Nivalainen and Illmakunnas (2025) find the 2017 reform led to a 6 percentage point increase in unemployment however this effect was concentrated at age 63 i.e. the previous OP eligibility age. Importantly, the authors find the reform effects reflect passive rather than active substitution between different labour market states. We note our analysis is restricted up to age 62 and the analysis of dynamic effects in the case of the 2010 reform found treated individuals adjust their labour market behaviour at ages 58-60 rather than ages 61-62 i.e. at ages relevant for EUB not OP.

In the case of the 2014 EUB reform, which was first announced in 2012 and affected all birth cohorts born 1957 and onwards, an individual's spell of initial unemployment could start at age 59 (i.e. in 2016) and entitlement to EUB at age 61. Therefore, given the birth cohort affected, the former age eligibility threshold therefore falls between the date the OP reform was announced and implemented (i.e. between 2014 and 2017).

Second, the dynamic analysis shows that increases in employment occur at ages 59-62 which corresponds with the years 2016-2019 for those born in 1957 and is below the OP eligibility

age. Nivalainen and Ilmakunnas (2025) note behavioral responses to the 2017 reform are visible at OP eligibility age and not before. In addition, the start of this period (beginning 2016) precedes the date at which the revised OP eligibility ages became law.

Third, visual inspection of unemployment trends for cohorts born between 1954 and 1957 over the years 2010-2020 (reported in Appendix P), highlights an upward trend which corresponds to EUB eligibility ages as well as reflecting the general macroeconomic conditions at the time. Figures P1 and P2 show a clear downward trend in unemployment in the lead up to OP eligibility age.³⁶ Nevertheless, visual inspection shows no evidence of a change in the unemployment rate in 2014, indeed the trend by birth cohort is largely parallel. Nivalainen and Ilmakunnas (2025) note the 2017 OP reform led to increased flows to *out of work* states at OP eligibility age, emphasizing that the size of the initially employed population is far larger than that of the unemployed; whereas our findings show the impact of 2014 EUB reform went in the opposite direction: it led to *increases* in economic activity among those previously employed in the private sector.

5. Discussion and conclusion

Extending working lives, particularly among long-term unemployed individuals in the years prior to normal retirement age, is a key objective among policymakers in many advanced economies. We study a series of reforms implemented in Finland in 2003, 2010 and 2014 which collectively raised the minimum eligibility age for EUB by four years. We show that these reforms increased long-term employment and earnings among affected individuals, particularly those who had previously worked in the private sector and comprised the majority of the claimant group.

Consistent with the larger increase in minimum eligibility age and existing evidence (Kyyrä and Wilke, 2007; Kyyrä and Pesola, 2020), we find behavioural responses were stronger in 2003 than in 2010 and 2014. Effect sizes are also shaped by baseline labour market attachment and retirement norms, thus the smaller responses to later reforms is consistent with lower labour market participation at older ages and with the shrinking gap between EUB eligibility and

³⁶ In the case of the unemployment trends observed among the 1956 and 1957 birth cohorts, the divergence towards the very end of the sample period reflects a combination of (i) the impact of the OP reform and the onset of the Covid-19 pandemic (see Nivalainen and Ilmakunnas (2025)).

normal retirement age. We also show that reform effects evolve dynamically across ages up to normal retirement age, with the 2003 and 2014 reforms generating persistent changes in long-labour market outcomes.

More broadly, our findings add to a growing literature showing that individuals only partially adjust to increases in early retirement eligibility ages (Staubli and Zweimüller, 2013; Kanabar and Kalwij, 2026; Nivalainen and Ilmakunnas, 2025). However, whereas most existing studies focus on reforms to programmes with broad-based eligibility, our results relate to a setting that is less well understood but relatively common: early exit pathways available to the long-term unemployed (Müller, Wilke and Zahn, 2007; Kyyrä and Pesola, 2020; Arranz and García-Serrano, 2023).

A central finding of our study is that the composition of the long-term unemployed group in their mid-late 50s in Finland has changed over time. Whilst the majority of EUB claimants continue to be low educated manual workers who previously worked in the private sector, a growing minority are educated to tertiary level: rising from 1 in 6 to close to 1 in 3 claimants across the birth cohorts we analyse. Consistent with this, such individuals are more likely to have previously worked in higher occupational class jobs. More generally, our results show the characteristics of *claimants* has changed considerably faster than those of *eligible* individuals, indicating the reforms affected a different *type* of unemployed individual in 2003 versus 2014.

Our findings also show that responses to EUB reform differed systematically by individual characteristics, and separately that response behaviour changed over time. Whilst the 2003 reform to EUB has been previously studied (Kyyrä and Pesola, 2020), we extend the analysis by showing strong employment and earnings responses are observed among low-educated individuals previously employed in private sector manual occupations. We also show that tertiary educated higher earning individuals in professional occupations as well as those previously employed in the public sector responded to the reform.

In the case of the 2010 reform, similar types of individuals in the private sector were affected, although responses were more visible among men, consistent with broader changes in claimant characteristics. By contrast, we find very limited effects among those previously employed in the public sector. Finally, for the 2014 reform, behavioural effects were concentrated among higher-educated men previously employed in the private sector in professional occupations and

in medium to higher paying jobs. At the same time, over 70 per cent of EUB claimants remained low educated and were previously employed in relatively low-level occupations. The fact we find such individuals do not respond to the most recent reform is therefore a concern.

Our findings have implications for policymakers seeking to extend working lives. First, they underline the importance of labour market attachment in the years prior to normal retirement age: individuals are more likely to adjust to increases in age-based eligibility criteria if they are connected to the labour market at the point at which such reforms bind. Put another way, reforms to early exit routes that increase employment also influence the effectiveness of reforms to the normal retirement age. Second, reforms to legacy retirement programmes should be evaluated not only in terms of their average effects on employment and earnings but should pay specific attention to heterogeneity in treatment effects, since the distributional consequences of reforms differ substantially across cohorts. The Finnish EUB reforms studied in this paper offers a case in point.

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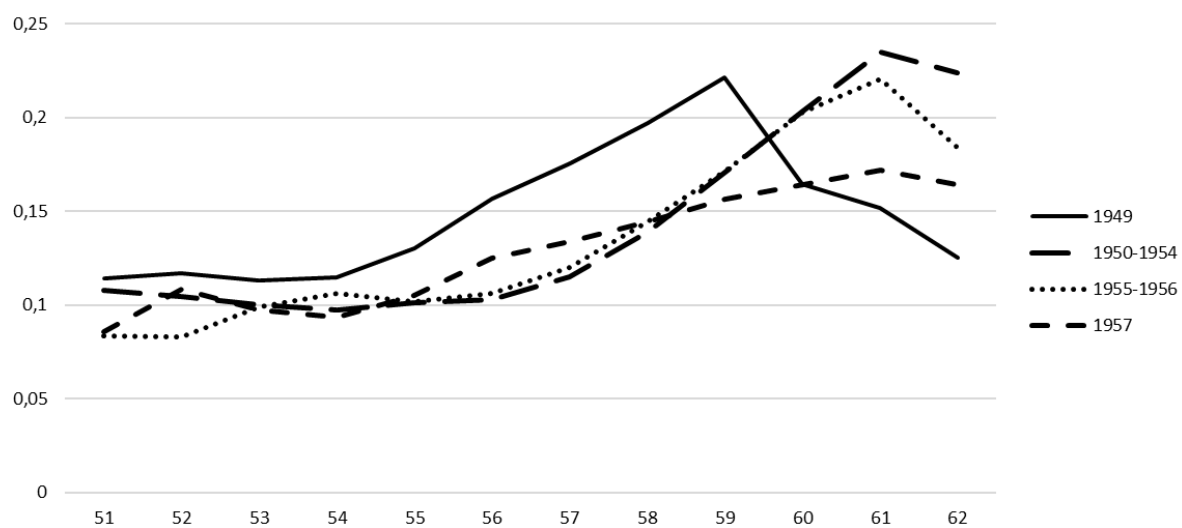
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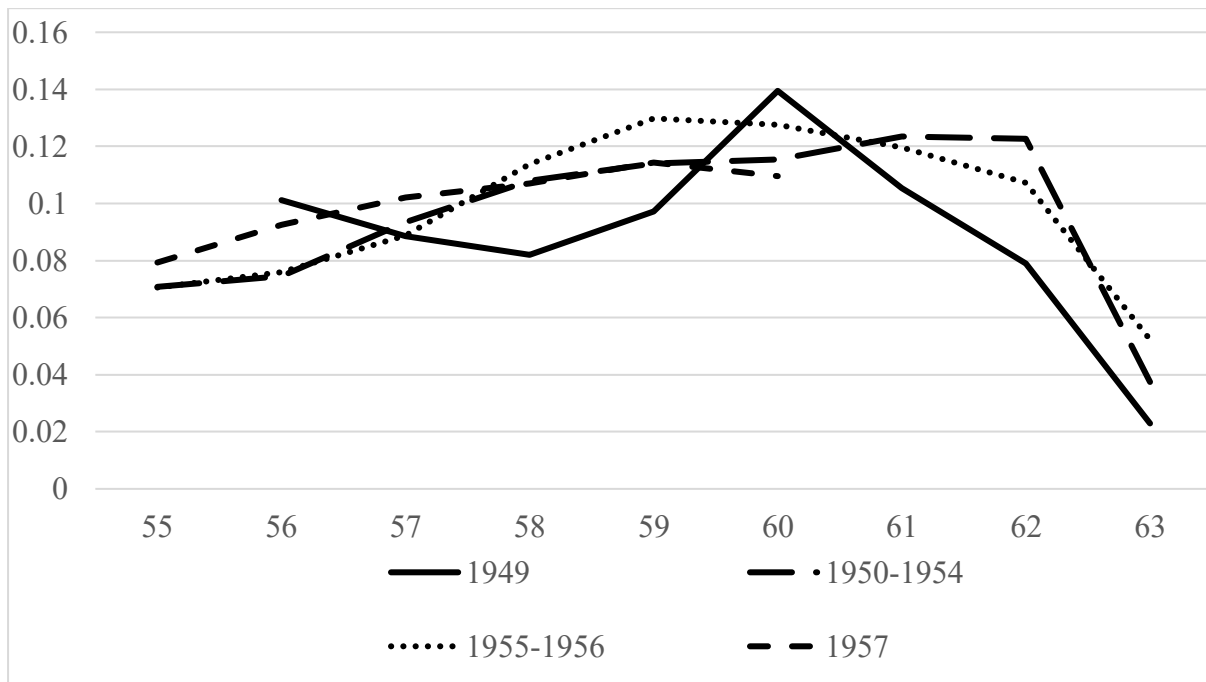
Appendix A: Aggregate unemployment rate by birth cohort and age



Notes: Unemployment rate by age for selected birth cohorts. Source: Statistics Finland registers.

Appendix B: Risk of unemployment by birth group and sector

Figure B1: Private sector workers



Notes: Unemployment risk by age for selected birth cohorts. N=1.73 million observations in risk set. Activity status defined at 31st December of each calendar year. Source: FCP registers (2005-2017).

