Labor Market Effects of the Early Retirement Age*

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Abstract

This paper presents empirical evidence on the effects of increasing the Early Retirement Age on individuals' labor supply. We examine the impacts of two pension reforms in Austria in 2000 and 2004 that increased the Early Retirement Ages (ERAs) for men and women. The empirical analysis uses administrative, matched employer-employee data covering the private sector in Austria. This data allows us to distinguish between two retirement-related outcomes: pension claims and job exits. Nonparametric graphical evidence indicates the following results. First, men and women delay their pension claims and job exits in response to the increased ERAs. Second, there is little evidence of substitution to disability insurance or unemployment insurance as alternative pathways into retirement. Third, there is little distinction between short-run and long-run labor supply responses to the increased ERAs; the labor supply responses of cohorts immediately following the reforms are similar to those of cohorts roughly 5 years after the reforms. Fourth, there is evidence of spillover effects as individuals who are exempt the increased ERAs also delay their retirements. Based on these responses and the changes in financial incentives from the pension reforms, we estimate lower bounds of extensive margin labor supply elasticities. The results indicate lower bounds of roughly 0.30 for men and 0.10 for women.

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1 Introduction

In many countries social security programs are the largest social insurance programs. Social security systems are typically framed around two age thresholds: the Early Retirement Age (ERA) and the Normal Retirement Age (NRA). The ERA is the youngest age at which individuals can become eligible to claim government provided retirement pensions. The NRA is the age around which legislation is framed and benefits are computed. Due to demographic transitions and the generosity of government provided retirement benefits, there is increasing pressure for social security reforms. A widely discussed policy option to contain the growing costs of the social security system is increasing the Early Retirement Age as this would shorten the period for which individuals claim social security benefits.

With the increasing pressure for reform, researchers and policy-makers are seeking to understand how changes to the ERA are likely to affect the labor market. For credible analysis it is however difficult to find an ideal research design. Most of the empirical literature investigating individual retirement decisions has focussed on financial incentives (Gruber and Wise 2007). But there is little evidence on the labor market impacts of the Early Retirement Age.

In this paper, we present empirical evidence on the effects of increasing the Early Retirement Age on individuals' retirement decisions, exploiting policy variation from social security reforms in Austria. In the years 2000 and 2004, there were two pension reforms that increased the ERAs for men and women in Austria. The 2000 pension reform increased the ERAs by 1.5 years using incremental two-month increases for each quarterly birth cohort beginning with men born in the last quarter of 1940 and women born in the last quarter of 1945. The 2004 pension reform increased the ERAs first using the same incremental two-month increases for each quarterly birth cohort and then using incremental one-month increases for each quarterly birth cohort. These reforms allow us to compare outcomes across quarterly birth cohorts to identify the effects of increasing the ERAs on individuals' retirement decisions.

The empirical analysis is based on administrative data from the Austrian Social Security Database. This database provides social security record data on all private sector employees in Austria. We focus on a sample individuals reaching the ERA around the reform dates. As we want to study retirement decisions we restricting ourselves to individuals with at strong labor market attachment, who are still employed at age 53. The administrative data allows us to distinguish between two retirement-related outcomes: pension claims and job exits. This distinction is important for measuring labor supply responses to changes in the ERA; pension claims mechanically adjust to changes in the ERA and individuals' labor supply may not change if they are able to substitute to other social insurance programs. Economic models generally focus on individuals' labor supply decisions, so researchers have generally sought to measure individuals' work. However, because of data limitations, researchers have had to use a variety of different outcomes to measure retirement in practice. By focusing on actual job exits, we are able to accurately measure retirement decisions relating to labor supply.

The empirical analysis is divided into four parts. First, we characterize the differences between job exits and pension claims among cohorts not yet affected by the ERA reform. This allows us to establish the importance of the Early Retirement Age in the Austrian social security system. We see a huge increase in the exit rates out of jobs and into pension claims at the ERA for both men and women, while the NRA only applies to a small minority. The analysis also indicates that job exits occurring at the ERA or older ages generally correspond to pension claims. Job exits occurring prior to the ERAs do not always correspond to pension claims because only some men and women are able to be classified as disabled to claim disability pensions for retirement.

Second, we provide evidence on the effects of increasing the ERA on pension claims and job exits. Histograms on the distributions of claiming and exiting ages by birth cohort show spikes for both claims and exits at the ERAs that move to older ages as younger cohorts become affected by the reforms. Claiming and exiting at ages beyond the ERAs do not appear to have been affected significantly by the policy changes.

Third, we present regression evidence to quantify the labor supply responses to the increases in the ERAs. Specifically, we estimate changes in the probability of working and changes in individuals' implicit tax rates on earnings from work. Combining these changes allows us to estimate bounds on extensive margin labor supply elasticities. We are only able to estimate lower bounds for these elasticities because the probability of retirement approaches the lower bound of zero following the increases in the ERAs.

Fourth, we investigate potential mechanisms through which the reform affects retirement decisions. Specifically, we focus on substitution to alternative pathways and on spillovers to unaffected groups. One concern with reforms involving an increase in the ERA is that individuals might substitute government pensions with alternative social insurance programs. By looking job exits and pension claims separately, we can investigate whether the gap between both outcomes widens after the reform. In addition, we can follow individuals who take up disability pensions or unemployment benefits. Our analysis shows that in our sample of highly attached individuals, substitution with other programs plays a minor role.

We also examine spillover effects to individuals who were not directly affected by the pension reforms. In particular, the pension reforms specified that individuals with long years of experience were exempt from the increased ERAs and they could continue to claim retirement pensions at the pre-reform ERAs. We examine changes in pension claiming and job exiting for these individuals that were exempt from the increased ERAs and find significant changes in their pension claiming and job exiting. In particular, the changes for these exempt individuals are similar to the changes for non-exempt individuals suggesting significant spillover effects.

This paper is organized as follows. In the next section, we discuss the institutional background and data and empirical patterns of job exiting and pension claiming behaviors prior to the pension reforms. In Section 3, we present the main empirical analysis of the effects of the pension reforms on pension claims and job exits.

2 Institutional Background & Data

2.1 Retirement in Austria

Austria has a public pension system that automatically enrolls every person employed in the private sector. Fixed pension contributions are withheld from each individual's wage and annuitized benefits during retirement are then based on prior contributions (earnings histories). Replacement rates from the annual payments are roughly 75% of pre-retirement earnings.[1] While there are some actuarial adjustments to benefits for delaying retirement to a later age, the system is actuarially unfair on average. Pension benefits are entirely withdrawn if an individual earns more than roughly 300 Euros per month; therefore very few individuals are observed returning to the labor force once they claim a pension.[2]

Individuals can claim Disability pensions, Early Retirement pensions and Old Age pensions. Eligibility for each of these pensions depends on an individual's age and gender, as

[1]Given the generosity of the public pension system, private pensions are virtually non-existent in Austria. The monetary value of an individual's social security benefit is computed as a product of two factors: (1) the assessment basis, which is an earnings history measure similar to the average indexed monthly earnings (AIME) in the U.S. and (2) the pension coefficient, which is a percentage that is applied to the assessment basis. The pension coefficient is increasing in the individual's retirement age and his insurance years (years of labor market experience) up to a maximum of 80%. The assessment basis is an inflation-adjusted average of the individual's annual earnings over the 15 years with highest earnings. Prior to 2001, old-age, early retirement and disability pensions were computed identically; in 2001 and after, a reduction was applied to the pension coefficient for disability pensions.

[2]It is possible to claim a partial pension and receive partial benefits while continuing to work. Very few individuals claim these pensions so we exclude them from our analysis.

well as having a sufficient number of insurance years or contribution years. Contribution years are determined by the time spent in employment subject to pension contributions and also include sick leave, maternity leave, and times of compulsory military service. Insurance years additionally include the time spent in unemployment and secondary education; In regard to Disability pensions, private sector male and female employees can claim Disability pensions beginning at age 55.[3] For these pensions, disability is based on reduced working capacity of 50% relative to someone working in the same occupation.[4] To claim a Disability pension, an individual must have at least 10 insurance years in the last 20 years or 15 contribution years in total. In regard to Early Retirement pensions, men and women become eligible for Early Retirement pensions at the Early Retirement Ages (ERA) which were 60 and 55 for men and women respectively. As we discuss in more detail below, these ERAs were increased in the 2000 and 2004 pension reforms. To claim an Early Retirement pension, an individual must have at least 35 insurance years. Lastly, in regard to Old Age pensions, men and women become eligible for Old Age pensions at the Normal Retirement Ages (NRA) which are age 65 and 60 respectively.[5] To claim an Old Age pension, an individual must have at least 15 insurance years in the last 30 years, 15 contribution years in total or 20 insurance years in total.

Unemployment benefits can also affect individuals' job exiting decisions. Prior to claiming a pensions, individuals can receive unemployment benefits that are roughly 55% of their net wage. Individuals over age 50 are eligible to receive 20, 30, 39 or 52 weeks of benefits if they have respectively completed 1 year of employment in the last 2 years, 3 years of employment in the last 5 years, 7 years of employment in the last 10 years, or 9 years of

[3]See Staubli (2011) for an analysis of the labor market effects of increasing the age for claiming disability pensions to 57.

[4]It is also possible to receive disability pensions prior to age 55; these benefits are based on permanent disability status.

[5]Benefits from disability and early retirement are entirely withdrawn if an individual earns more than about 300 Euros per month; therefore we see very few individuals returning to the labor force once they are retired.

employment in the last 15. Individuals who enter unemployment through voluntary quits face a four-week waiting period to be able to receive their benefits; individuals entering unemployment through an involuntary separation do not face this waiting period.[6]

2.2 Pension Reforms

Pension reforms in 2000 and 2004 increased the Early Retirement Ages (ERAs) for men and women. These increases in the ERAs are illustrated in Figure 1. The 2000 pension reform increased the ERAs by 1.5 years from 60 and 55 to 61.5 and 56.5 for men and women respectively. The reform was announced in July of 2000, and the increases in the ERAs were phased in between October of 2000 to October of 2002. Specifically, men born in the fourth quarter of 1940 faced an ERA of 60 and 2 months, and each subsequent quarterly birth cohort faced an ERA that was 2 months higher than the previous cohort. For women, the 2-month increases for each quarterly birth cohort started with women born in the fourth quarter of 1945.

The 2004 pension reform continued to increase the ERAs for men and women. This reform was announced in June of 2003 and took effect on January 1, 2004. The ERAs were increased by two months for each quarter of birth for men born in the first two quarters of 1943 and women born in the first two quarters of 1948. Following these increases, the ERAs were increased by one month for each quarter of birth for men born in the third quarter of 1943 and later and for women born in the third quarter of 1948 and later. Furthermore, the 2004 pension reform also created special corridor pensions for men born in the last quarter of 1943 and later. The minimum entry age for these corridor pensions was 62, thereby making the ERA beyond age 62 non-binding in many cases.[7]

[6]See Kuhn, Wuellrich, Zweimüller (2010) for a discussion of UI as pathway to retirement in Austria.

[7]Corridor pensions could be claimed by men who (1) were born in the fourth quarter of 1943 or later, (2) reached age 62 with at least 37.5 insurance years and (3) were employed or receiving UI benefits. With the corridor pensions, re small reduction on benefit amounts was imposed as a penalty for early claiming.

Men and women with 45 and 40 pension contribution years were exempt from the increases in the ERAs and hence could continue to claim pensions at 60 and 55. Originally this exception was only announced for a few cohorts, but it was extended later on. Individuals who have accumulated 45 contribution years at the age of 60 must have entered the labor market at age 15 and have been continuously employed throughout. Only short gaps are allowed for military service, maternity leave, or higher education.

2.3 Data & Sample Restrictions

Our empirical analysis is based on administrative, matched employer-employee data from the Austrian Social Security Database (ASSD, see Zweimüller et al (2009)). This data is collected with the principle aim of verifying individual pension claims and computing individuals' pension benefits. The data provide longitudinal information for the universe of private sector workers in Austria throughout their working lives. Specifically, information is collected on employment and earnings as well as other labor market states relevant for computing insurance years such as military service, unemployment, maternity leave and sick leave. In each calendar year, individuals' work histories are summarized in spells that have a maximum length of 365 (or 366) days. Total earnings are reported for each employment spell. Additionally, information is recorded on the lengths of spells with receipt of benefits from unemployment, disability and pensions.

The data is collected from 1972 onwards, though some information prior to 1972 is available. In particular, detailed electronic records with employer identifiers are recorded from January 1, 1972 onwards.[8] The combination of the employer identifiers and individual employment spells allows for construction of firm-level variables such as firm size, hires and exits. Additional information on industry and region is also recorded for each employer. For

[8]Because there are no rules specifying distinctions between firms and plants, the employer identifier does not distinguish between firms and plants.

the years prior to 1972, retrospective information on states relevant for computing insurance years is available for all individuals who have retired by the end of the observation period. Combining the administrative data from 1972 onwards and the retrospective data prior to 1972 yields information on complete earnings and employment careers of retirees. In the empirical analysis, we use information through 2009.

