How Does Raising Women's Full Retirement Age Affect Labor Supply, Income, and Mortality? Evidence from Switzerland

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Abstract

Understanding why and when individuals retire is central to the current debate on pension reform. We study how women change their employment decisions in response to a Swiss reform that increased the full retirement age (FRA) twice, from 62 to 63 years, and from 63 years to 64 years, by date of birth. We find that raising the FRA strongly affects women's labor supply. A one year increase in the FRA delays labor market exit by 7.9 months and claiming of retirement benefits by 6.6 months. We neither find an effect on labor supply nor on benefit claiming of affected women's spouses. Mortality increases somewhat but the effect is not precisely estimated. Increasing the FRA has no statistically significant effect on the level of social security benefits but lowers social security wealth. Increasing the FRA by two years reduces the present discounted cost of a retiree by 10%.

Keywords: Full retirement age, social security reform, retirement behavior, regression discontinuity design

JEL Classification: H55, J21, J26

1 Introduction

Between 1960 and 2010 the average life expectancy at age 65 in the United States increased by 4.5 years for men and 4.2 years for women (OECD, 2011b). Over the same period the average effective retirement age has declined by approximately three years (OECD, 2011a). These forces have substantial fiscal ramifications for social security. Social security reforms in the United States and other countries have implemented measures aimed at delaying labor force exit of older workers to decrease the pressure on their pension systems. Increasing the retirement age is an appealing policy measure that simultaneously increases labor supply and delays benefit claiming.

A growing literature studies the impact of this measure on labor force participation for men. Few studies focus on labor supply of women, and fewer still examine the effects of pension reform on income and and well-being of older workers. Understanding when women decide to leave the labor force is interesting for several reasons. Many countries grant women the right to leave the labor force earlier than men even though women have a longer life horizon due to their higher life-expectancy. Focusing on women is also interesting since women could respond to incentives to delay labor force exit more strongly than men. Studying outcomes beyond labor supply is important. Whether and how much pension reform decreases income is a central piece of information when discussing welfare implications of pension reform. Concerns with lack of health and lack of employability in old age is the original Bismarckian motivation for the social security program. Studying whether pension reform affects health is of key importance to policy makers and the general public.

We examine the causal impact of an increase in the full retirement age (FRA) for women in Switzerland on labor force participation, income, and mortality. We rely on exogenous variation in the FRA that is generated by a major pension reform. This reform became effective in 1997 and increased the FRA for women from age 62 to age 64 in two stages. Women born in 1938 or before were unaffected by the reform, while the FRA was increased by on year for women born between 1939 and 1941, followed by an additional one year increase for women born after 1942. Affected women could still claim benefits from age 62 at a penalty of 3.4% for every year of claiming before the new FRA. This penalty was increased to 6.8% for women born in 1948 or after, affecting women retiring in 2010 or after.

This reform allows us to discuss several interesting aspects. First, the Swiss context is interesting

from a conceptual point of view. There is no mandatory retirement in Switzerland, similar to the U.S. Moreover, there is no earnings test so individuals can both draw retirement benefits and continue working. Changes to retirement benefits affect wealth but do not change the incentive to work or not. The Swiss reform allows us to study wealth effects on labor supply. Second, we use the Swiss Social Security Database (SSSD) which contains the complete labor market and earnings histories of 25% of workers and their spouses in Switzerland. We can go beyond studying individual labor supply and examine whether an increase in the FRA has spill-over effects into other social insurance programs, or whether there is an effect on the labor supply of the spouse. Third, the database also contains detailed information on mortality allowing us to explore the health effects of an increase in the FRA.

How does Switzerland compare to the United States in terms of labor supply in the years before age 65? Figure 1A shows labor force participation for men aged 60 to 64 years – about five years before the statutory retirement age – in the period from 1990 until 2012. Switzerland differs from the United States in terms of labor supply of men. Swiss men are more likely to work just before the full retirement age than U.S. men. Figure 1B reports labor force participation for women aged 60 to 64 years. U.S. women work somewhat more than Swiss women. But both countries witness a tremendous increase in labor force participation of women over the period 1990 to 2012. Labor supply increases from 35 % to 50 % in the U.S. and from 33 % to 50 % in Switzerland. Interestingly, Swiss women catch up to U.S. women in the period between 2002 to 2005. This catching phenomenon is at the heart of our study. Figure 1 suggests that the lessons we draw from the Swiss reform for women could apply similarly for the U.S. context since women's labor supply patterns are comparable.

The causal effect of the reform can be identified using a credible empirical design. The reform mandated a discontinuous increases in the FRA for women celebrating their birthday on January 1, 1939 or later compared to women born on December 31, 1938 or earlier. Women born after 1939 were eligible for a full pension in the month following their 63rd birthday. Women born in 1938 or earlier could ask for a full pension already in the month following their 62nd birthday. The reform increased the FRA a second time, from 63 years to 64 years for women born on or after January 1, 1942. Our analyis adopts a regression discontinuity design (RDD) comparing women born just after the cut-off dates (January 1st, 1939 and 1942) to those born before.

Figure 1: International Context: Labor Force Participation

(a) Men, Age 60-64   (b) Women, Age 60-64
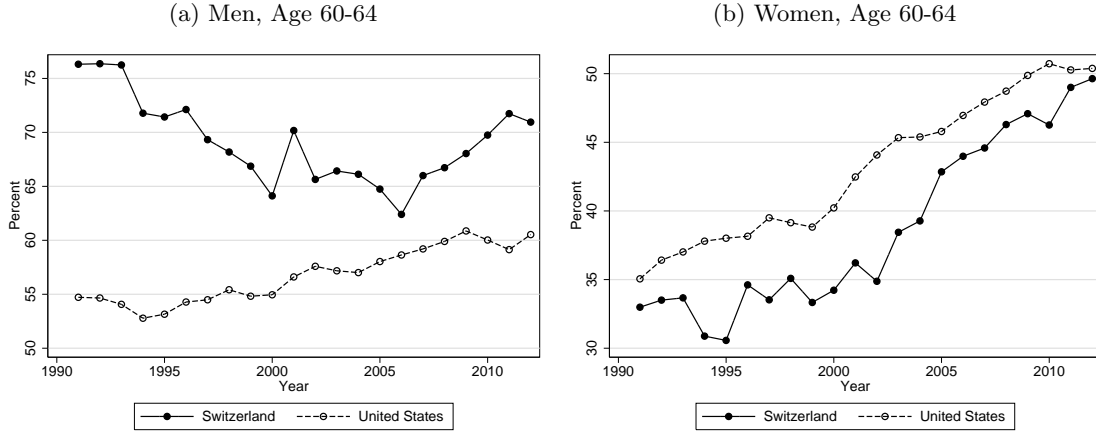
Notes: This figure shows labor force participation rates in Switzerland and the United States of 60-64 year old men (a) and 60-64 year old women (b).
Source: OECD labor force statistics.