Figure B2: Public sector workers



Notes: Unemployment risk by age for selected birth cohorts. N= 1.23 million observations in risk set. Activity status defined at 31st December of each calendar year. Source: FCP registers (2005-2017).

Appendix C: Characteristics of individuals eligible for EUB

Table C1: Private sector

Characteristic	2003 EUB reform		2010 EUB reform		2014 EUB reform	
Birth cohort	1949	1950	1954	1955	1956	1957
Female	0.423	0.419	0.422	0.417	0.408	0.411
<i>Marital status</i>						
Single	0.073	0.071	0.071	0.069	0.065	0.062
Married	0.767	0.766	0.747	0.751	0.747	0.744
Divorced	0.151	0.153	0.172	0.170	0.179	0.183
Other	0.008	0.010	0.010	0.011	0.009	0.011
<i>Education level</i>						
Tertiary education (minimum 13 years FT education)	0.251	0.256	0.312	0.321	0.335	0.348
Below tertiary education (9–12 years FT education)	0.749	0.744	0.688	0.679	0.665	0.652
<i>Socioeconomic status (in 2001, 2008 and 2011, respectively)</i>						
Upper-level employees with administrative, managerial, professional and related occupations	0.133	0.140	0.153	0.157	0.158	0.166
Lower-level employees with administrative and clerical occupations	0.336	0.322	0.335	0.332	0.322	0.315
Manual workers	0.420	0.445	0.399	0.390	0.360	0.366
Other (unemployed, students, pensioners)	0.107	0.078	0.094	0.093	0.144	0.132
<i>Annual earnings (euro 000's in 2001, 2008 and 2011, respectively)</i>	43.598	45.143	47.799	47.874	47.976	48.909
<i>Employment history</i>						
Proportion of time spent in employment between age 48 and 54	95.893	96.226	95.830	95.980	95.811	96.241
N	29,047	28,675	26,415	26,390	25,200	24,291

Notes: Sample refers to individuals who eligible for EUB among control and treated birth cohorts. Earnings reported in 2024 prices and adjusting using CPI. Source: FCP registers.

Table C2: Public sector

Characteristic	2003 EUB reform		2010 EUB reform		2014 EUB reform	
Birth cohort	1949	1950	1954	1955	1956	1957
Female	0.714	0.724	0.747	0.746	0.754	0.754
<i>Marital status</i>						
Single	0.074	0.069	0.064	0.064	0.062	0.060
Married	0.766	0.765	0.758	0.752	0.747	0.743
Divorced	0.151	0.155	0.166	0.171	0.180	0.182
Other	0.009	0.011	0.011	0.013	0.011	0.014
<i>Education level</i>						
Tertiary education (minimum 13 years FT education)	0.449	0.445	0.510	0.521	0.532	0.535
Below tertiary education (9–12 years FT education)	0.551	0.555	0.490	0.479	0.468	0.465
<i>Socioeconomic status (in 2001, 2008 and 2011, respectively)</i>						
Upper-level employees with administrative, managerial, professional and related occupations	0.292	0.289	0.311	0.316	0.314	0.309
Lower-level employees with administrative and clerical occupations	0.432	0.442	0.489	0.487	0.487	0.493
Manual workers	0.214	0.207	0.166	0.163	0.154	0.154
Other (unemployed, students, pensioners)	0.057	0.057	0.030	0.030	0.041	0.041
<i>Annual earnings (euro 000's in 2001, 2008 and 2011, respectively)</i>	42.553	43.694	46.429	46.407	46.226	46.325
<i>Employment history</i>						
Proportion of time spent in employment between age 48 and 54	96.497	96.849	97.083	97.506	97.098	97.579
N	19,119	18,555	18,190	18,322	18,460	18,173

Notes: Sample refers to individuals who eligible for EUB among control and treated birth cohorts. Earnings reported in 2024 prices and adjusting using CPI. Source: FCP registers.

Appendix D: Heterogeneity in reform effects

Table D1: Change in cumulative employment duration among private sector workers

Characteristic	2003 reform	2010 reform	2014 reform
Male	7.352*** (2.005)	3.291** (1.614)	2.966*** (1.133)
Female	7.329*** (2.162)	3.719** (1.788)	2.908* (1.749)
Marital status (in 2001, 2008 and 2011, respectively)			
Single	7.067 (4.973)	8.027* (4.594)	2.262 (3.522)
Married	7.000*** (1.657)	3.302*** (1.144)	2.938** (1.204)
Divorced	12.827*** (3.697)	0.456 (2.581)	4.156* (2.378)
Other			
Education level (in 2001, 2008 and 2011, respectively)			
Basic (9 years FT education)	8.965*** (2.516)	3.985* (2.294)	2.908 (2.265)
Secondary (11-12 years FT education)	7.938*** (2.499)	1.387 (1.756)	2.567 (1.622)
Lowest tertiary (13-15 years FT education)	3.758 (2.972)	7.231*** (2.690)	4.456* (2.303)
Lower tertiary (14-16 years FT education)	14.833*** (5.285)	5.931 (3.910)	2.950 (2.699)
Higher tertiary (17+ years FT education)	-1.718 (6.508)	4.222 (3.536)	9.624*** (3.486)
Socioeconomic status (in 2001, 2008 and 2011, respectively)			
Upper-level employees with administrative, managerial, professional and related occupations	9.494** (3.702)	2.059 (2.620)	5.048*** (1.889)
Lower-level employees with administrative and clerical occupations	4.889** (2.453)	2.577 (1.851)	2.619 (1.598)
Manual workers	8.677*** (2.060)	5.140*** (1.776)	3.076* (1.745)
Other (unemployed, students, pensioners)	6.046 (6.349)	8.447 (6.559)	0.986 (5.302)
Earnings quartile (in 2001, 2008 and 2011, respectively)			
1	7.508** (3.693)	11.755*** (3.877)	4.123 (2.629)
2	5.225 (3.247)	5.417** (2.336)	1.520 (2.495)
3	5.047* (3.030)	3.931** (1.943)	3.367** (1.653)

4	10.030*** (2.671)	0.668 (2.035)	3.602** (1.623)
N	57,722	52,805	49,491

Notes: outcome variables measured over ages 56-63, 57-63 and 58-63 in the case of the 2003, 2010 and 2014 reform to EUB, respectively. Sample size refers to full sample, from which subsamples used for estimation purposes. Estimates based on package developed by Calonico et al. (2025), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Table D2: Change in cumulative employment duration among public sector workers

Characteristic	2003 reform	2010 reform	2014 reform
Male	3.292 (2.909)	1.090 (2.314)	2.759 (2.844)
Female	4.224** (1.945)	0.481 (1.399)	1.930** (0.973)
Marital status (in 2001, 2008 and 2011, respectively)			
Single	4.931 (5.888)	-0.687 (4.524)	4.605 (3.873)
Married	3.887** (1.845)	-0.845 (1.299)	1.107 (1.143)
Divorced	1.817 (3.905)	9.892*** (3.348)	4.283** (2.126)
Other			
Education level (in 2001, 2008 and 2011, respectively)			
Basic (9 years FT education)	5.680 (4.017)	12.360*** (4.738)	-0.815 (3.439)
Secondary (11-12 years FT education)	3.656 (2.893)	1.680 (2.121)	-0.053 (1.958)
Lowest tertiary (13-15 years FT education)	5.473* (2.950)	-1.219 (2.210)	2.122 (1.514)
Lower tertiary (14-16 years FT education)	-1.365 (3.763)	-1.589 (3.054)	1.187 (2.533)
Higher tertiary (17+ years FT education)	-1.669 (4.394)	-0.968 (1.950)	6.077*** (2.280)
Socioeconomic status (in 2001, 2008 and 2011, respectively)			
Upper-level employees with administrative, managerial, professional and related occupations	2.332 (2.601)	-1.053 (1.434)	3.041 (2.145)
Lower-level employees with administrative and clerical occupations	1.734 (2.623)	0.360 (1.611)	0.961 (1.105)
Manual workers	5.383* (3.196)	5.124 (3.748)	-0.267 (2.582)
Other (unemployed, students, pensioners)	14.571 (8.860)	9.668 (13.761)	
Earnings quartile (in 2001, 2008 and 2011, respectively)			

1	14.134*** (5.264)	3.280 (5.477)	6.037 (4.171)
2	0.473 (2.347)	2.651 (1.623)	-0.060 (1.731)
3	3.353 (2.365)	1.274 (2.089)	2.672* (1.507)
4	2.580 (2.732)	-1.996 (1.910)	3.211 (2.142)
N	37,674	36,512	36,633

Notes: outcome variables measured over ages 56-63, 57-63 and 58-63 in the case of the 2003, 2010 and 2014 reform to EUB, respectively. Estimates based on package developed by Calonico et al. (2025), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Table D3: Change in cumulative earnings among private sector workers

Characteristic	2003 reform	2010 reform	2014 reform
Male	35,626*** (12,006)	18,683* (10,582)	16,277 (10,174)
Female	16,179 (10,804)	6,090 (8,828)	15,129 (9,270)
Marital status (in 2001, 2008 and 2011, respectively)			
Single	34,795 (23,773)	35,237 (22,187)	37,085 (24,067)
Married	26,340** (10,370)	20,172** (9,361)	14,130* (8,485)
Divorced	43,212** (17,084)	5,010 (15,342)	26,851 (17,638)
Other			
Education level (in 2001, 2008 and 2011, respectively)			
Basic (9 years FT education)	26,421*** (10,234)	4,592 (10,863)	22,033** (11,241)
Secondary (11-12 years FT education)	38,058*** (11,135)	8,592 (9,068)	-4,063 (7,907)
Lowest tertiary (13-15 years FT education)	1,100 (21,545)	11,969 (16,529)	28,086* (15,799)
Lower tertiary (14-16 years FT education)	91,685** (37,018)	37,196 (30,789)	26,924 (32,279)
Higher tertiary (17+ years FT education)	14,142 (56,943)	21,809 (36,300)	58,543 (40,196)
Socioeconomic status (in 2001, 2008 and 2011, respectively)			
Upper-level employees with administrative, managerial, professional and related occupations	37,061 (27,564)	22,117 (20,889)	56,881** (22,301)
Lower-level employees with administrative and clerical occupations	27,367* (14,142)	969 (10,413)	11,639 (9,458)

Manual workers	29,475*** (9,466)	10,254 (7,400)	12,250 (8,733)
Other (unemployed, students, pensioners)	21,739 (23,515)	22,758 (31,860)	-6,255 (27,443)
Earnings quartile (in 2001, 2008 and 2011, respectively)			
1	12,299 (11,108)	15,012 (11,468)	4,974 (9,002)
2	18,635* (9,847)	16,197* (9,005)	3,949 (8,536)
3	22,655* (12,500)	18,587** (8,923)	12,168* (7,362)
4	54,427*** (16,873)	18,480 (16,513)	27,565* (14,407)
N	57,722	52,805	49,491

Notes: outcome variables measured over ages 56-63, 57-63 and 58-63 in the case of the 2003, 2010 and 2014 reform to EUB, respectively. Estimates based on package developed by Calonico et al. (2025), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Table D4: Change in cumulative earnings among public sector workers