To analyze the effects of increasing the ERAs on labor supply decisions of older workers, we construct the sample for the labor supply analysis by starting with all men born between 1930 and 1947 and women born between 1935 and 1952. We exclude the following sets of individuals: individuals who are not Austrian citizens, individuals who die before age 65, individuals who are last employed prior to age 53, individuals who have 1 or more years of self-employment, and individuals in government-dominated industries at older ages.[9] The sample restrictions are summarized in Table 1. After imposing the sample restrictions, our sample consists of $299,789$ men and $290,412$ women. empirical analysis section below.

2.4 Pension Claims & Job Exits

Before analyzing the effects of the pension reforms on changes to pension claims and job exits, we characterize pension claiming and job exiting patterns prior to the pension reforms. Thereby pension claims include all forms of pensions: disability pensions, early retirement, and old age pensions. Job exits are defined by the last date we see an individual in employment. Figure 2 presents survival functions for pension claims and job exits from the labor force for the sample of private sector employees who were not affected by any increases in the ERAs. In particular, the survival curves for men are based on birth cohorts 1930 through 1939 and the curves for women are based on birth cohorts 1935 through

[9] We exclude self-employed individuals from the analysis because pensions for self-employed individuals are determined under separate rules from those of private sector employees. Examples of government-dominated are education, railways, and public administration. We exclude these individuals since pensions for civil servants are also determined under separate rules from those of private sector employees.

1944. They are presented separately for men and women given the different eligibility ages. The survival functions illustrate sharp declines at ages 55 and 60 highlighting a significant amount of entry into the pension system once individuals become eligible for the Early Retirement pensions. Additionally, the figure demonstrates that, for both men and women, most claims and exits occur between ages 55 and 60. Further, the graph shows that roughly 40% of the male sample claims disability pensions prior to age 60.

For men and women respectively, there are small but noticeable increases in job exits at ages 59 and 54 that are not accompanied by increases in pension claims. Many of these exits correspond to exits into unemployment insurance. At these ages, individuals are eligible for 52 weeks of unemployment insurance (UI) benefits if they have completed 9 years of employment out of the last 15 years. Thus, eligible men exiting at age 59 and women exiting at age 54 can receive UI benefits for one year before claiming their pensions at ages 60 and 55, respectively.

Next, we focus on the time between pension claims and job exits. The survival curves in Figure 2 highlight that job exits generally occur prior to pension claims. This could be driven by responses to pension rules that suspend an individual's benefits if the individual's labor market earnings exceed roughly 300 euros per month. In Figure 2, the differences between claims and exits for men suggest that men exiting at each age prior to age 60 generally claim their pensions either at their exit ages if they are permitted to claim disability pensions or at age 60 when they qualify for early retirement pensions. For women, the survival curves in Figure 2 indicate that, between ages 55 and 60, job exits generally correspond to pension claims. Prior to age 55, many women exit their jobs and these women claim pensions either at age 55 if they are eligible for early retirement pensions or at age 60 once they are eligible for old age pensions at the Normal Retirement Age.

3 Empirical Analysis: Effects of Increasing the ERA

This section presents the empirical analysis on the labor supply effects of the increases in the ERA. The first part of the section presents graphical evidence to illustrate changes in pension claiming and job exiting behavior due to the pension reforms. The second part of the section focuses on developing and estimating a regression specification to quantify the labor supply effects of the policy changes. The last part of the section presents some further analysis.

3.1 Graphical Evidence

Exiting and claiming ages

Changes in the exit- and claiming ages and ERA reforms

To better illustrate the changes in claims and exits at specific ages following the ERA reforms, Figures $3A-D$ present panels of histograms of claiming and exiting ages for select cohorts. Each histogram has vertical red lines that mark the ERAs that apply to individuals in the specified cohort. The multiple ERAs, and hence multiple vertical red lines, for some histograms, reflects that some individuals in the cohort with high contribution years face a lower ERA than individuals with lower insurance years.

Consistent with the previous figures, the histograms highlight the increases in claims and exits at older ages as the ERAs increase. In particular, the histograms reveal consistent spikes for claims and exits at the ERAs for each cohort. Claims and exits at ages beyond the ERAs do not appear to have been affected significantly by the policy changes. The histograms emphasize that claims and exits at specific, affected ages closely track the increases in the ERAs. Intuitively, individuals appear to delay their pension claims and job exits as the ERAs increase, but many of these individuals continue to claim and exit exactly at the specified ERA for their birth cohort.

Comparing the histograms for job exits and pension claims, we see that the spikes move to the new ERAs for both outcomes. This gives a first indication that spillovers to other social insurance programs cannot be quantitatively important. If individuals exit to unemployment or disability, we would see moving spikes in pension claims, but stationary spikes in job exits.

3.2 Regression Specification & Results

In this section, we focus on quantifying the changes in pension claiming and job exiting when the ERA increases and examining these changes when controlling for observable individual characteristics. We use a regression specification to model claiming and exiting rates as functions of age effects, birth cohort effects, indicators for the cohort-specific ERA and other individual-level covariates. When estimating these regressions, we use panel data with individual-age observations where age is measured at a quarterly frequency.[10] We use observations starting at ages 59 for men and 54 for women. We do not use observations from earlier ages because claims and exits for disability pensions may not be driven by the ERAs and hence we do not want to use this variation to estimate the effects of the ERAs at specific ages. Additionally, we use observations up until an individual claims or exits, but we censor observations at each individual's ERA based on the individual's birth cohort and insurance years.[11]

With this panel data, we estimate the following regression specification,

$$y_{ict} = \theta_t + \delta_{ct} * ERA_{ict} + \gamma_c + \beta' X_{ict} + \varepsilon_{ict}. \tag{1}$$

[10] We avoid using higher frequency data since (1) the quarterly frequency is sufficient to exploit variation from the pension reforms, (2) many covariates do not vary at a higher frequency level, and (3) higher frequency data is computationally burdensome given the large sample of individuals.

[11] For all cohorts, men and women with ≥ 45 and ≥ 40 insurance years are respectively censored at ages 60 and 55.

The dependent variable y_{ict} is an indicator equal to 1 if individual i in birth cohort c claims or exits at age t. Separate regressions are estimated for claims and exits and for each gender. The coefficients θ_t capture age-specific hazard rates when the ERA is at an age higher than t. The variable ERA_{ict} captures the cohort-specific and insurance year specific ERA for individual i; in particular, ERA_{ict} is an indicator variable equal to 1 if age t corresponds to the ERA for individual i in cohort c. The coefficients δ_{ct} therefore capture the marginal effects of having the ERA at age t on the hazard rate at age t and the sum $\theta_t + \delta_{ct}$ captures the hazard rate at age t when the ERA is at age t. Lastly, the terms γ_c, X_{ict}, and ε_{ict} are cohort dummies, individual-level covariates and the error term respectively.

Tables 3 and 4 present the estimated age effects and marginal effects from the ERAs from the regressions for men and women respectively. To better illustrate the results, we present plots of these estimated coefficients in Figures 5 and 6 for men and women, respectively. Specifically, within each gender and retirement outcome, we plot the hazard rate at a given age t when the ERA is at that age (i.e. $\hat{\theta}_t + \hat{\delta}_{ct}$) and the hazard rate at that same age when the ERA increases to a higher age (i.e. $\hat{\theta}_t$). The plots are based on the estimated coefficients when including a full set of individual-level covariates. We focus first on the pension claiming results for men in the left graph in Figure 5. This plot illustrates that, when the ERA for men is at age 60, the hazard rate to pension claims is roughly 0.6, When the ERA increases to a higher age, the hazard rate to pension claims falls to nearly 0. A similar pattern holds for higher ages as well, indicating that pension claims at a given age at much higher when the ERA is at that age. While the claiming effects may be mechanical, the right graph in Figure 5 illustrates a similar pattern for job exits. In particular, when the ERA is at a given age t, the hazard rate into job exits is much higher then when the ERA increases to higher ages. Thus, even after accounting for control variables, hazard rates for job exits decrease by almost 100% when the ERA increases. The graphs in Figure 6 show similar patterns for pension claims and job exits for women, though the levels of the hazard rates for women are generally lower than those for men since fewer women retire at their ERA than men (as indicated in the survival curves in Figure 2).

3.3 Labor Supply Elasticities

To compute reduced form labor supply elasticities, we have to relate the participation responses from above to the financial incentives from the ERA change. We proceed according to the following steps. First, we compute implicit tax rates on gross earnings at the early retirement age for each individual. The implicit tax rate measures the tax rate applied to gross earnings that results in gross earnings net of taxes and benefits (see Gruber and Wise (1999 and 2004) for more discussion on implicit tax rates from social security benefits). Intuitively, the implicit tax rate captures overall financial incentives for continued work, since it reflects after-tax compensation beyond the benefits an individual would receive if he retired. Since the increases in the ERAs changed access to retirement benefits, the reforms created changes in individuals' implicit tax rates at the ERAs. The second step focuses on quantifying the changes in implicit tax rates at the ERAs. To do this, we estimate an analogous regression model as the one specified in equation (1) using as the dependent variable $\ln(1-\tau_{ict})$, where τ_{ict} is the implicit tax rate for individual i in cohort c at age t,

$$\ln(1-\tau_{ict}) = a_t + d_{ct} * ERA_{ict} + g_c + b' X_{ict} + e_{ict}.$$

The coefficients of this regression capture the determinants of changes in the net-of-tax rates as the ERAs increase. The third step computes labor supply elasticities based on the ratios of the estimated coefficients on the ERA_{ict} indicator variable from the two regression equations,

$$e = \frac{d\ln(p)}{d\ln(1-\tau_{ict})} = \frac{\ln(1-\theta_t) - \ln(1-\theta_t-\delta_{ct})}{d_{ct}}.$$

Intuitively, the first regression equation allow us to compute changes in the probability of working as the ERA increases, and the second equation will allow us to compute changes in the net-of-tax rates as the ERA increases. Because the probability of working has an upper bound of 1 and we see large increases in the probability of working at ages just below the ERA from the policy reform, our elasticity estimates represent lower bounds for the labor supply elasticities (i.e. given the change in financial incentives, individuals may want to increase their work by more than can be observed given the upper bound).

The lower bound labor supply elasticity estimates are reported separately for men and women in Table 5. Our regressions allow for different participation effects and changes in the implicit tax rate for all quarterly ages from 60 to 62 for men and 55 to 57.75 for women. The table reports estimates of the elasticity at age 60 (55 for women) and the average of the elasticities over all available ages. The estimates indicate lower bounds for labor supply elasticities around 0.4 for men, and an elasticity smaller than roughly 0.2 for women. Women basically reduce their probability of exiting jobs at ages below the ERA to zero as the early retirement age is increased by the reforms. By definition we cannot observe a retirement probability below zero, thus we interpret the elasticity estimates as lower bounds.

4 Potential Mechanisms

Alternative pathways & short vs. long-run responses

Figure 3 demonstrated the responses to the ERA reform steps in terms of job exits and pension claims. To get a more precise impression of the labor supply responses, we investigate whether entry into alternative programs such as unemployment insurance or disability pensions has increased with the ERA reforms. To see this, we plot the shares of exits to pension claims and alternative programs in Figures 4A and 4B for men and women respectively.

Panel (a) of Figure 4A shows different exit states for men exiting their last jobs at ages 60 or older. Starting with the share of exits to pension claims - shown by the black area - the plot cumulatively adds the share of exits to disability, to UI, and exits without claims (thus summing up to 100% in total). Among the pre-reform cohorts, the roughly 50% of men exit their jobs at age 60 and claim pension benefits. As all of these are eligible for social security, only small fractions exit to UI or disability. The second option is to exit after age 60 as shown by the light area. Among the individuals from the post-reform cohorts the vast majority exits their jobs after age 60 as we can see from the light area. Only a small share either exit their jobs at 60 and claim some form of benefits.

Panel (b) of Figure 4A zooms in on those individuals who exit within one quarter of reaching age 60 for different birth cohorts. For post-reform cohorts, this graph represents individuals in the small grey bars in Panel (a). Now we can see the distribution among the alternative pathway of individuals exiting to UI to disability or claiming some form of social security. All these exit channels are about equally important. But given that they are taken by very few individuals we conclude that substitution to alternative insurance programs is not a significant factor at least for our sample of relatively highly attached indivduals.

Figure 4B shows the same graphs for women. Again, exits to alternative insurance programs is quantitatively not important. Among the different pathways, women are most likely to claim UI.