Increasing the FRA triggers the following effects. First, increasing the FRA by one year strongly affects women's labor supply. We find that a one year increase in the FRA delays labor market exit by 0.66 years or 7.9 months. Increasing the FRA also increases the claiming age of retirement benefits by 0.55 years or 6.6 months. Second, there are no effects on labor supply and benefit claiming of women's spouses, suggesting that husbands and wives do not coordinate retirement dates. Third, mortality increases somewhat but the effect is not precisely estimated. Fourth, we find that social security benefits decrease only slightly because most women continue working to undo the early claiming penalty. However, there is sizeable reduction in social security wealth. The reason is that social security wealth not only looks at pension benefits (which decrease only marginally) but also at the duration of benefit receipt (which decreases by almost one half year due to the later claiming).

This paper is related to several strands of the literature. First, U.S. studies examine how the Social Security Amendments of 1983, which increased the FRA from 65 to 67, affected labor force participation of older workers in the U.S. Blau and Goodstein (2010), Mastrobuoni (2009), and Song and Manchester (2007) find that a one year increase in the FRA delays in labor force exit and benefit claiming among affected birth cohorts of about half a year. Duggan *et al.* (2007) find that the Amendments significantly increased Social Security Disability Insurance (SSDI) enrollment.

Behaghel and Blau (2012) find that the benefit claiming hazard at 65 moved in lock-step along with the FRA increase implemented with the 1983 Amendments. Second, our analysis is related to studies that focus on the effects of changes in pension rules on labor supply of women near retirement age. Staubli and Zweimüller (2013) study the effects of raising the early retirement age (ERA) by 2 years for men and 3.25 years for women in Austria and find that both men and women are about 10 percentage points more likely to work. Using labor force data, Cribb *et al.* (2013) measure the effects of increasing the women's state pension age from 60 to 61 years in the U.K. and find that this reform induced women (7.3 percentage points) and their spouses (4.2 percentage points) to work more. Hanel and Riphahn (2012) study the Swiss 1997 reform using labor force data and find that an increase in the FRA by one year delayed labor force exit by half as much. Third, our paper is also related to the literature on the role of financial incentives for retirement on labor supply (Krueger and Pischke, 1992;Gruber and Wise, 1999;Coile and Gruber, 2007; and Manoli and Weber, 2014) and the literature on the impact of retirement on health (Kuhn *et al.*, 2010; Coe and Zamarro, 2011; and Hernaes *et al.*, 2013).

This paper complements the existing literature in several ways. First, many governments implemented gradual increases in the FRA of a few months per age cohort coupled with a very strong financial incentive to comply with the policy change. Our study provides evidence on an opposite reform: a strong increase in the FRA by one entire year coupled with a modest financial incentive. Understanding whether this alternative works is interesting from a policy perspective. Second, the drastic increase in the FRA allows adopting a RDD, a transparent and credible empirical design. Previous studies adopt a difference-in-difference or interrupted time series design, both designs that are susceptible to violations of identifying assumptions. Third, our analysis builds on comprehensive data covering detailed labor supply effects but also partner labor supply, income, and health aspects. We use these data to understand the effects of pension reform on these additional facets of people's lives.

The outline of this paper is as follows. We next discuss the institutional background. Section 3 presents the data and descriptive analyses. Section 4 discusses our empirical strategy and tests of its validity. Section 5 presents the main results. Section 6 concludes with a summary of our findings and their policy implications.

2   Background

This section presents the Swiss old age pension system, discusses the reform we use to assess the effects of raising the full retirement age on labor supply, income, and mortality, and presents our main hypotheses.

2.1   Swiss Pension System

This section provides an overview of the Swiss pension system before the 1997 reform. The Swiss pension is build on three pillars.[1]

First pillar: The first pillar is a public pay-as-you go insurance, introduced in 1947. This first pillar has a strong redistributive character since it is aimed at covering the basic living expenses, the resulting pension is relatively small, and financed by contributions of 8.4% of every employee's wage. The full retirement age (FRA) was set at 65 years for both women and men at inception but fell to 62 years for women in 1964. Retirement at that age was not mandatory but an eligibility condition for claiming the full old age pension.

The level of pension benefits is based on contribution years and average earnings. To qualify for a full pension, men and women need to contribute to the pension system from age 20 onwards. Men get a full pension after 44 contribution years, women after 42 contribution years. Pensions are reduced by 2.3 percent per missing contribution year. Students or other non-employed individuals pay voluntary contributions to close holes in their contribution history. Voluntary contributions are means tested and range from less than 500 Swiss Franc or CHF (CHF 1 = USD 1.07 = 0.83 EUR) for individuals with wealth below 300,000 CHF to 24,000 CHF for individuals with wealth at 8,4 Million CHF or higher. Average earnings mainly reflect real indexed earnings from employment or self-employment.[2]

Pension benefits are between a minimal pension level of about 12,000 CHF and a maximum pension level, equivalent to twice the minimum. Due to the cap of pensions from below and from above, pension replacement rates vary across individuals. The replacement rate is 100 % or more for individuals earning below the minimum pension level. The replacement rate is 34 % or less for

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[1]For details see Queisser and Vittas (2000), especially concerning institutional details, and Bütler and Staubli (2011) for the second pillar.

[2]Average earnings are supplemented for parents who have taken care of children below age 16, or individuals who care for relatives in need of care. Supplements are equivalent to three times the minimal pension.

Figure 2: Adjustment Factors
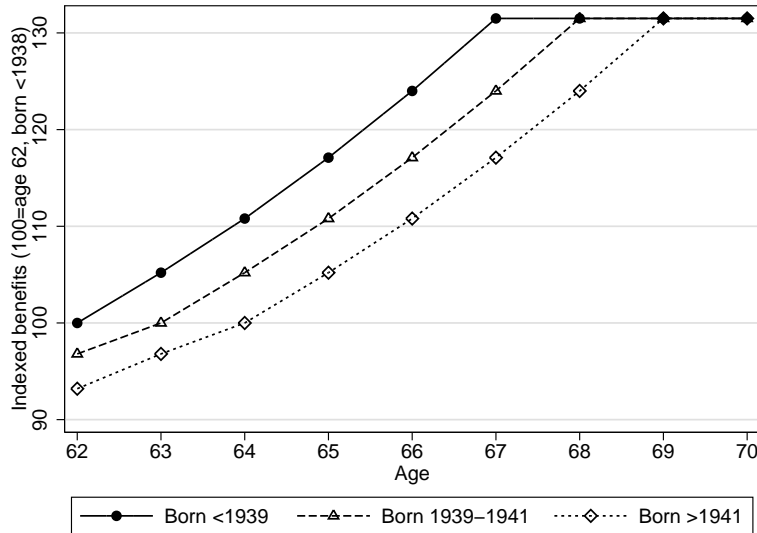
Notes: This figure shows how the Swiss social security system adjusts women's old age pensions as a function of the claiming age for different birth cohorts. Old age pension are indexed, basis (=100): women born in 1938 or before claiming at age 62 years. Source: Own calculations based on Swiss social security rules.

people earning three times the maximum pension level or more. Late claiming up to five years is possible, entailing an increase in the pension of between 5 and 6 % per year of delaying. Early claiming is not possible before the reform. There is no earnings test so individuals can continue working while claiming an old age pension.

