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ABSTRACT

We present quasi-experimental evidence on the effects of increasing the Early Retirement Age (ERA) on older workers' retirement decisions. The analysis is based on social security reforms in Austria in 2000 and 2004, and administrative data allows us to distinguish between pension claims and job exits. Using a Regression Kink Design, we estimate that, within a birth cohort, a 1.0-year increase in the ERA leads to a 0.4-year increase in the average job exiting age and a 0.5-year increase in the average pension claiming age. When the ERA increases, many older workers remain in their jobs longer.

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1 Introduction

Countries around the world are facing increasing pressure for social security reforms due to demographic transition and generosity of government-provided pension systems. To restore financial balance and increase labor force participation of older workers, researchers and policy makers are seeking to understand how social security systems affect individuals' retirement decisions. A central aspect of social security systems is the Early Retirement Age (ERA), or Early Entitlement Age, which is the earliest age at which individuals can claim social security retirement benefits. Generous retirement benefits and low ERAs can create incentives for early exits from the labor force and low labor force participation rates at older ages. Thus, many potential social security reforms consider increasing ERAs (see for example Congressional Budget Office, 2012; OECD, 2015). In this context, it is important to answer the question: how does increasing the ERA influence retirement and labor supply decisions?

In this paper we address this question by studying a series of pension reforms in Austria in 2000 and 2004. The reforms introduced a step-wise increase in the ERA over multiple birth cohorts and provide a clean quasi-experimental setting to study the effects of the ERA on retirement decisions for several reasons. First, similar to other countries, the ERA is a highly salient factor in individual retirement decisions in Austria as there are high rates of retirement at the ERA for each birth cohort. Second, detailed administrative data from Austria allow us to examine a large sample and observe two margins of retirement: pension claims, which are mechanically related to changes in the ERA and job exits, which reflect individuals' labor supply decisions. Third, it is plausible to consider observed changes in retirement decisions in Austria as being driven only by the changes in the ERA since other adjustments in the social security benefit system were highly complicated and hence difficult for individuals to respond to.[1]

We show that the main features of the Austrian setting can be captured by a simple static lifecycle labor supply model with a kink in the budget set due to the implicit tax on earnings after the ERA. This model predicts bunching of retirements at the ERA and shifts in bunching as the ERA increases. In the case of exact shifts in bunching, we show that the magnitude of the effect of the ERA increase on average retirement ages should

[1]Furthermore, Brown et al. (2016) present evidence on individuals' cognitive difficulties in valuing annuities.

be directly related to the pre-reform share of bunching at the ERA.

The first part of our empirical analysis presents graphical evidence on labor supply responses to the pension reforms. In line with prior studies that highlight shifts in bunching in response to social security or retirement policy changes (Behaghel and Blau, 2012; Brown, 2013), we find precise shifts in bunching at cohort specific ERAs for both pension claims and job exits in Austria. This finding is entirely consistent with the predictions of the static labor supply model, and it relates to the recent literature on bunching (Brown, 2013; Kleven, 2016; Seibold, 2016). The parallel response in job exits and pension claims indicates that the reforms did not lead to increased substitution to other benefit programs such as unemployment insurance or sick leave. There is also no evidence of increased entry into disability pensions prior to the ERA in response to the reforms. The lock-step shift in job exits with the increase of the ERA suggests that the cost of adjustment in retirement decisions is low. We show that an important channel of adjustment is that affected individuals keep their jobs longer.

We further point out that it is important to disentangle the precise incentives from the pension reform for different groups of individuals. In particular, we distinguish between individuals who are directly affected by the ERA increase, and a second group of individuals who have the potential of reaching an exemption from the reforms by remaining continuously employed up to the pre-reform ERA at which they can still claim benefits. We find that individuals with the potential of reaching the exemption respond to the pension reform by reducing their job exits and disability claims prior to the pre-reform ERA.

To quantify the effects of the ERA increase on the average job exit and pension claiming age, the second part of our empirical analysis applies a Regression Kink (RK) design (Card et al., 2015b). The research design exploits the kinked schedule by which the reforms increase the ERA by quarterly birth cohorts and relates these increases in the ERA to changes in average retirement ages due to the shifts in bunching. We estimate that a one year increase in the ERA leads to a 0.4 year increase in the average job exiting age and a 0.5 year increase in the average pension claiming age within a birth cohort.

This paper contributes to the retirement literature by providing quasi-experimental evidence on the effects of increasing the ERA on retirement decisions and on the mechanisms behind these labor supply responses. Due to lack of policy variation, prior studies have been forced to rely on out-of-sample predictions and model simulations. Conclusions on the impacts of increasing the ERA strongly depend on model assumptions. Regression based models typically rely on exogenous age effects to explain bunching in retirements at the Normal (or Full) Retirement Age (NRA) and ERA (Gruber and Wise, 2007; Panis et al., 2002)). Simulations of responses to increases in the ERA based on these models either assume fixed age effects or shifting age effects, whereby individuals either stick with pre-reform retirement ages or delay their exits when the ERA increases.

Dynamic lifecycle models also form different predictions regarding labor supply responses to increases in the ERA. Models focusing on exogenous age effects, heterogeneous preferences, borrowing or health insurance constraints to explain retirements at the ERA and NRA, predict some labor supply response to changes in the ERA (see Burtless, 1986; Gustman and Steinmeier, 1985, 2005; Mitchell and Phillips, 2000; Rust and Phelan, 1997). Other dynamics models that emphasize health shocks and savings decisions predict little to no labor supply responsiveness to changes in the ERA (see French, 2005).[2]

Our empirical analysis relates to prior studies of changes in the NRA (Behaghel and Blau, 2012; Mastrobuoni, 2009). These studies highlight bunching at the NRA in the United States as well as shifts in bunching and changes in average retirement ages as the NRA increases, which is in line with our findings. Another strand of empirical studies exploiting policy variation focuses on employment effects (Giesecke and Kind, 2013) or substitution between social insurance programs (Duggan et al., 2009; Inderbitzin et al., 2016; Staubli and Zweimüller, 2013) as opposed to changes in retirement ages and job durations.[3]

This paper is organized as follows. In the next section, we discuss the institutional background of the Austrian pension system and the pension reforms. Section 3 formalizes a static lifecycle labor supply model, discusses predictions on bunching and implications

[2]In simulations of increases in the ERA (or Early Entitlement Age) in the United States (such as Congressional Budget Office, 2012; French, 2005; Panis et al., 2002), lifetime social security benefit income remains roughly constant. This is because the benefit schedule is such that benefits increase to compensate for having less time to receive benefits when the ERA increases. This is not the case in the Austrian context we study. In the Austrian context, when the ERA increases, benefits do not increase to compensate for having less time to receive benefits. Thus, lifetime social security benefit income decreases when the ERA increases in Austria. This point is highlighted in the institutional background and theoretical model that we discuss below.

[3]Staubli and Zweimüller (2013) study the same Austrian pension reform as we do. Their analysis is based on a different population of individuals who are less attached to the labor market and they estimate the effect of the ERA increase on the probability of being employed, unemployed, or receiving disability benefits.

for average retirement ages. In Sections 4 and 5, we present the data and the graphical analysis of changes in job exits and pension claims by birth cohorts. Sections 6 and 7 present the RK estimation strategy and results. The final section concludes.

2 Institutional Background

2.1 The Austrian Pension System Before 2000

Austria has a universal government provided pension system that automatically enrolls every worker who is employed in the private sector. This system is operated as a traditional pay-as-you-go system. Social security contributions along with unemployment and health insurance contributions are withheld from the worker's salary up to a contribution cap. Throughout the working life an individual accumulates *insurance years* either in the form of *contribution years* by actively contributing to the system when employed, or in the form of *additional qualifying years* that accrue due to unemployment, military service, parental leave, or sickness leave. At the end of the working life a worker receives pension benefits from the system.

Eligibility for pension benefits depends on age at retirement and a minimum number of insurance years. The normal retirement age (NRA) at which individuals with at least 15 insurance years become eligible for the *old age pension* is 65 for men and 60 for women. The system also allows access to pension benefits through an *early retirement* pathway. The early retirement age (ERA) is 60 for men and 55 for women. Early retirement pensions can either be accessed if an individual has 35 or more insurance years or if she is long-term unemployed with at least 15 insurance years. In addition, an individual with health problems can access benefits through the *disability pension*. Access depends on a severe health impairment that lasts for at least 6 months and a reduced work capacity of at least 50% in any occupation. Starting with age 57 the eligibility criterion applies only to the individual's last occupation, which implies that at this age a wider group of individuals become eligible for DI.[4]

Pension benefits are determined by an individual's revaluated average gross earnings over a baseline period of 15 years with earnings qualifying for social security contributions.

[4] The pension reform in 1996 increased this age threshold from 55 to 57. The first cohort affected by the reform in the disability pension are individuals born in the last quarter of 1941, who turned 55 after September 1996. Staubli (2011) studies the effects of the 1996 reform in disability pensions. See **?** for a discussion of changes in DI benefit generosity over multiple reforms.

This *assessment basis* is multiplied by the *pension coefficient*, which depends on age at retirement and the number of insurance years. The maximum pension coefficient is 0.8, which implies that the maximum pension benefit amounts to 80% of the average gross earnings over 15 years. Although small penalties applied for claiming benefits prior to the NRA, the system was not actuarially fair before 2000.[5] The 2000 and 2004 pension reforms introduced more severe penalties for early retirement raising the average penalty for each year of early retirement to about 8 - 9% bringing the system closer to actuarial fairness.

Individuals receiving pension benefits pay contributions to health insurance and the pension is subject to income tax. The resulting net replacement rate is roughly 75% on average, which makes the pension the major source of income of retired individuals and private pensions play a minor role. Labor earnings of individuals receiving early retirement benefits are taxed at 100%, if they exceed a low threshold (376 Euro per month in 2012). Employment protection, which tends to be high for older workers, is discontinued at the NRA and workers can be laid off by their employers at age 65 (60) without cause.

2.2 Pension Reforms in 2000 and 2004

Budgetary problems and projections indicating serious long-term problems with the fiscal sustainability of the Austrian pension system led the government to implement pension reforms in 2000 and 2004. The main aim of these reforms was to raise the effective retirement age, increase labor force participation of older workers, and reduce the generosity of the benefit system. For a detailed overview of the reforms and a discussion of the fiscal implications see Knell et al. (2006). Here we focus on components of the reforms that are relevant for labor supply decisions, namely the increase in the ERA and changes in the pension benefit formula.

Increase in the Early Retirement Age

Throughout the late 1990s, there was public discussion of possible reforms to the pension system. Several components of the reform package that was implemented in 2000 were already passed into law in late 1996. However, the increases in the ERA from the pension reform in 2000, and the exact schedule by which it was rolled out, were mostly unexpected. The pension reform in 2000 was passed in parliament in August 2000, and

[5] For information see Appendix Section A1.

the implementation of the increases in the ERA started immediately after the law passed. The first cohort of affected workers were those who became eligible for early retirement under the old rule in October 2000.

The reform scheduled an increase in the ERA from age 60 to 61.5 for men and from 55 to 56.5 for women. It was implemented based on quarterly birth cohorts starting with men born in the fourth quarter of 1940 and with women born in the fourth quarter of 1945. For these individuals, the ERA was increased to 60 and 2 months (men) and 55 and two months (women). The ERA for each subsequent quarterly birth cohort was raised by an additional 2 months. In August 2003 an extension of the ERA increase was passed. This extension continued the cohort-wise increase up to age 62 for men and 57 for women. For subsequent cohorts the increase in ERA slowed down to 1 month by quarterly cohort. We refer to this second part of the ERA increase as the 2004 reform. The overall schedule of the increases in the ERA leads to an elimination of the early retirement option by 2017, when the ERA equals the NRA for both men and women. The green squares in Figure 1 show the reformed ERA schedule by cohort in Panels A and B for women and men, respectively. Horizontal red lines mark the initial cohorts affected by the increases from the 2000 and 2004 reforms.

There are two exemptions from the increases in the ERAs, which are also shown in Figure 1. First shown by blue triangles in the figure, the *corridor pension* was introduced in 2004 as an element of a newly established retirement corridor around the NRA of 65. This corridor pension allows men to access early retirement at age 62, if they have accumulated at least 37.5 insurance years. Second, to acknowledge "hard workers" who have contributed to the social security system throughout their careers, an exemption for individuals with *long contribution years* was introduced. It applied to men with at least 45 contribution years and women with at least 40 contribution years. These individuals were be exempt from the increased, cohort-specific ERAs and could access early retirement at age 60 (men) or 55 (women) or once they reached the required number of contribution years, shown by the red squares in Figure 1. We note that this exemption was only relevant for individuals who had entered the labor market at age 15 and remained continuously employed (with limited interruptions only for military service or parental leave) since only these individuals could potentially reach the contribution year thresholds by age 60 or 55.[6] Initially in 2000, this exemption was planned for only few birth cohorts, but the

[6]The majority of each cohort in our sample period left school at age 14 and entered the labor market

exemption was subsequently extended and stayed in place until 2011.

The access to early retirement for individuals who are long-term unemployed was closed in 2004. Consequently only individuals with at least 35 insurance years can draw early retirement pensions, if they did not qualify for disability. Rules for access to DI remained unchanged until 2014.[7]

Changes in Benefits and Penalties for Early Retirement

In addition to increasing the ERAs for men and women, a second component of the 2000 pension reform aimed at reducing benefit generosity and increasing penalties for early retirement. The changes started with a simplification of the formula defining the pension coefficient, and were implemented in January 2000. The overall reform process was designed to establish a new pension account system that reshapes the defined benefit model and increases the assessment basis from 15 years to 40 years. The roll-out of benefit adjustments toward this goal were implemented over an extended period and in many small steps, partly to avoid abrupt benefit changes across cohorts and groups. For example, a set of caps on benefit losses with respect to prior regulations were introduced. The main benefit adjustments are explained in detail in Appendix Section A1. In the Appendix we also show that due to benefit adjustments the pension coefficients stayed roughly constant across reform and non-reform cohorts, which implies that lifetime benefit income was decreasing with the reform. We further provide evidence that the timing of pension benefit changes did not coincide with the cohort-wise reform in the ERA.

Most importantly, the reform process made changes in benefits over time and across cohorts extremely opaque. Complicated rules, uncertainty over future adjustments, and some retroactive changes made strategic planning of retirement entries based on expected benefits virtually impossible, at least over the period which is the focus of our analysis. By 2014 the benefit system along with rules for future changes has stabilized and the government has started sending out information on pension contributions and expected benefits to the insured.

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directly or via the apprenticeship system. In both cases they start contributing to the social security system. Labor force participation below age 20 is high in Austria compared to other countries.

[7]We have examined aggregate counts of DI pensions and applications by calendar year, and these accounts appear stable across the years of the 2000 and 2004 pension reforms (results are available on request). We have not been able to gain access to individual-level data on DI applications. For more details see Staubli (2011); **?**.

Incentives from the pension reforms

As explained above, the reformed ERA schedule based on birth cohorts sets very clear incentives for individual retirement decisions. On the other hand, the reforms to the benefit schedule were highly complicated and uncertain. Non-actuarially-fair benefit adjustments prior to the pension reform and the risk of benefit cuts imposed on new pension entrants over the roll-out of the reform result in a high "perceived" implicit tax rate on working once an individual reaches eligibility for early retirement. Due to the opaqueness of the benefit schedules, we cannot credibly measure or model the precise financial incentives. However, we can clearly measure responses to the ERA increases in terms of pension claims and job exits. Our empirical strategy thus focuses on changes in the two retirement margins over birth cohorts and we interpret them as responses to the changes in the ERA.

To understand the changes in incentives on pension claim and job exit decisions, it is important to distinguish between 2 groups of individuals based on the eligibility for the exemption of the ERA increase. Once an individual learns about the change in their ERA, she either (i) has not accumulated sufficient contribution years to have any potential to be exempt from the cohort-specific increases in the ERA, or (ii) she has accumulated sufficient contribution years so that there is potential to be exempt from the cohort-specific increases in the ERA by age 60 (men) or 55 (women) if she remains continuously employed. We refer to individuals in the first group as *individuals with short contribution years*, and the second group as *individuals with long contribution years* (see section 4 for detailed definitions in our data).

The pension reforms differentially impact individuals in the two groups. For individuals with short contribution years, the reforms create incentives to delay job exits until they reach eligibility for early retirement benefits at the new ERAs. For individuals with long contribution years, the reforms create incentives to delay job exits until age 60 (men) or 55 (women) when they have accumulated sufficient contribution years to qualify for the exemption and can thus claim early retirement benefits.[8] The comparison of incentives for the two groups clarifies that the setup of the Austrian pension reform does not provide an untreated comparison group, but two groups who experience different treatments.

[8]As explained in Appendix Section A1 the pension reform 2004 also lifted all penalties on early retirement benefits of individuals who claim with 45(40) contribution years, which further increases the financial incentives to remain employed and accumulate long contribution years.

3 A Model of Retirement Decisions

This section presents a static model of retirement decisions in the presence of a binding Early Retirement Age (ERA), which captures the main features of the Austrian pension system and reforms. It further provides a simple framework to interpret the patterns we observe in the data and to motivate the empirical analysis based on a RK design. The model is common to both the public finance and the retirement literature. In public finance, the setting is a standard static labor supply model (for examples, see Kleven, 2016; Kleven and Waseem, 2013; Saez, 2010); in the retirement literature, it is a standard lifetime budget constraint model (see Brown, 2013).