We conclude that substitution between alternative insurance programs is not a significant factor in the labor supply responses to the increase in the ERA. Furthermore, Figures

$4A$ and $4B$ highlight that the short-run labor supply adjustments in response to the ERA reform continue to persist. There is little distinction between the labor supply responses immediately following the increases in the ERA and the labor supply responses for cohorts roughly 5 years after the initial affected cohorts.

4.1 Spillover Effects

The legislation of the 2000 and 2004 pension reforms specified that men and women with more than 45 and 40 contribution years respectively were exempt from increases in the ERAs and could still claim at ages 60 and 55 respectively. To examine differences in behavior between individuals above and below these contribution year thresholds, and to examine persistence in how the hazard rates at specific ages change once the ERA moves to a higher age, Figure 9 presents the hazard rates at ages 60 (men) and 55 (women) by birth cohort.

We highlight two features of these plots. First, the plots indicate that changes in the hazard rates for claims and exits at these ages once the ERA increases are persistent. In particular, once the ERA moves to a higher age, the hazard rate falls and remains persistently low for subsequent birth cohorts.

Second, the plots indicate that, even though they were exempt from the increases in the ERA, men and women with more than 45 and 40 contribution years at ages 60 and 55 respectively still adjusted their behavior to delay pension claims and job exits. This indicates that information about the increased ERAs may have played an important role. Since the exemptions to the increased ERAs may not have applied to a majority of individuals, the increased ERAs may have been emphasized in the media or by government officials and this emphasis may have caused some exempt individuals to make decisions based on the increased ERAs.

4.2 What is driving the Spillover Effects?

We have documented substantion spillover effects from the ERA reform to a group who is not affected by the reform. Now we would like to find out what is driving these spillovers. There are several potential explanations. One of them would be information. If individuals with long contribution years are not aware of the exception or are uncertain about the exact number of their contribution years, we could still see them adjusting their retirement ages. Another explanation would be network or peer effects, which change social norms. If the ERA increases among the peers, even individuals who are still eligible to retire early might follow their peers and decide to work longer. A third explanation would be that retirements are partly decided by firms, who announce a firm-specific retirement age for their workers and make it difficult for individuals who would like to work longer to keep their jobs. Here we present some analysis at the industry level and among networks of coworkers.

Networks Effects at the Industry Level

We start by examining behavior across aggregated groups based on industry classifications. Intuitively, if peer effects at the industry level are important, we expect to see a higher within-group fraction of individuals with high contribution years (≥ 45 or 40 contribution years) delaying their retirements when there is a larger within-group fraction of workers with high or low contribution years delaying their retirements. Figure 10 presents plots based on two-digit industry groups. We see that, in industries in which there is a higher fraction of low contribution years individuals delaying their exits beyond the pre-reform ERA, there tends to be a higher fraction of high contribution years individuals who delay their exits beyond the pre-reform ERA even though they could still claim their pension at the pre-reform ERA. This evidence is consistent with peer effects at the industry level.

Coworker Networks

If individuals base their retirement decisions on their friends' or peers' decision, we should see behavioral changes among individual networks. Our data allows us to define networks of coworkers, i.e. groups of individuals who are currently working together in the same firm or who used to work together in the past.[12]

We focus on individuals with long contribution years just prior to reaching the ERA, i.e. men at the age of 59 and women at 54, for whom we define coworker networks. Specifically, individual i's networks consists of all workers who were employed at the same firms as i over the last 10 years and their employment spell overlapped with i's employment spell for at least 30 days. To measure spillover effects driven by the network, we focus on the following network characteristics:

- # male/female coworkers in similar age range (max 5 years older or younger)
- # male/female coworkers in cohorts affected by ERA reform
- # male/female coworkers still employed when i is age 59, 54

Table 6 shows summary statistics of coworker characteristics.

Then we estimate the following regression, with the dependent variable $y_i =$ is an indicator equal 1 if individual i retires at age 60, 55

$$y_i = \beta_0 + \sum_j \beta_{j1} * Cow_{ji} + \sum_j \beta_{j2} * Cow_{ji} * Post_i + \delta X_i + \varepsilon_i$$

The regressors include a rich set of individual-level and firm-level covariates, $X_i =$, an indicator for post ERA reform cohorts $Post_i =$, and our network characteristics denoted

[12]Cingao and Rosolia (2012) use this definition of networks to investigate the effects of peers on unemployment durations.

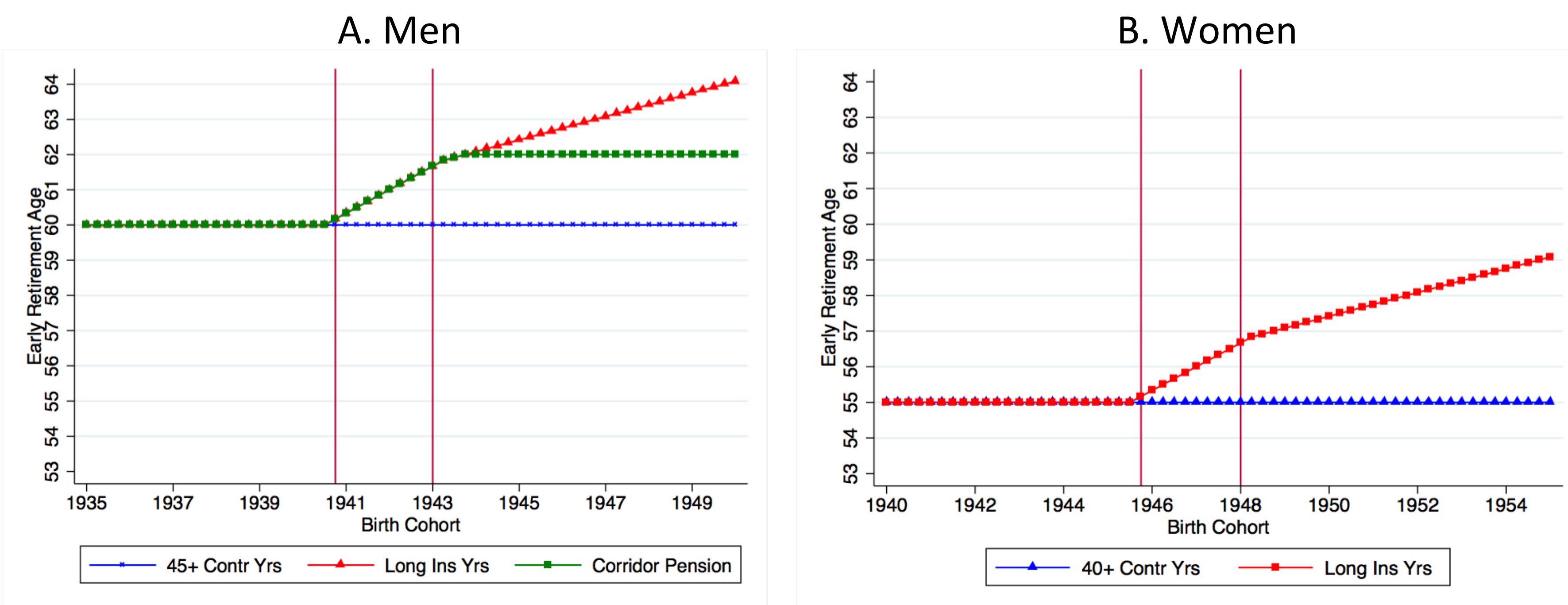
by $Cow_i =$. To allow for flexible specifications we use quintiles of each characteristic ($j = 1, ...5$ denotes quintiles).

Regression results are shown in Table 7 separately for men and women. The indicate that first, coworkers matter in pre-reform, but not post-reform period. This would be in line with an interpretation story. Second, we find significant effects of coworkers on men's retirement decisions, but no coworker effects for women. They are always small and insignificant. Third, male workers show different responses to their male and female coworkers: If an individual has more male coworkers, he is more likely to retire at 60. If he has more female coworkers, he is more likely to delay retirement.

5 Conclusion

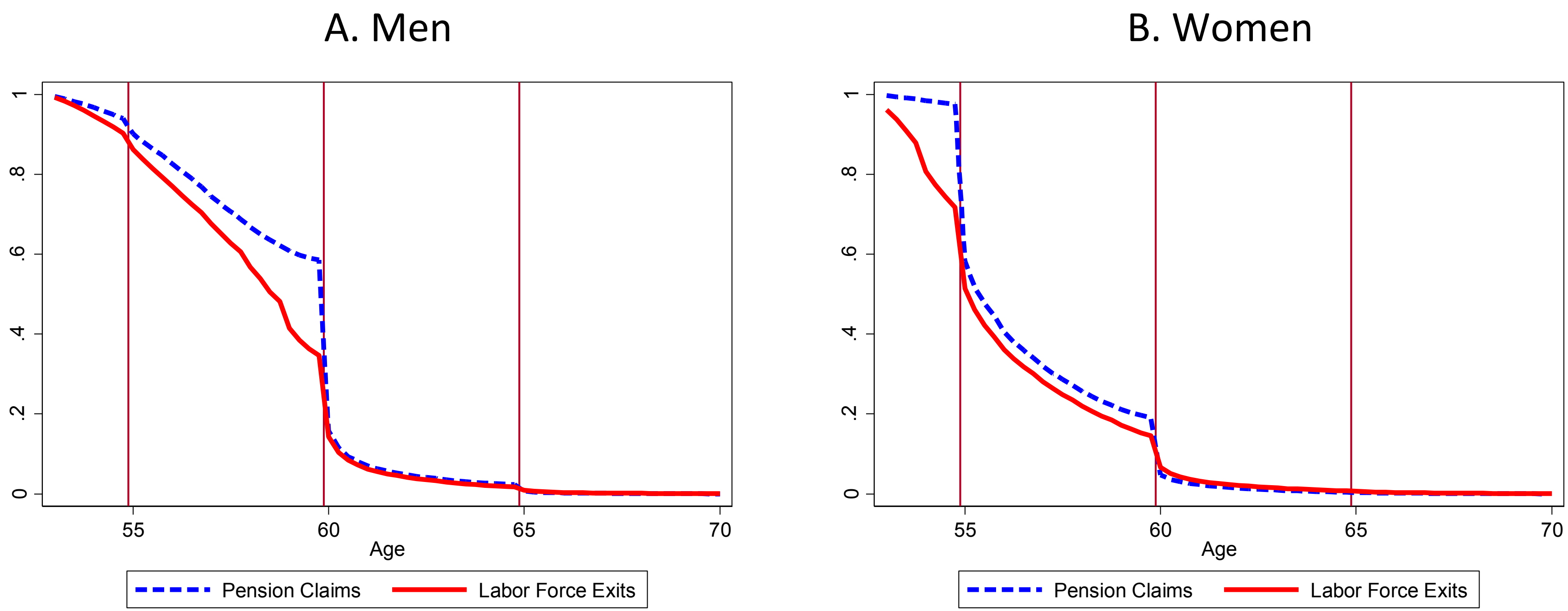
In this paper we have presented empirical evidence on the labor supply responses to increases in the Early Retirement Age in Austria. Using administrative, matched employer-employee data, the main analysis characterizes labor supply behavior at retirement in terms of job exits and pension claims. We show that this distinction adds important information about retirement decisions; on average individuals exit their jobs roughly 6 months to 1 year before claiming pension benefits. The Austrian pension reforms in 2000 and 2004 increased the Early Retirement Ages (ERAs) in several steps for men and women. The graphical analysis shows clear response patterns to the ERA changes: affected cohorts delay their exits from jobs and pension claims exactly in step with the ERA reforms. The shifts in job exits and pension claims across affected cohorts lead to slightly longer gaps between the exiting and claiming ages, but we do not find evidence for substantial substitution with alternative insurance programs such as disability pensions or unemployment insurance. Based on the observed labor supply responses and the changes in financial incentives from the pension reforms, we estimate lower bounds of reduced form extensive margin labor supply elasticities. The results indicate relatively large elasticities. We also find evidence of spillover effects to individuals not directly affected by the pension reforms.