Figure 2 shows how the Swiss systems adjusts pensions for early or late claiming. The solid black line gives the pension adjustment factor (PAF) for women born in 1938, the last cohort unaffected by the reform we discuss below. Women in the 1938 cohort could not claim old age pensions before age 62. Women who started claiming old age pensions at age 62 received the full pension amount, i.e. their PAF was at 100 percent. Women who deferred claiming an old age pension by one year to age 63 were entitled to a pension that was 5.2 % higher than the full pension (even if they were eligible for the maximum regular pension). Women who delayed claiming by 2 years to age 64 were eligible for a pension that was 10.8 % higher than the full pension. Women who delayed claiming an old age pension by the maximum of five years to age 67 received an old age pension that was 31.5 % higher than the regular pension.

Special rules were in place concerning retirement of spouses. Before the reform, the pension

system primarily focused on the labor market trajectory of the husband to determine the pension level for couples. Couples became eligible to a joint pension of 150% of the individual pension to which the husband is eligible once husband and wife had reached the statutory pension age. In case the wife claimed a pension before the husband did, she was eligible for a single pension based on her labor market history. In case the husband claimed a retirement pension before the spouse did, he was also eligible for the single pension based on his labor market history. On top of this single pension, a retired husband whose wife was 55 years or older received a supplementary pension benefit of 30 % of his individual pension.

Second Pillar: The second pillar is an occupational benefit plan. This pillar intends to provide retired workers with an appropriate income to guarantee the accustomed (pre-retirement) standards of living. It was formally introduced in 1985 but a variety of schemes were already in place before that year. Federal law imposes employers to contribute at least as much as employees do but there exists a large degree of flexibility since contribution rates are proposed by pension funds. Second pillar contributions are mandatory for annual earnings that exceed about CHF 20,000. Occupational pensions specify a full retirement age that can but need not be the same as the first pillar FRA. Individuals who reach the second pillar FRA can either withdraw an annuity, a lump-sum amount, or a mix of these two. The majority of retired individuals chooses the annuity even though the first pillar already provides an annuity stream in old age (Bütler and Teppa, 2007). Second pillar pensions can be withdrawn as early as age 58 years, with actuarially fair adjustment. Late claiming is also possible if the pension plan allows it. The net replacement rate of the second pillar is on the order of 40 % for the average earner. The second pillar system is very fragmented: 2,543 pension funds operated in 2007 offering plans that are very heterogenous regarding claiming and payout options.

Third pillar: The third pillar is a private pension scheme. It has been thought to supplement the state pension with sufficient means to ensure an ultimately comfortable retirement. The contribution rate is decided individually. Contributions to the third pillar are deducted from taxable income. Payouts of the third pillar are taxed, albeit at a reduced rate.

Old age pension replacement rates are fairly high (OECD, 2011b). The first and second pillars pay a combined benefit of about two thirds of the pre-retirement earnings to the average wage earner. The net replacement rate is substantially lower for high earners. For instance, individuals

earning twice the average wage see one third of their pre-retirement earnings replaced. High earners rely heavily on the third pillar to guarantee adequate income replacement.

Employment relationships do not end automatically at the FRA (Senti, 2011). Workers who wish to leave the labor force upon reaching the FRA have to quit their job by formally informing their employer of their decision. Workers covered by collective agreements or public sector employees may have contracts that terminate automatically upon reaching the FRA. These contract can, however, be renewed. Continuing work beyond the FRA is often attractive from the financial point of view as contributions to the first and second pillar are no longer mandatory.[3]

2.2 The 1997 Reform

Changes to the FRA: To improve the fiscal health of the public pension system, the Swiss government drafted a major pension reform in 1995, enacted as of January 1, 1997. The most important element of this reform was an increase in the FRA for women from age 62 to age 64. The increase occurred in two main stages. The FRA was increased to age 63 for women born between 1939 and 1941 affecting all women retiring in 2001 or after. The FRA was further increased to age 64 for women born in 1942 or later, affecting women retiring in 2005 or after. Affected women could still claim benefits as early as age 62 subject to a penalty of 3.4% of full benefits for each year of claiming prior to the FRA.[4]

The increase in the FRA was achieved by modifying the pension adjustment factor (PAF). Figure 2 shows how the reform affected the PAF. The dashed line provides the adjustment factor for women born 1939 to 1941. The 1939 to 1941 birth cohorts could still claim benefits at age 62 years, albeit with a pension that was 3.4 % lower than the full pension. Women born 1939 to 1941 who decided to delay claiming to age 63 were again eligible for a full pension, and those who delayed claiming a pension by five more years, to age 68, were eligible to the maximal pension, 31.5 % higher than the full pension. The dotted line gives the adjustment factor for women born 1942 to 1947. The 1942 to 1947 birth cohorts could claim an old age pension at age 62 years, albeit with a pension that was 6.8 % lower than the full pension. Delaying claims by two years, to 64

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[3]Part-time retirement is not possible in the first pillar. Workers who move to part-time employment in the years before retiring incur a penalty as their average pension contributions decrease. The second pillar allows for par-time retirement with penalties for late or early claiming on the part taken out before or after the FRA.

[4]This penalty was increased to 6.8% for women born in 1948 or after, affecting women retiring in 2010 or after.

years, the 1942 to 1947 women were again eligible to a full pension; delaying pension claims for an additional five years, to age 69, ensured a maximal pension, 31.5 % higher than the full pension.

Women who wanted to claim pensions early had to inform a pension agency no later than one day ahead of their early retirement birthday. Late claims for early retirement were not tolerated. Women who wanted to delay claiming an old age pension could inform the relevant agency about this anytime during the year they attaining the FRA.

Other Changes: The 1997 reform also affected a number of other details of the pension system. First, the 1997 reform changed pensions for couples. Prior to the reform, retired couples earned 150 % of the husband's pension. The 1997 reform introduced splitting. Once both husband and wife entered retirement, the earnings accumulated by husband and wife during the marriage were split equally between the two. These split earnings trajectories were used to determine the pension benefit separately for husband and wife. All new pensions were calculated according to the new rules immediately. Existing pensions were re-calculated from January 1, 2001 onwards. The new rules concerning pensions of couples do not affect our analysis of the effects of the FRA on women's decisions as they apply to all women and men.