Characteristic	2003 reform	2010 reform	2014 reform
Male	-8,081 (22,793)	-5,090 (17,104)	19,101 (19,466)
Female	9,263 (9,314)	437 (8,699)	21,844** * (6,714)
Marital status (in 2001, 2008 and 2011, respectively)			
Single	-23,252 (39,414)	-976 (37,330)	4,374 (22,322)
Married	7,040 (11,089)	-549 (9,976)	17,738** (7,616)
Divorced	-6,991 (21,622)	10,299 (22,072)	21,653 (16,267)
Other			
Education level (in 2001, 2008 and 2011, respectively)			
Basic (9 years FT education)	11,223 (15,273)	66,543*** (20,760)	15,816 (19,770)
Secondary (11-12 years FT education)	13,323 (10,017)	3,631 (7,851)	950 (8,301)
Lowest tertiary (13-15 years FT education)	8,696 (17,372)	6,084 (12,374)	10,675 (8,872)
Lower tertiary (14-16 years FT education)	-11,848 (27,188)	-2,715 (19,671)	-7,180 (19,476)
Higher tertiary (17+ years FT education)	-32,039 (36,778)	-5,230 (20,618)	21,775 (19,233)

Socioeconomic status (in 2001, 2008 and 2011, respectively)

Upper-level employees with administrative, managerial, professional and related occupations	11,631 (18,630)	4,058 (16,788)	23,305 (16,690)
Lower-level employees with administrative and clerical occupations	5,370 (9,932)	2,307 (8,118)	5,935 (5,865)
Manual workers	10,531 (11,061)	19,930 (14,479)	8,488 (11,940)
Other (unemployed, students, pensioners)	16,904 (34,774)	106,046 (150,550)	

Earnings quartile (in 2001, 2008 and 2011, respectively)

1	18,667 (16,880)	8,582 (18,472)	20,374 (16,581)
2	565 (7,912)	16,294** (6,457)	-2,254 (5,967)
3	11,472 (11,298)	13,728 (10,596)	11,570 (7,384)
4	-13,084 (24,064)	-50,164** (21,262)	28,533* (16,543)
N	37,674	36,512	36,633

Notes: outcome variables measured over ages 56-63, 57-63 and 58-63 in the case of the 2003, 2010 and 2014 reform to EUB, respectively. Estimates based on package developed by Calonico et al. (2025), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Table D5: Change in cumulative unemployment duration among private sector workers

Characteristic	2003 reform	2010 reform	2014 reform
Male	-7.347*** (1.491)	-0.478 (1.283)	-2.072** (0.874)
Female	-7.837*** (2.075)	-1.075 (1.295)	-0.540 (1.216)
Marital status (in 2001, 2008 and 2011, respectively)			
Single	-0.073 (4.857)	-7.750** (3.813)	-4.661 (3.342)
Married	-8.368*** (1.310)	-1.058 (1.043)	-1.143 (0.898)
Divorced	-6.884** (3.430)	-1.314 (2.482)	0.928 (2.101)
Other			
Education level (in 2001, 2008 and 2011, respectively)			
Basic (9 years FT education)	-8.690*** (2.759)	-2.996 (2.046)	-2.508 (1.858)
Secondary (11-12 years FT education)	-8.986*** (1.920)	-0.089 (1.407)	-0.967 (1.104)

Lowest tertiary (13-15 years FT education)	-6.274** (2.624)	-0.211 (1.979)	-1.222 (1.560)
Lower tertiary (14-16 years FT education)	- 15.935*** (5.236)	-5.606** (2.716)	0.885 (2.123)
Higher tertiary (17+ years FT education)	-3.950 (6.187)	-1.735 (2.502)	-2.807 (2.789)
Socioeconomic status (in 2001, 2008 and 2011, respectively)			
Upper-level employees with administrative, managerial, professional and related occupations	- 12.353*** (3.390)	0.704 (1.816)	-1.533 (1.727)
Lower-level employees with administrative and clerical occupations	-3.612* (2.172)	-2.623 (1.667)	0.008 (1.299)
Manual workers	-9.416*** (1.726)	-2.075 (1.381)	-2.935** (1.368)
Other (unemployed, students, pensioners)	-6.712 (6.007)	-1.117 (6.060)	-4.910 (5.265)
Earnings quartile (in 2001, 2008 and 2011, respectively)			
1	-6.617* (3.771)	-4.471 (3.526)	-2.929 (2.545)
2	-7.737** (3.014)	-2.739 (2.173)	-1.126 (2.008)
3	-5.483*** (2.040)	-0.850 (1.478)	-1.693 (1.282)
4	-8.634*** (2.305)	-0.308 (1.552)	-0.890 (1.348)
N	57,722	52,805	49,491

Notes: outcome variables measured over ages 56-63, 57-63 and 58-63 in the case of the 2003, 2010 and 2014 reform to EUB, respectively. Estimates based on package developed by Calonico et al. (2025), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Table D6: Change in cumulative unemployment duration among public sector workers

Characteristic	2003 reform	2010 reform	2014 reform
Male	-4.936*** (1.676)	0.088 (1.180)	0.039 (1.295)
Female	-3.244** (1.303)	-0.414 (0.799)	-1.159* (0.644)
Marital status (in 2001, 2008 and 2011, respectively)			
Single	-5.884* (3.308)	-0.398 (2.773)	-1.104 (3.107)
Married	-3.659*** (1.213)	-0.566 (0.836)	-0.902 (0.639)
Divorced	-2.791 (2.608)	-0.020 (1.543)	-0.866 (1.437)
Other			

Education level (in 2001, 2008 and 2011, respectively)

Basic (9 years FT education)	-4.190 (2.588)	-1.224 (2.883)	-2.756 (2.594)
Secondary (11-12 years FT education)	-3.260* (1.872)	-0.570 (1.185)	-0.173 (0.975)
Lowest tertiary (13-15 years FT education)	-2.180 (2.217)	-0.363 (1.076)	-1.254 (0.976)
Lower tertiary (14-16 years FT education)	-3.106 (2.183)	1.048 (1.714)	-0.312 (1.439)
Higher tertiary (17+ years FT education)	-2.213 (2.283)	-0.298 (1.262)	-0.482 (1.353)

Socioeconomic status (in 2001, 2008 and 2011, respectively)

Upper-level employees with administrative, managerial, professional and related occupations	-4.572*** (1.520)	-0.109 (0.957)	-1.257 (0.873)
Lower-level employees with administrative and clerical occupations	-0.389 (1.389)	-0.574 (1.005)	0.188 (0.711)
Manual workers	-4.668** (1.891)	-1.616 (2.281)	-1.927 (1.427)
Other (unemployed, students, pensioners)	-10.986 (7.980)		

Earnings quartile (in 2001, 2008 and 2011, respectively)

1	-9.876** (4.773)	0.315 (4.404)	-4.893 (3.603)
2	-1.967 (1.531)	-0.803 (1.073)	0.267 (0.876)
3	-1.205 (1.470)	-1.106 (0.997)	-0.853 (0.839)
4	-3.820*** (1.293)	0.901 (0.768)	-0.325 (0.770)
N	37,674	36,512	36,633

Notes: outcome variables measured over ages 56-63, 57-63 and 58-63 in the case of the 2003, 2010 and 2014 reform to EUB, respectively. Estimates based on package developed by Calonico et al. (2025), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Appendix E: Lag and lead discontinuity estimates by sector and EUB reform

Table E1: Private sector workers

	Months employed	Cumulative earnings	Months unemployed	N
EUB reform				
2003				57,722
Age 52- 54	-0.419* [0.236]	-	-	
Age 55- 56	2.125*** [0.229]	7,857*** [2180]	-1.436*** [0.194]	
Age 57- 58	2.615*** [0.323]	12,025*** [2278]	-2.566*** [0.264]	
Age 59- 62	5.199*** [0.791]	19,569*** [4173]	-5.996*** [0.674]	
2010				52,805
Ages 54- 57	-0.474** [0.206]			
Ages 58- 59	0.940*** [0.265]	1454 [1978]	-0.591** [0.263]	
Ages 60- 62	1.083 [0.596]	4508 [3621]	0.203 [0.464]	
2014				49,491
Age 55- 58	-0.357** [0.165]			
Age 59- 60	1.120*** [0.350]	5566*** [2038]	-0.825*** [0.262]	
Age 61- 63	1.463*** [0.442]	5569*** [2168]	-0.646** [0.297]	

Notes: estimates based on package developed by Calonico et al. (2017), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

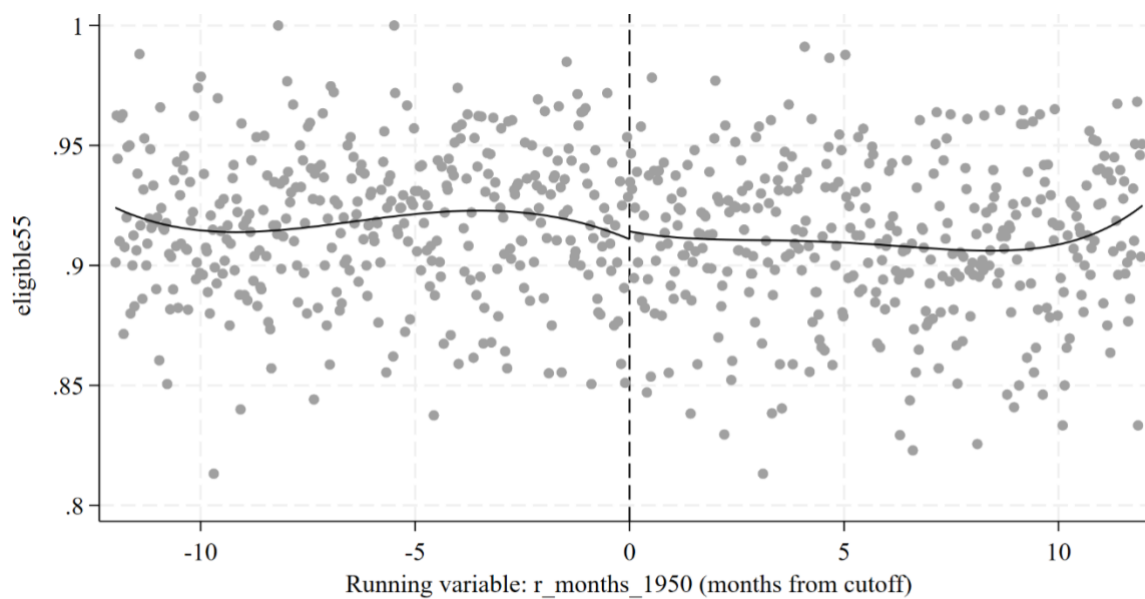
Table E2: Public sector workers

	Months employed	Cumulative earnings	Months unemployed	N
EUB reform				
2003				37,674
Age 52- 54	-0.165 [0.296]	-	-	
Age 55- 56	0.603** [0.274]	-1218 [1877]	-0.489*** [0.199]	
Age 57- 58	0.787** [0.382]	776 [1899]	-0.821*** [0.233]	
Age 59- 62	1.715** [0.780]	3770 [5053]	-2.347*** [0.550]	
2010				36,512
Age 54- 57	0.246 [0.164]			
Age 58- 59	0.452** [0.233]	728 [2068]	-0.243[0.172]	
Ages 60- 62	0.804 [0.672]	-218 [3690]	-0.355 [0.349]	
2014				36,633
Age 55- 58	0.020[0.166]			
Age 59- 60	0.657** [0.311]	4325* [2372]	-0.438** [0.192]	
Age 61- 63	0.567 [0.467]	4629* [2738]	-0.007 [0.231]	