Fig. 1. Early Retirement Ages by Pension Type



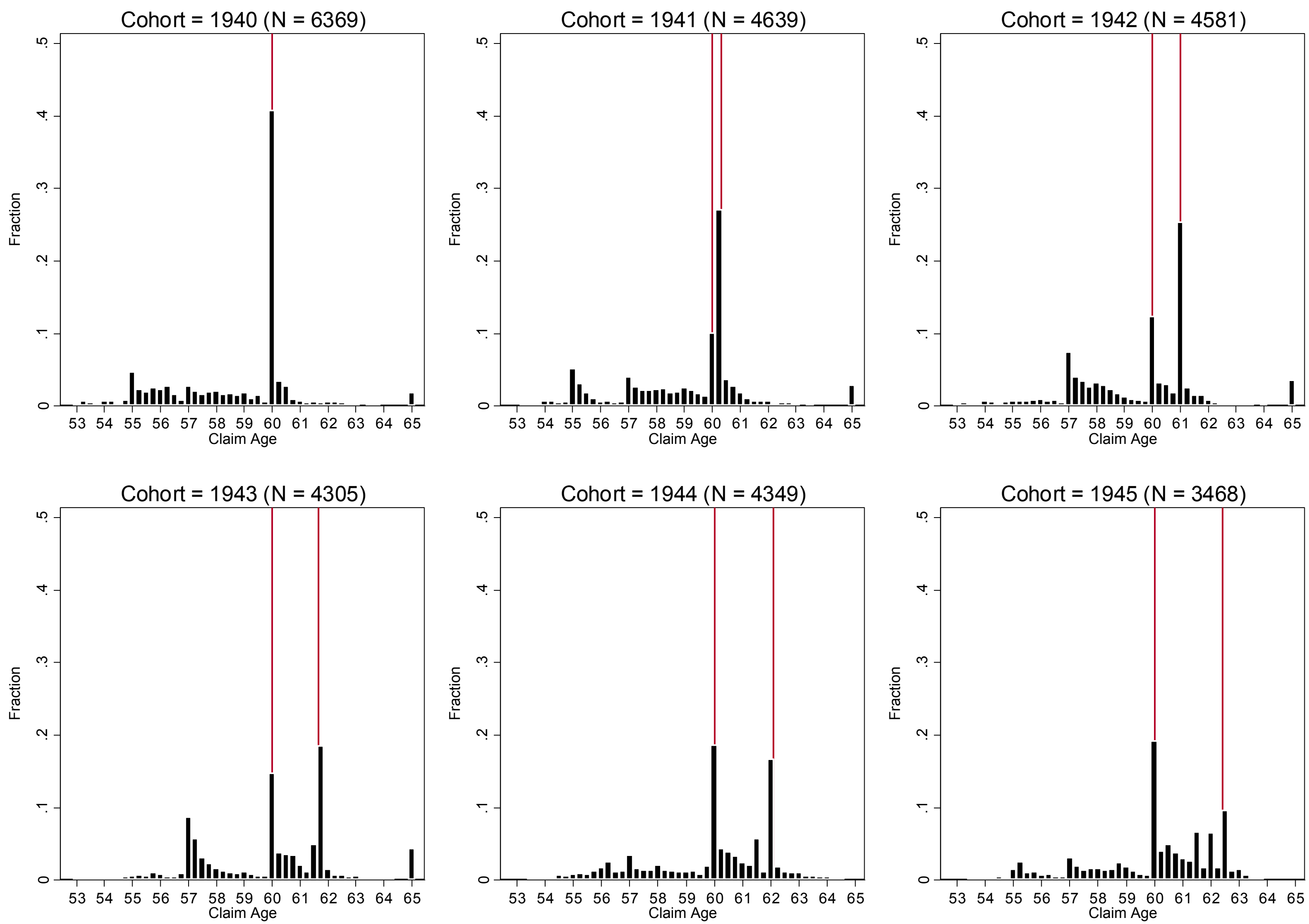
Notes: The vertical lines mark the beginning of changes implemented under the 2000 and 2004 pension reforms.

Fig. 2. Pre-Reform Pension Claims & Job Exits



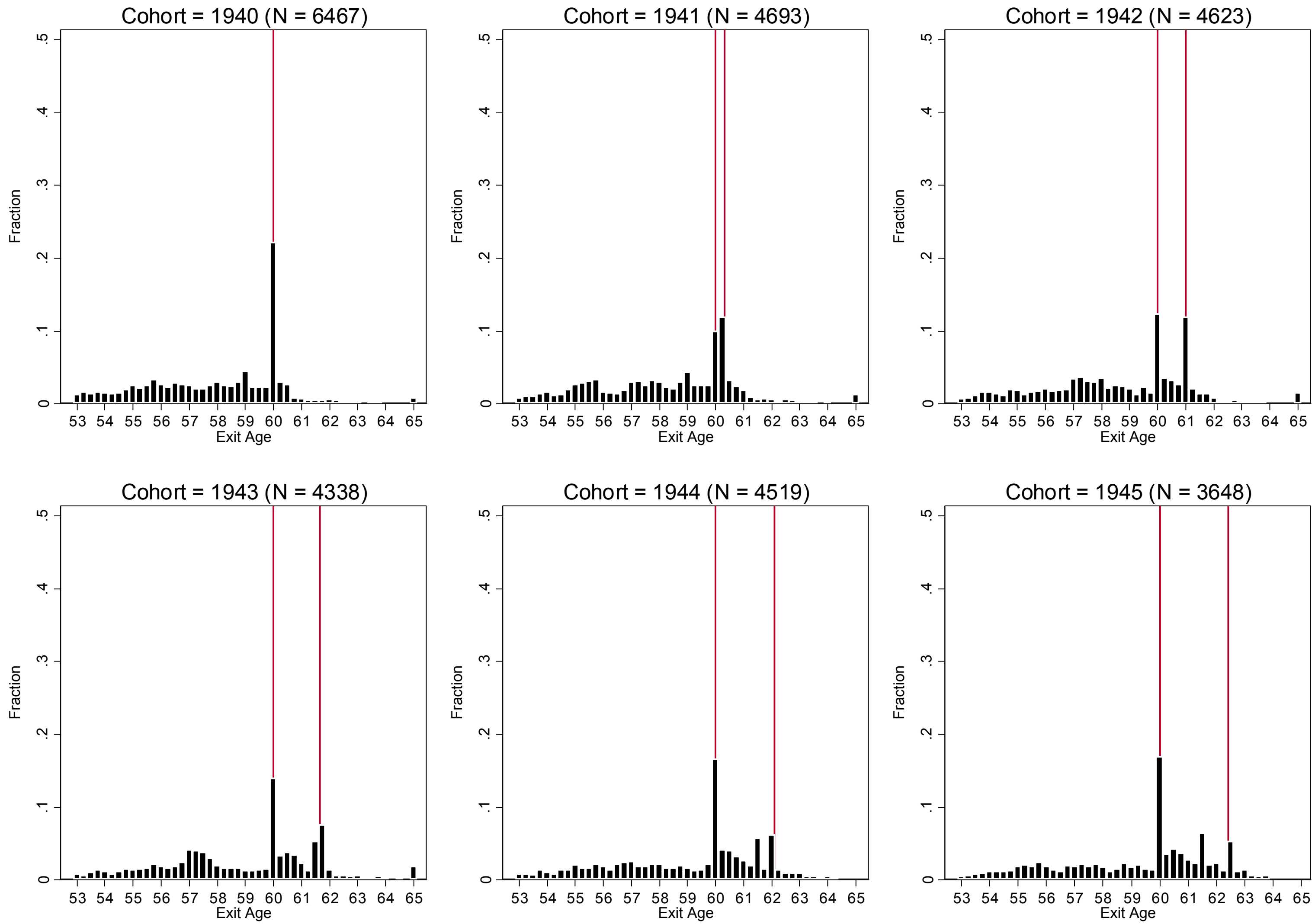
Notes: For computing the survival curves, the sample is restricted to pre-reform birth cohorts (1930 through 1939 for men and 1935 through 1944 for women) and also to individuals for whom a claim is observed prior to age 70. See Table 1 for the full sample restrictions.

Fig. 3A. Men's Claiming Ages by Cohort



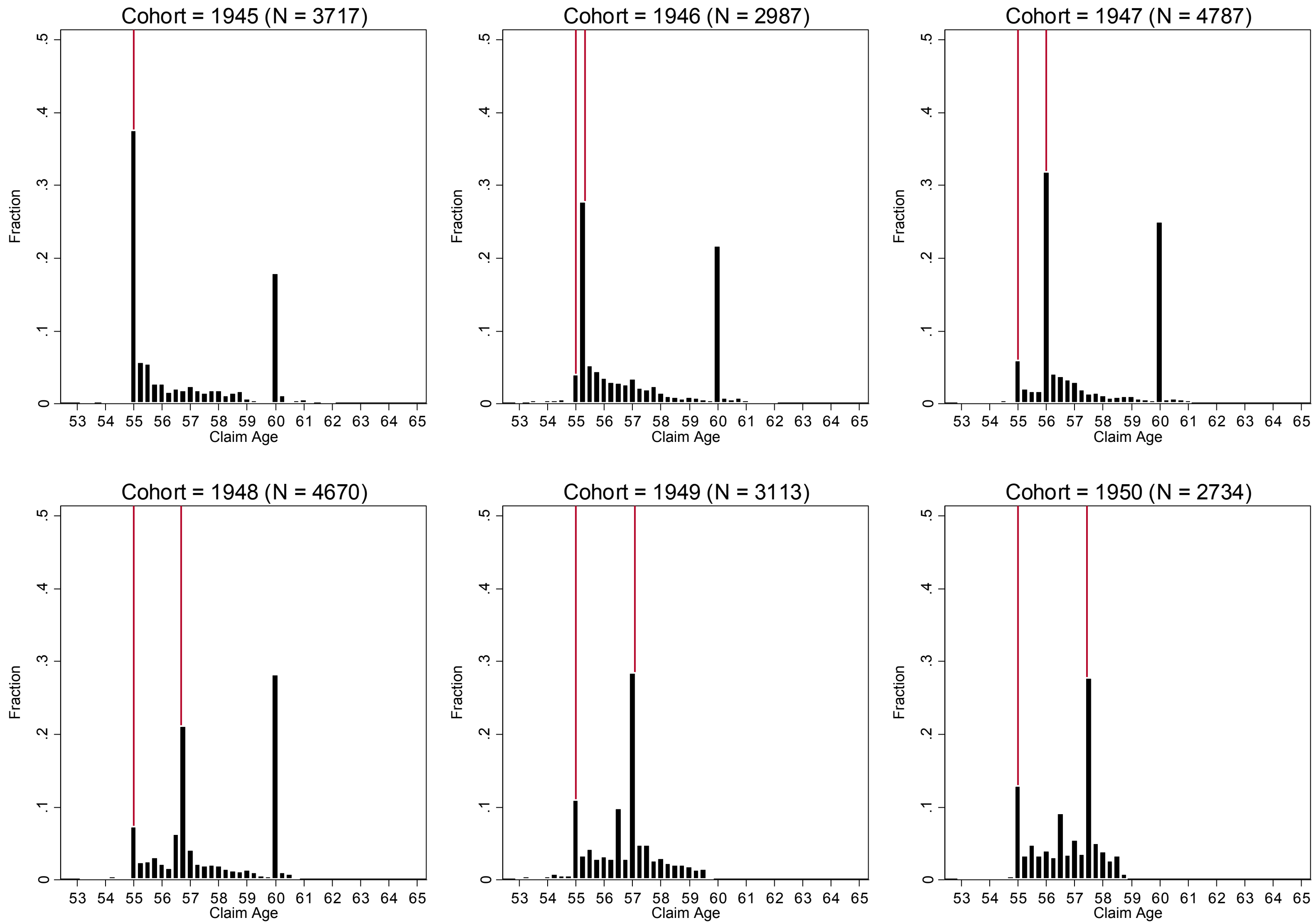
Notes: Each histogram plots the distribution of claiming ages where claiming age is computed at a quarterly frequency based on time between an individual's birth date and pension claiming date. Birth cohort is also computed at a quarterly frequency; each plot includes individuals who were born in the first quarter of the specified birth year. Vertical red lines denote Early Retirement Ages.