We start by describing the model of retirement decisions with a fixed ERA and then consider responses to a reform that increases the ERA. We aim to illustrate the key intuitions of responses to the ERA with the simplest framework, so we abstract from uncertainty and time discounting and assume that individuals live for T periods with complete certainty. We assume that each individual decides on labor supply over the life-cycle be choosing his or her retirement age R to maximize utility. The individual's utility function is defined over life-time consumption C and the retirement age as $U(C,R) = u(C) - \phi(\theta, R)$, where $\phi(\theta, R)$ denotes the disutility from working R years and the parameter θ reflects heterogeneity in the tastes for work across the population. Hence individuals with different levels of θ choose different retirement ages.

Consumption is based on total lifetime income from wages w while working and pension benefits while retired. The pension system is defined around the ERA denoted by $\underline{R}_0$. We assume pension benefits are a function of age so that for ages prior to the ERA, benefits are 0, and for ages at the ERA and higher, pension benefits are positive. Benefits are taxed at 100% if an individual stays employed after the ERA, and for simplicity, we assume that benefits are set at a constant level b after the ERA. Given our assumptions, the individual's budget constraint is then given by $C = wR + \int_R^T [b * 1(t \geq \underline{R}_0)]\, dt$.

The budget constraint, illustrated in Figure 2 panel A, shows a kink at the ERA . At ages below the ERA, the slope of the budget constraint equals w as each additional year of work increases income by w. Individuals who remain employed beyond the ERA forgo a year of pension benefits, thus the slope in the budget set above the ERA is reduced to $w - b$. The implicit tax rate on working can be seen as the tax rate τ that solves $w(1-\tau) = w - b$, or $\tau = \frac{b}{w}$. In the Austrian setting the kink in the budget set results from actuarially unfair benefit adjustments prior to the reform and uncertainty over benefit adjustments during the reform period.[9] [10]

A key prediction of this model is that there will be bunching of retirements at $\underline{R}_0$ as a result of the kink in the budget constraint. Individuals who would have chosen a retirement age above $\underline{R}_0$ under a linear budget constraint in absence of the implicit tax due to the ERA, find it optimal to reduce their retirement age to $\underline{R}_0$ when they are faced with the kink.

Next, we present the model predictions for responses to the changes introduced by the 2000 and 2004 pension reforms. As discussed above, the reforms provided different incentives for individuals with short contribution and long contribution years. Thus we consider both types of incentives within our model framework.

Increase in the ERA: Shifting kinks

For individuals with short contribution years, the Austrian pension reforms increased the ERA across birth cohorts. To capture this in the model, we consider a policy change that increases the ERA from $\underline{R}_0$ to $\underline{R}_1$.[11] The increase in the ERA lowers lifetime income, as the pension benefit can only be consumed for the shorter period from $\underline{R}_1$ to T. Figure 2, panel B illustrates the change in the budget constraint, which moves from the solid line to the dashed line. The plot highlights that the increase in the ERA shifts the kink point from $\underline{R}_0$ to $\underline{R}_1$, and above $\underline{R}_1$ the budget set remains unchanged.

Relative to the pre-reform case with the ERA at $\underline{R}_0$, the model predicts that bunching shifts from the original ERA, $\underline{R}_0$, to the new ERA, $\underline{R}_1$. Specifically, individuals who brought their retirements forward in response to the pre-reform kink will now shift their retirements to the new kink at $\underline{R}_1$. In addition, the reduction in lifetime income may induce some individuals who chose to retire prior to $\underline{R}_0$ before the reform, to work longer and delay their retirements relative to pre-reform the scenario. In absence of adjustment

[9] Although it is not possible to measure the magnitude of the kink, there are several arguments that the kink that is perceived by decision makers is large. First, there is uncertainty over benefit cuts for new pension claimants. Second, labor earnings are taxed at nearly 100% for individuals claiming early retirement benefits. Third, survey and experimental evidence shows that individuals have problems understanding annuities and making rational decisions when they are faced with complicated benefit schedules (Brown et al., 2016).

[10] While this simplification is appropriate for the Austrian context that we study, we note that other social security benefit systems, such as the system in the United States, may be such that benefits increase with retirement age so that lifetime benefit income does not decrease when individuals claim benefits at later ages.

[11] The simple model considers only one retirement margin, and we thus abstract from considering the effects of increases in the ERA on substitution to other retirement margins or programs such as UI.

costs or frictions, the model thus predicts a shift in bunching from $\underline{R}_0$ to $\underline{R}_1$.

To motivate the RK analysis below and to provide some intuition for the interpretation of the estimation results, we consider the model's predictions for the impacts of the increases in the ERA on average retirement ages. For illustrative purposes, we assume that the share of the population that bunches at the ERA does not change as the ERA increases, which should hold for small adjustments in the ERA. With this assumption in mind, we use s to denote the share of a cohort that bunches at the ERA. We further assume that the share of individuals retiring after the ERA is negligible. For a fixed ERA prior to the reform, the average retirement age within a given cohort can be approximated by $\bar{R} = \bar{R}_l * (1-s) + \underline{R}_0 * (s)$ where $\bar{R}_l$ denotes the average retirement ages of individuals retiring prior to the ERA. In the absence of wealth effects, an increase in the ERA should have no effect on $\bar{R}_l$. Thus, when the ERA increases from $\underline{R}_0$ to $\underline{R}_1$, the change in the average retirement age can be approximated as

$$\Delta R = [\bar{R}_l * (1-s) + \underline{R}_1 * (s)] - [\bar{R}_l * (1-s) + \underline{R}_0 * (s)] = [\underline{R}_1 - \underline{R}_0] * s.$$

The approximation highlights that the effect of an increase in the ERA on the average retirement is directly proportional to the share of individuals bunching at the ERA. In the case of Austria, where we observe about half of each pre-reform cohort bunching at the ERA, i.e. $s = 0.5$, we can thus expect that the average retirement age rises roughly half as fast as the ERA over the reform period. Depending on the share of bunchers in other settings, the effect on the average retirement ages should be higher or lower. Structural models of retirement decisions could be calibrated to match this approximation and the reduced form effects we describe below.

Individuals with Long Contribution Years: Notches

Now we turn to individuals with long contribution years who are potentially eligible for the exemption from the ERA increase. As illustrated in Figure 2, panel C these individuals face a change in their budget set to the left of $\underline{R}_0$. If they retire before they have accumulated sufficient contribution years to qualify for the exemption, their budget set shifts downward to the dashed line due to the decrease in lifetime income. If they accumulate sufficient contribution years and retire at $\underline{R}_0$ their budget set remains unchanged at the solid line. The resulting upward notch in the budget set of post-reform birth cohorts, creates incentives to delay retirement until $\underline{R}_0$ to qualify for the exemption. As illustrated in the figure, the model thus predicts an increase in bunching at $\underline{R}_0$ among individuals with long contribution years in the post-reform cohorts and a reduction in retirements before $\underline{R}_0$. Moreover, we note that the size of the notch in the budget line increases, if the ERA increases to higher ages. Thus, we expect that bunching of individuals with long contribution years at $\underline{R}_0$ increases as $\underline{R}_1$ increases.

4 Data and Sample Definition

Our empirical analysis is based on administrative data from the Austrian Social Security Database (ASSD, see Zweimüller et al. (2009)). The records are collected with the main aim of verifying individual pension claims and computing individuals' pension benefits. For research they provide unique longitudinal information for the universe of private sector workers throughout their working lives. In particular, we observe employment and earnings careers at a daily level along with information on other insurance states that are relevant for social security such as military service, unemployment, maternity leave and sick leave. At retirement information on spells with receipt of benefits in disability, early retirement, and old age pensions is recorded.

For the analysis of the 2000 and 2004 pension reforms we focus on men born between 1930 and 1948 and women born between 1935 and 1952, and we restrict our sample to workers who are still employed at age 53. We choose age 53, because we want to fix the age at which we start following workers to observe their retirement decisions. As we will see in the next section, age is an important determinant of job exits and pension claims. Therefore it is important to hold age constant when comparing retirement decisions across birth cohorts. Note that with this definition some individuals in our sample are already older than 53 when the first ERA reform is announced in August 2000. We will keep this in mind when interpreting our results.

Using data on individual labor market careers, we can compute the accumulated insurance and contribution years at age 53 along with other characteristics of the earnings and employment careers.[12] Starting at age 53, we follow the individuals until the day when they (i) exit the labor market, (ii) start claiming pension benefits, or (iii) reach

[12]Some data limitations are due to changes in the recording in the ASSD. Insurance careers of men in the older birth cohorts are recorded from retrospective records in the years before 1972 and thus less precise than information from later years. For women born in 1938 and earlier we do not observe full information on maternity leave spells as child care times were not taken into account in the computation of pension benefits before 1993.

age 70. The observation period in the data ends in 2012, and thus we have virtually no censored observations.

To identify individuals who are potentially eligible for the exemption from the ERA increase, we distinguish between two groups based on their contribution years at age 53. The first group is individuals with *long contribution years*. These individuals are defined based on having accumulated 38 or more contribution years at age 53.[13] (Having accumulated 38 or more contribution years at age 53 essentially requires individuals to have been continuously employed from age 15, which is the end of compulsory schooling, through age 53.) If these individuals remain employed until age 60 (55) they are exempt from the ERA increase with the 2000 pension reform. The second group is individuals with *short contribution years*. These individuals are defined based on having accumulated less than 38 contribution years at age 53. Thus, these individuals cannot be eligible for the exemption at age 60 or 55.

Table 1 provides descriptive statistics for the female and male samples. We distinguish between individuals with short contribution years and the full sample. In total we have 357,147 observations for women and 386,830 for men. Individuals with short contribution years account for 80% of the full sample of women, but only for 60% of men. As expected, individuals with short contribution years have less stable employment careers and lower earnings than the average individual in the full sample. The pathways to retirement also differ by gender. Only 10% of women retire through disability, but the share is almost 40% among men.[14]

5 Job Exits and Pension Claims After Age 53

This section presents graphical evidence on employment and claiming responses to the increases in the ERAs, which can be interpreted in the light of the model described in Section 3. We start by plotting survival curves from age 53 until job exits and pension claims for selected birth cohorts with increasing ERAs in Figures 3 and 4 for women and men, respectively. In these graphs, the red lines indicate survival rates until job exits and the blue dashed lines show survival rates until pension claims.[15] Vertical lines indicate

[13]Contribution time is time spent in employment, voluntary insurance, education, up to 2.5 years of military service, and up to 5 years of maternity leave.

[14]The share of early retirement is under-reported, especially among men, as the ASSD records do not distinguish between different types of pension benefits before the year 1993.

[15]Pension claims include old age pension, early retirement and disability pensions.

age 55 (women) or 60 (men) and the cohort specific ERA.

The first two panels in Figure 3 show cohorts of men born in 1938 and 1940, who are not yet affected by the ERA increase. For both cohorts, the patterns are very similar. Labor force participation steadily declines from age 53 to age 60 and a gap opens up between job exits and pension claims during these ages as some individuals exit their jobs prior to claiming pensions at age 60. Before age 60, about 42% of men are claiming disability benefits and roughly 62% of men have exited their jobs. There is a noticeable drop in the job exit and pension claim survival functions at the ERA of 60, and very low shares of individuals remain in employment. By the NRA of 65, virtually all individuals have left the labor market. The drop in survival rates at age 60 is consistent with the model prediction of bunching at the ERA explained in Section 3.

Turning to cohorts affected by the 2000 and 2004 pension reforms, there are noticeable shifts in the survival curves. We see pronounced drops in survival rates on both margins that move along with the cohort specific ERAs. In addition, there are still drops in the survival rates at age 60, but the drops are smaller in magnitude than in the pre-reform cohorts since only men with long contribution years become eligible for early retirement benefits. Comparing across cohorts, the share of men who exit their jobs prior to age 60 and who claim disability pensions declines substantially to almost half of the pre-reform share. Overall, there is no evidence of widening gaps between job exits and pension claims across cohorts. This indicates that substitution with other social insurance programs such as UI or sick leave is not a major response to the increases in the ERAs for individuals who are still employed at age 53. If the would still exit their jobs at younger ages and move to other programs before they become eligible to claim benefits at the post-reform ERAs, we would see a widening of the gaps, which does not appear to be the case.

Figure 4 shows the corresponding graphs for women. Among the pre-reform cohorts born in 1943 and 1945, about 25% leave their jobs before age 55, and at age 55 another 25% exit. Pension claims are initially close to zero and there is a large drop of about 40% at the ERA of 55. After age 55 participation gradually decreases, and the gap between the red and blue lines is small, indicating that individuals who exit their jobs at these ages claim benefits without long delays. The remaining women exit the labor market and claim pensions at the NRA of 60.

Similar to the graphical evidence for men, we see pronounced shifts in the survival curves of women born in cohorts affected by the 2000 and 2004 pension reforms. The major drops in job exits and pension claims move to the higher cohort-specific ERAs indicated by the vertical lines. There are smaller drops at age 55 which are due to individuals with long contribution years. The job exit rate before age 55 strongly declines and is less than 10% for the cohort born in 1953. The share of women remaining in the labor force past the ERA until age 60 is also increased over the cohorts. While 20% of the 1943 cohort has not claimed a pension by age 60, this share is almost twice as high in the 1951 cohort.

Next, we investigate differences in survival curves by the potential eligibility for the exemption from the ERA increase, comparing individuals with long insurance years and individuals with short contribution years. Figure 5 shows cohort specific survival graphs for men and women with long contribution years born in pre-reform cohorts 1940 and 1945 and post-reform cohorts 1948 and 1951, respectively. Among men, shown in panels A and B, we see sharp declines in survival rates at age 60 in both cohorts. The survival rates do not drop to zero after age 60 in the post-reform cohort, as some of the individuals with long contribution years fail to qualify for the exemption at age 60 due to interruptions of their employment careers between age 53 and 60. Nonetheless, there is a sharp increase in survival rates up to age 60 for both job exits and pension claims between the cohorts. While 63% of men in the 1940 cohort with long contribution years have exited their jobs prior to age 60 and 43% are claiming disability pensions, the corresponding numbers are less than half for the 1948 cohort (28% exits and 20% claims). Panels C and D shows similar patterns for women with long contribution years. Across cohorts, we see drops in survival rates for job exits and pension claims at age 55. However, the gap between the red and blue lines that is visible in the pre-reform cohort prior to age 55 essentially vanishes in the post-reform cohort. This evidence indicates that individuals with long contribution years are delaying job exits and pension claims until age 60 or 55 in order to qualify for the exemption from the ERA increases.

Figure 5 confirms the model predictions from Section 3 for individuals with long contribution years. The reduction in retirements prior to age 60 across cohorts of males with long contribution years can be explained by two factors. First the notch in the budget line increases as life-time income drops with the ERA increases. Second, the announcement date of the reform creates adjustment problems for individuals in post-reform birth cohorts who have already exited their jobs between age 53, when we measure contribution years, and August 2000, when the reform is announced. For younger cohorts the time between age 53 and August 2000 decreases and hence they are less and less affected by the adjustment problem.

To see whether responses in Figures 3 and 4 prior to the ERA are driven exclusively by individuals potentially exempt from the reform, we separately investigate survival patterns in the group of individuals with short contribution years for whom the ERA increases are binding. We present graphical evidence on these individuals in a slightly different format. In particular, the graphs in Figure 6 show survival curves for different cohorts aligned at the cohort specific ERAs, denoted by the value zero on the horizontal axis. Panels A and B show survival rates until pension claims and until job exits, respectively, for men. Panels C and D show the corresponding figures for women. For men, we see that survival patterns around the ERA are almost identical across cohorts with big drops in pension claims and job exits at the ERA. For women, we see parallel shifts in survival curves at the cohort specific ERAs.

The patterns in Figure 6 panel A, for males with short contribution years also confirms the model predictions from Section 3. The figure shows almost identical drops in the survival curves at the ERA across cohorts, which correspond to precise shifts in bunching and suggest that frictions or adjustment costs play a minor role for older workers to remain in the labor force (Kleven, 2016). This is in stark contrast with empirical evidence of the problems, which older workers face when they try to re-enter the labor market after job displacement.

In summary, the descriptive evidence indicates three main responses to the 2000 and 2004 pension reforms. First, individuals who are directly affected by the ERA (i.e. those with short contribution years) shift pension claims and job exits to the increased ERAs. Second, individuals who are potentially exempt from the reform (i.e. those with long contribution years) delay job exits and pension claims until age 60 or 55 to take advantage of the exemption. Third, there is no is no indication of increased substitution to other benefit programs. Job exits and pension claims move more or less in parallel leaving little room for substitution with sickness leave or unemployment insurance programs. In addition, we do not find evidence of increased inflows into disability pensions prior to the ERA. For individual with short contribution years, men in particular, entry rates into disability pension claims, shown in Figure 6, are parallel across cohorts in the years prior to the ERA, while entries into disability pensions before age 60 decline for men among men with long contribution years. For a detailed graph of male disability entries prior to the ERA see Appendix Figure A.6.

6 Empirical Strategy

The graphical evidence in section 5 shows clear responses to the reformed ERA schedule in terms of exit and claiming ages. To quantify the overall response to the pension reform, we exploit the kinked reform schedule that links quarterly birth cohorts and early retirement ages in Figure 1. In particular, the green lines that show the changes in ERAs without exemptions, feature two kinks where the slope between birth cohort and ERA changes: the first at the onset of the 2000 pension reform and the second at the 2004 reform. We will exploit both kinks to measure the average response of the exit and claiming ages to the ERA.