Second, the 1997 reform abolished the supplementary pensions for retired husbands whose women were born 1942 or after. This change does not affect our analysis of the increase in the retirement age from 62 to 63 years, since this analysis focuses on women born before 1942. Abolishing the supplementary pension can affect our estimate of increasing the FRA from 63 to 64 years but it can both decrease or increase the incentive to retire for women born 1942 or later.

Third, the reform introduced early retirement for men. From January 1, 1997 onwards, men could claim old age pensions at age 64, one year prior to men's FRA at 65. The first cohort affected is the cohort born in 1933. Pension benefits were reduced by 6.8% for those men who decided to retire early, i.e. the early claiming penalty was twice as large for men than for women. Starting January 1, 2001, men could claim old age pensions at age 63, up to two years prior to the FRA, at a discount of 6.8 % per year of early claiming. The first cohort affected is born in 1938. There were no changes in supplements for late retirement. Introduction of early retirement for men does not affect our analysis of when spouses of affected women take retirement since both partners of affected women and unaffected women gained access to early retirement at the same rate.

Individuals were informed of the reform in two ways. First, the national press discussed the key

features of this reform intensely. Second, the Federal Social Insurance Office (FSIO) printed a leaflet summarizing the key questions people might have and answering them. The leaflet provided useful information on the rules guiding early and late retirement showing a range of real life examples.

2.3 Research Questions

We are interested in how increasing the FRA affects labor supply, pension claiming, and health. The labor supply effects are best understood in the context of the pension adjustment and claiming age figure 2. The Swiss pension system does not offer any pension benefits before age 62, a full pension at the full retirement age of 62 (FRA), and pension benefits that increase in an actuarially fair way until the late retirement age (LRA) of 67. These rules introduce two kinks in the budget set; one at the FRA and one at the LRA. These kinks introduce bunching in claiming behavior: a first group of women – those with strong preferences for leisure – will take retirement exactly at the FRA; a second group of women – those with strong preferences for consumption – will take retirement exactly at the LRA of 67. The system will also encourage continuous claiming behavior between the FRA and LRA.

The increase in the FRA from age 62 to age 63 induces a negative wealth effect. The budget set shifts downward by 3.4 percentage points between the old FRA (age 62) and the new FRA (63 years), and by about 5-6 percentage points between the new FRA and the new LRA (age 68). The pension system after the reform still features a strong kink at the old FRA (age 62), a continuous and upward sloping profile thereafter, and a new kink at the new LRA (age 68).

Fully informed and forward looking women will adjust labor supply in response to this negative income effect. Specifically, women who were just indifferent between taking retirement at the old FRA and working a bit longer will now work longer. Also, women who were just indifferent between taking retirement at the LRA and working a bit less than that will now continue to work to the new LRA. But these two groups are likely to be small compared to the population, assuming that preferences for work and leisure follow a continuous distribution. Standard labor supply theory suggests the effect of raising the FRA from age 62 to age 63 will be limited.

It is possible, however, that women were not fully informed about the nature of the policy change. Specifically, women might have perceived the change as moving the kink from the old FRA to the new FRA. Partially informed women will respond much more strongly to the policy change

than fully informed women. Specifically, all women with strong preference for leisure, who would have taken retirement at the old FRA, now will do so at the new FRA if they believe that pension benefits are zero before the FRA.

Many individuals are less than fully informed about their social security benefits (Bernheim and Levin, 1989, Lusardi and Mitchell, 2007). Fully-informed women with strong preference for leisure will continue to take retirement at the old FRA. Partially-informed women with strong preference for leisure will take retirement at the new FRA. The extent of the labor supply response and its timing will be informative on the size of the two sub-groups. We will pay attention to the detailed timing of the labor supply response in our analysis below. We also study to what extent an employment response is likely to be full-time or part-time by studying effects on monthly earnings, setting to zero earnings for women who do not work. We also study whether increasing the FRA for women affects their spouse's labor supply decisions.

Women can delay old-age pension claiming also by entering other income support programs. We study to what extent increasing the FRA affects unemployment insurance (UI) inflow and disability insurance (DI) inflow. Note that both UI and DI claimants continue to accumulate work experience enabling them to avoid reductions in their pensions due to lack of complete work history. Women can also delay old-age pension claiming while continuing to accumulate contribution years by paying the voluntary non-employment contributions.

The second question concerns how increasing the FRA affects old age pension claiming behavior. This question is of key importance to policy makers. We separately analyze how this reform affects the age at which women start claiming an old age pension, and how it affects the age at which individuals claim any pension, i.e. disability or old age pension. This distinction is important for women who leave the labor force before reaching the FRA via disability insurance.

The third question concerns the health and income effects of increasing the FRA. A key welfare rationale for retirement programs is deteriorating health among older workers. We study whether an increase in the FRA affects health. Specifically, we ask whether women whose FRA was increased from age 62 to age 63 in 2001 were more likely to die by the year 2012 (the last year observed in our data). A second welfare aspect concerns how reducing pensions to increase the FRA affects income of retired individuals. We study how increases in the FRA affect the level of pension benefits and social security wealth, key components of retired individual's income.

3 Data and Descriptive Statistics

3.1 Data

Our empirical analysis uses Swiss Social Security data (SSSD) from three sources. The first data source is a 25 % random sample of the individual accounts that register pension contributions giving access to labor market histories starting in 1982 currently observed until the end of 2012. Individual accounts contain detailed information on labor supply. Employed or self-employed individuals generate one record per employment per year that details the starting and ending month of an employment relationship along with the total earnings over that time period, without information on full- or part-time status. Unemployed benefit recipients also generate one record per year that contains information on unemployment benefits and the starting and ending months of an unemployment spell. Individual accounts also contain information on dates of birth (daily precision) and nationality.

The second data source contains information on all disability and old age pension claims matched to the 25 % sample of individuals above. For old age pensions, we observe the start date of the old age pension, its benefit level along with the contribution years and average indexed monthly earnings used to calculate the pension level. For disability pensions, we observe the start date of the disability pension, its level, and the reasons for granting it. The pension claims data also contains information on mortality as both disability and old age pension claims terminate when its claimant dies. Pension claims also contain an identifier for the married spouse, information that we use to match information on spouses.

The third data source contains income tax records of individuals who live in a large region of Switzerland. These records cover the period between 2000 and 2010. We use these records to identify the age at which individuals start receiving retirement income from the occupational pension plan.

3.2 Descriptive Statistics

We extract a series of samples of women with labor force attachment who were just affected or not affected by the changes implemented with the reform. Specifically, we focus on women born between 1938 and 1939 and between 1941 and 1942. We exclude the following sets of women:

women who are never employed between age 50 and age 53, women who claim a disability pension before age 53, and women who never claim an old-age pension.