Fig. 3B. Men's Job Exiting Ages by Cohort



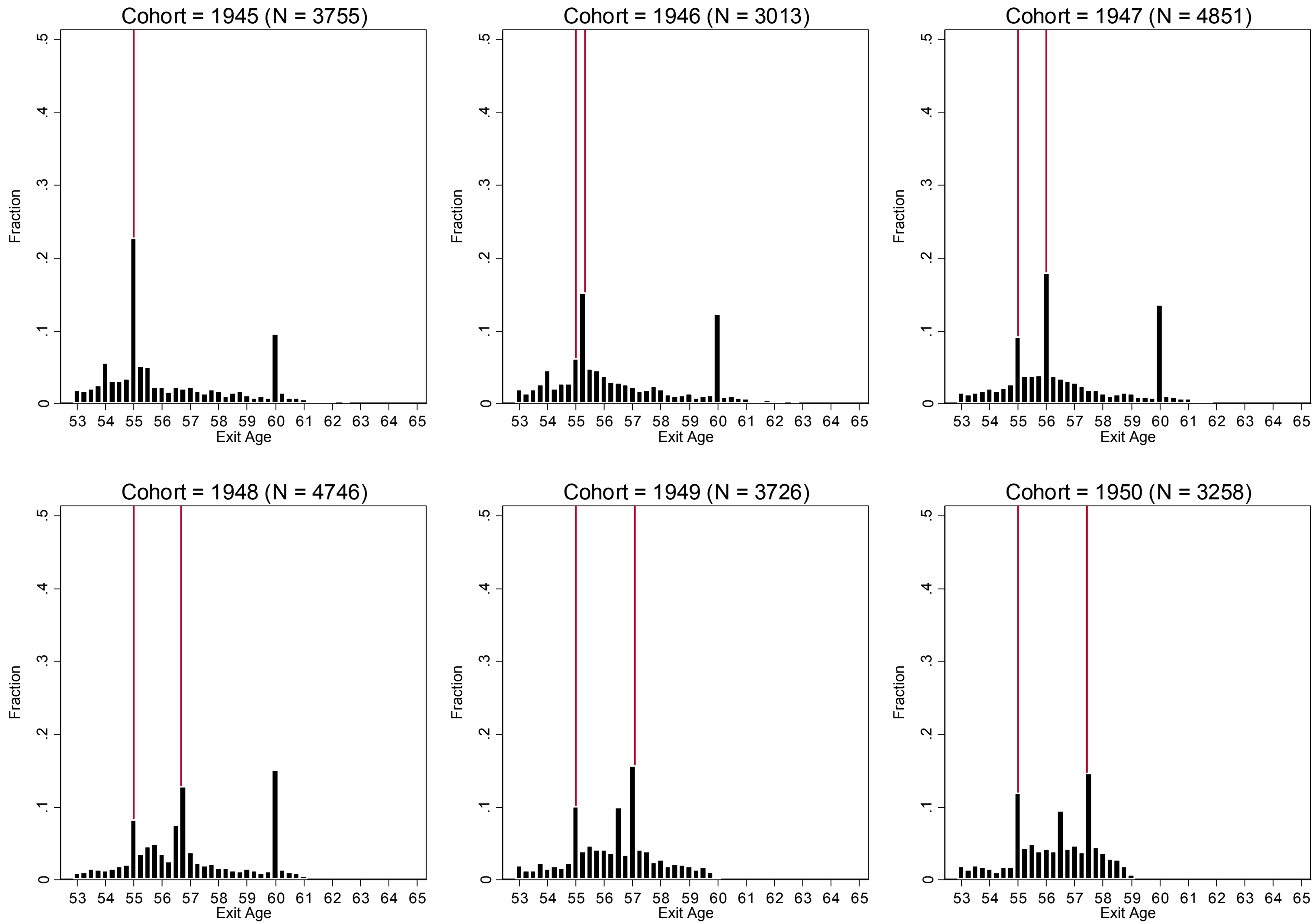
Notes: Each histogram plots the distribution of claiming ages where claiming age is computed at a quarterly frequency based on time between an individual's birth date and pension claiming date. Birth cohort is also computed at a quarterly frequency; each plot includes individuals who were born in the first quarter of the specified birth year. Vertical red lines denote Early Retirement Ages.

Fig. 3C. Women's Pension Claiming Ages by Cohort



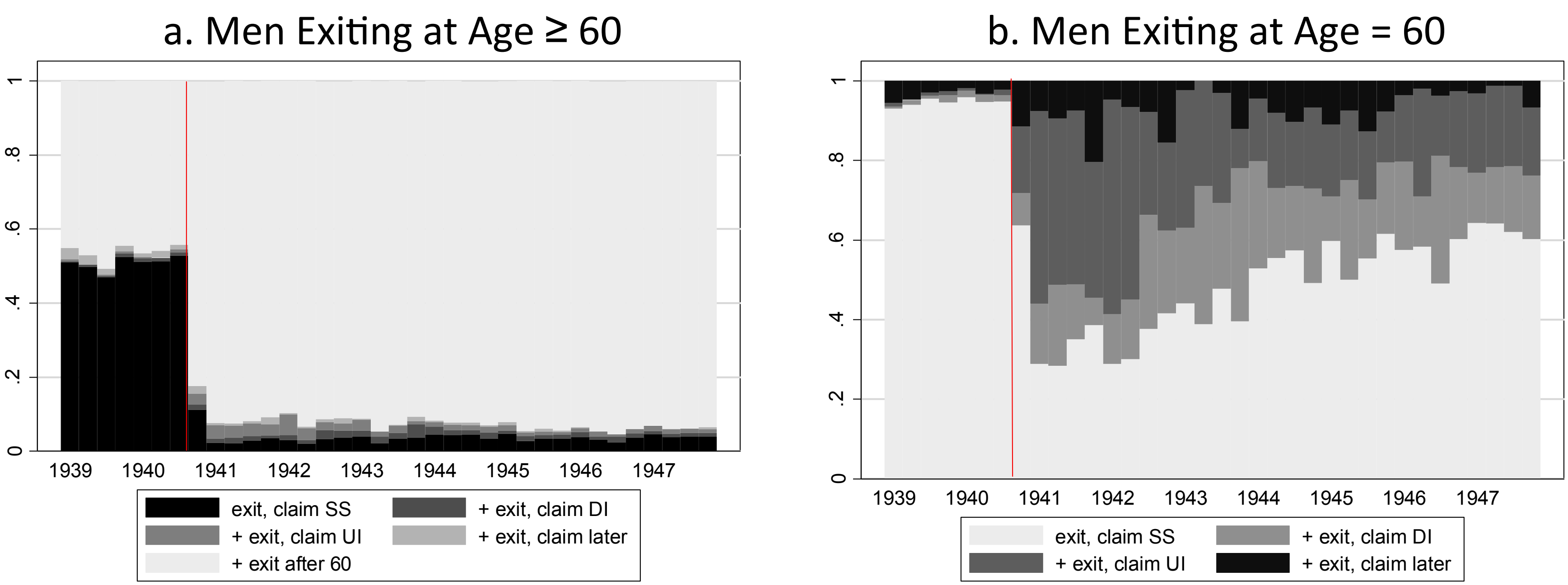
Notes: Each histogram plots the distribution of claiming ages where claiming age is computed at a quarterly frequency based on time between an individual's birth date and pension claiming date. Birth cohort is also computed at a quarterly frequency; each plot includes individuals who were born in the first quarter of the specified birth year. Vertical red lines denote Early Retirement Ages.

Fig. 3D. Women's Job Exiting Ages by Cohort



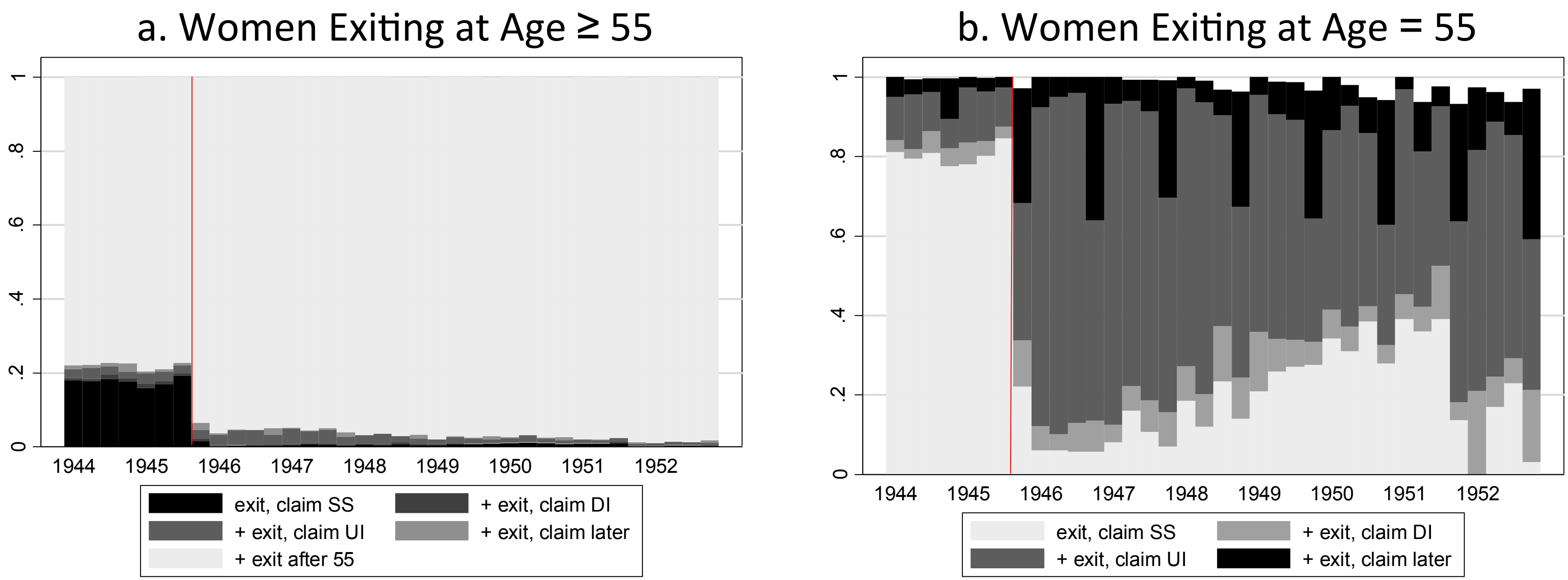
Notes: Each histogram plots the distribution of claiming ages where claiming age is computed at a quarterly frequency based on time between an individual's birth date and pension claiming date. Birth cohort is also computed at a quarterly frequency; each plot includes individuals who were born in the first quarter of the specified birth year. Vertical red lines denote Early Retirement Ages.

Fig. 4A. Substitution to Alternative Pathways at Age 60



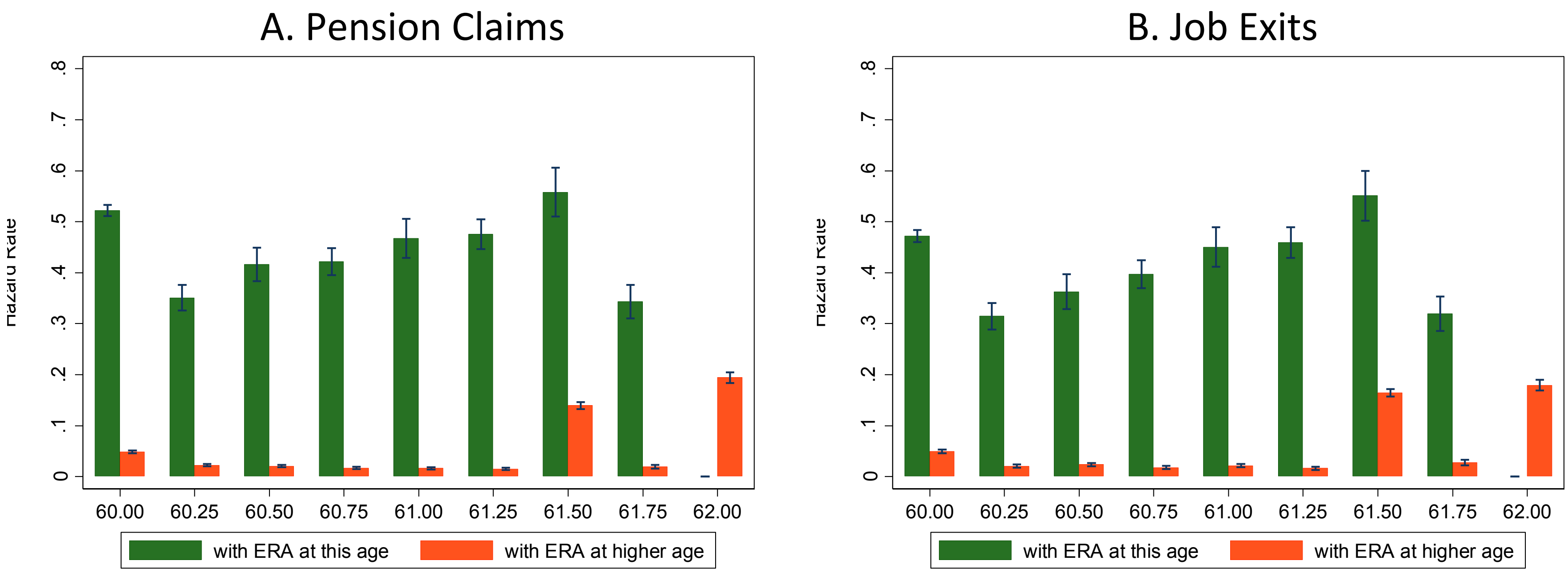
Notes: These figures illustrate outcomes for men who exit at ages ≥ 60 (a) and for men who exit at age 60 (b). For each quarterly birth cohort, the fractions sum to 1 by construction. The "+" indicates that the specified group is added to the previously specified groups so that the fractions represent cumulative totals.

Fig. 4B. Substitution to Alternative Pathways at Age 55



Notes: These figures illustrate outcomes for women who exit at ages ≥ 55 (a) and for women who exit at age 55 (b). For each quarterly birth cohort, the fractions sum to 1 by construction. The "+" indicates that the specified group is added to the previously specified groups so that the fractions represent cumulative totals.