Our strategy is to use corresponding kinks in the relationship between birth cohorts and individual exit and claiming ages and relate slope changes in the outcome relationship to slope changes in the policy rule defined by the pension reforms using a regression kink (RK) design. Since the ERA is a function of birth date, it is likely to be correlated with other characteristics that determine labor supply and retirement decisions. The regression kink design circumvents this endogeneity problem by using the quasi-experimental variation induced by the pension reforms.[16]

To define the estimator formally, we let Y be the outcome of interest, i.e. claiming age or age at exit from the labor force, ERA the early retirement age as determined by the policy rule, and V the birth date. Card et al. (2015b) show that under smoothness conditions, the RK estimand

$$\beta = \frac{\lim_{v_0 \to 0^+} \frac{dE[Y|V=v]}{dv}\Big|_{v=v_0} - \lim_{v_0 \to 0^-} \frac{dE[Y|V=v]}{dv}\Big|_{v=v_0}}{\lim_{v_0 \to 0^+} \frac{dE[ERA|V=v]}{dv}\Big|_{v=v_0} - \lim_{v_0 \to 0^-} \frac{dE[ERA|V=v]}{dv}\Big|_{v=v_0}} \tag{1}$$

identifies a weighted average of the marginal effects of the ERA on Y. The identification assumptions in Card et al. (2015b) give rise to the testable implication that

[16] The empirical methods used in this paper relate to a literature that applies RKD to estimate causal effects. See also Card et al. (2015a); Gelber et al. (2016); Landais (2015); Manoli and Turner (2014); Marx and Turner (2015).

the distribution of V and the conditional expectation function of any pre-determined characteristics are continuously differentiable at $V = 0$.

In a sharp RK design, the ERA is directly linked to the birth date and thus a deterministic function of V. In this case the denominator of equation (1) is a known constant. In our application we choose a fuzzy RK design and estimate the slope change of the first stage function $E[ERA|V = v]$ to account for variation in the eligibility for early retirement pensions at the individual level, which depends on age and the number of insurance and years.[17]

For estimation we follow Card et al. (2015b) and adopt local polynomial estimators for the slope changes in the numerator and denominator of equation (1). We present local linear estimates using alternative bandwidths, as well as the bias-corrected estimates per Calonico et al. (2014). However, we cannot make the bandwidth arbitrarily small, as the policy formula is not continuous but defined at the quarterly level.

To define the individual ERA according to the reform schedules in the 2000 and 2004 reforms we apply the following procedure. We assume that eligibility for different types of ERA's – early retirement with long insurance years or the corridor pension – are determined by an individual's insurance career at age 53 and that every individual stays employed from age 53 until the exit from their last job. We thus set the ERA equal to the gender and cohort specific ERA and we define the ERA as 62, the corridor pension age, for men with more than 29.5 insurance years at age 53. To individuals with long contribution year we assign the cohort specific ERA, indicating the age at which they can claim benefits if they fail to accumulate 45(40) contribution years.

Tests for validity of the RK design

Before we discuss estimation results, we check the validity of the design via the testable implications on identifying assumptions. First, the identifying assumptions in Card et al. (2015b) imply a continuously differentiable density of the running variable V following the argument that endogenous sorting would invalidate this assumption. In our case, the ERA is defined by birth cohort, which is exogenous and not subject to manipulation for individuals close to retirement. As the pension reforms are implemented with a long-run

[17]Specifically, we code the ERA variable as the cohort-specific ERA illustrated in Figure 1 (ERA series), but for men with with high contribution years and in post-1943 birth cohorts, we code the ERA as age 62 because of the availability of corridor pensions for these individuals. See Section 7.

perspective it is also not plausible that policy makers would have chosen particular cohorts to start the reform. Nonetheless, we plot the frequency of observations by birth cohorts in Appendix Figure A.1 for four samples, women and men with short contribution years, and the full samples of women and men. The patterns in these figures do not appear smooth around the vertical lines marking the 2000 and 2004 pension reforms, but the fluctuations in our sample directly mirror patterns by birth cohorts in the overall population, as shown in Appendix Figure A.2. These patterns in the birth rates are driven by strong fluctuations around World War II and are independent of the pension reforms we study.

As second check we assess the smoothness of pre-determined covariates around the cutoff birth dates. Appendix Table A1 shows estimation results of local linear regressions for a set of observable characteristics. Most of the coefficient estimates are insignificant indicating no slope changes in the relationship between individual characteristics and birth dates, which is supports our assumptions. To combine multiple covariates we estimate composite covariate indices by predicting the individual claiming and exit ages based on rich information on employment and earnings histories up to age 53. For some samples – men around the 2000 kink and women around the 2004 kink – the coefficient estimates in Table A1 indicate significant kinks in the relationship between birth dates and predicted claiming or exiting ages. However, the coefficients are very small, an order of magnitude smaller than the actual claiming and exiting ages which are presented below. Therefore we conclude that kinks in covariates are not driving the main results. Appendix Figures A.3 and A.4 provide a graphical confirmation of the smoothness of predicted exit and claiming ages around the reform cutoffs.

7 RK Analysis

7.1 Graphical Evidence

We first present graphical results of the RK analysis showing the first stage and reduced forms for exiting and claiming ages, respectively, and turn to the regression analysis in the next section. Each figures plots average outcomes by quarterly birth cohorts over the full range of birth cohorts, showing the kinks due to the pension reforms. The green lines show linear fits for each of policy regime, the pre-reform, the 2000, and 2004 pension reform, respectively.

The first stage plots in Figure 7 illustrate changes in the average ERAs by quarterly birth cohorts for women and men. For women, shown in panel A the average ERA changes directly follow the legislated ERA schedule. For men, we also take into account eligibility for the corridor pension at age 62, which is first available for men born in the first quarter of 1944. The share of men eligible for the corridor pension is larger in the full sample than in the sample with short contribution years, which explains the explains the bigger reduction in the slope after the 2004 kink.

Figures 8 and 9 show reduced form results for average exit ages and pension claiming ages by quarterly birth cohort. Each figure presents results for women and men with short contribution years, who are directly affected by the increase in the ERA, in the panels on the left and results for the full sample of women and men, in the right hand side panels. Figure 8, plotting average job exiting ages, shows kinked patterns in the outcome variable that closely follow the kinks in legislated ERA schedules. While among pre-reform cohorts the average job exiting ages are almost flat, we see a pronounced linear increase after the 2000 reform kink and a further decrease in the slope at the 2004 reform kink. The increases in average job exit ages are slightly smaller in the full samples than among individuals with short contribution years, but the difference is not large. Figure 9 shows very similar patterns for claiming ages by birth cohort. Interestingly the linear increase in average claiming and exiting ages persists for all cohorts beyond the kink point. This indicates immediate adjustments in retirement decisions with the announcement of the reform, that do not change for cohorts for whom the retirement date is further away.[18]

7.2 Estimation Results

We present the main RK results for estimates with a symmetric bandwidth of 2.75 years around each kink point in Table 2 and Table 3, presenting reduced form and fuzzy estimates respectively. Estimates based on the full range of birth cohorts are shown in Appendix Tables A2 and A3, and Table A4 presents further robustness checks based on alternative estimators and bandwidths.

Regression results in Table 2 quantify the changes in the slopes of the average ERAs, exiting ages and claiming ages across birth cohorts for the four samples illustrated in the figures in the previous section. Panel A presents estimates around the kink generated

[18]Appendix Figure A.5 shows average job exit and pension claiming ages by birth cohort for individuals with long contribution years for whom the kinked ERA schedule does not apply. This figure confirms that the kinked pattern in the outcome variables by birth cohorts is similar among individuals with long contribution years.

by the 2000 pension reform and panel B shows corresponding estimates around the 2004 reform kink. In panel A, estimates for individuals with short contribution years document that the ERA increases according to the reform schedule by two thirds of a year per annual birth cohort, while the average exit age increases by 0.26 years for women and 0.24 years for men per annual birth cohort. The average increase in the pension claiming age is slightly larger with 0.36 years or about 4 months per annual birth cohort for both men and women. If we compare the increases in average job exiting and pension claiming ages in the full sample, which includes individuals with long contribution years who are potentially exempt from the ERA increase, we see that they are roughly comparable in magnitude to the increases among individuals with short contribution years. This documents that the incentives for individuals with long contribution years, as discussed in section 3, are substantial and contribute to increases in the pension claiming and job exiting ages in the overall population.

The reduced form results in panel B of Table 2 highlight the effects from reducing the slope of the ERA per quarterly birth cohort by half, as can be seen from the coefficient for women with short contribution years. For men the slope decreases effectively by more than 50%, because a large share are eligible for the corridor pension at age 62. In line with the first stage relationship, the increase in job exiting and pension claiming ages is also slowed down. The absolute size of the coefficient estimates for women with short contribution years is a bit larger than 50% of the kink 2000 estimates, which indicates larger responses to the 2004 reform than to the 2000 reform. For the full samples, we also see declines in the slopes of job exit ages and pension claiming ages. However, all of the coefficients are smaller in absolute value than the 2000 reform coefficients, which indicates that on average, job exit ages and pension claiming ages keep rising as the cohort-specific ERA continues to rise.

We now turn to the fuzzy RK estimates in Table 3 to present the estimated effects of changes in the ERAs on average exiting and claiming ages for individuals with short contribution years. The fuzzy RK estimates are based on the ratio of reduced form and first stage estimates and thus reflect the impact of increasing the ERA by 1 year on average exiting and claiming ages. Focusing on the results from the 2000 pension reform and individuals with short contribution years, we find that a 1-year increase in the ERA increases exiting ages by roughly 0.4 years and claiming ages by roughly 0.5 years. These effects are very similar for men and women.[19] The results for the 2004 pension reform are less precisely estimates with standard errors that are about twice as large. According to these estimates the effects at the 2004 kink are larger for women and smaller for men than around the 2000 kink. But the magnitude of the 2004 estimates is still in the same ball-park.

Turning to the results for the full sample, we find effects from a one year increase in the ERA that are very similar to the effects among individuals who are directly affected by the ERA increase. This implies that incentives for individuals with long contribution years to delay their job exits and pension claims are substantial and lead to similar effects as those for individuals with short contribution years. Moreover, these effects persist also among younger cohorts, who have more time to adjust to the announcement of the reform.

7.3 Adjustment Mechanisms

The results in the previous section show strong effects from raising the ERA on job exits and pension claims. These effects appear to be constant across affected cohorts. Relative to previous evidence from the bunching literature (Kleven, 2016), our findings indicate that adjustment costs or frictions play a minor role. How do individuals adjust to the increase in the ERA? One possible explanation is that they stay in their pre-retirement jobs longer. Another explanation would be that they switch to temporary jobs in which they can work until older ages.

To shed some light on the adjustment mechanisms, we examine durations of jobs held at age 53. Figure 10 presents graphical evidence indicating that many individuals are able to respond to the increased ERAs by remaining in their jobs longer rather than finding new jobs. These graphs plot the average duration of jobs held at age 53 by quarterly birth cohort. The plot for women with short insurance years demonstrates that, starting exactly for the cohorts first affected by the 2000 pension reform, average job durations begin to increase and the increases continue across cohorts with rising ERAs. The plot for the full sample of women shows a similar pattern. The plots for men show kinks in average job durations for the cohorts affected by the 2000 and 2004 pension reforms. Overall the graphs closely follow the same patterns as the earlier graphical evidence on average exiting and claiming ages.

[19] Interestingly, we do not find any evidence for heterogeneous effects along other characteristics such as health and income, either. See Appendix Table A6.

Appendix Table A5 reports the corresponding RK estimates. The results imply that, around the 2000 kink, the increase in job durations per quarterly birth cohort can account for about two thirds of the increase in the average job exit age and for more than half of the increase in the average pension claiming age for both men and women and for both individuals with short contribution years and the full sample.

In thinking about the mechanisms, we also examine the relative importance of income versus substitution effects in the overall observed labor supply responses. The bunching literature typically estimates compensated elasticities, arguing that income effects are negligible in applications with small kinks, i.e. due to nonlinearities in tax schedules (Saez, 2010). In the current Austrian setting, the RK estimates are driven by marginal increases in the ERA across birth cohorts (increases of 1 or 2 months per quarterly birth cohorts). Since these changes in the ERA across successive quarterly birth cohorts are relatively small, it is plausible that the income effects are negligible and hence substitution effects may drive the estimated increases in the average retirement ages. Nonetheless, while the observed responses are consistent with a model with no income effects, we note that responses to relatively large increases in the ERA (for example a 2 year increase across successive birth cohorts or eliminating the kink at the ERA completely) could still be driven by a combination of income and substitution effects. As Kleven (2016) points out, large kinks can produce responses from individuals whose counterfactual choices under a linear budget constraint are located relatively far away from the kink, and in this case, bunching will be driven by a combination of income and substitution effects. The Austrian pension schedule creates large kinks in individuals' budget constraints at the ERA, and we observe significant bunching at the ERA. Overall, while we do not have sufficient evidence to rule out income effects for relatively large changes to the ERA, we conclude based on the results that the local increases in the ERA reduced the tax force to retire and hence reduced unused labor capacity at older ages (Gruber and Wise, 2007), and these responses to marginal increases in the ERA might primarily reflect substitution effects.

Additionally, relative to cohorts immediately affected by the ERA increases, we note the persistence in the labor supply responses to the ERA increases for more recent cohorts who had more time to adjust their savings decisions. This persistence suggests two insights. First, the inability to adjust savings does not appear to have been a main driver for the labor supply responses of cohorts immediately affected by the ERA increases.

Second, many individuals may have preferred to adjust their job durations rather than adjust their savings decisions.

8 Conclusion

The objective of social security reforms implemented in many countries has been to increase labor force participation of older workers and delay retirement entries (OECD, 2015). An important policy towards achieving this goal is restricting access to early retirement either by increasing the early retirement age or by increasing the required insurance period. In this paper we evaluate Austrian pension reforms that implemented both measures for separate groups of individuals. The pension reforms in 2000 and 2004 step-wise increased the ERA over several cohorts and introduced an "exemption" for individuals who reached a high threshold of contribution years and could thus claim benefits at an unchanged ERA.

We provide quasi-experimental evidence showing that the reforms increased pension claiming ages and job exit ages in both groups. For a given birth cohort, a one year increase in the ERA leads to a 0.4 year increase in the average job exiting age and a 0.5 year increase in the average pension claiming age. Our estimates are similar in magnitude to the effects from raising the NRA from 65 to 66 in the US reported by (Mastrobuoni, 2009). An important adjustment mechanism leading to increased employment is that individuals kept their pre-retirement jobs longer.

We emphasize that in the Austrian setting we observe responses a policy parameter that is well understood. While policy changes in the ERA and eligibility conditions were highly salient, financial incentives from benefits were unclear because of complexity and unannounced adjustments. Our results highlight that the ERA potentially is an important reference point for retirement decisions, especially in an environment with lack of information on financial incentives.

The results in this paper can inform models of retirement decisions with respect to importance of taking into account interactions between different incentives of the social security system as well as the degree of information about policy parameters.

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Table 1: Summary Statistics

	Women		Men	
	Short Contr. Years	Full Sample	Short Contr. Years	Full Sample
Continuously Employed				
Age 50 - 53	0.71	0.75	0.68	0.76
	(0.45)	(0.43)	(0.47)	(0.42)
Any sick leave	0.15	0.14	0.17	0.16
	(0.64)	(0.65)	(0.62)	(0.63)
Av Annual Earnings	20610	21852	30978	32244
	(10594)	(10787)	(99276)	(92323)
Unemployment Age 43 - 53	0.51	0.42	0.50	0.33
(in years)	(1.12)	(1.02)	(1.13)	(0.91)
Childcare up to Age 53	3.43	3.14		
(in years)	(2.46)	(2.42)		
Exits from Job held at 53	0.79	0.81	0.65	0.69
	(0.41)	(0.39)	(0.48)	(0.46)
Qualifies for early retirement				
due to unemployment	0.92	0.93	0.95	0.97
	(0.28)	(0.25)	(0.21)	(0.17)
with long insurance years	0.41	0.53	0.75	0.85
	(0.49)	(0.50)	(0.43)	(0.36)
First Pension Claim				
Disabilitiy	0.10	0.09	0.39	0.38
	(0.30)	(0.28)	(0.49)	(0.49)
Early Retirement	0.44	0.51	0.33	0.41
	(0.50)	(0.50)	(0.47)	(0.49)
Exit Age	57.07	56.74	58.91	58.78
	(2.40)	(2.33)	(2.94)	(2.73)
Claim Age	57.62	57.23	59.72	59.51
	(2.08)	(2.08)	(2.75)	(2.54)
Gap bw Exit and Claim	0.67	0.60	0.83	0.77
(in years)	(1.15)	(1.07)	(1.44)	(1.39)
Number of observations	282,298	357,147	229,915	386,830

Note: Sample includes birth cohorts 1930 - 1948 for men and 1935 - 1953 for women; individuals still employed at age 53. Sample with short contribution years is defined as having accumulated 38 contribution years at age 53. Individuals qualify for early retirement due to unemployment if they have accumulated at least 20 insurance years, and for early retirement with long insurance years if they have accumulated at leas 35 insurance years. We proxy the qualification with insurance years accumulated at 53 and assume individual stays continuously employed.

Table 2: Reduced Form Estimates, Maximum Symmetric Bandwith

	Short Contribution Years		Full Sample	
	Women	Men	Women	Men
A. Kink Pension Reform 2000				
Early Retirement Age	0.665	0.666	0.665	0.666
	(0.003)	(0.004)	(0.003)	(0.004)
Exit Age	0.259	0.239	0.260	0.213
	(0.041)	(0.032)	(0.033)	(0.020)
Claim Age	0.359	0.359	0.330	0.309
	(0.039)	(0.033)	(0.032)	(0.021)
Observations	83,575	71,880	110,897	133,334
B. Kink 2004				
Early Retirement Age	-0.333	-0.533	-0.333	-0.580
	(0.003)	(0.016)	(0.003)	(0.019)
Exit Age	-0.182	-0.104	-0.174	-0.079
	(0.040)	(0.040)	(0.031)	(0.032)
Claim Age	-0.342	-0.263	-0.287	-0.212
	(0.044)	(0.042)	(0.031)	(0.030)
Observations	84,336	57,642	109,819	112,857

Note: Maximum symmetric bandwidth equals 2.75 years. Standard errors are clustered based on quarterly birth cohort.