Our empirical analysis focuses on the following key outcome variables. *Exit Age* is the last age an individual has positive earnings in the individual accounts data (monthly precision). *Claiming Age* is the age an individual first starts claiming a disability or old-age pension (daily precision). *Mortality* is the probability to die by 2012, the last year we observe in our data. *Social Security Benefits* refer to the old age pension amount (in CHF per year). We also construct a measure of *Social Security Wealth* as the expected sum of discounted benefits after the claiming age. Specifically SS Wealth= $\sum_{s=R}^{T} \frac{b(s=R)}{(1+r)^{(s-R)}} * p_{s|R}$ where R is claiming age, $b(s = R)$ is the pension benefit at that claiming age, T is the maximum age possible (assumed to be 100 years), r is the discount rate (set at 2.5%), and $p_{s|R}$ is the probability to be alive at date s conditional on claiming old age pension benefits at age R.

Table 1 reports summary statistics for the two samples we use to measure the effects of increasing the FRA from 62 to 63 years (column 1), and from 63 to 64 years (column 2). Panel A provides statistics on the key outcome variables. Women leave the labor force about one to two years before the FRA. Average claiming age is within one year of the FRA. Mortality is around 7 percent for the cohort affected by the reform increasing the FRA from age 62 to age 63 (in 2001) and about 5 percent for the cohort affected by the increase from age 63 to age 64 (in 2005). Average social security benefits are around 20,000 CHF for one year. Discounted social security wealth is about 23 times larger than the annual pension benefit.

Panel B of Table 1 shows summary statistics on key background variables. About 55 percent of women are married and wives are on average 2.6-3 years younger than their husband. About one in five or six women has a non-Swiss nationality. Indexed average earnings – the base for setting the benefit amount – are 52,757 CHF per year for the women affected by the FRA increase from 62 to 63, and about 4,500 CHF larger for women affected by the change in the FRA from 63 to 64 years. Old age benefits replace about 38 percent (=20,110/52,757 * 100) of indexed earnings in the 62 to 63 years sample, and the replacement rate is similar for the 63 to 64 years sample. About 40 % of the married women in the 62 to 63 years sample get a supplementary pension. Supplementary pensions are less frequent in the 63 to 64 years sample; only 30 percent of all women receive one because the 1997 reform abolished the supplemental pension for the treated women in the 63

Table 1: Summary Statistics

	FRA 62 $\Rightarrow$ 63 years (1)	FRA 63 $\Rightarrow$ 64 years (2)
A. Outcome variables		
Exit Age (years)	60.8 (4.14)	61.4 (4.18)
Claiming Age (years)	61.8 (1.93)	62.4 (2.3)
Mortality, Pr(die by 2012), %	6.9 (25.4)	5 (21.7)
SS benefits (CHF per year)	20110 (4850)	20376 (4887)
SS wealth (CHF)	473054 (113676)	471680 (112112)
B. Characteristics		
% married	55 (49.8)	57.3 (49.5)
Age wife - age husband (years)	-3 (5.63)	-2.6 (5.55)
% foreign	18 (38.4)	15.5 (36.2)
Average indexed earnings (CHF per year)	52757 (27418)	55106 (31033)
% supplemental benefits spouse	40.9 (49.2)	29.6 (45.6)
Supplemental benefits amount (CHF per year)	7219 (1600)	7188 (1599)
Earnings at age 55 (CHF per year)	37743 (38429)	39924 (57741)
No. observations	22,908	27,766

Notes: This table reports summary statistics of key outcome variables in Panel A, and background characteristics in Panel B for the two samples we use to measure the effects of increasing the FRA. The FRA 62 to 63 years sample refers to the cohorts born 1938 and 1939, the FRA 63 to 64 years sample refers to the cohorts born 1941 and 1942.

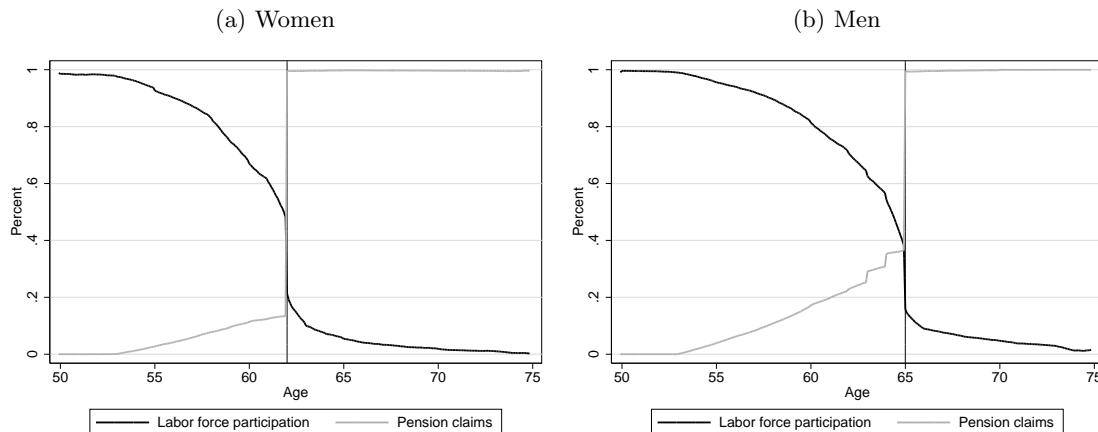Source: Own calculations, based on SSSD.

to 64 years sample. The supplemental benefit amount is on the order of one third of the old age pension. Annual earnings at age 55 are between 37,743 CHF in the older cohorts (or 3,145 CHF per month), and 39,924 in the younger cohorts (or 3,327 CHF per month). Annual earnings are lower than indexed earnings for two reasons. First, annual earnings look at the entire year regardless of whether a women worked or not; periods of non-employment contributing zero to annual earnings. Second, indexed earnings also reflect care supplements. This explains why annual earnings are substantially lower than indexed earnings. Old age pensions replace a substantial proportion of annual earnings: the replacement rate is 53 percent in the younger cohort, and 51 percent in the older cohort.

Figure 3 shows life-cycle labor force participation profiles for women and men, both born in 1938, i.e. before the FRA was increased, for women aged 50 to 75 years. Figure 3(a) shows results for women. The bold line gives the proportion of women working vs age measured in years and months. Almost all women in our analysis sample are employed at age 50 but many leave the labor market already before reaching the FRA: the proportion working is about 90 percent at age 55, about 65 percent age age 60, and 50 percent in the month before celebrating the 62nd birthday. About 30 percent of all women leave the world of work exactly at age 62 years, the FRA before the reform. Women who are older than the FRA retire continuously from the world of work between age 62 and 75. The light line shows the proportion of women on disability or old age pensions. This share is exactly zero at age 50 years, increases somewhat to 5 percent at age 55, and further to about 15 percent between age 60 and 62 years. Almost all women start to claim old age pension benefits exactly in the month they turn 62 years, i.e. exactly upon reaching the FRA. By contrast, the LRA is quantitatively irrelevant: fewer than 1 percent of all women defer claiming an old age pension beyond the FRA.