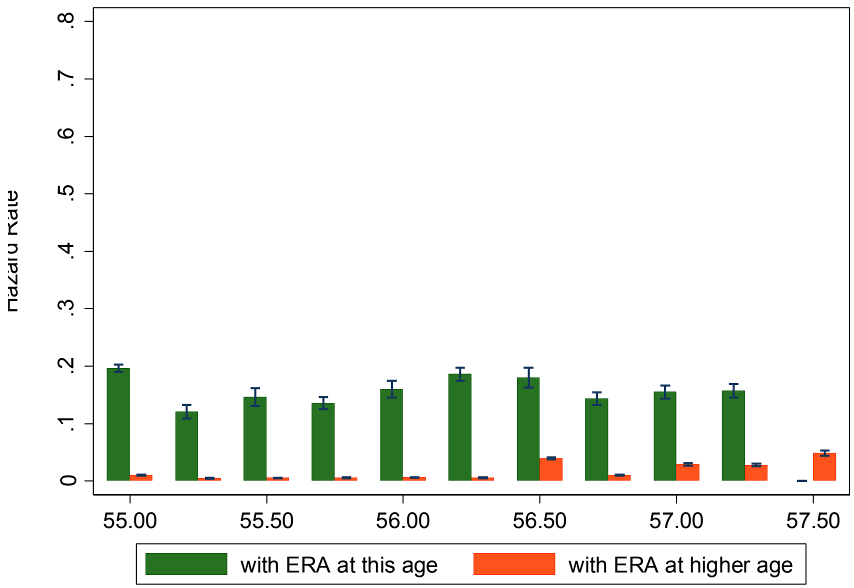
Fig. 5. Hazard Rate Models, Men



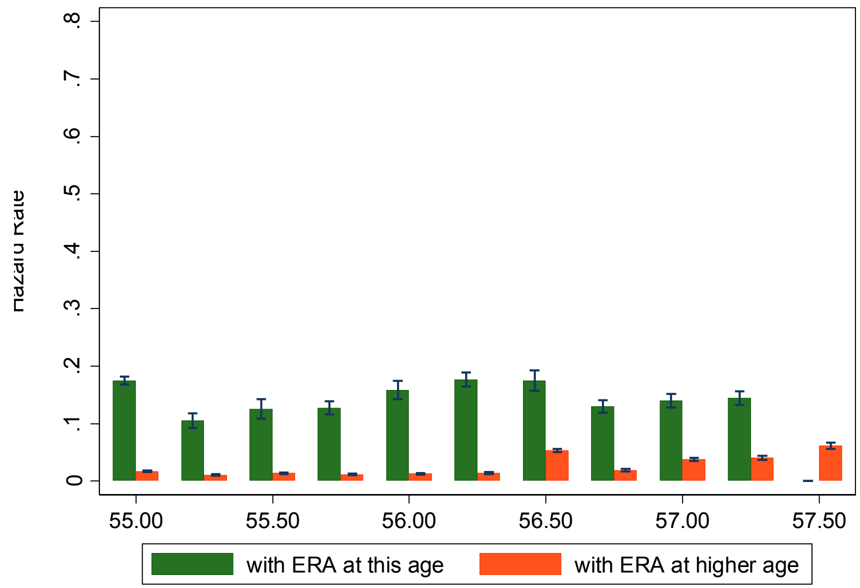
Notes: These figures illustrate estimated coefficients from regressing a retirement indicator on age dummies, age dummies interacted with an Early Retirement Age indicator and control variables. These regressions are based on panel data with person-age observations and age is computed at a quarterly frequency. As specified in the respective figures, the retirement outcome is defined in terms of claiming or exiting within the specified quarterly age. Regressions for men and women are estimated separately. For men, the regressions include observations from ages 59 through 62 and birth cohorts 1939 through 1947. For women, the regressions include observations from age 54 through age 57.75 and birth cohorts 1944 through 1952. Vertical lines on each bar reflect 95% confidence intervals based on standard errors for the estimated coefficients; the standard errors are clustered at the individual level. The control variables included in the regression are birth cohort dummies (quarterly frequency), dummies for insurance years (for men: <30, 30-35, 35-40, 40-45, ≥45 insurance years; for women: <30, 30-35, 35-40, ≥40 insurance years), dummies for percentiles of average earnings between ages 50 through 54, dummies for firm size at the last job (0-4, 5-9, 10-24, 25-49, 50-99, 100-199, 200-499, 500-999, ≥1000 employees), dummies for total days receiving unemployment insurance through age 54 (0, 1-30, 31-90, 91-180, 181-365, 366-730, ≥731 days), dummies for total days receiving sick leave benefits through age 54 (0, 1-30, 31-90, ≥91 days), dummies for total days receiving sick leave benefits between age 55 through age 59 (0, 1-30, 31-90, ≥91 days), and dummies for weeks of unemployment insurance eligibility (20, 30, 39, 52 weeks).

Fig. 6. Hazard Rate Models, Women

C. Pension Claims

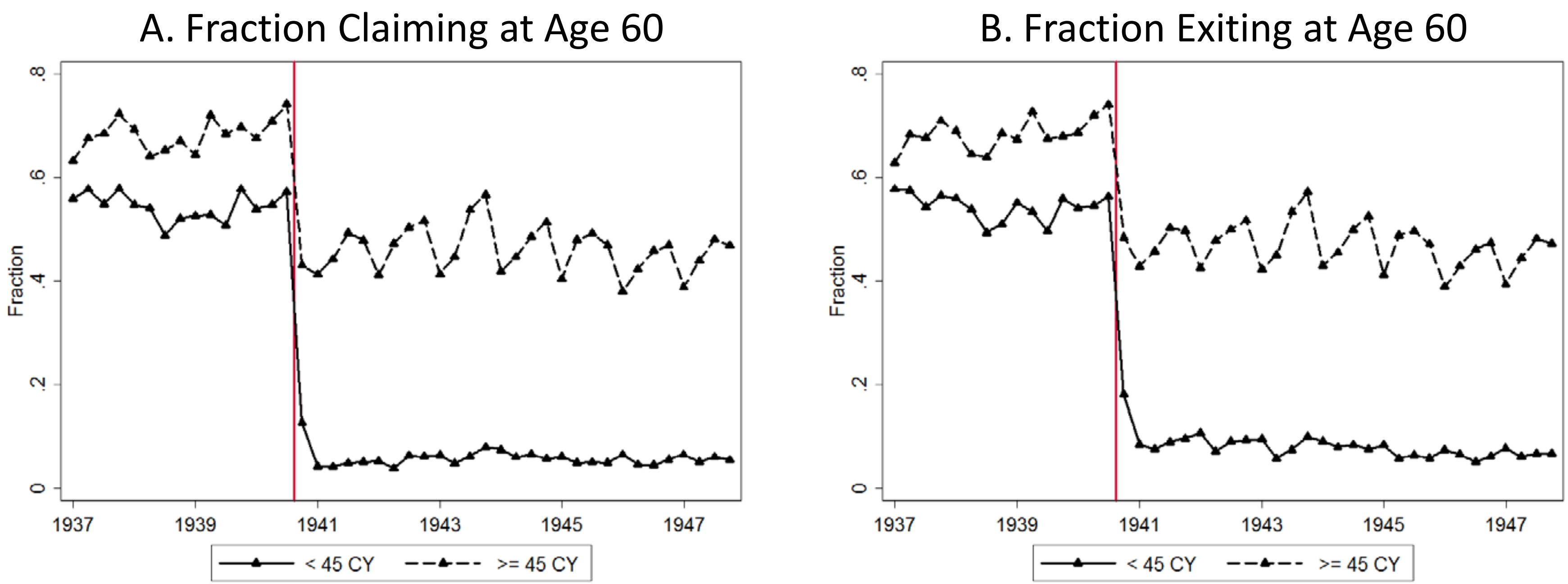


D. Job Exits



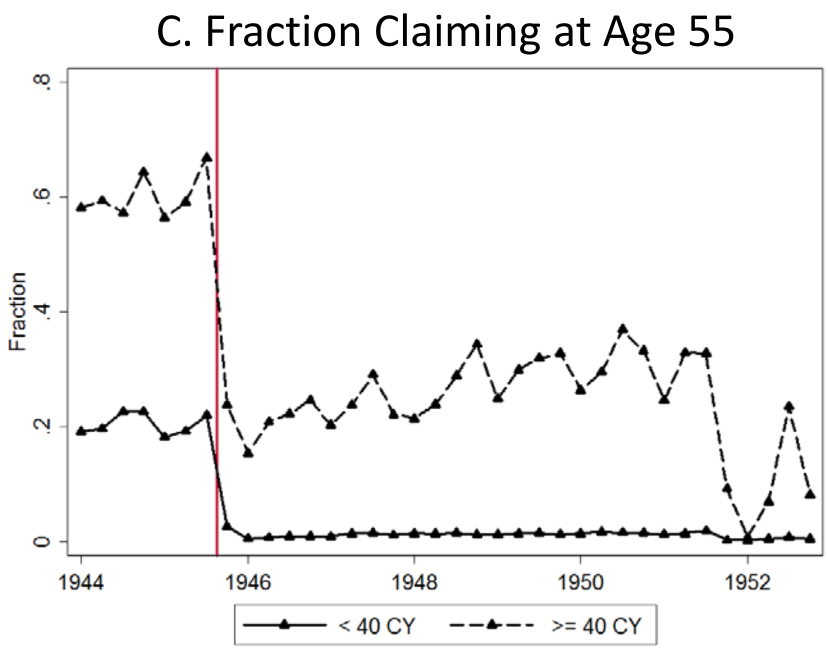
Notes: These figures illustrate estimated coefficients from regressing a retirement indicator on age dummies, age dummies interacted with an Early Retirement Age indicator and control variables. These regressions are based on panel data with person-age observations and age is computed at a quarterly frequency. As specified in the respective figures, the retirement outcome is defined in terms of claiming or exiting within the specified quarterly age. Regressions for men and women are estimated separately. For men, the regressions include observations from ages 59 through 62 and birth cohorts 1939 through 1947. For women, the regressions include observations from age 54 through age 57.75 and birth cohorts 1944 through 1952. Vertical lines on each bar reflect 95% confidence intervals based on standard errors for the estimated coefficients; the standard errors are clustered at the individual level. The control variables included in the regression are birth cohort dummies (quarterly frequency), dummies for insurance years (for men: <30, 30-35, 35-40, 40-45, ≥45 insurance years; for women: <30, 30-35, 35-40, ≥40 insurance years), dummies for percentiles of average earnings between ages 50 through 54, dummies for firm size at the last job (0-4, 5-9, 10-24, 25-49, 50-99, 100-199, 200-499, 500-999, ≥1000 employees), dummies for total days receiving unemployment insurance through age 54 (0, 1-30, 31-90, 91-180, 181-365, 366-730, ≥731 days), dummies for total days receiving sick leave benefits through age 54 (0, 1-30, 31-90, ≥91 days), dummies for total days receiving sick leave benefits between age 55 through age 59 (0, 1-30, 31-90, ≥91 days), and dummies for weeks of unemployment insurance eligibility (20, 30, 39, 52 weeks).

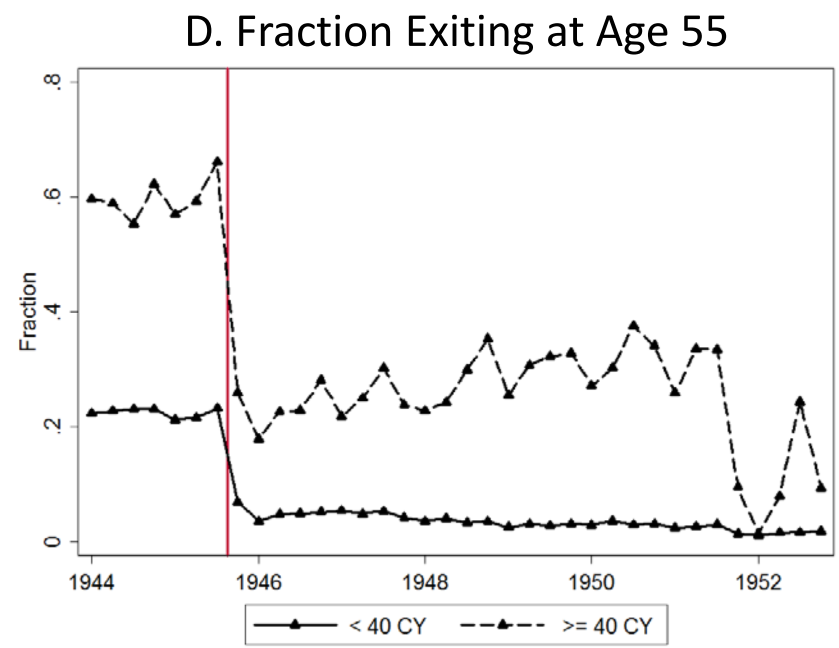
Fig. 9. Claiming & Exiting by Birth Cohort & Contribution Years, Men



Notes: Each figure plots the fraction individuals still in the labor market who claim pensions or exit jobs by birth cohort. Women with 40 or more contribution years and men with 45 or more contribution years are exempt from the increases in the Early Retirement Ages and can continue to retire at ages 55 and 60 respectively. The sample is restricted to men ages 59 through 62 in birth cohorts 1939 through 1947 and women ages 54 through 57.75 in birth cohorts 1944 through 1952. Observations are censored at the Early Retirement Age specified for each individual. Vertical red lines mark the beginning of the 2000 pension reform that affected birth cohorts 1940.75 (men) and 1945.75 (women).