Table 3: Fuzzy Regression Kink Estimates, Maximum Symmetric Bandwith

	Short Contribution Years		Full Sample	
	Women	Men	Women	Men
A. Kink Pension Reform 2000				
Exit Age	0.390	0.358	0.391	0.320
	(0.062)	(0.047)	(0.050)	(0.030)
Claim Age	0.540	0.539	0.496	0.464
	(0.059)	(0.049)	(0.048)	(0.031)
Observations	83,575	71,880	110,897	133,334
B. Kink Pension Reform 2004				
Exit Age	0.548	0.195	0.522	0.136
	(0.121)	(0.077)	(0.095)	(0.056)
Claim Age	1.028	0.492	0.863	0.366
	(0.136)	(0.082)	(0.094)	(0.051)
Observations	84,336	57,642	109,819	112,857

Note: Maximum symmetric bandwidth equals 2.75 years. Standard errors are clustered based on quarterly birth cohort.

Figure 1: Changes in the Early Retirement Age in the 2000 and 2004 Pension Reforms

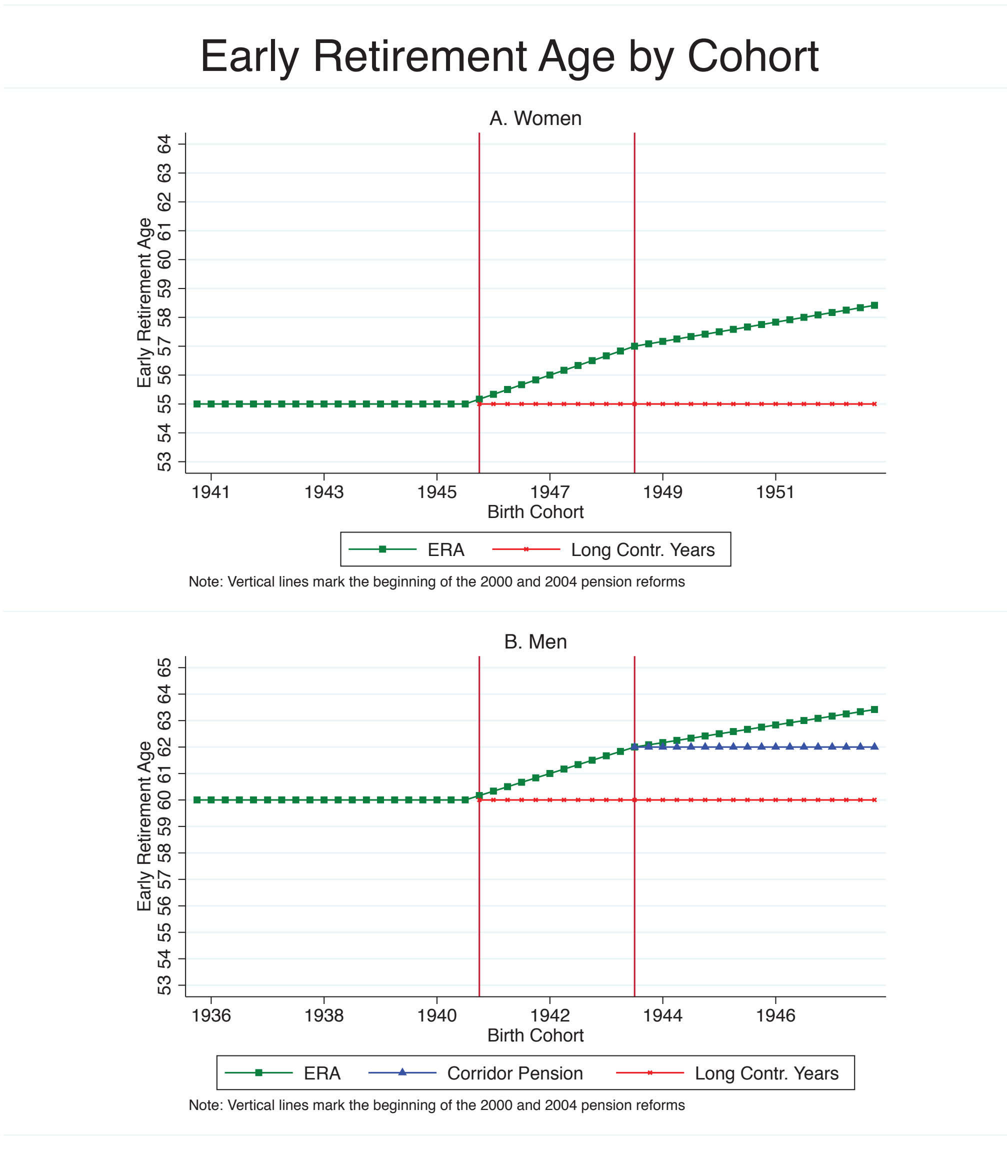
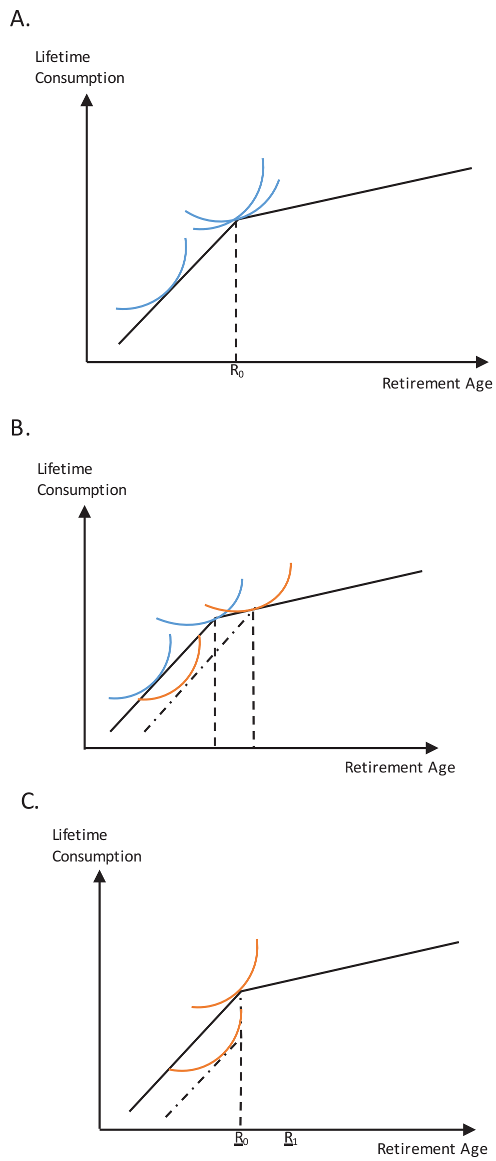
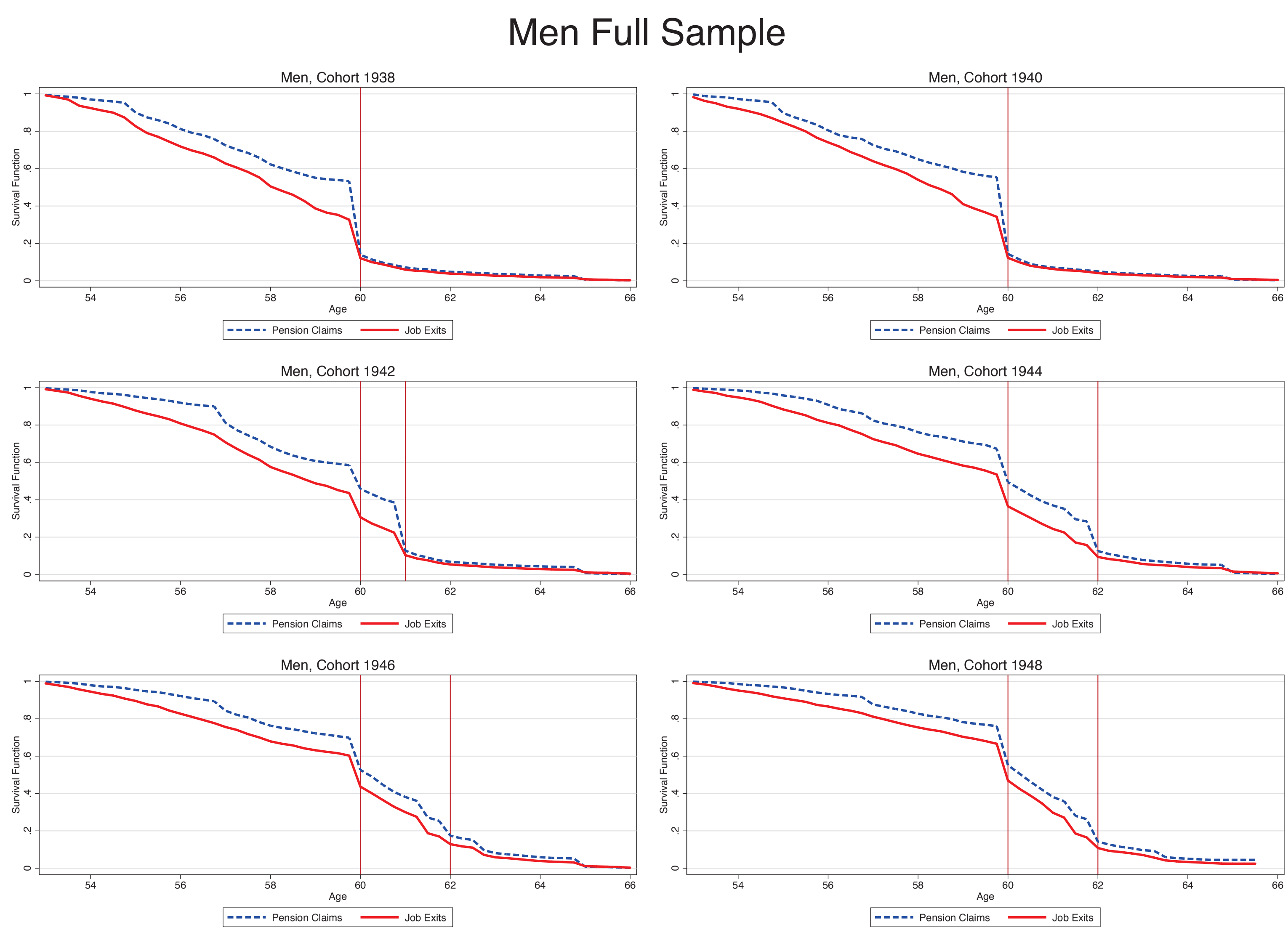


Figure 2: Optimal Retirement Ages



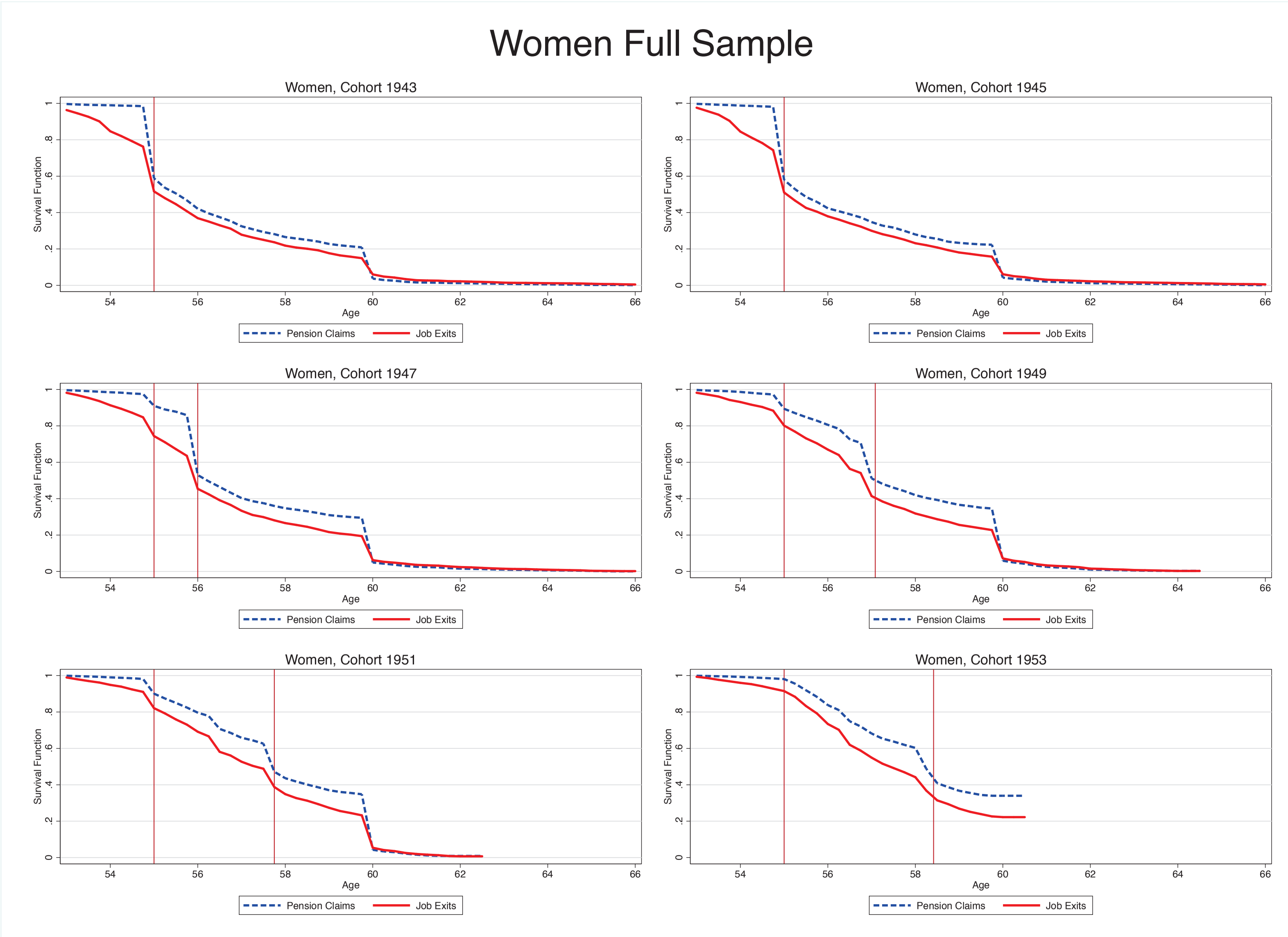
Notes:

Figure 3: Survival in the labor market after age 53, Men



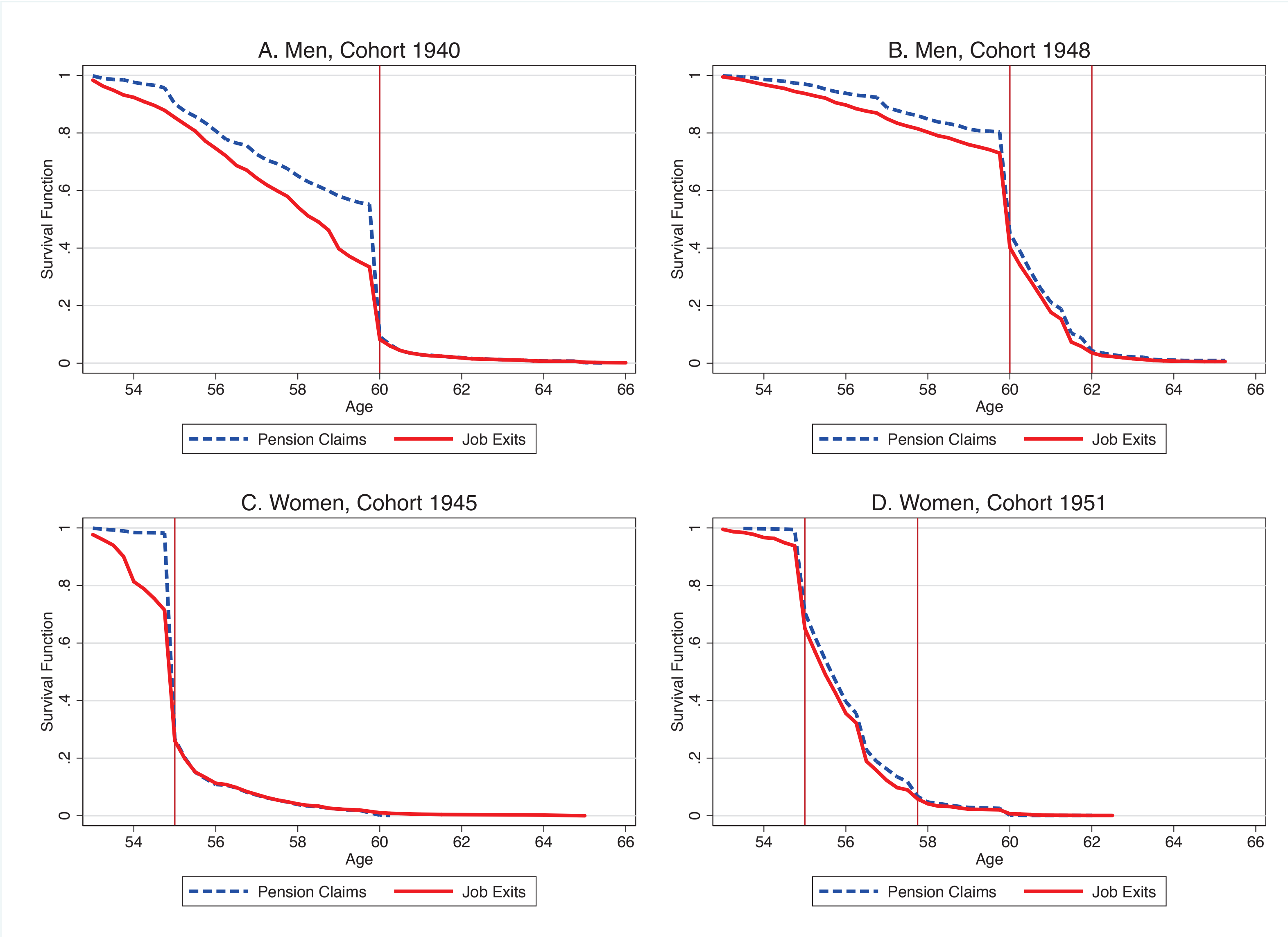
Notes: Survival rates until pension claims and job exits for selected birth cohorts. Vertical lines mark age 60 and the cohort specific ERA.