Figure 3 (b) shows results for men for comparison. Overall, men's life-cycle labor supply profile is very similar to the profile for women. This is because our analysis sample covers women who have worked at least once between age 50 and 53 years, a sub-group of women with labor force attachment. One key difference is the proportion of men still working just before turning 65 years old, i.e. just before reaching the FRA. The proportion working just before the FRA is 40 percent among men and 50 percent among women. But this is because men's FRA is three years later than women's FRA. In contrast, the proportion on some form of pension is much higher for men than

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Figure 3: Labor Force Participation and Pension Claims Around Retirement

(a) Women   (b) Men

Notes: This figure shows the life-cycle profiles of labor force participation and pension claims for women born 1938 (a) and men born 1938 (b). The horizontal axis measures age in years and months.
Source: Source: Own calculations, based on SSSD.

for women. It starts at zero at the age of 50, but quickly increases after the 55th birthday to reach a level of about 38 percent on the eve of the 65th birthday. Men use the option to retire early created by the 1997 reform. The proportion of men on a pension increases sharply at age 63 and 64. As for women, almost all remaining men start claiming an old age pension upon celebrating their 65th birthday. Late claiming of an old age pension is not quantitatively important among Swiss men.

4 Empirical Strategy

We estimate how women's FRA affects their labor supply, income, and mortality. We build our identification strategy on the quasi-experimental increase in the FRA for women. Specifically, we exploit the increase in the FRA to 63 for women born in 1939, as well as the fact that the FRA remained at 62 years for their counterparts born in 1938. We can estimate the causal effects of increasing the FRA by comparing women born on January 1, 1939 or after (treated group) with women born on December 31, 1938 or before (control group). A similar discontinuity in the birth date can be exploited to examine the second increase in the FRA for women from 63 to 64. This comparison will yield unbiased estimates if the distribution of observable and unobservable

characteristics is similar to the left and to the right of the age threshold.

We implemented the RDD by estimating regressions of the following type:

$$y_i = \alpha + \beta D_i + \gamma_0(1 - D_i)f(Z_i - c) + \gamma_1 f(Z_i - c) + X_i'\delta + \varepsilon_i \tag{1}$$

where i denotes individual, D_i is a dummy that is equal to 1 if a woman is born after December 31, 1938 and 0 otherwise, Z_i denotes a womans birth date, c is the cut-off date for the FRA increase (January 1, 1939), and f is a function of the difference between a womans birth date and January 1, 1939. The coefficient of interest is β which measures the impact of the increase in the FRA on the outcome variable y_i.

We first examine the impact of the FRA on labor market exit and benefit claiming. Here the outcome variable y_i denotes the age of labor force exit and the age of benefit claiming, respectively. We can run similar regressions to examine the impact on spousal labor supply where y_i denotes the age of labor force exit (benefit claiming) of the husband. In a second step we examine the labor market effects in more detail, in particular spillover effects into other social insurance programs. In this case the outcome variable is a dummy variable indicating whether a woman is employed, enters unemployment insurance, or disability insurance at a particular age. Finally, we examine the impact of an increase in FRA on mortality, the probability to die before 2012, the end of our observation period.

How strong is the incentive to post-pone retirement? Figure 4 shows how increasing the FRA would have affected old age pensions if all women had taken retirement at the old FRA of 62 years. We look at both social security benefits and social security wealth. We use observed social security benefits for women born before January 1, 1939 and we reduuce social security benefits of women born in 1939 by 3.4 percent to reflect the change due to the reform. Social security wealth sums up discounted social security benefits as explained earlier. Figure 4(a) shows that social security benefits were about 20,000 CHF per year for women born in 1938 with no strong change in this benefit level by season of birth. Women born in 1939 earned about 19,300 CHF per year if they entered retirement at age 62, or about 3.5 percent less than women born in 1938. Importantly, the drop in social security benefits occurs exactly at the birthdate cutoff, leading to a discontinuous change in the financial incentive to retire at age 62. Social security wealth is just short of 480,000

Figure 4: SS Pension Benefits and SS Wealth (Without Adjustment)

(a) Benefits (CHF per year)   (b) SS Wealth (CHF)
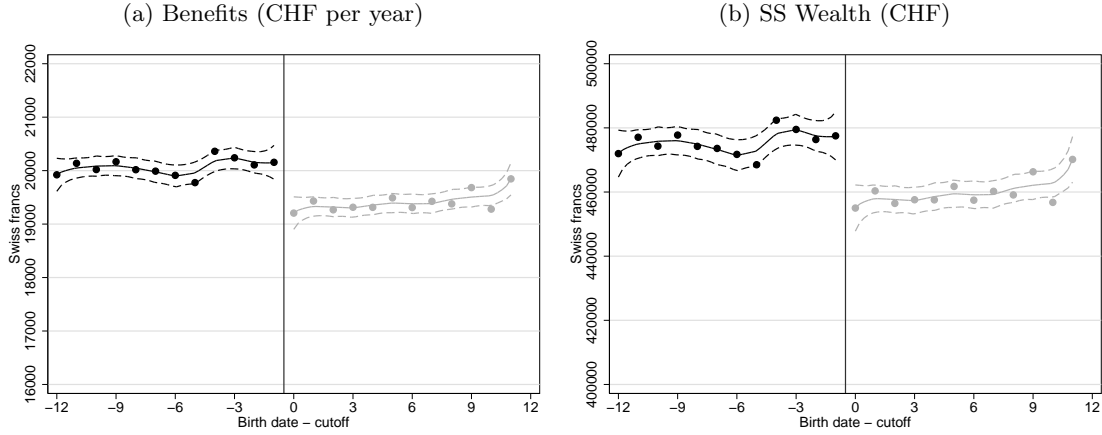
Notes: This figure shows mean pension benefits (a) and social security wealth (b) that women would have received if they had not adjusted their pension claiming age to the increase in the FRA from 62 to 63 years (in 2001). Source: Own calculations, SSSD.

CHF for women born in 1938, and around 460,000 CHF for women born after the 1939 birthday cutoff. Again, the reform introduces a discontinuous decline in social security wealth of around 3.5 percent exactly at the birthdate cutoff.

Validity of the RDD requires that women cannot manipulate the assignment variable (Lee and Lemieux, 2010). In our context, the assignment variable is the date of birth of women in the birth cohorts 1938 and 1939. Clearly, is impossible that women or their parents manipulated the date of birth in anticipation of the policy change. But seasonality in births or other policy changes or anticipation of WWII could still have been driving dates of birth. We are not aware of any change in the incentive to give birth in 1939 as opposed to 1938.