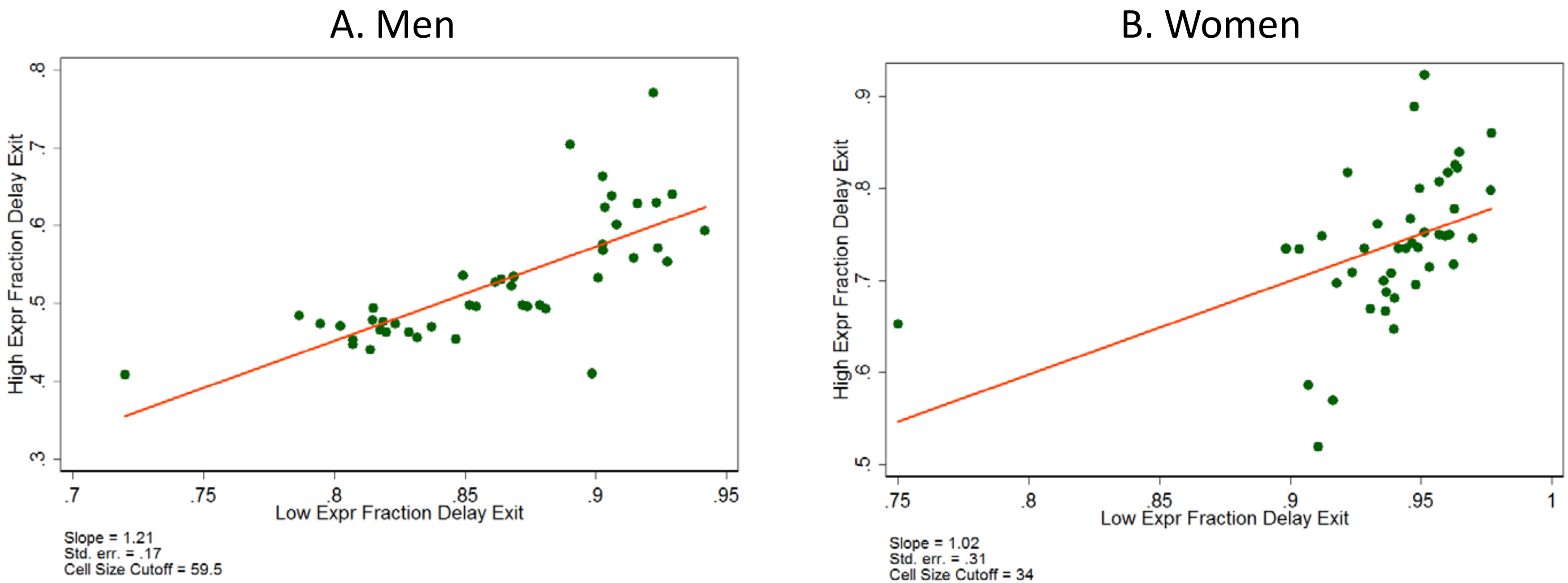
Fig. 9. Claiming & Exiting by Birth Cohort & Contribution Years, Women





Notes: Each figure plots the fraction individuals still in the labor market who claim pensions or exit jobs by birth cohort. Women with 40 or more contribution years and men with 45 or more contribution years are exempt from the increases in the Early Retirement Ages and can continue to retire at ages 55 and 60 respectively. The sample is restricted to men ages 59 through 62 in birth cohorts 1939 through 1947 and women ages 54 through 57.75 in birth cohorts 1944 through 1952. Observations are censored at the Early Retirement Age specified for each individual. Vertical red lines mark the beginning of the 2000 pension reform that affected birth cohorts 1940.75 (men) and 1945.75 (women).

Fig. 10. Spillover Effects by Industry



Notes: These figures are created via the following steps. First, we categorize individuals at age 60 (men) or 55 (women) into high and low experience groups based on whether they have at least of less than 45 (men) or 40 (women) contribution years. Second, we create cells based on group (two-digit industry or two-digit region), gender and high or low experience. Within each cell, we compute the fraction of individuals who exit at the pre-reform ERA of 60 (men) or 55 (women). For each gender, we then plot the high experience fraction (vertical axis) against the low experience fraction (horizontal axis) across all groups. For the industry plot, we drop cells that have a sample size below the 25th percentile of the cell size distribution.

Table 1. Sample Restrictions

	# of Men	# of Women
Initial Sample	613,491	587,985
1. After excluding non-Austrian citizens	554,756	551,067
2. After excluding individuals dying before age 65	495,986	525,125
3. After excluding individuals exiting before age 53	374,521	349,626
4. After Excluding Individuals with 1 or more years of self-employment	324,761	317,206
5. After Excluding Individuals in publicly-owned industries at ages 50 or older	299,789	290,412
Claims through December 31, 2008	282,556	241,286
Exits through December 31, 2008	291,149	253,944

Notes: In restriction (3), 2 individuals are also dropped for missing exit dates. The initial sample is based on cohorts 1930-1947 for men and cohorts 1935 through 1952 for women.

Table 2
Summary Statistics

Panel A. Men

Age at Job Exit	N	Earnings at Age 54			Censored Earnings	Insurance Years at 54			Positive Sick Leave,	Positive Unemployment,
		Mean	Median	Std. Dev.	at 54	Mean	Median	Std. Dev.	Ages 50-54	Ages 50-54
53	11,839	2,773	0	6,323	0.041	28.077	36.162	15.064	0.575	0.696
54	16,705	14,650	13,242	10,958	0.095	34.250	38.022	9.078	0.578	0.480
55	28,203	21,359	20,630	10,009	0.126	36.157	38.521	6.178	0.367	0.241
56	24,460	22,387	21,876	9,699	0.142	36.110	38.507	6.112	0.284	0.264
57	29,965	23,573	23,180	9,379	0.149	36.495	38.756	5.698	0.240	0.235
58	30,684	23,224	23,081	8,991	0.186	36.423	38.595	5.590	0.199	0.217
59	31,551	22,935	22,522	9,046	0.201	36.199	38.433	5.801	0.166	0.216
60	82,350	27,325	26,860	9,430	0.299	37.483	39.263	4.643	0.094	0.108
61	19,563	30,430	30,673	11,441	0.387	36.025	38.268	6.309	0.108	0.167
62	11,564	30,428	30,522	14,075	0.414	33.809	36.422	7.550	0.106	0.207
63	4,785	30,334	30,561	14,771	0.503	31.199	34.830	9.360	0.077	0.156
64	2,305	28,295	28,691	14,573	0.502	29.263	32.605	10.089	0.070	0.160
65	4,317	27,402	28,081	14,133	0.514	28.462	30.918	9.770	0.055	0.123
66	640	27,712	28,691	15,001	0.541	27.789	31.549	11.211	0.041	0.128
67	332	24,152	26,860	14,198	0.500	26.423	30.789	12.264	0.045	0.139
68	189	24,122	26,633	14,119	0.529	24.900	30.748	13.496	0.032	0.048
69	135	22,280	26,250	13,392	0.496	25.562	30.085	13.192	0.052	0.141
70	202	21,374	25,029	12,673	0.510	26.579	32.279	12.566	0.109	0.074

Panel B. Women

Age at Job Exit	N	Earnings at Age 54			Censored Earnings	Insurance Years at 54			Positive Sick Leave,	Positive Unemployment,
		Mean	Median	Std. Dev.	at 54	Mean	Median	Std. Dev.	Ages 50-54	Ages 50-54
53	23,972	2,539	0	6,235	0.049	31.878	35.367	10.758	0.398	0.888
54	34,261	12,146	10,181	9,461	0.071	33.237	35.203	7.988	0.328	0.635
55	78,012	20,965	19,250	11,192	0.089	36.370	38.589	6.553	0.157	0.131
56	38,125	21,629	19,713	12,517	0.090	34.574	37.195	7.210	0.141	0.175
57	35,847	20,180	17,995	12,178	0.091	32.135	34.315	7.850	0.124	0.192
58	22,675	19,181	16,940	11,959	0.091	29.996	31.707	8.155	0.120	0.181
59	15,490	17,230	14,941	11,845	0.055	27.787	29.093	8.297	0.127	0.215
60	31,735	17,175	14,994	11,085	0.051	27.175	27.847	7.438	0.120	0.151
61	3,915	18,318	16,029	12,854	0.076	24.853	25.753	9.988	0.102	0.147
62	2,264	16,973	14,689	12,958	0.083	23.716	24.338	10.485	0.099	0.157
63	1,393	16,035	13,359	13,554	0.078	22.759	23.542	10.850	0.098	0.143
64	833	15,570	13,282	12,619	0.072	22.098	22.340	10.668	0.085	0.124
65	767	16,547	13,542	13,396	0.107	22.818	23.668	10.910	0.090	0.100
66	361	15,201	13,200	12,715	0.080	22.500	23.145	11.868	0.122	0.136
67	255	16,525	14,517	12,811	0.071	24.198	24.586	11.631	0.102	0.094
68	165	11,852	8,504	12,103	0.073	20.302	21.159	13.223	0.109	0.133
69	142	12,797	9,206	12,074	0.120	20.382	20.186	13.663	0.162	0.056
70	200	12,870	11,502	10,594	0.100	23.625	23.578	11.453	0.155	0.065

Notes: See Table 1 for sample restrictions. Exit ages are computed at an annual frequency. Statistics are means unless otherwise notes.

Table 3
Regression Results, Men

	Outcome = Pension Claim		Outcome = Job Exits	
	No Controls	Controls	No Controls	Controls
t=60	0.0411	0.0420	0.0461	0.0508
	(0.00126)	(0.00129)	(0.00169)	(0.00172)
t=60.25	0.0114	0.0129	0.0125	0.0184
	(0.00102)	(0.00104)	(0.00146)	(0.00148)
t=60.50	0.00919	0.0111	0.0153	0.0221
	(0.00103)	(0.00106)	(0.00157)	(0.00159)
t=60.75	0.00485	0.00711	0.00865	0.0164
	(0.00102)	(0.00105)	(0.00155)	(0.00157)
t=61	0.00354	0.00632	0.0117	0.0205
	(0.00105)	(0.00108)	(0.00168)	(0.00170)
t=61.25	0.00367	0.00668	0.00821	0.0180
	(0.00113)	(0.00116)	(0.00174)	(0.00176)
t=61.50	0.0933	0.0964	0.153	0.163
	(0.00242)	(0.00244)	(0.00358)	(0.00357)
t=61.75	0.00389	0.00842	0.0178	0.0319
	(0.00133)	(0.00137)	(0.00234)	(0.00235)
t=62	0.219	0.223	0.181	0.196
	(0.00376)	(0.00373)	(0.00462)	(0.00457)
ERA(t=60, c<1940.75)	0.558	0.556	0.420	0.420
	(0.00435)	(0.00432)	(0.00573)	(0.00568)
ERA(t=60.25, c=1940.75-1941)	0.489	0.488	0.273	0.275
	(0.00970)	(0.00962)	(0.0126)	(0.0125)
ERA(t=60.50, c=1941.25)	0.488	0.486	0.319	0.319
	(0.0133)	(0.0132)	(0.0168)	(0.0166)
ERA(t=60.75, c=1941.50-1941.75)	0.511	0.509	0.371	0.370
	(0.0103)	(0.0102)	(0.0135)	(0.0134)
ERA(t=61, c=1942)	0.526	0.521	0.398	0.395
	(0.0141)	(0.0139)	(0.0181)	(0.0180)
ERA(t=61.25, c=1942.25-1942.50)	0.519	0.517	0.421	0.418
	(0.0113)	(0.0112)	(0.0147)	(0.0146)
ERA(t=61.50, c=1942.75)	0.438	0.436	0.355	0.353
	(0.0177)	(0.0176)	(0.0237)	(0.0235)
ERA(t=61.75, c=1943-1943.25)	0.404	0.402	0.278	0.273
	(0.0124)	(0.0122)	(0.0156)	(0.0154)
Observations	618649	618649	466535	466535
Individuals	113322	113322	93135	93135
R-squared	0.269	0.283	0.131	0.148

Notes: All regressions include dummies for birth cohort at a quarterly frequency. Standard errors are clustered at the individual level. The additional control variables included in the "Full Control" specifications are birth cohort dummies (quarterly frequency), dummies for insurance years (for men: <30, 30-35, 35-40, 40-45, ≥45 insurance years; for women: <30, 30-35, 35-40, ≥40 insurance years), dummies for percentiles of average earnings between ages 50 through 54, dummies for firm size at the last job (0-4, 5-9, 10-24, 25-49, 50-99, 100-199, 200-499, 500-999, ≥1000 employees), dummies for total days receiving unemployment insurance through age 54 (0, 1-30, 31-90, 91-180, 181-365, 366-730, ≥731 days), dummies for total days receiving sick leave benefits through age 54 (0, 1-30, 31-90, ≥91 days), dummies for total days receiving sick leave benefits between age 55 through age 59 (0, 1-30, 31-90, ≥91 days), and dummies for weeks of unemployment insurance eligibility (20, 30, 39, 52 weeks).