Figure 4: Survival in the labor market after age 53, Women



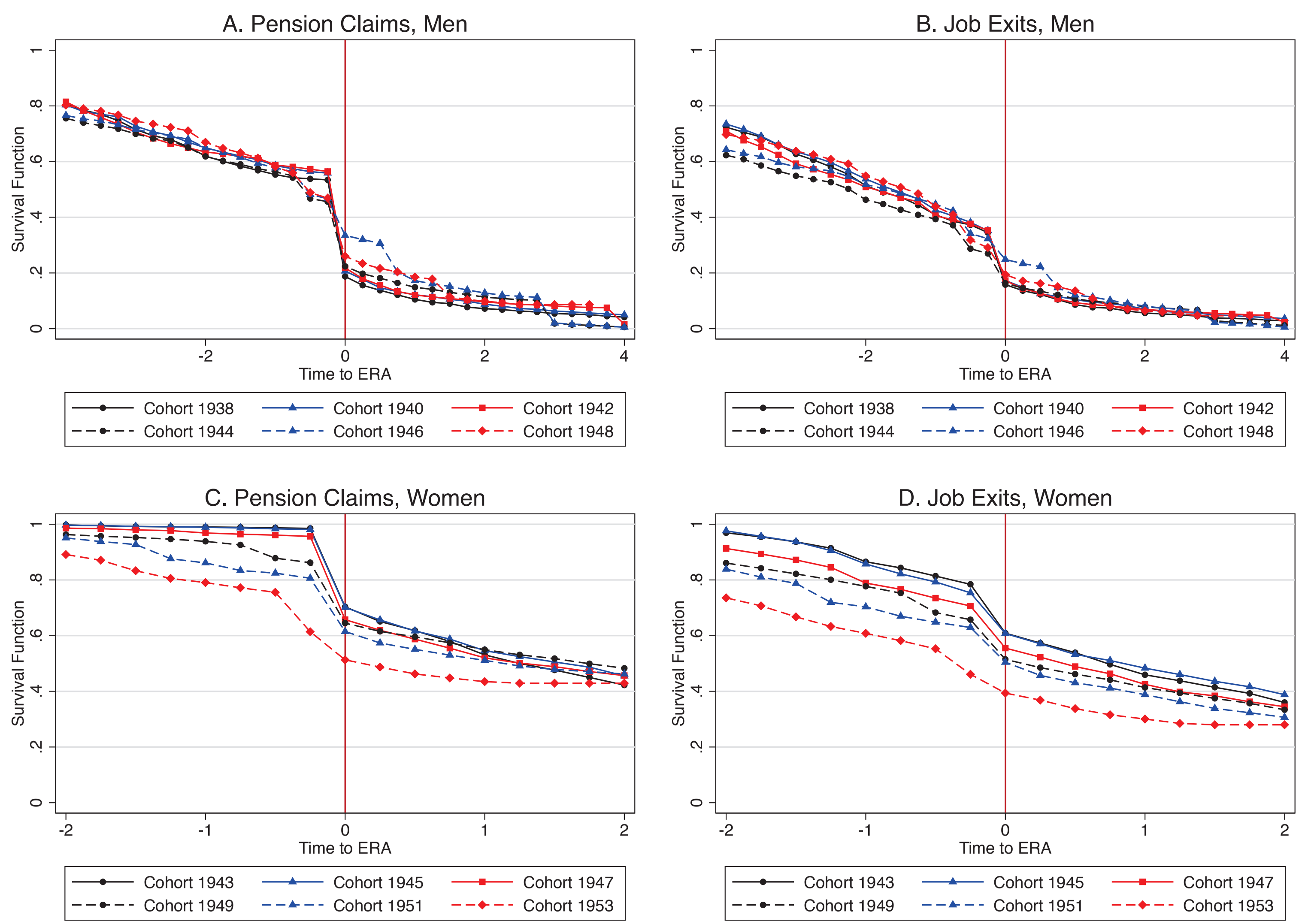
Notes: Survival rates until pension claims and job exits for selected birth cohorts. Vertical lines mark age 60 and the cohort specific ERA.

Figure 5: Survival in the labor market after age 53, Individuals with long contribution years



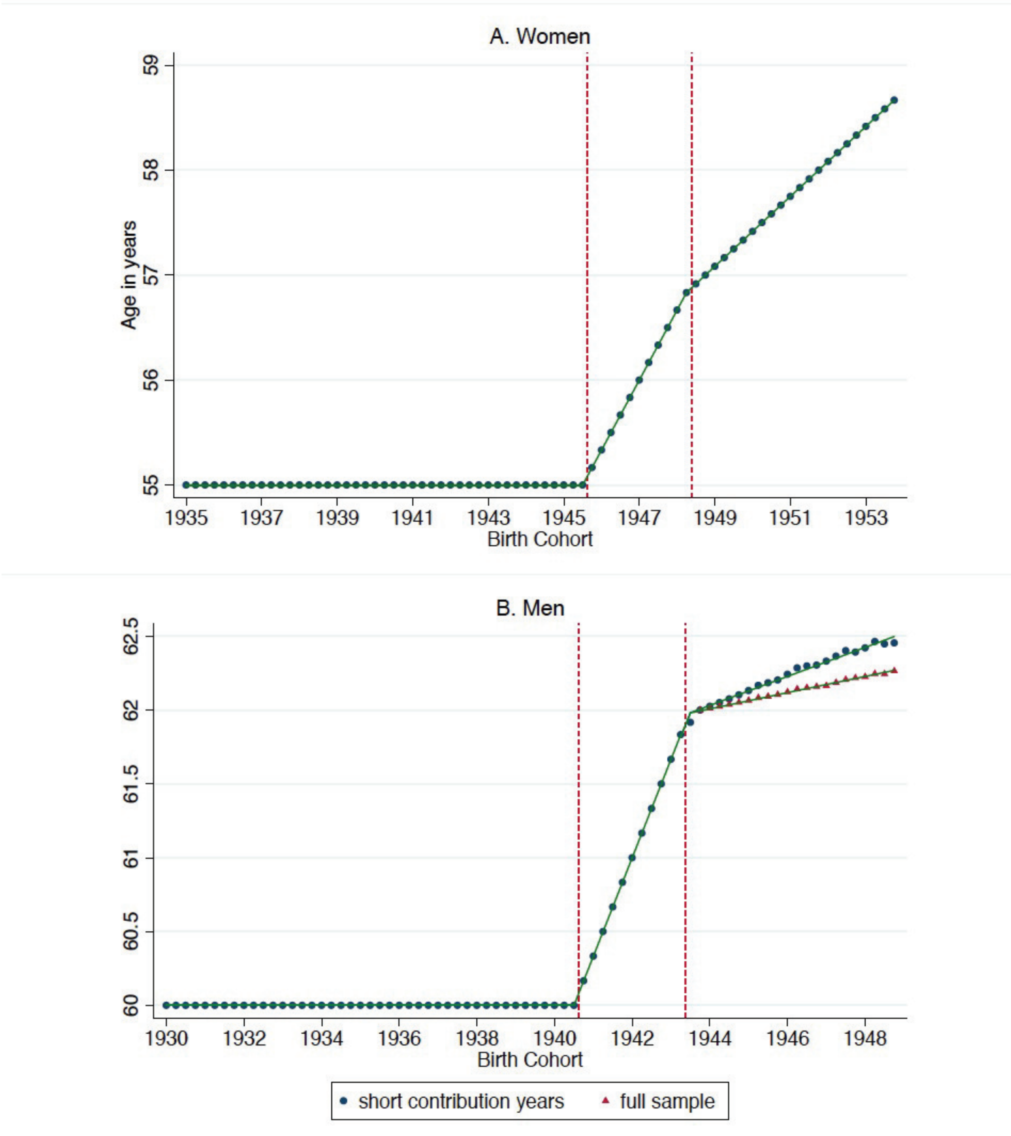
Notes: Survival rates until pension claims and job exits for selected birth cohorts. Vertical lines mark age 60 and the cohort specific ERA.

Figure 6: Survival in the labor market relative to ERA, Individuals with short contribution years



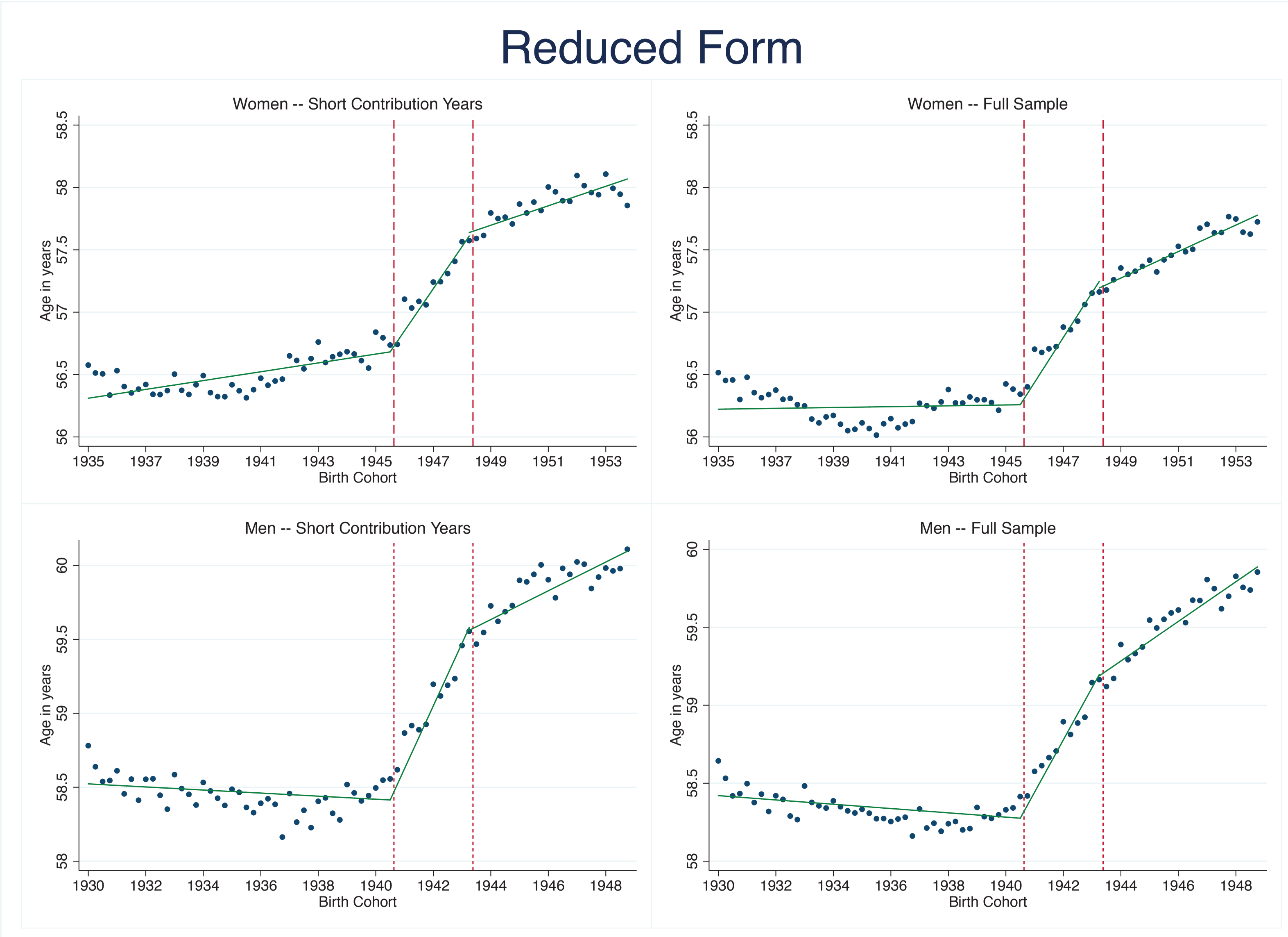
Notes: Horizontal axis shows time in years relative to the cohort specific ERA.

Figure 7: Early Retirement Age by Quarterly Birth Cohort



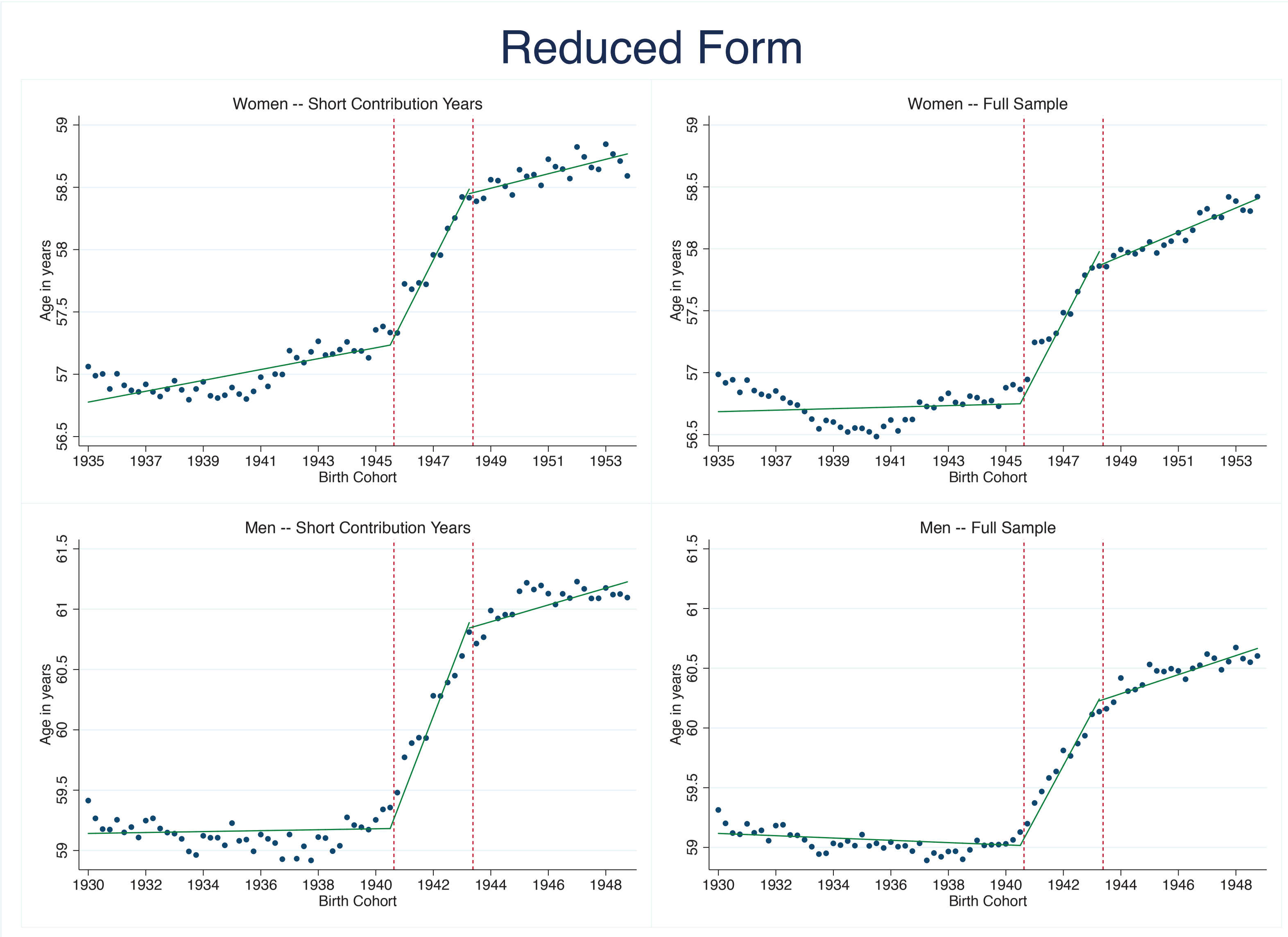
Notes: Early Retirement Age by quarterly birth cohorts.