We carefully examine the distribution of co-variates and the number of women born in 1938 and 1939. Figure A.1 in the Appendix shows earnings at age 55, marital status, nationality, and the age difference between wife and husband. We find no evidence of a significant change in the means of these background variables. Moreover, there is no change in the number of women born around the cutoff date of January 1, 1939. These checks suggest that the RDD is valid from a statistical point of view. We have conducted the same statistical tests of the validity of the research design for the increase of the FRA from 63 to 64 years and find no violation of the identifying assumptions.

The RDD identifies the effects of an increase in the FRA only if there is no other policy change

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at the same age cutoff. The 1997 reform also introduced a new algorithm to separately calculate old age pensions for husbands and wives. This splitting algorithm does not affect our estimates of the effects of increasing the FRA since it applies to all women regardless of their date of birth. The reform also abolished the supplementary pension for women born after 1942. This aspect of the reform could confound our estimate of an increase in the FRA from 63 to 64 years.

5   Results

This section discusses how increasing the FRA affects labor supply, pension claiming, health, and income. The section then discusses how women changed their labor supply behavior in anticipation of the reform. The section finally presents an overview of the empirical results.

5.1   Labor Supply and Pension Claiming

Figure 5 shows how increasing the FRA from 62 to 63 years affects women's decision to leave the labor force. Women who were born in 1938 and eligible for a full pension at age 62 (solid line) leave the labor force at age 60.5 years, or 1.5 years before reaching the FRA. In contrast, women who were born in 1939 and subject to the new FRA at age 63 years leave the labor force at age 61 years, about 2 years before reaching the new FRA. Interestingly, women born early in 1939 delay labor force exit by about 0.5 years compared to women born late in 1938. Since birth cohorts around the January 1 cutoff are very similar, the delay in labor force exit must be due to the reform.

We have seen that the reform delayed labor force exit. Figure 6 shows how the reform affected the timing of labor supply in more detail. The dark line is the the labor supply profile of the last cohort of women unaffected by the reform (born 1938) from age 50 to age 75; the light line shows the labor supply profile of the first cohort affected by the reform (born 1939). Increasing the FRA by one year changes the timing of labor force exit around the old and new FRA in important ways. Women who are eligible for a full pension only at age 63 are substantially more likely to continue working until that age. About 38 percent of women born in 1939 still work on the eve of their 63rd birthday but only about 12 percent of all women born 1938 do so at that time. The reform also increases labor supply somewhat just before the old FRA and just after the new FRA. A small

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Figure 5: Effect on Women's Labor Force Exit Age, FRA 62 to 63
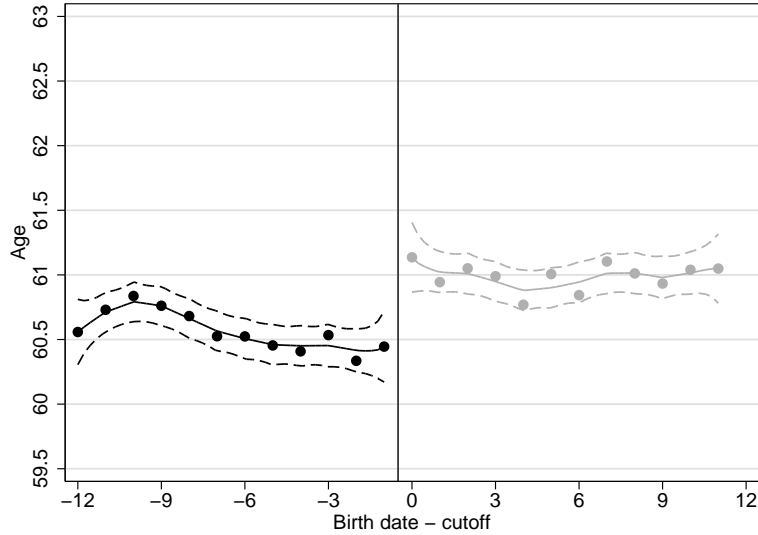
Notes: This figure reports the average labor force exit age for the women just affected or not affected by the increase of the FRA fromo 62 years to 63 years. The x-axis reports the date of birth minus the reform cutoff on January 1st 1939. The solid line refers to women born in 1938 who were just not affected by the reform. The light line refers to women born in 1939 just affected by the reform.

Source: Own calculations, SSSD.

sub-group of women born in 1939 continue to leave the labor force upon reaching the old FRA of 62 years. These women make use of the possibility to take early retirement at the cost of reducing pension benefits by 3.4 percent.

The previous figure contrasts the labor supply profiles of two entire birth cohorts which may differ in terms of their composition. Figure 7 shows how increasing the FRA affects employment and earnings by contrasting women born late in 1938 and early in 1939, i.e. adopting the RDD estimation approach. Figure 7(a) shows causal effects on employment. The solid vertical line indicates the year women were informed about the increase in the FRA from 62 to 63 years. Increasing the FRA changes employment of women in the age bracket 61 to 63 years. Women eligible for a full pension at age 63 are about 8-12 percentage points more likely work when they are 61 years old (difference marginally significant). Increasing the FRA to 63 years also strongly encourages women to work when they are 62 years oold. The difference is particularly pronounced in the month women turn 62 years old (35 percentage points) and it remains sizeable throughout that entire year (about 25 percentage points). Increasing the FRA to 63 years also encourages somewhat

Figure 6: Effect on the Labor Supply Profile, FRA 62 to 63
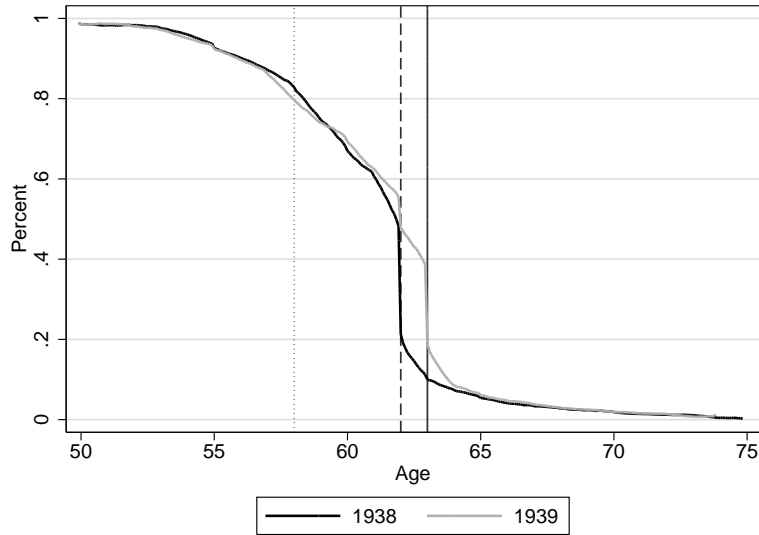
Notes: This figure shows the proportion working by age for women born 1938 (with FRA 62 years; dark line) and women born 1939 (with FRA 63 years; light line). Increasing the FRA changes labor supply strongly in the age bracket between the old FRA and the new FRA.