Table 4

Regression Results, Women

	Outcome = Pension Claim		Outcome = Job Exits	
	No Controls	Full Controls	No Controls	Full Controls
t=55	0.0153	0.0159	0.0201	0.0212
	(0.000470)	(0.000476)	(0.000751)	(0.000751)
t=55.25	0.00395	0.00478	0.00837	0.0102
	(0.000337)	(0.000339)	(0.000680)	(0.000678)
t=55.50	0.00440	0.00513	0.0116	0.0140
	(0.000355)	(0.000357)	(0.000726)	(0.000724)
t=55.75	0.00419	0.00493	0.00849	0.0114
	(0.000368)	(0.000372)	(0.000716)	(0.000715)
t=56	0.00422	0.00482	0.00952	0.0129
	(0.000382)	(0.000386)	(0.000746)	(0.000745)
t=56.25	0.00395	0.00447	0.0103	0.0141
	(0.000396)	(0.000400)	(0.000780)	(0.000780)
t=56.50	0.0276	0.0281	0.0419	0.0463
	(0.000764)	(0.000772)	(0.00113)	(0.00113)
t=56.75	0.00675	0.00745	0.0154	0.0210
	(0.000499)	(0.000506)	(0.000920)	(0.000921)
t=57	0.0276	0.0281	0.0480	0.0543
	(0.000881)	(0.000876)	(0.00136)	(0.00136)
t=57.25	0.0182	0.0190	0.0586	0.0660
	(0.000866)	(0.000868)	(0.00168)	(0.00168)
t=57.50	0.0254	0.0262	0.0811	0.0894
	(0.00121)	(0.00121)	(0.00233)	(0.00232)
t=57.75	0.0750	0.0759	0.139	0.148
	(0.00228)	(0.00227)	(0.00339)	(0.00338)
ERA(t=55, c<1945.75)	0.254	0.252	0.141	0.141
	(0.00322)	(0.00319)	(0.00336)	(0.00334)
ERA(t=55.25, c=1945.75-1946)	0.217	0.214	0.0770	0.0768
	(0.00665)	(0.00659)	(0.00604)	(0.00602)
ERA(t=55.50, c=1946.25)	0.194	0.194	0.0795	0.0795
	(0.00828)	(0.00821)	(0.00779)	(0.00776)
ERA(t=55.75, c=1946.50-1946.75)	0.197	0.195	0.0985	0.0980
	(0.00547)	(0.00541)	(0.00531)	(0.00529)
ERA(t=56, c=1947)	0.230	0.226	0.121	0.120
	(0.00752)	(0.00744)	(0.00736)	(0.00734)
ERA(t=56.25, c=1947.25-1947.50)	0.201	0.200	0.121	0.121
	(0.00557)	(0.00551)	(0.00572)	(0.00570)
ERA(t=56.50, c=1947.75)	0.134	0.131	0.101	0.0990
	(0.00749)	(0.00745)	(0.00858)	(0.00855)
ERA(t=56.75, c=1948-1948.25)	0.123	0.121	0.0782	0.0768
	(0.00472)	(0.00469)	(0.00507)	(0.00505)
ERA(t=57, c=1948.50-1948.75)	0.114	0.113	0.0593	0.0570
	(0.00517)	(0.00514)	(0.00555)	(0.00553)
ERA(t=57.25, c=1949-1949.50)	0.106	0.105	0.0474	0.0448
	(0.00499)	(0.00496)	(0.00562)	(0.00559)
ERA(t=57.50, c>1949.75)	0.102	0.102	0.0257	0.0253
	(0.00509)	(0.00505)	(0.00579)	(0.00574)
Observations	1301871	1301871	1156898	1156898
Individuals	155371	155371	148151	148151
R-squared	0.108	0.125	0.033	0.047

Notes: All regressions include dummies for birth cohort at a quarterly frequency. Standard errors are clustered at the individual level. The additional control variables included in the "Full Control" specifications are birth cohort dummies (quarterly frequency), dummies for insurance years (for men: <30, 30-35, 35-40, 40-45, ≥45 insurance years; for women: <30, 30-35, 35-40, ≥40 insurance years), dummies for percentiles of average earnings between ages 50 through 54, dummies for firm size at the last job (0-4, 5-9, 10-24, 25-49, 50-99, 100-199, 200-499, 500-999, ≥1000 employees), dummies for total days receiving unemployment insurance through age 54 (0, 1-30, 31-90, 91-180, 181-365, 366-730, ≥731 days), dummies for total days receiving sick leave benefits through age 54 (0, 1-30, 31-90, ≥91 days), dummies for total days receiving sick leave benefits between age 55 through age 59 (0, 1-30, 31-90, ≥91 days), and dummies for weeks of unemployment insurance eligibility (20, 30, 39, 52 weeks).

Table 5

Participation Elasticities by Gender and Early Retirement Age, Full Sample

	Men (N=92071)				Women (N=143232)		
		controls				controls	
Age	dln(p)	dln(1-t)	e	Age	dln(p)	dln(1-t)	e
60.0000	0.6097	-1.4767	0.4129	55.0000	0.1764	-1.0059	0.1754
	(0.0089)	(0.0047)	(0.0059)		(0.0034)	(0.0035)	(0.0033)
Average	0.5631	-1.3509	0.4171	Average	0.1321	-0.8882	0.1481
	(0.0111)	(0.0083)	(0.0083)		(0.0018)	(0.0020)	(0.0020)

Uncensored Earnings

	Men (N=60012)				Women (N=137898)		
		controls				controls	
Age	dln(p)	dln(1-t)	e	Age	dln(p)	dln(1-t)	e
60.0000	0.7532	-1.5312	0.4919	55.0000	0.1723	-1.0040	0.1716
	(0.0128)	(0.0079)	(0.0081)		(0.0035)	(0.0037)	(0.0034)
Average	0.3471	-1.1655	0.2978	Average	0.1296	-0.8860	0.1456
	(0.0178)	(0.0125)	(0.0146)		(0.0019)	(0.0021)	(0.0021)

Notes: N referes to the number of individuals used in the regressions to estimate changes in the probabilities of work (retirement) and changes in the net-of-tax rates. Bootstrapped standard errors based on 1000 replications are shown in parentheses.

Table 6
Summary statistics of coworker characteristics

	Men (N=53,195)			Women (N=43,492)		
	Median	Mean	SteDev.	Median	Mean	SteDev.
Number of coworkes	357	746	985	255	764	1147
Male coworkers	243	501	671	103	343	545
Similar age male coworkers	32	83	125	16	59	102
Similar age female coworkers	9	33	63	19	70	121
Affected male coworkers	224	458	617	95	312	496
Affected female coworkers	67	217	421	97	370	663
Employed male coworkers	104	265	401	39	170	300
Employed female coworkers	32	120	243	43	195	354

Notes: Sample of male workers with at least 44 contribution years at age 59, female workers with at least 39 contribution years at age 54. Coworkers are defined as individuals employed in the same firms over the last 10 years with an overlap period of at least 40 days. Similar age coworkers are defined as coworkers who are born 5 years before to 5 years after the respective workers. Affected coworkers are defined as coworkers affected by the ERA reform (born after Nov 1, 1940 for male s or Nov 1, 1945 for females. Employed coworkers are defined as coworkers still employed when the worker is aged 59 (54).

Table 7

Effects of coworkers on the probability to claim at age 60 (men) or 55 (women)

	Men (N=53,195)			Women (N=43,492)		
	(1) Similar Age Coworkers	(2) Affected Coworkers	(3) Still Employed Coworkers	(4) Similar Age Coworkers	(5) Affected Coworkers	(6) Still Employed Coworkers
Male coworkers						
Quintile 2	0.038	0.013	0.056	0.007	-0.004	-0.005
	(0.013)	(0.016)	(0.014)	(0.012)	(0.012)	(0.012)
Quintile 3	0.097	0.024	0.056	-0.013	-0.024	-0.004
	(0.016)	(0.022)	(0.018)	(0.014)	(0.016)	(0.014)
Quintile 4	0.132	0.005	0.079	0.024	-0.021	0.008
	(0.019)	(0.026)	(0.021)	(0.017)	(0.020)	(0.017)
Quintile 5	0.190	-0.019	0.097	0.053	-0.082	-0.029
	(0.021)	(0.030)	(0.024)	(0.019)	(0.023)	(0.019)
Male coworkers * Post reform cohorts						
Quintile 2	-0.027	-0.016	-0.051	-0.021	0.003	0.008
	(0.016)	(0.019)	(0.016)	(0.015)	(0.016)	(0.015)
Quintile 3	-0.093	-0.019	-0.04	0.017	0.031	0.013
	(0.019)	(0.026)	(0.021)	(0.019)	(0.021)	(0.018)
Quintile 4	-0.107	-0.021	-0.077	-0.022	0.011	0.001
	(0.022)	(0.031)	(0.023)	(0.021)	(0.025)	(0.020)
Quintile 5	-0.157	-0.032	-0.089	-0.033	0.034	0.020
	(0.025)	(0.035)	(0.026)	(0.024)	(0.029)	(0.023)
Female coworkers						
Quintile 2	-0.006	-0.049	-0.02	-0.008	-0.03	-0.014
	(0.011)	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)
Quintile 3	-0.018	-0.091	-0.071	0.03	-0.043	0.01
	(0.013)	(0.015)	(0.014)	(0.015)	(0.017)	(0.015)
Quintile 4	-0.015	-0.117	-0.11	0.07	-0.027	0.023
	(0.015)	(0.017)	(0.015)	(0.018)	(0.021)	(0.018)
Quintile 5	0.034	-0.162	-0.118	0.123	-0.061	0.022
	(0.018)	(0.020)	(0.018)	(0.022)	(0.025)	(0.020)
Female coworkers * Post reform cohorts						
Quintile 2	0.012	0.043	0.029	0.023	0.041	0.052
	(0.013)	(0.014)	(0.014)	(0.015)	(0.017)	(0.015)
Quintile 3	0.042	0.093	0.09	-0.003	0.059	0.044
	(0.015)	(0.017)	(0.016)	(0.019)	(0.022)	(0.019)
Quintile 4	0.043	0.1	0.108	-0.032	0.025	0.032
	(0.017)	(0.020)	(0.018)	(0.023)	(0.026)	(0.022)
Quintile 5	0.025	0.140	0.137	-0.053	0.067	0.050
	(0.020)	(0.023)	(0.020)	(0.027)	(0.031)	(0.025)

Notes: Results from separate linear regressions, dependent variable is an indicator equal to one if the individual starts claiming pension benefit at age 60 (men) or age 55 (women). Coworker characteristic in columns (1) and (4) refer to the number of coworkers with similar age, columns (2) and (5) the number of affected coworkers, columns (3) and (6) the number of still employed coworkers. Coworkers charactersics are measured separately for female and male coworkers and interacted with an inicator for individuals born in post-reform cohorts. All regressions also control for quintiles in the total number of coworkers interacted with post-cohort indicator, indicators for years of employment categories (10) interacted with post cohorts, birthyear and birthmonth dummies, categories of average earnings during the last 5 years (10), firm size categories (10), region (6), and industry indicators (8). Sample of male workers with at least 44 contribution years at age 59, female workers with at least 39 contribution years at age 54. For coworkers definitions see notes to Table 6.

Appendix Table 1

Number of retirement entries: official statistics and alternative definitions

Retirements with long contribution years, >= 45 CY for men, >=40 CY for women				
Year	Official Statistics	Count only years of employment	Count years of employment, military service, child care	Count years of employment, military service, child care, and unemployment
2000		2,243	6,289	9,095
2001		2,061	5,155	7,147
2002		2,353	6,885	9,346
2003		2,851	8,863	11,739
2004	11,900	2,450	8,718	11,597
2005	13,000	2,434	8,950	12,158
2006	14,000	2,668	9,514	12,783
2007	17,079	3,131	11,273	14,694
2008	19,878	3,477	11,436	14,976
2009	26,268	3,286	11,118	15,499

Notes: Official statistics according to BMASK (2011), military service up to 12 months, child care up to 60 months, unemployment up to 12 months.