Figure 8: Exit Age from the Labor Force



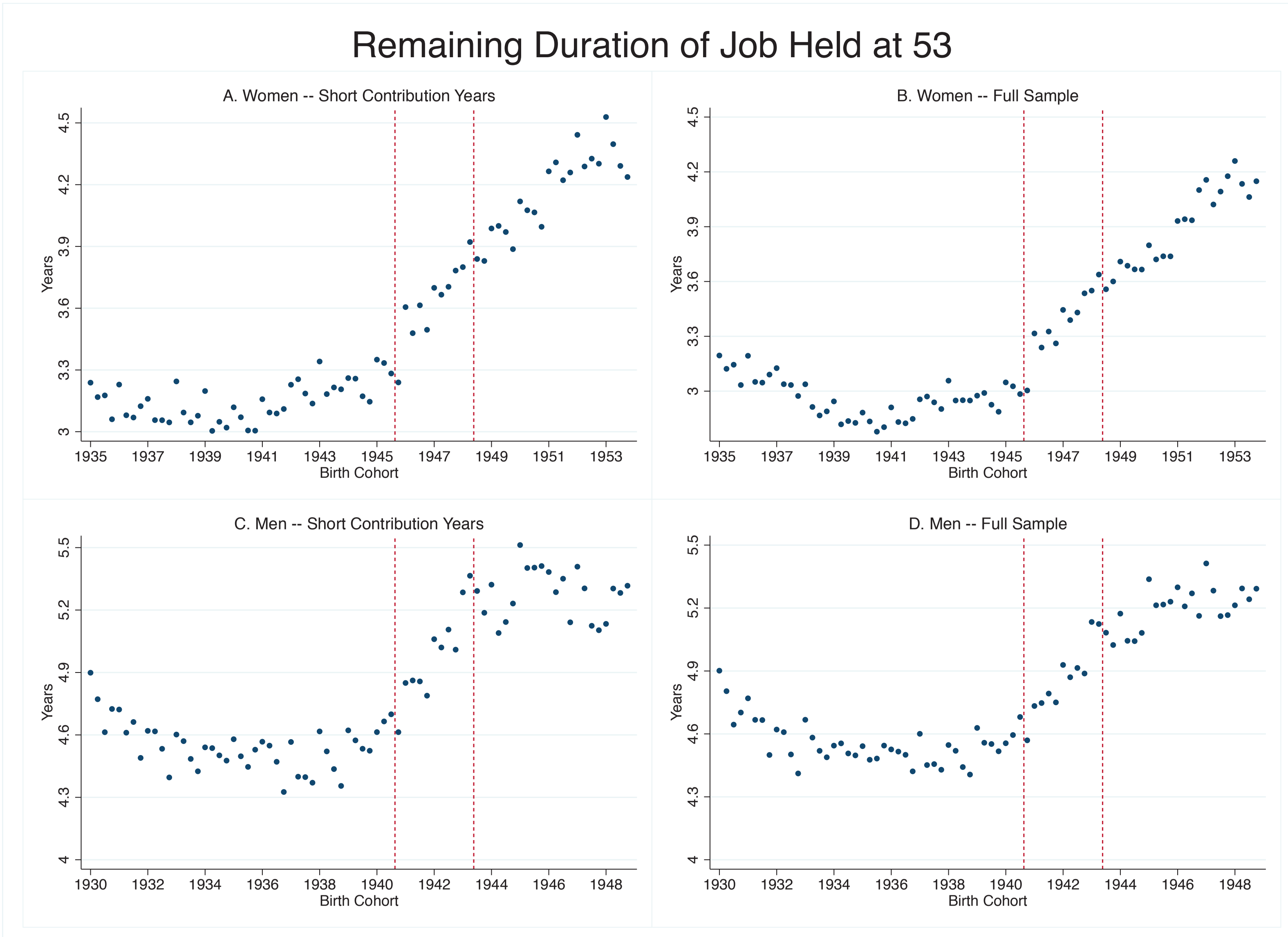
Notes: Average by quarterly birth cohort.

Figure 9: Pension Claiming Age



Notes: Average by quarterly birth cohort.

Figure 10: Remaining Duration of Job Held at 53



Notes: Average job duration in years by quarterly birth cohort.

Appendix – Not for publication

A1 Additional Information on the Austrian Pension System over Time

A1.1 Pension Reform in the 1990's

Several pension reforms over the 1990's targeted the pension coefficient rather than the assessment basis. Up to 1993, the pension coefficient was not age dependent, it increased by 2 percentage points for each insurance year. A worker reached the maximum pension coefficient with 40 insurance years and was not able to increase the pension benefit by working longer. A reform in 1993 introduced penalties for retiring before the NRA by making the pension coefficient age dependent. The average penalty for one year of early retirement ranged between 2% and 4%, but the maximum pension coefficient of 0.8 still applied such that individuals with more than 40 insurance years faced the smallest penalties for early retirement. The pension coefficient was slightly adjusted by a pension reform in 1996 that lowered the average penalty for early retirement. The 2000 and 2004 pension reforms introduced more severe penalties for early retirement raising the average penalty for each year of early retirement to about 8 - 9 % bringing the system closer to actuarial fairness.

A1.2 Pension Reform 2000 and 2004

Changes in Penalties for Early Retirement

The second component of the 2000 pension reform aimed at reducing benefit generosity and increasing penalties for early retirement. With January 2000 the formula defining the pension coefficient was simplified. Each insurance year counts for two percentage points of the pension coefficient. Individuals drawing pension benefits before the NRA face a penalty of 2 percentage points for each year of early retirement with a maximum penalty of 10 percentage points. A second cap states that the reduction can be at most 15% of the pension coefficient before penalty. With the increase in the ERA starting in October 2000, the penalty was adjusted to the step-wise schedule, such that the maximum penalty for retiring at the cohort-specific ERA remains at 10 percentage points. For example, for the cohort with ERA of 61 the penalty for each year of early retirement amounts to $10/4 = 2.5$ percentage points. However, the cap at 15% still applies, which is particularly relevant for individuals with high pension coefficients.

In 2004 the formula for the pension coefficient was changed again and a system with penalties and bonuses for retirements earlier or later than the NRA was introduced. The factor for each insurance year is reduced from 2 to 1.78 percentage points, such that 45 insurance years are now required to reach the maximum pension coefficient. Each year of early retirement before the NRA lowers this pension coefficient by 4.2 percent with a maximum penalty of 15%. In order to avoid too abrupt changes in the benefit formula an additional cap was introduced at a fixed fraction of the pension coefficient computed according to the pre 2004 formula. For individuals first becoming eligible for pension benefits in 2004 this fraction was 95% and it was decreased in the subsequent years. Interestingly, the discounted pension coefficient according to the pre-2004 formula is higher than the pension coefficient computed with the reformed 2004 formula for most individuals who first become eligible for early retirement benefits from 2006 onwards.

The pension coefficient for men retiring under the corridor pension at age 62 is computed by the pre-2004 formula and applies two sets of penalties. First, a penalty of 2 percentage points for each year of retiring before the NRA is deducted. Second, a penalty of 2.1% for each year of retirement before the cohort specific ERA is applied.

Appendix Figure A.7 shows the pension coefficients for retiring at the cohort specific ERA for the female and male samples of individuals with short contribution years. The figure shows that, due to benefit adjustments, the pension coefficients stayed roughly constant across cohorts. This implies that with rising Early Retirement Ages lifetime pension benefits were decreasing with the pension reform.

To visualize the change in financial incentives by birth cohort, Panels A and C in Appendix Figure A.8 plot the percent increase in the pension coefficient from retiring at the cohort specific ERA versus retiring one year after the ERA for women and men who do not qualify for the exemption due to long contribution years. The means by quarterly cohort in the figure are based on observations of individual insurance years in our analysis sample (see section 4 for details). Even though the rules for computing benefits are identical for women and men, women have on average accumulated fewer insurance years than men due to their lower ERAs. The figure shows that before 2000 penalties for early retirement were slightly higher for women and benefits increased between 3 and 5 percent for one year of delayed retirement, which is below the actuarially fair rate. With the 2000 pension reform penalties started to rise; initially more so for women than for men, for whom the caps in penalties applied. The 2004 pension reform raised penalties significantly bringing the gain in benefits for one year of delayed retirement up to 8-9%, which is close to actuarially fair.

Individuals with long contribution years, who qualify for the exemption from the ERA increase after the reform, face different financial incentives for early retirement. Men with 45 contribution years always reach the maximum pension coefficient of 0.8 even after accounting for penalties. For women with 40 contribution years penalties for retiring at age 55 apply with the 2000 pension reform. However, the pension reform 2004 eliminated penalties from early retirement for both men and women with long contribution years. For individuals who hit the maximum pension coefficient, financial incentives to delay retirement beyond age 60 (55) are zero. In contrast, leaving the labor force at ages younger than 60 or 55 and claiming benefits at the ERA had minor effects on the pension coefficient before 2000, which created a strong incentive for individuals with long contribution years to exit the labor force before the ERA. The 2000 pension reform changed this incentive, it allowed individuals to claim benefits at ate 60 (55) if they reach 45 (40) contribution years, which essentially requires that they stay employed as any job interruption does not count as contribution time. To visualize how financial incentives for exiting before age 60 change over cohorts for individuals with long contribution years, Panels B and D of Appendix Figure A.8 plot the benefit increase of exiting the labor market with 44 (39) contribution years and claiming at the cohort specific ERA versus claiming benefits at age 60 (55) with 45 (49) contribution years for women and men, respectively.[20] The figure shows that before 2000 the financial incentives of exiting at the ERA are very low, individuals who exited one year early only faced a benefit cut of around 2%.[21] This basic pattern did not change with the 2000 reform. The reason is that even though penalties for early retirement were increased, caps on the maximum penalties applied to individuals

[20]We consider as alternatives to either remain employed until age 60 and claim benefits with 45 contribution year or to exit employment at age 59 with 44 contribution years. Individuals choosing this second option are eligible to claim UI benefits for up to 12 months and they can apply for disability benefits. However, because eligibility for disability depends on health this option is not open to everybody. We therefore assume that the earliest age at which they can claim pension benefits is the cohort specific ERA. With the 2000 reform benefit cuts would be higher for individuals claiming before the ERA, because higher penalties apply. Large gender differences only 2.4% of women with long contribution years claim disability benefits.

[21]The figure is based on the assumption that individuals who exit with 44 contribution years cannot accumulate additional insurance years, say by registering as unemployed. For those individuals the gain in benefits would be zero.

with long contribution years. In 2004 all penalties for retiring at 60 with long contribution years were abolished and the pension coefficient for retiring at 60 was set to 0.8 for both men and women. Individuals with 44 contribution years retiring at their cohort specific ERA still were subject to increased penalties, which raised the cost of choosing this option to about 7% for men and to 12% for women. In addition to benefit cuts, these individuals also faced increasingly long waiting times from age 59 (54) until the cohort specific ERA as the ERA reform schedule progressed.

Overall, Appendix Figure A.8 illustrates that financial incentives to delay retirement around the ERA increased over the cohorts affected by the 2000 and 2004 pension reforms. There changes do not follow the kinked schedule of the ERA reform in Figure 1, however. Our empirical strategy is to identify responses to the ERA around the kinks in the schedule. If we compare incentives from the ERA schedule change and financial incentives due to the changes in the pension coefficient, we argue that the ERA schedule is much more transparent and easier to understand than the benefit adjustments. Eligibility for ERA is only based on birth cohort, while benefits depend on several factors. The formulas are complex, many different caps apply, and in most cases computations across multiple regimes have to be compared before the final benefit is determined. Furthermore, changes in benefit formulas were introduced repeatedly and with short notice. In several cases the formula was even changed retroactively. For example, the 2004 reform originally stipulated penalties for early retirement at age 60 for individuals with long contribution years (by a law passed in August 2003). However, in December 2004 a new law overruled this regulation, penalties were dropped and benefits for individuals retiring in 2004 had to be re-computed. Another example is the computation of the corridor pension, which was changed in 2007. Given these information problems, it was hard for retirees to optimally respond to financial incentives. Individuals planning to retire at a certain age did not have sufficient information about benefits they would receive at alternative retirement dates. We will therefore attribute the observed changes in exit and claiming ages in the data to changes in ERA rather than financial incentives, also assumed by Staubli and Zweimüller (2013).

Components of the 2004 pension reforms with long-run perspective

The pension reform passed in 2004 also included steps that aimed at the long-run sustainability of the Austrian pension system and affects cohorts born in 1955 and later.

The main components include the scheduled increase in the statutory retirement age for women from 60 to 65 between 2024 and 2034 in half-year steps and the introduction of pension corridor around the uniform NRA of 65. Individuals are free to choose the age at which they start claiming benefits in a 6 year window around age 65, with penalties for early retirement before 65 and bonuses for delayed retirement between 65 and 68. By age 68 all workers are supposed to leave labor force and employment protection is discontinued at this age.

A further change concerns the establishment of a new pension account system that reshapes the defined benefit model. The new system is based on individual accounts and lifelong assessment periods. To phase-in this adjustment, the assessment basis is raised from 15 years to 40 years, starting in 2004 with an increase by one year for each annual cohort.

Table A1: Covariates, Reduced Form

	Kink Pension Reform 2000				Kink Pension Reform 2004			
	Short Contribution Years		Full Sample		Short Contribution Years		Full Sample	
	Women	Men	Women	Men	Women	Men	Women	Men
Predicted Exit Age	0.007	-0.058	0.011	-0.045	0.050	-0.011	0.049	-0.003
	(0.008)	(0.009)	(0.008)	(0.006)	(0.008)	(0.010)	(0.008)	(0.007)
Predicted Claim Age	0.007	-0.055	0.017	-0.044	0.050	-0.007	0.041	0.000
	(0.008)	(0.009)	(0.009)	(0.007)	(0.008)	(0.010)	(0.009)	(0.007)
Age 50 - 53								
Days Employed	-3.79	-8.30	-3.65	-8.74	12.91	-0.14	9.55	-0.91
	(3.29)	(3.42)	(2.56)	(1.96)	(3.16)	(4.11)	(2.49)	(2.26)
Av Annual Earnings	216	-1049	237	-1012	199	-221	114	-174
	(92.7)	(90.1)	(81.8)	(60.1)	(85.1)	(101.6)	(76.0)	(64.7)
Any sick leave	-0.002	0.008	-0.002	0.008	-0.014	0.004	-0.012	0.001
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)
Childcare up to Age 53	-0.007		-0.003		-0.072		-0.034	
	(0.020)		(0.017)		(0.019)		(0.016)	
Insurance years at 53	-0.149	-0.355	-0.183	-0.439	-0.417	-0.020	-0.395	-0.116
	(0.062)	(0.069)	(0.056)	(0.046)	(0.060)	(0.078)	(0.054)	(0.049)
Qualifies for early retirement from unemployment	-0.007	-0.006	-0.005	-0.004	-0.008	-0.005	-0.007	-0.003
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)
Qualifies for early retirement with long insurance years	-0.005	-0.020	-0.005	-0.019	-0.020	0.002	-0.018	-0.002
	(0.004)	(0.004)	(0.004)	(0.002)	(0.004)	(0.004)	(0.004)	(0.002)
Observations	83,575	71,880	110,897	133,334	91,330	63,223	119,052	123,683

Note: Reduced form estimates with maximum symmetric bandwidth equal 2.75 years. Sample includes birth cohorts 1930 - 1948 for men and 1935 - 1953 for women .

Table A2: Reduced Form Estimates, Global

	Short Contribution Years		Full Sample	
	Women	Men	Women	Men
A. Kink Pension Reform 2000				
Early Retirement Age	0.665	0.665	0.665	0.665
	(0.001)	(0.001)	(0.001)	(0.001)
Exit Age	0.297	0.426	0.350	0.343
	(0.020)	(0.023)	(0.022)	(0.017)
Claim Age	0.405	0.607	0.433	0.450
	(0.022)	(0.027)	(0.024)	(0.017)
Observations	188,498	169,846	240,735	270,249
B. Kink Pension Reform 2004				
Early Retirement Age	-0.332	-0.595	-0.332	-0.640
	(0.000)	(0.002)	(0.000)	(0.001)
Exit Age	-0.254	-0.266	-0.177	-0.173
	(0.013)	(0.021)	(0.011)	(0.013)
Claim Age	-0.354	-0.456	-0.233	-0.316
	(0.010)	(0.018)	(0.010)	(0.012)
Observations	137,428	94,002	173,908	182,069

Note: Estimates based on global sample including birth cohorts 1930 - 1948 for men and 1935 - 1953 for women. Standard errors are clustered based on quarterly birth cohort.

Table A3: Fuzzy Regression Kink Estimates, Global

	Short Contribution Years		Full Sample	
	Women	Men	Women	Men
A. Kink Pension Reform 2000				
Exit Age	0.447	0.641	0.526	0.515
	(0.030)	(0.035)	(0.033)	(0.026)
Claim Age	0.609	0.914	0.652	0.677
	(0.033)	(0.041)	(0.036)	(0.026)
Observations	188,498	169,846	240,735	270,249
B. Kink Pension Reform 2004				
Exit Age	0.729	0.448	0.534	0.270
	(0.116)	(0.048)	(0.074)	(0.035)
Claim Age	1.066	0.766	0.702	0.493
	(0.103)	(0.053)	(0.068)	(0.035)
Observations	137,428	94,002	173,908	182,069

Note: Estimates based on global sample including birth cohorts 1930 - 1948 for men and 1935 - 1953 for women. Standard errors are clustered based on quarterly birth cohort.