Notes: estimates based on package developed by Calonico et al. (2017), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

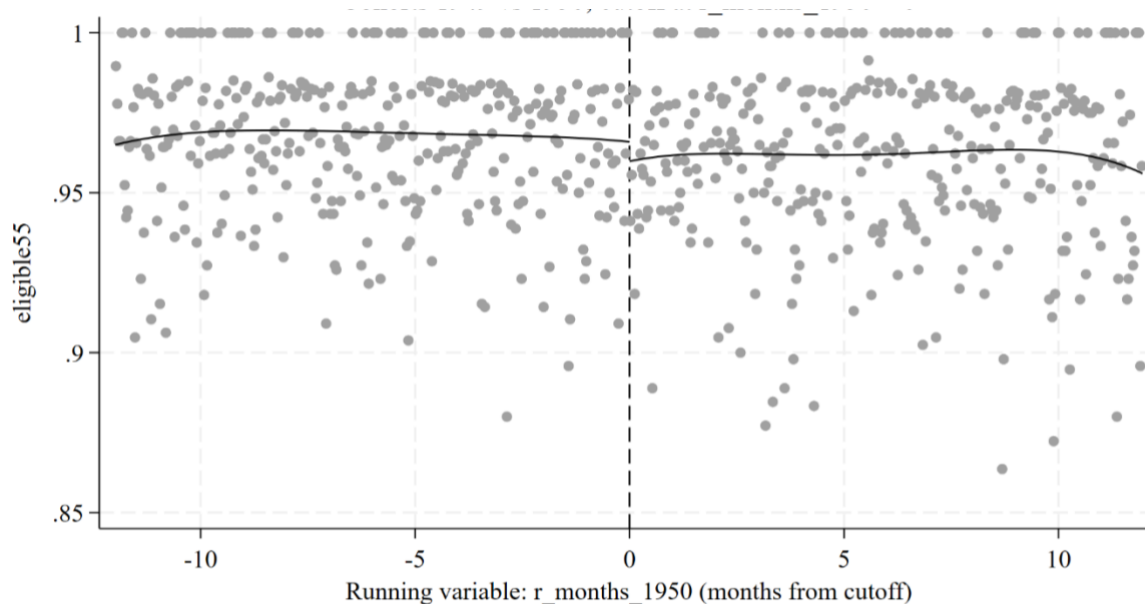
Appendix F: Programme eligibility among selected birth cohorts

Figure F1: Programme eligibility among birth cohorts 1949 and 1950 (private sector)



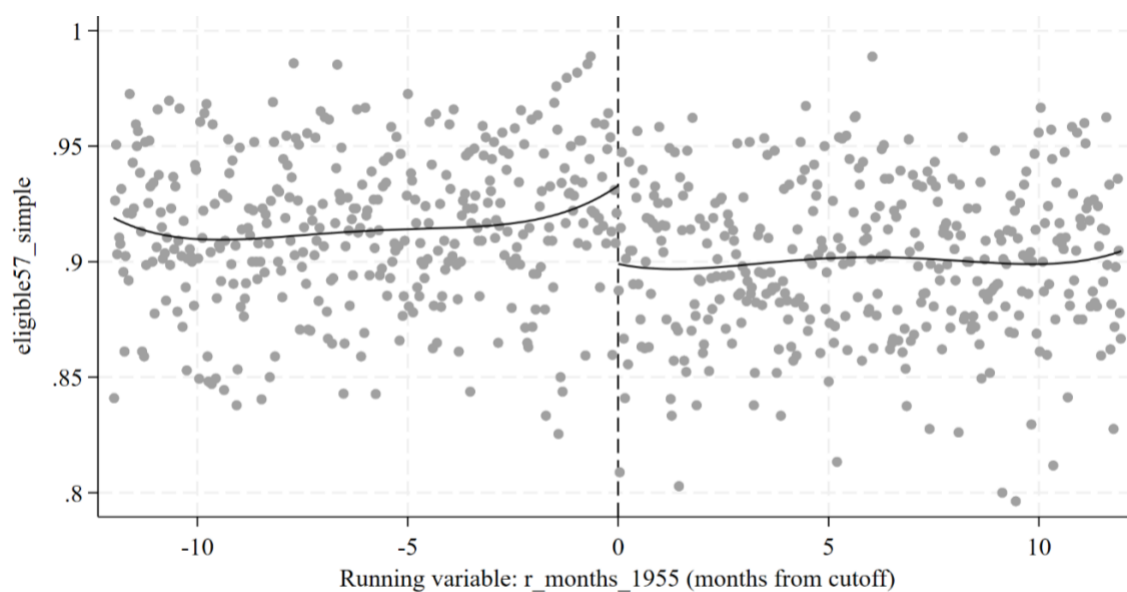
Notes: Authors calculations based on FCP register data. Sample refers to individuals employed in the private sector in 2001. Source: FCP registers.

Figure F2: Programme eligibility among birth cohorts 1949 and 1950 (public sector)



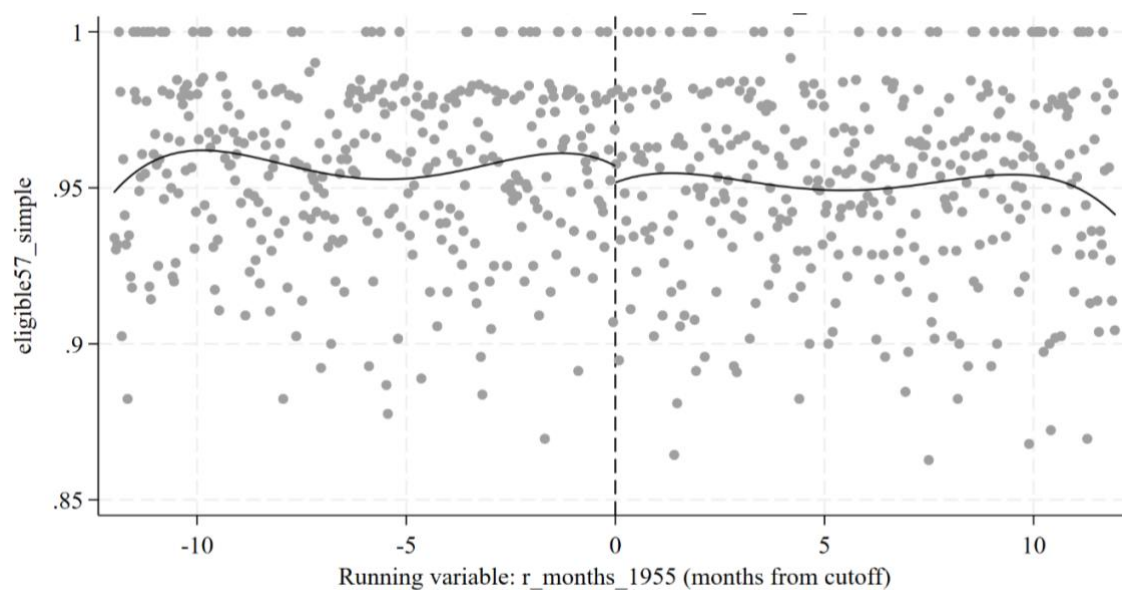
Notes: Authors calculations based on FCP register data. Sample refers to individuals employed in the public sector in 2001. Source: FCP registers.

Figure F3: Programme eligibility among birth cohorts 1954 and 1955 (private sector)



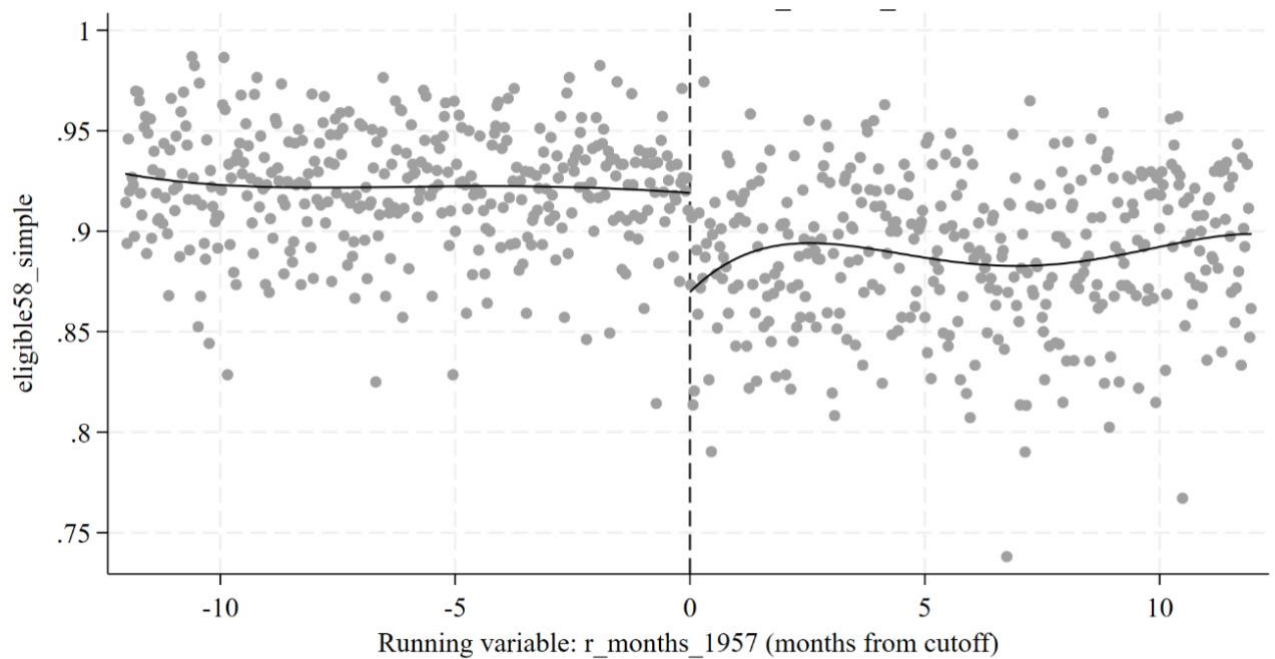
Notes: Authors calculations based on FCP register data. Sample refers to individuals employed in the private sector in 2008. Source: FCP registers.