Table A4: Alternative Estimators and Bandwidths

	Kink Pension Reform 2000				Kink Pension Reform 2004			
	Women		Men		Women		Men	
	Exit Age	Claim Age	Exit Age	Claim Age	Exit Age	Claim Age	Exit Age	Claim Age
Default CCT (with regularization)								
Main Bandwidth (Pilot)	0.50 (1.18)	0.67 (1.41)	0.41 (0.94)	0.81 (1.57)	0.62 (1.19)	0.73 (1.46)	0.52 (1.04)	0.76 (1.46)
Estimated Kink	1.73	0.77	0.24	0.61	0.95	1.44	0.99	0.49
(conventional standard error)	(0.39)	(0.28)	(0.72)	(0.23)	(0.53)	(0.61)	(0.47)	(0.44)
Bias-corrected Estimate	2.20	0.97	0.93	0.62	1.37	2.39	0.53	0.50
robust conf. Interval	[1.12 , 3.29]	[0.07 , 1.87]	[-0.90 , 2.75]	[-0.09 , 1.34]	[-0.36 , 3.10]	[0.60 , 4.19]	[-0.92 , 1.98]	[-0.36 , 1.36]
CCT with no regularization								
Main Bandwidth (Pilot)	2.07 (1.55)	1.84 (1.81)	0.54 (1.04)	1.12 (1.86)	1.04 (1.52)	1.13 (1.53)	1.80 (1.36)	1.04 (1.64)
Estimated Kink	0.27	0.33	1.41	0.65	0.46	0.53	1.14	0.48
(conventional standard error)	(0.05)	(0.07)	(0.34)	(0.14)	(0.23)	(0.27)	(0.09)	(0.26)
Bias-corrected Estimate	0.19	0.43	1.75	0.84	0.19	1.10	0.80	0.21
robust conf. Interval	[-0.63 , 1.01]	[-0.18 , 1.04]	[0.65 , 2.85]	[0.31 , 1.38]	[-0.85 , 1.23]	[-0.26 , 2.46]	[-0.45 , 2.05]	[-0.88 , 1.30]
Fuzzy CCT (no regularization)								
Main Bandwidth (Pilot)	1.54 (3.01)	1.42 (1.71)	0.58 (1.09)	1.06 (1.98)	1.03 (1.53)	0.74 (1.44)	1.17 (1.34)	1.24 (3.21)
Estimated Kink	0.23	0.36	1.30	0.63	0.46	0.61	0.99	0.46
(conventional standard error)	(0.08)	(0.10)	(0.31)	(0.15)	(0.23)	(2.35)	(0.15)	(0.20)
Bias-corrected Estimate	0.15	0.21	1.58	0.84	0.19	2.39	0.84	0.21
robust conf. Interval	[-0.10 , 0.39]	[-0.42 , 0.84]	[0.54 , 2.63]	[0.34 , 1.34]	[-0.85 , 1.23]	[0.60 , 4.19]	[-0.14 , 1.82]	[-0.31 , 0.73]
Fuzzy IK (no regularization)								
Main Bandwidth (Pilot)	2.34 (2.67)	2.01 (2.19)	1.23 (1.87)	4.14 (1.99)	1.32 (1.86)	1.17 (1.55)	0.77 (1.97)	1.73 (1.69)
Estimated Kink	0.31	0.34	0.19	0.62	0.39	0.37	0.33	0.51
(conventional standard error)	(0.04)	(0.06)	(0.10)	(0.03)	(0.17)	(0.23)	(0.27)	(0.11)
Bias-corrected Estimate	0.01	0.79	-0.01	1.22	0.44	0.88	0.50	0.66
robust conf. Interval	[-0.27 , 0.28]	[0.35 , 1.22]	[-0.43 , 0.41]	[0.34 , 2.09]	[-0.34 , 1.22]	[-0.39 , 2.15]	[-0.18 , 1.19]	[-0.21 , 1.53]
FG								
Main Bandwidth (Pilot)	0.92 (5.60)	1.63 (3.45)	0.74 (2.53)	0.95 (2.10)	0.72 (2.15)	1.30 (3.00)	0.51 (1.35)	1.67 (4.69)
Estimated Kink	0.22	0.47	0.78	0.55	0.31	0.31	0.99	0.62
(conventional standard error)	(0.16)	(0.09)	(0.23)	(0.17)	(0.40)	(0.21)	(0.47)	(0.12)
Bias-corrected Estimate	0.19	0.44	0.53	0.77	0.43	0.23	0.96	0.37
robust conf. Interval	[-0.16 , 0.54]	[0.16 , 0.72]	[0.04 , 1.02]	[0.29 , 1.26]	[-0.46 , 1.32]	[-0.35 , 0.81]	[-0.18 , 2.10]	[-0.03 , 0.77]

Note: Estimations based on short contribution year sample, birth cohorts 1930-1948 for men and 1935 - 1953 for women. Conventional point estimates and standard errors are obtained from 2SLS regressions described in Card et al. (2012). The default CCT bandwidth, CCT with no

Table A5: Mechanism: Duration of Job at Age 53

	Short Contribution Years		Full Sample	
	Women	Men	Women	Men
A. Kink Pension Reform 2000				
Job Duration	0.173	0.157	0.189	0.127
	(0.040)	(0.041)	(0.033)	(0.031)
Observations	84,336	57,642	109,819	112,857
B. Kink Pension Reform 2004				
Job Duration	-0.106	-0.158	-0.120	-0.106
	(0.045)	(0.053)	(0.035)	(0.039)
Observations	83,575	71,880	110,897	133,334

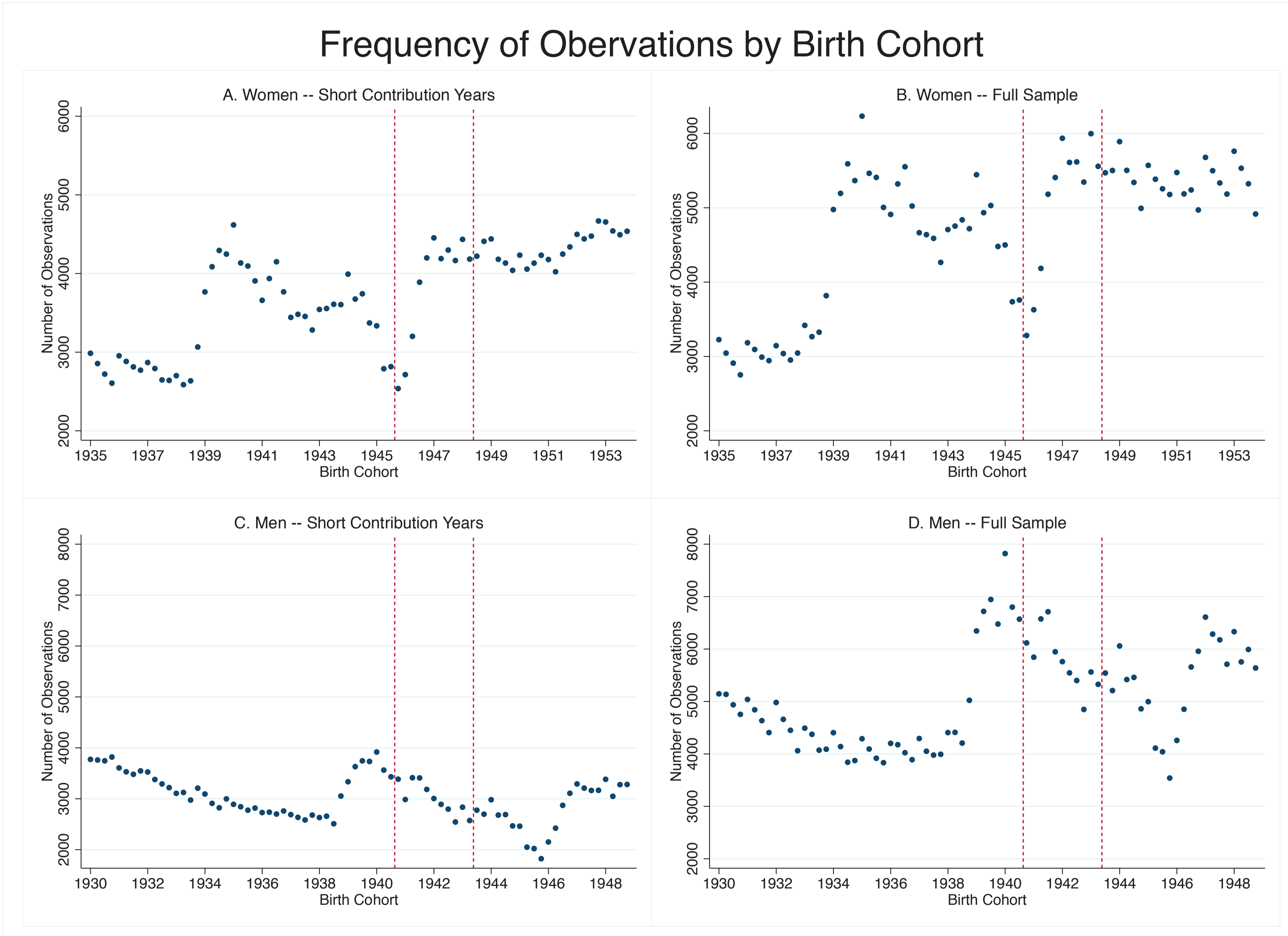
Note: Reduced form estimates with maximum symmetric bandwidth equal 2.75 years. Standard errors are clustered based on quarterly birth cohort. Job duration is measured as the remaining duration from age 53 of the job held at age 53.

Table A6: Effect Heterogeneity

	Any Sick Leave Age 40-53		Earnings Bottom Quartile		Earnings Top Quartile	
	Women	Men	Women	Men	Women	Men
Kink Pension Reform 2000						
Exit Age	0.482	0.684	0.446	0.685	0.666	0.437
	(0.069)	(0.152)	(0.084)	(0.057)	(0.130)	(0.155)
Claim Age	0.745	0.948	0.650	0.954	0.681	0.842
	(0.077)	(0.177)	(0.067)	(0.082)	(0.097)	(0.111)
Observations	16,453	20,488	27,741	33,253	27,447	28,272

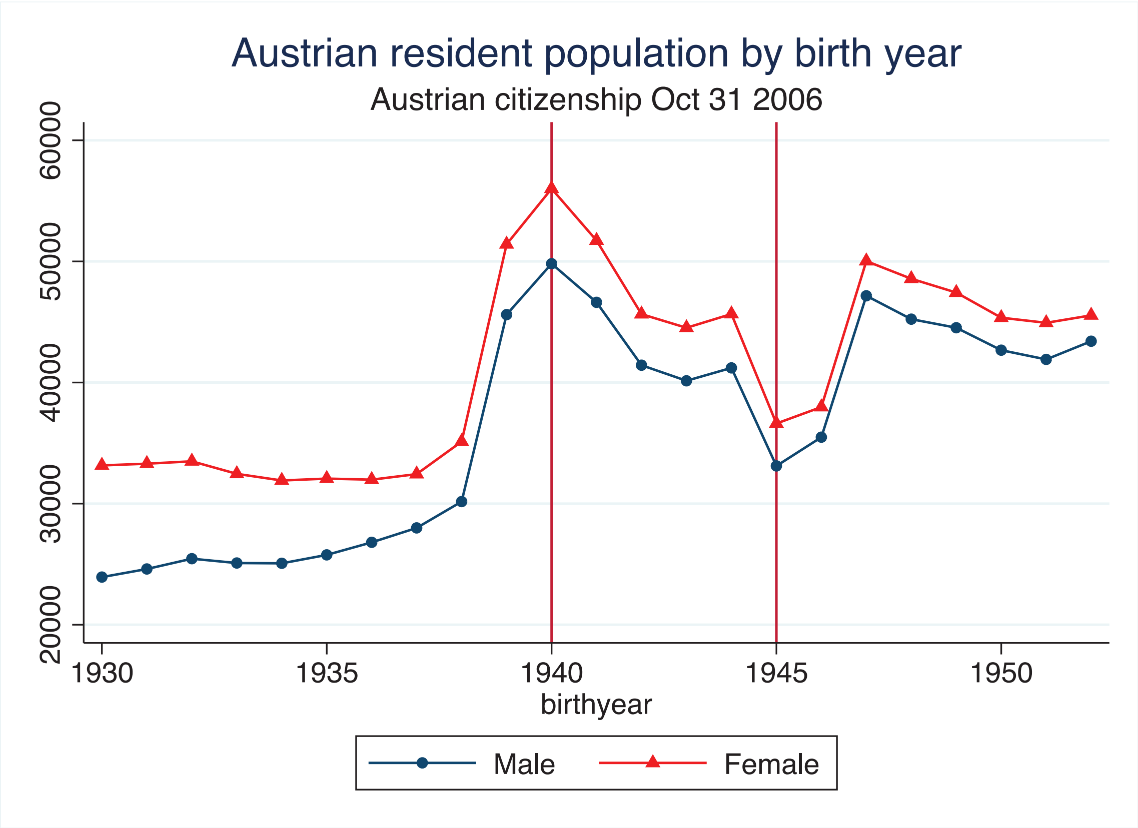
Note: Fuzzy RKD estimates with maximum symmetric bandwidth equal 2.75 years. Sample includes birth cohorts 1930 - 1948 for men and 1935 - 1953 for women .

Figure A.1: Distribution of birth cohorts



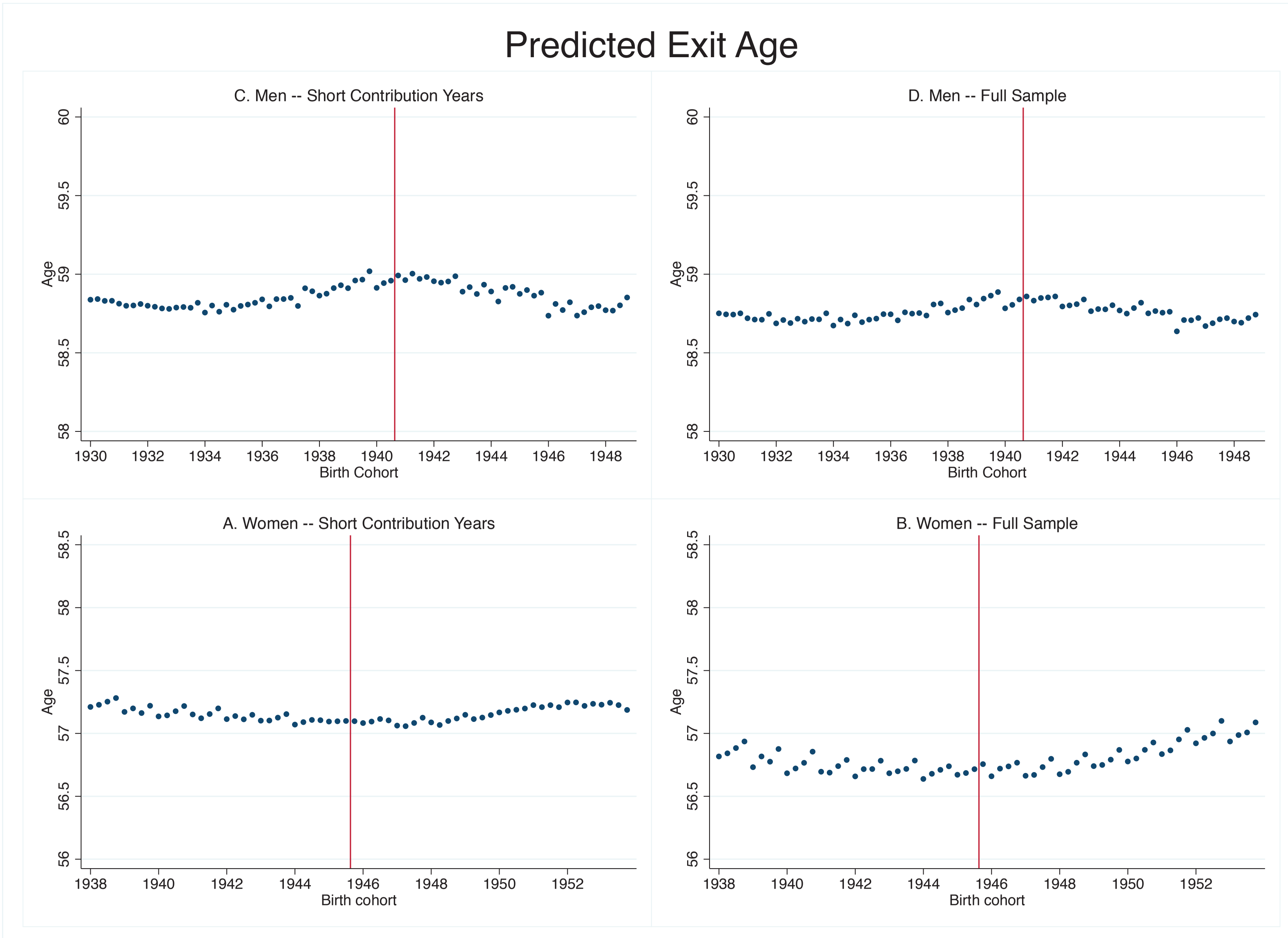
Notes: Number of observations by quarterly birth cohort.