Figure F4: Programme eligibility among birth cohorts 1954 and 1955 (public sector)



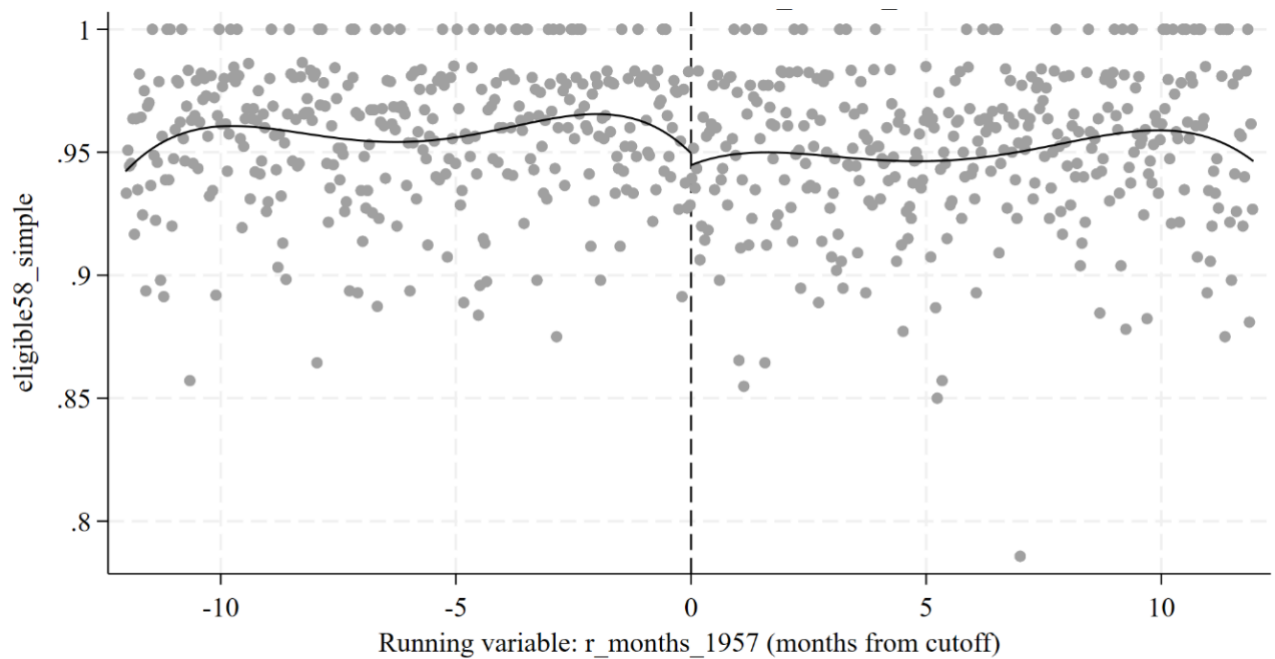
Notes: Authors calculations based on FCP register data. Sample refers to individuals employed in the public sector in 2008. Source: FCP registers.

Figure F5: Programme eligibility among birth cohorts 1956 and 1957 (private sector)



Notes: Authors calculations based on FCP register data. Sample refers to individuals employed in the private sector in 2011. Source: FCP registers.

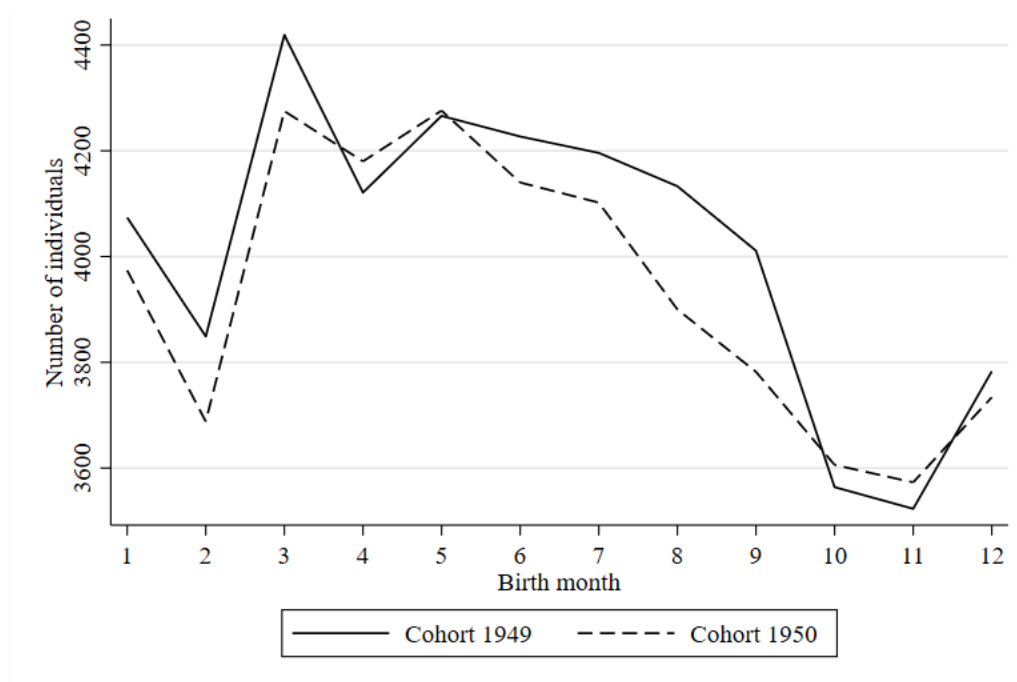
Figure F6: Programme eligibility among birth cohorts 1956 and 1957 (public sector)



Notes: Authors calculations based on FCP register data. Sample refers to individuals employed in the public sector in 2011. Source: FCP registers.

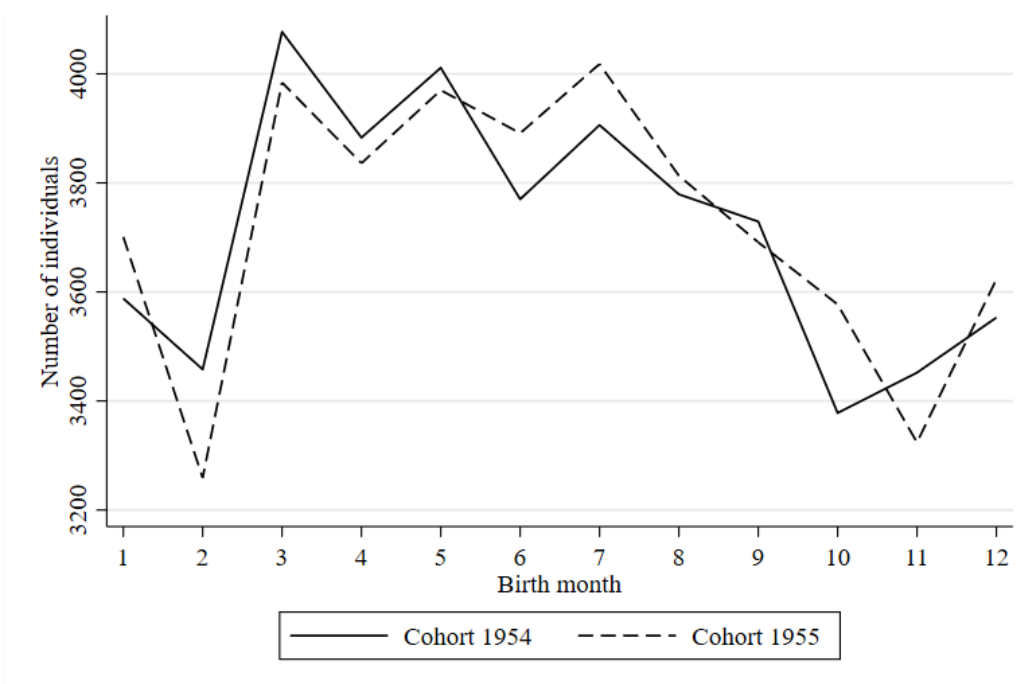
Appendix G: Birth month distribution by cohort

Figure G1: 1949 and 1950



Notes: Authors calculations based on FCP register data. Sample refers to individuals employed in the private or public sector in 2001 and meet EUB eligibility criteria. Source: FCP registers.

Figure G2: 1954 and 1955



Notes: Authors calculations based on FCP register data. Sample refers to individuals employed in the private or public sector in 2008 and meet EUB eligibility criteria. Source: FCP registers.

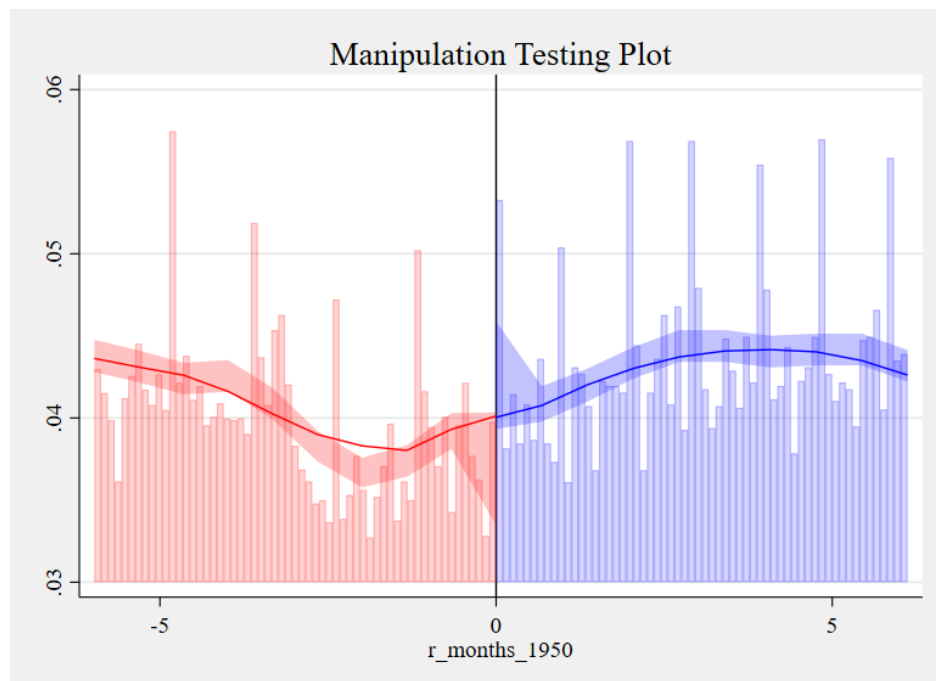
Figure G3: 1956 and 1957



Notes: Authors calculations based on FCP register data. Sample refers to individuals employed in the private or public sector in 2011 and meet EUB eligibility criteria. Source: FCP registers.

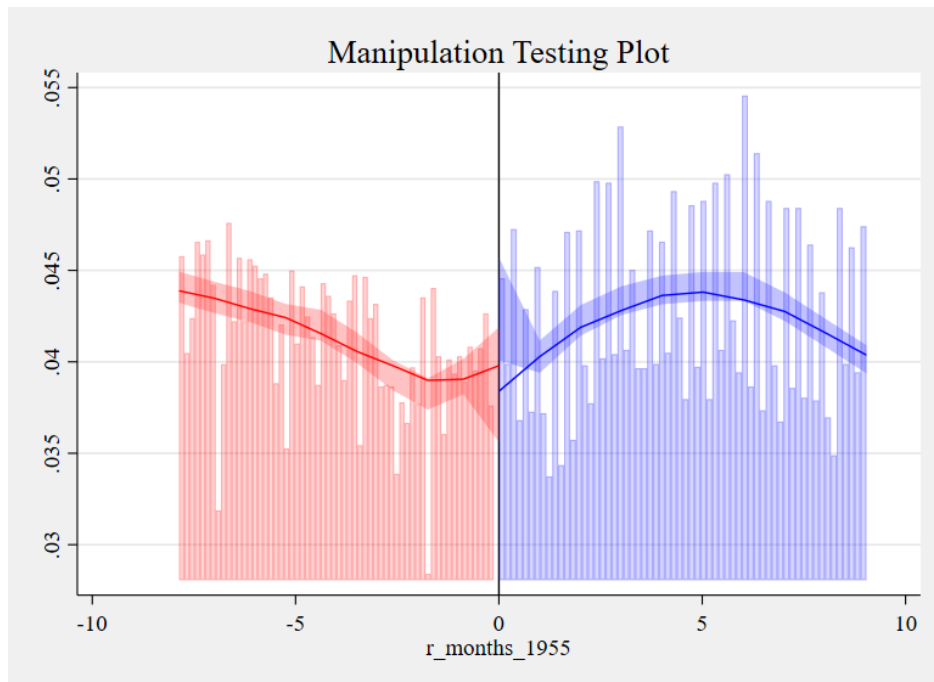
Non-parametric local polynomial density plots of births

Figure G4: 1949 and 1950 birth cohorts



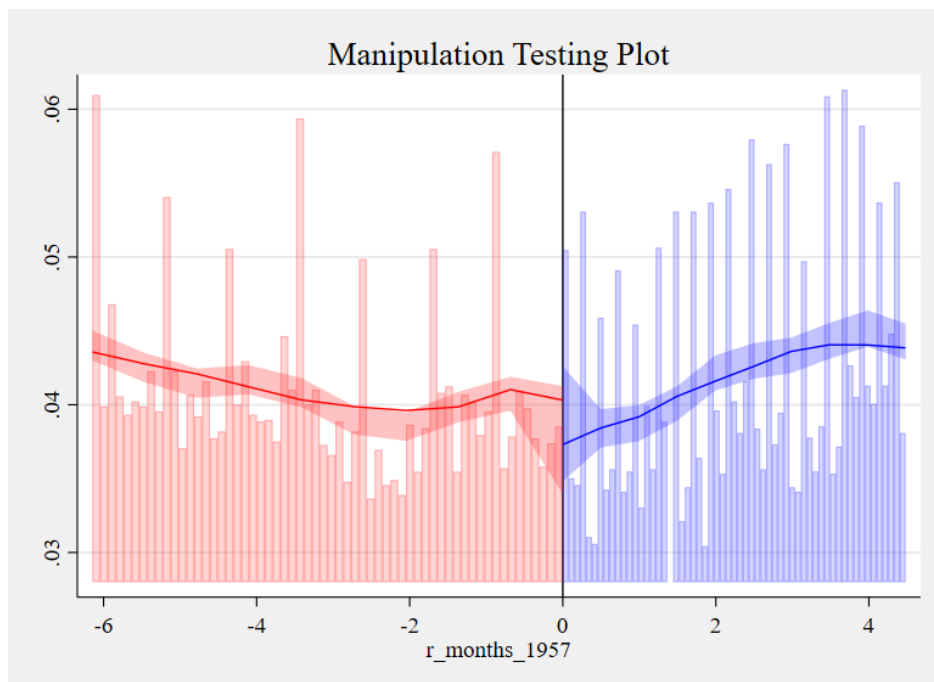
Notes: Authors calculations based on FCP register data. Sample refers to individuals employed in the private or public sector in 2001 and meet EUB eligibility criteria. Source: FCP registers.

Figure G: 1954 and 1955 birth cohorts



Notes: Authors calculations based on FCP register data. Sample refers to individuals employed in the private or public sector in 2008 and meet EUB eligibility criteria. Source: FCP registers.

Figure G6: 1956 and 1957 birth cohort



Notes: Authors calculations based on FCP register data. Sample refers to individuals employed in the private or public sector in 2011 and meet EUB eligibility criteria. Source: FCP registers.

Appendix H: Continuity in predetermined covariates one year prior to reform announcement

	2003 reform	2010 reform	2014 reform
Characteristic	$\beta(\sigma)$	$\beta(\sigma)$	$\beta(\sigma)$
Male	-0.022 (0.023)	-0.016 (0.020)	0.032 (0.022)
Female	0.017 (0.024)	0.016 (0.020)	-0.032 (0.022)
Marital status (in 2001, 2008 and 2011, respectively)			
Single	-0.004 (0.010)	0.002 (0.010)	-0.001 (0.009)
Married	-0.009 (0.015)	-0.004 (0.016)	0.043** (0.019)
Divorced	0.007 (0.012)	-0.002 (0.013)	-0.035** (0.014)
Other	0.001 (0.002)	0.000 (0.002)	0.001 (0.004)
Education level (in 2001, 2008 and 2011, respectively)			
Basic (9 years FT education)	-0.010 (0.020)	-0.007 (0.017)	-0.017 (0.015)
Secondary (11-12 years FT education)	-0.016 (0.019)	0.022 (0.018)	0.005 (0.022)
Lowest tertiary (13-15 years FT education)	0.035** (0.018)	0.008 (0.015)	-0.018 (0.019)
Lower tertiary (14-16 years FT education)	-0.002 (0.012)	0.010 (0.012)	0.011 (0.012)
Higher tertiary (17+ years FT education)	-0.027** (0.012)	-0.001 (0.014)	0.021* (0.012)
Socioeconomic status (in 2001, 2008 and 2011, respectively)			
Upper-level employees with administrative, managerial, professional and related occupations	-0.028 (0.019)	-0.022 (0.019)	0.028* (0.017)
Lower-level employees with administrative and clerical occupations	0.015 (0.018)	0.021 (0.021)	-0.034* (0.020)
Manual workers	0.002 (0.021)	-0.006 (0.020)	0.014 (0.021)
Other (unemployed, students, pensioners)	0.008 (0.010)	0.001 (0.006)	-0.005 (0.006)
Earnings quartile (in 2001, 2008 and 2011, respectively)			
1	-0.002 (0.015)	-0.002 (0.012)	-0.007 (0.012)

2	-0.035* (0.019)	0.054*** (0.019)	-0.011 (0.019)
3	0.012 (0.016)	-0.058*** (0.022)	-0.022 (0.017)
4	0.004 (0.020)	0.009 (0.019)	0.037* (0.019)
N	95,396	89,317	86,124

Notes: Estimates based on package developed by Calonico et al. (2025), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Appendix I: Programme eligibility discontinuity estimates by EUB reform and sector

	2003 reform	2010 reform	2014 reform
Sector			
Private	0.004 (0.011)	-0.031*** (0.012)	-0.033*** (0.013)
N	63,104	58,208	54,656
Public	-0.001 (0.009)	-0.004 (0.011)	-0.017 (0.012)
N	39,005	38,254	38,380

Notes: Sector of work refers to status in 2001, 2008 and 2011, respectively. Estimates based on package developed by Calonico et al. (2017), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Appendix J: Placebo discontinuity estimates by EUB reform and sector

Table J1: 2003 EUB reform (private sector)

	Cumulative employment age 56-63	N	Cumulative earnings age 56-63	N	Cumulative unemployment age 56-63	N
Placebo cutoff						
3 months post reform	0.123 (2.290)	14,915	-168 (12,831)	14,915	1.076 (1.497)	14,915
6 months post reform	1.603 (1.911)	14,546	-1,854 (10,527)	14,546	0.240 (1.469)	14,546
9 months post reform	0.456 (2.414)	13,826	4,847 (12,759)	13,826	-0.848 (1.490)	13,826

Notes: estimates based on package developed by Calonico et al. (2017), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Table J2: 2003 EUB reform (public sector)

	Cumulative employment age 56-63	N	Cumulative earnings age 56-63	N	Cumulative unemployment age 56-63	N
Placebo cutoff						
3 months post reform	2.144 (1.972)	9,891	501 (13,905)	9,891	-0.988 (0.922)	9,891
6 months post reform	1.433 (2.184)	9,652	18,030 (12,206)	9,652	0.149 (1.033)	9,652
9 months post reform	1.574 (2.133)	8,696	11,787 (16,200)	8,696	0.731 (1.108)	8,696

Notes: estimates based on package developed by Calonico et al. (2017), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Table J3: 2010 EUB reform (private sector)

	Cumulative employment age 57-63	N	Cumulative earnings age 57-63	N	Cumulative unemployment age 57-63	N
Placebo cutoff						
9 months pre reform	1.238 (1.692)	13,554	9,719 (11,660)	13,554	-1.103 (1.486)	13,554
6 months pre reform	-3.290* (1.712)	13,595	-23,900** (11,673)	13,595	1.973 (1.514)	13,595
3 months pre reform	1.158 (1.786)	12,915	-938 (10,792)	12,915	-0.339 (1.503)	12,915
3 months post reform	2.493 (1.517)	13,493	6,963 (9,837)	13,493	-1.753 (1.275)	13,493
6 months post reform	0.993 (1.853)	13,582	-2,256 (10,271)	13,582	-0.063 (1.324)	13,582
9 months post reform	3.927** (1.988)	12,878	21,341* (11,009)	12,878	-1.152 (1.306)	12,878

Notes: estimates based on package developed by Calonico et al. (2017), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Table J4: 2010 EUB reform (public sector)

	Cumulative employment age 57-63	N	Cumulative earnings age 57-63	N	Cumulative unemployment age 57-63	N
Placebo cutoff						
9 months pre reform	0.166 (1.418)	9,500	3,040 (12,778)	9,500	-1.569* (0.939)	9,500
6 months pre reform	-3.396* (1.949)	9,348	-10,474 (12,913)	9,348	1.127 (1.045)	9,348
3 months pre reform	1.141 (2.048)	8,745	14,011 (14,108)	8,745	1.558 (1.177)	8,745
3 months post reform	-0.700 (1.774)	9,414	-8,767 (13,327)	9,414	0.193 (1.088)	9,414
6 months post reform	-0.285 (1.427)	9,474	-12,365 (9,811)	9,474	1.151 (1.078)	9,474
9 months post reform	-4.512*** (1.690)	8,902	-24,905** (11,683)	8,902	0.663 (1.015)	8,902

Notes: estimates based on package developed by Calonico et al. (2017), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Table J5: 2014 EUB reform (private sector)

	Cumulative employment age 58-63	N	Cumulative earnings age 58-63	N	Cumulative unemployment age 58-63	N
Placebo cutoff						
9 months pre reform	1.938 (1.323)	12,944	4,266 (9,095)	12,944	-1.990 (1.261)	12,944
6 months pre reform	-0.464 (1.483)	12,921	-11,433 (9,514)	12,921	0.492 (1.264)	12,921
3 months pre reform	0.188 (1.599)	12,254	5,056 (9,941)	12,254	-2.764* (1.443)	12,254
3 months post reform	0.153 (1.347)	12,490	-6,723 (11,243)	12,490	-0.227 (1.200)	12,490
6 months post reform	-0.484 (1.459)	12,451	-6,741 (11,106)	12,451	-0.789 (0.989)	12,451
9 months post reform	-2.153 (1.607)	11,801	-27,875** (13,477)	11,801	0.728 (1.213)	11,801

Notes: estimates based on package developed by Calonico et al. (2017), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