Figure A.2: Population by Birth Year in Austria



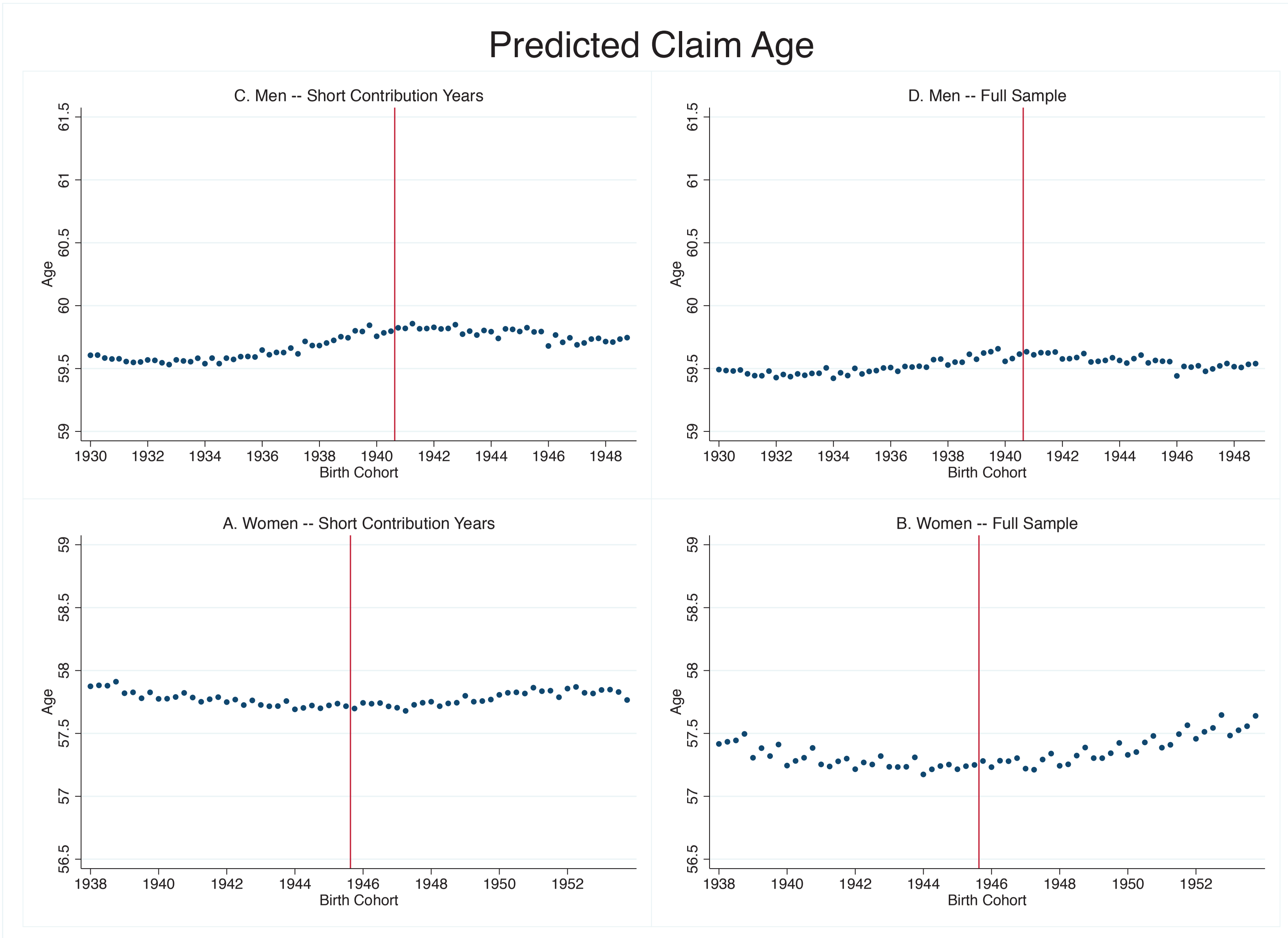
Notes: Resident population with Austrian citizenship on October 31, 2006 by year of birth.

Figure A.3: Predicted job exits by cohort



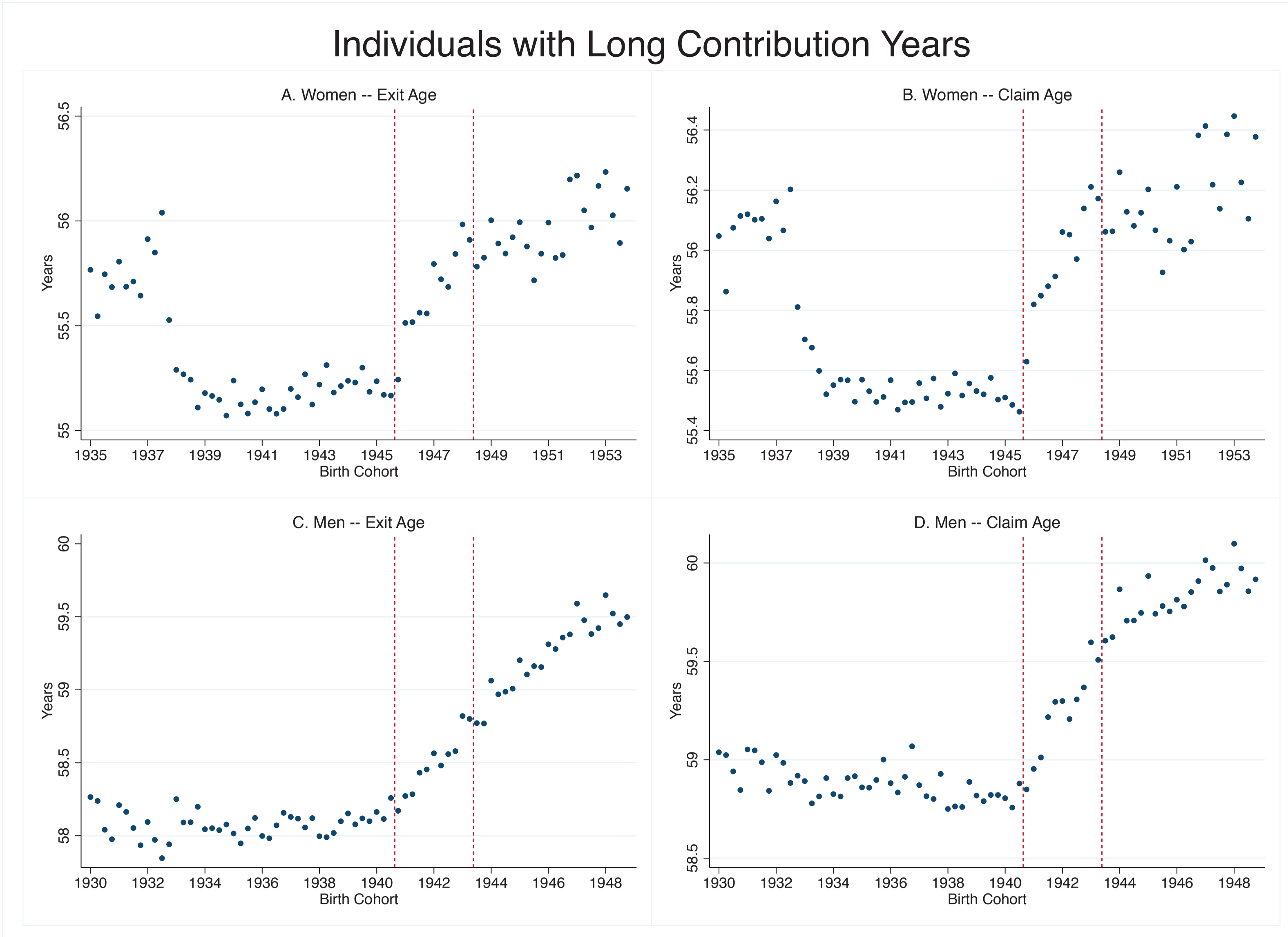
Notes: Number of observations by quarterly birth cohort.

Figure A.4: Predicted pension claims by cohort



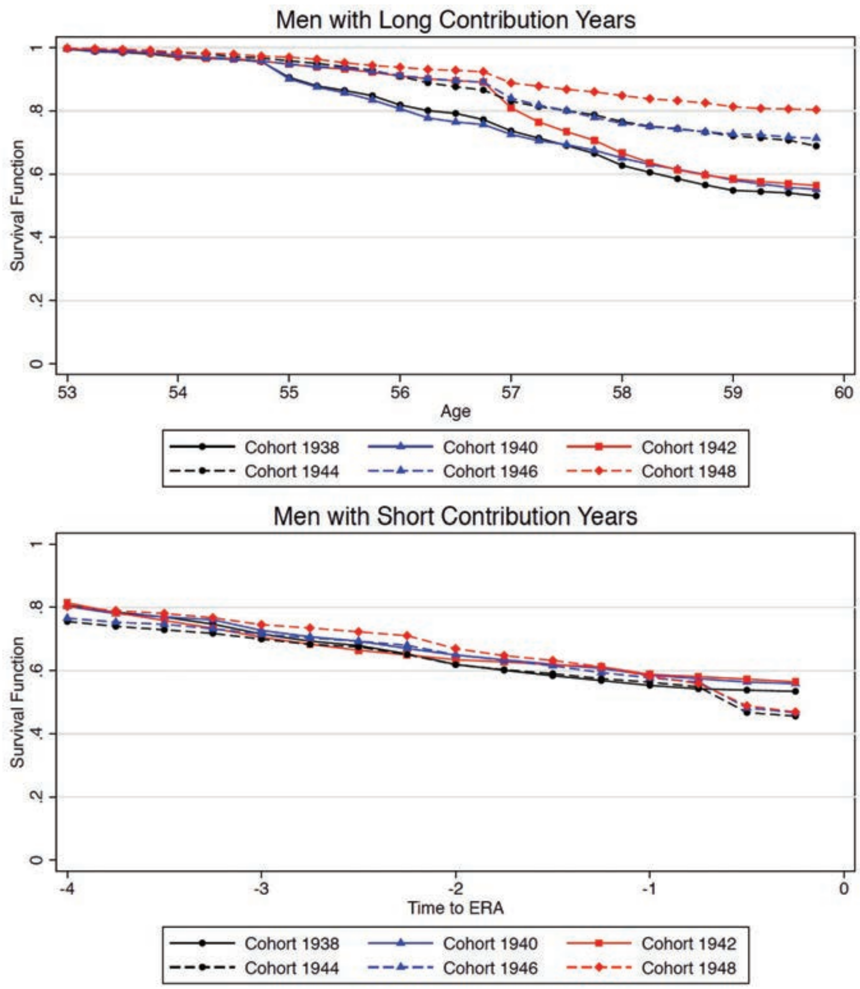
Notes: Number of observations by quarterly birth cohort.

Figure A.5: Exit Age from the Labor Force, individuals with long insurance years



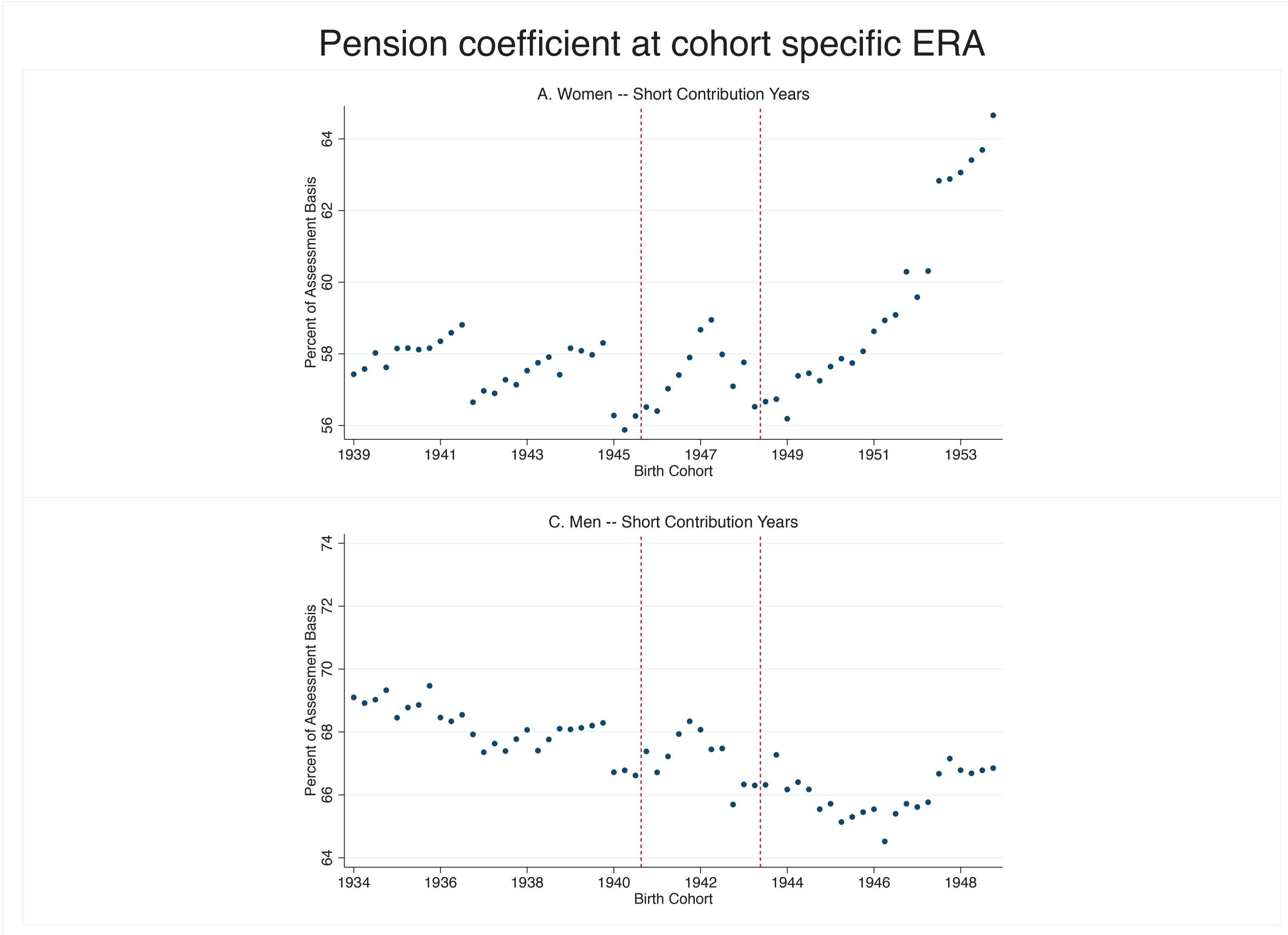
Notes: Average by quarterly birth cohort.

Figure A.6: Disability pension claims prior to the ERA for men



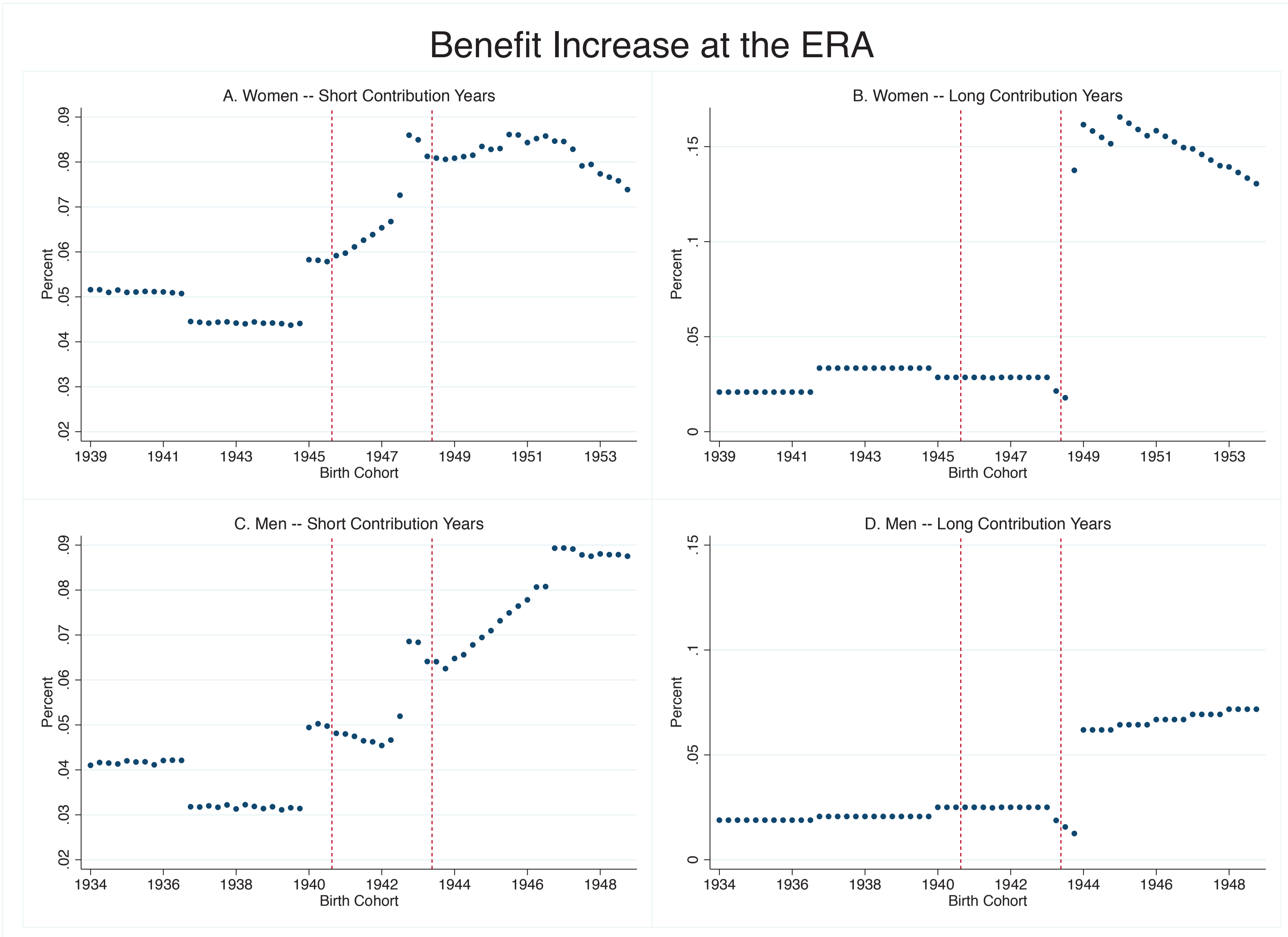
Notes: Survival rates age 53 to 60 in the top graph and survival rates in years before the cohort specific ERA in the bottom graph.

Figure A.7: Pension coefficient at the ERA



Notes: Panels A and C show the average pension coefficient at the cohort specific ERA. The pension benefit is defined by the pension coefficient times the revaluated average annual income over 15 years. The number of years over which the average is taken increases step-wise from 15 to 40, starting 2004.

Figure A.8: Increases in Benefits at the ERA



Notes: Panels A and C show the benefit increase from retiring at the cohort specific ERA versus retiring one year after the ERA for women and men who do not qualify for the exemption based on long contribution years. Panels B and D show the benefit increase of exiting the labor market with 44 (39) contribution