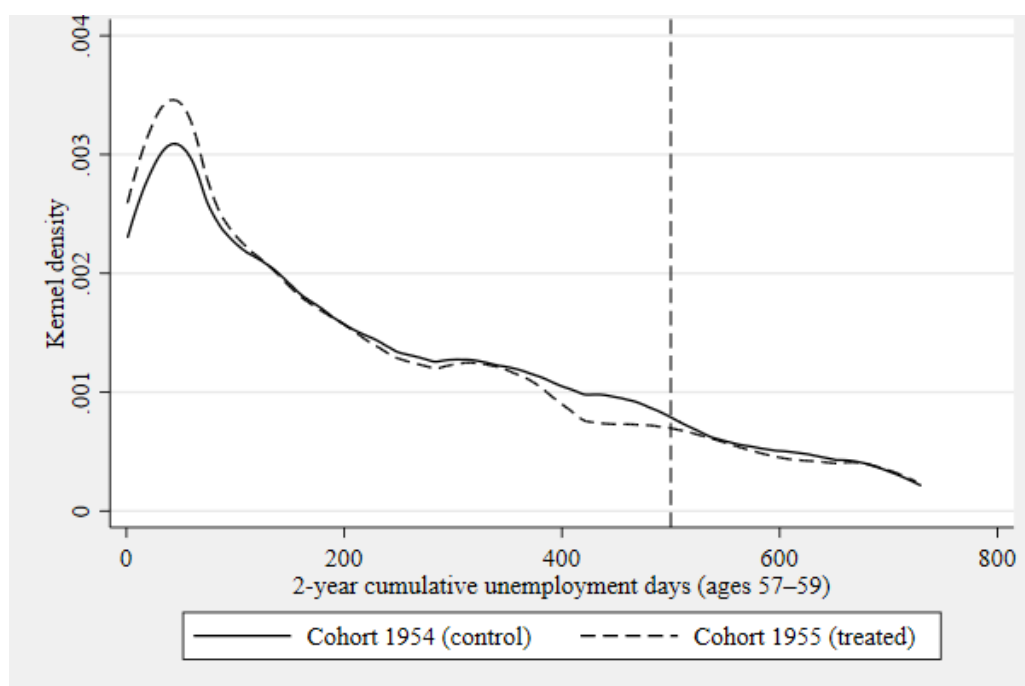
Table J6: 2014 EUB reform (public sector)

	Cumulative employment age 58-63	N	Cumulative earnings age 58-63	N	Cumulative unemployment age 58-63	N
Placebo cutoff						
9 months pre reform	-1.513 (1.165)	9,703	4,652 (9,967)	9,703	0.138 (0.898)	9,703
6 months pre reform	1.586 (1.443)	9,524	4,679 (9,371)	9,524	-1.450* (0.841)	9,524
3 months pre reform	0.538 (1.320)	8,754	1,800 (12,115)	8,754	0.782 (0.943)	8,754
3 months post reform	0.415 (1.254)	9,305	9,466 (9,450)	9,305	-1.255* (0.752)	9,305
6 months post reform	-0.600 (1.405)	9,372	468 (11,783)	9,372	-1.273 (0.938)	9,372
9 months post reform	0.212 (1.577)	8,868	-3,095 (11,890)	8,868	-0.930 (0.849)	8,868

Notes: estimates based on package developed by Calonico et al. (2017), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

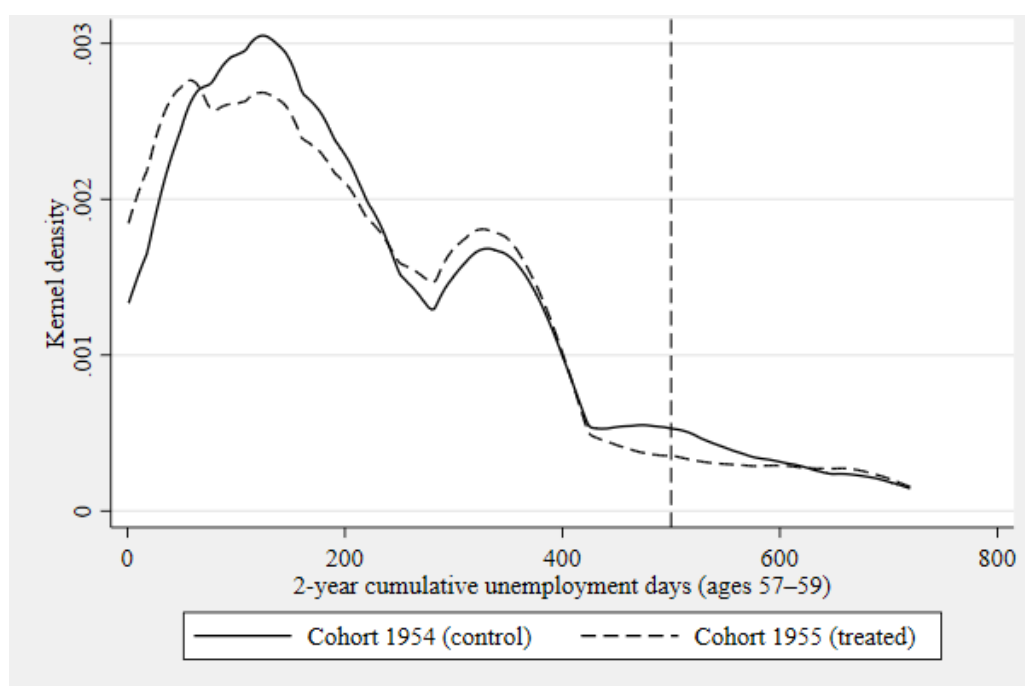
Appendix K: 2-year unemployment durations at selected ages

Figure K1: Private sector workers belonging to 1954 and 1955 birth cohort, ages 57-59



Notes: N= 12,530. Sample restricted to individuals with at least one day of unemployment. Source: Author calculations based on FCP registers. Source: FCP registers.

Figure K2: Public sector workers belonging to 1954 and 1955 birth cohort, ages 57-59



Notes: N= 4,268. Sample restricted to individuals with at least one day of unemployment. Source: Author calculations based on FCP registers. Source: FCP registers.

Figure K3: Private sector workers belonging to 1956 and 1957 birth cohort, ages 58-60



Notes: N= 13,074. Sample restricted to individuals with at least one day of unemployment. Source: Author calculations based on FCP registers. Source: FCP registers.

Figure K4: Public sector workers belonging to 1956 and 1957 birth cohort, ages 58-60



Notes: N=4,941. Sample restricted to individuals with at least one day of unemployment. Source: Author calculations based on FCP registers. Source: FCP registers.

Appendix L: Discontinuity estimates imposing the long-term employment condition

	Cumulative employment age	Cumulative earnings age	Cumulative unemployment age	N
2010 EUB reform				
Private sector	2.264*** (0.803)	4,106 (5,820)	-0.846 (0.757)	52,759
Public sector	1.538 (0.935)	2,554 (6,403)	-0.607 (0.536)	36,501
2014 EUB reform				
Private sector	3.181*** (0.814)	14,397*** (4,803)	-1.977*** (0.572)	49,448
Public sector	1.277 (0.786)	8,041 (5,683)	-0.698 (0.447)	36,624

Notes: outcome variables measured over ages 57-63 (58-63) in the case of the 2010 (2014) reform, respectively. Estimates based on package developed by Calonico et al. (2017), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Appendix M: Difference in discontinuity estimates- 2010 EUB reform

	Months employed	Cumulative earnings	Months unemployed	N
Private sector	1.89*** [0.56]	7,159 [3620]	-0.94** [0.45]	105,645
Public sector	0.23 [0.56]	859 [3875]	-0.41 [0.32]	71,053

Notes: outcome variables measured over ages 57-63 . Estimates based on package developed by Calonico et al. (2017), using a local linear regression, second order polynomial to correct for bias and variance adjusted. Uniform kernel. *, **, *** refer to significance at the 10 %, 5 % and 1 % level, respectively. Source: FCP registers.

Appendix N: Ordinary Disability Pension application rates by birth cohort

Figure N1: Employed in the private sector in 2001



Notes: N= 57,691. Source: Author calculations based on FCP registers. Source: FCP registers.

Figure N2: Employed in the public sector in 2001



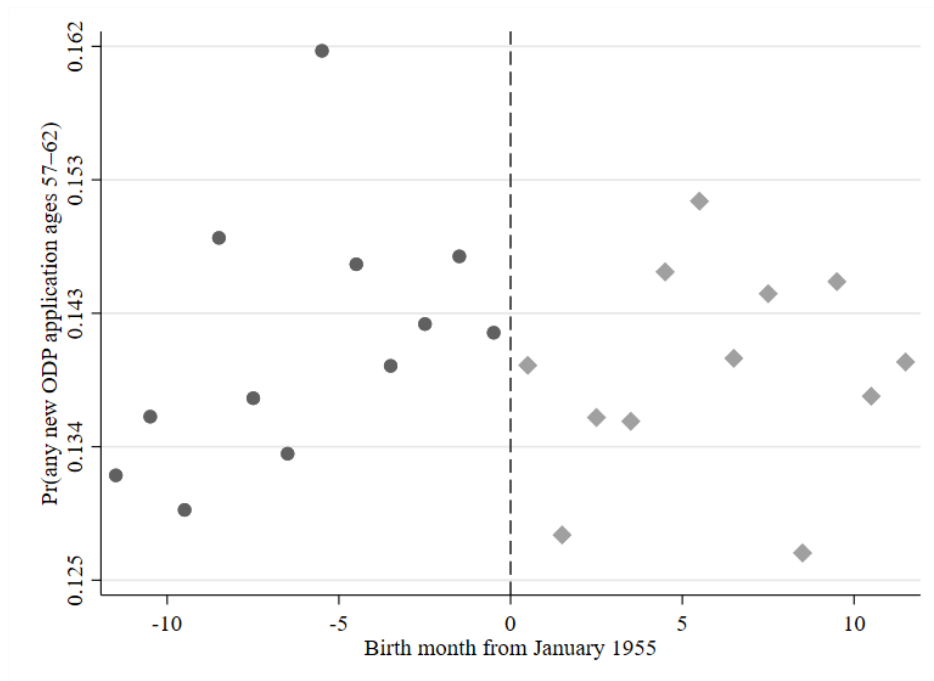
Notes: N= 37,645. Source: Author calculations based on FCP registers. Source: FCP registers.

Figure N3: Employed in the private sector in 2008



Notes: N= 52,769. Source: Author calculations based on FCP registers. Source: FCP registers.

Figure N4: Employed in the public sector in 2008



Notes: N= 36,502. Source: Author calculations based on FCP registers. Source: FCP registers.

Appendix O: Part Time and Partial Old Age Pension application rates by birth cohort

Figure O1: Employed in the private sector in 2001



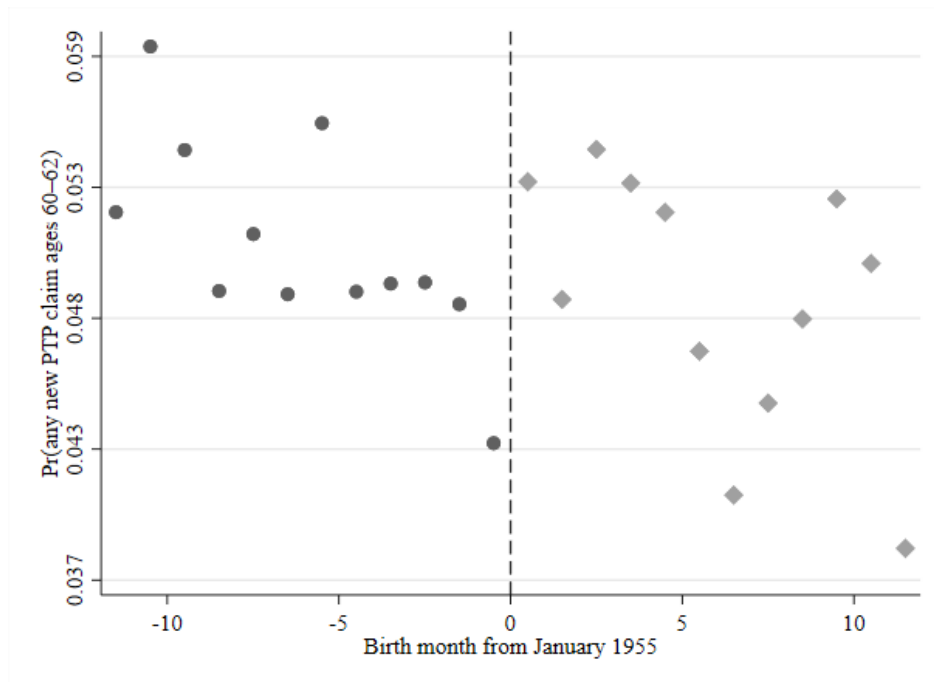
Notes: N= 55,368. Source: Author calculations based on FCP registers. Source: FCP registers.

Figure O2: Employed in the public sector in 2001



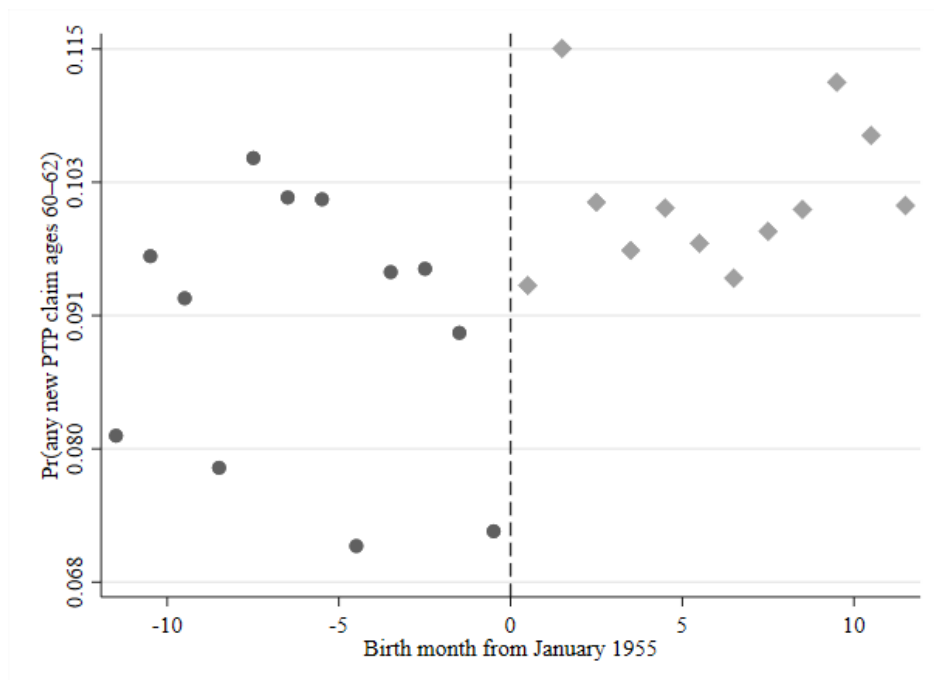
Notes: N= 36,691. Source: Author calculations based on FCP registers. Source: FCP registers.

Figure O3: Employed in the private sector in 2008



Notes: N=52, 610. Source: Author calculations based on FCP registers. Source: FCP registers.

Figure O4: Employed in the public sector in 2008



Notes: N= 36,424. Source: Author calculations based on FCP registers. Source: FCP registers.

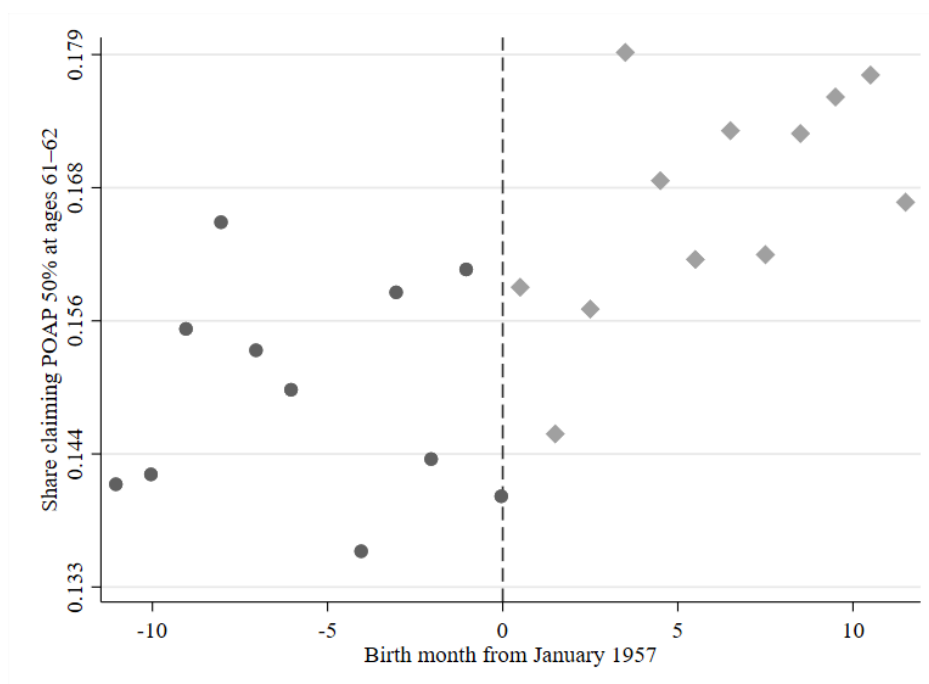
Figure O5: Employed in the private sector in 2011

25% POAP pension



Notes: N= 49,458. Source: Author calculations based on FCP registers. Source: FCP registers.

Figure O6: 50% POAP pension



Notes: N= 49,458. Source: Author calculations based on FCP registers. Source: FCP registers.

Figure O7: Employed in the public sector in 2011

25% POAP pension



Notes: N= 36,628. Source: Author calculations based on FCP registers. Source: FCP registers.

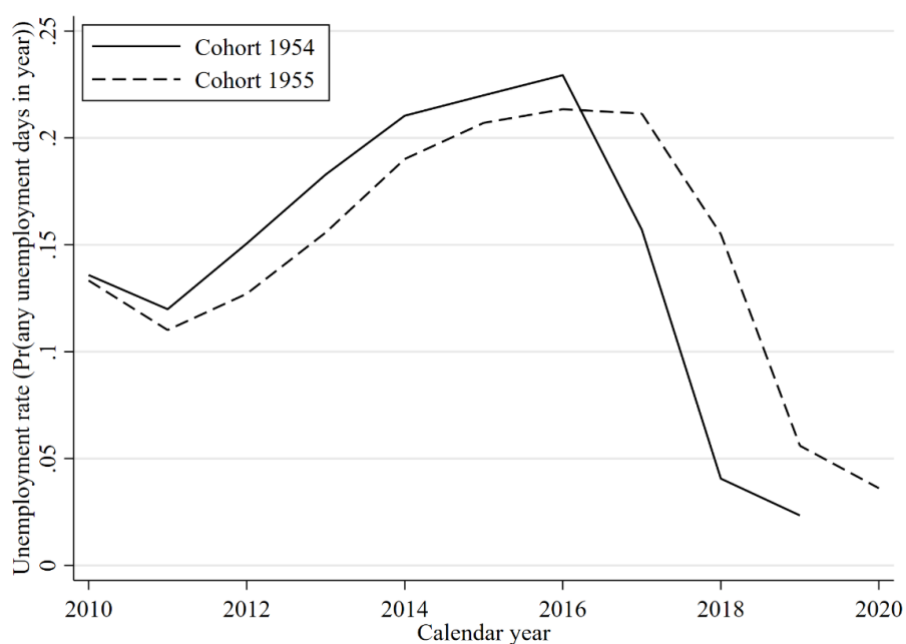
Figure O8: 50% POAP pension



Notes: N= 36,628. Source: Author calculations based on FCP registers. Source: FCP registers.

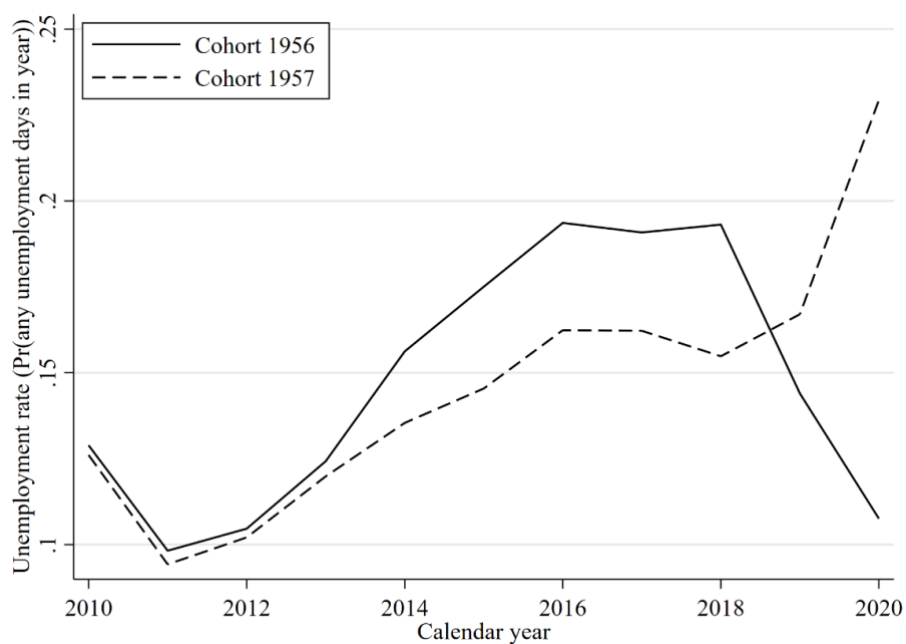
Appendix P: Unemployment rates by birth cohort

Figure P1: 1954 and 1955



Notes: restricted to estimation sample. Unemployment rate based on an individual reporting at least one day of earnings or non-earnings related unemployment benefit in a calendar year. N= 85,943. Source: Author calculations based on FCP registers. Source: FCP registers.

Figure P2: 1956 and 1957



Notes: restricted to estimation sample. Unemployment rate based on an individual reporting at least one day of earnings or non-earnings related unemployment benefit in a calendar year. N= 84,038. Source: Author calculations based on FCP registers. Source: FCP registers.