Source: Own calculations, based on SSSD.

more work at age 63 but the difference is smaller (5 percent) and not statistically significant.

Figure 7(a) shows that increasing the FRA induces women to keep on working but we do not know whether they work more or fewer days or hours. Figure 7(b) reports effects on monthly earnings, setting earnings to zero for women who are not employed. Earnings detect whether more women work and also how much more they work, i.e. changes at the extensive and intensive margin of labor supply. Increasing the FRA generates significantly higher earnings at age 62 years, when the control group of women could already claim a full pension but the treated group could not. The earnings effect is sizeable: treated women earn about 1,000 CHF more at age 62 than control women. Recall that about one in four women was induced to keep on working at age 62 years in response to the increase in the FRA. Increasing the FRA generated a monthly salary of about 4,000 CHF per month (=1,000 CHF / 0.25) among women who keep on working, higher than average monthly earnings at age 55 of 3,145 CHF. This suggests that highly paid women or women with a full-time position were encouraged to stay in the labor force. Increasing the FRA also generates higher earnings at age 61 but the effects are nowhere near statistical significance. Increasing the FRA does not affect earnings at any other age, consistent with results for employment.

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Figure 7: RDD Effects on Employment and Earnings, FRA 62 to 63
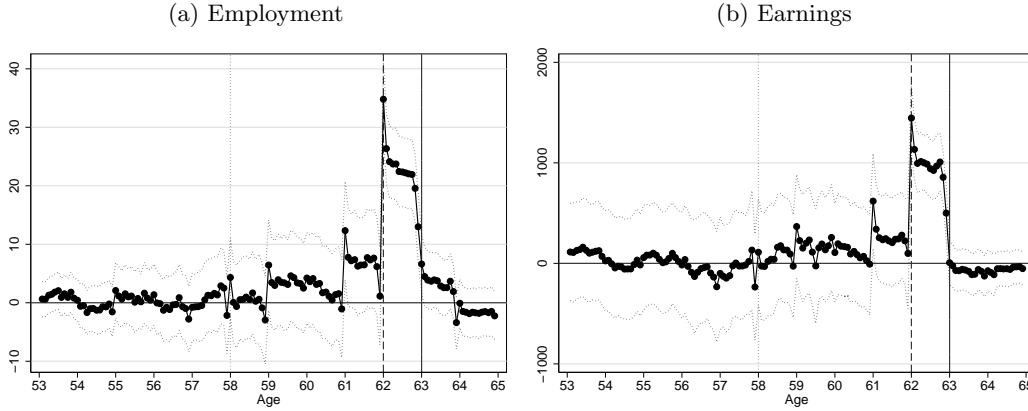
(a) Employment

(b) Earnings

Notes: This figure reports RDD estimates of the effects of increasing the FRA from 62 to 63 years on employment (a) and monthly earnings (b) along with the 95 % confidence interval. The vertical line indicates the age when women were informed of the reform.

Source: Own calculations, based on SSSD.

Increasing the FRA induces some but not all women to work longer. What happens to the women who do not work more? Figure 8 reports RDD effects on unemployment insurance (UI) inflow, disability insurance (DI) inflow, and non-employment (NE) contributions. Figure 8(a) shows that increasing the FRA increases UI inflow by about 0.5 percentage point at age 62 years. This effect is statistically significant but economically small. Figure 8(b) shows that raising the FRA also increases DI inflow by 2 percentage points at age 61 and by one percentage point at age 62 years. These effects are not only statistically significant but also economically important. Non-employed women can also make NE contributions to accumulate pension contribution years and to avoid a cut in their pension benefits. Figure 8(c) shows that increasing the FRA encourages women to make more NE contributions. The effects are sizeable: 28 percent more women contribute at age 61, and 33 percent more women do so at age 62 years. A sizeable proportion of women find it worthwhile to remain non-employed and make the NE contribution payments to avoid a reduction of their pension benefits.

How does increasing the FRA affect pension claiming behavior? Figure 9 shows the age women start claiming an old age pension. Women who are eligible for a full pension at age 62 start claiming an old age pension exactly upon reaching this age. Early claiming is not possible for these women and hardly any women chooses to post-pone retirement. Women eligible for a full-pension at age 63

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Figure 8: RDD Effects on Unemployment, Disability, and Pension Contributions, FRA 62 to 63

(a) UI Inflow   (b) DI Inflow   (c) NE Contributions
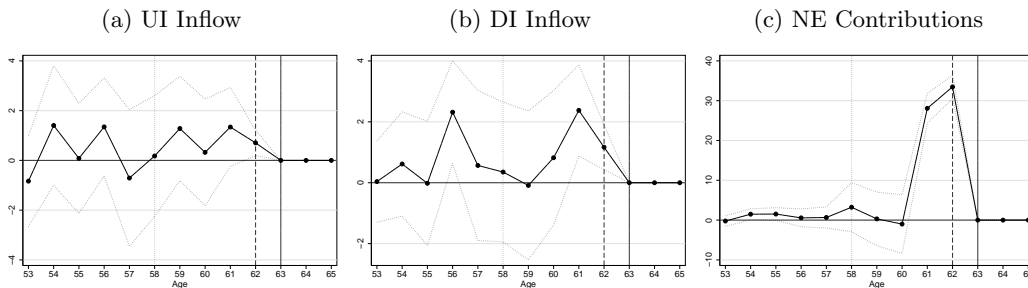
Notes: This figure reports RDD effects of increasing the FRA from 62 to 63 years on UI inflow (a), DI inflow (b), and NE contributions (c). We report average effects by age in years since monthly figures are extremely noisy (DI and UI) or because the timing of NE contributions within age years is not informative. The vertical line indicates the age when women were informed of the reform.
Source: Own calculations, based on SSSD.

years started claiming an old age pension only at age 62.7. The reform delayed the old age pension claiming age substantially.

But recall that about 15 percent of all women already claim a disability pension before entering retirement. Disability pensions are mechanically delayed by the reform since women on disability benefits can not choose to go on retirement before the FRA. Also, a women on disability benefits who delays claiming an old age pension does not generate savings to the combined budget of old age pensions and disability insurance. These considerations motivate us to study the age when women claim either a disability or an old age pension, the so-called all pension claiming age. Figure 10 reports how increasing the FRA from 62 to 63 years affects the all pension claiming age. Women who are not subject to the reform start claiming a pension at age 61.5 years. The all pension claiming age is lower than the FRA because some women enter disability insurance before claiming an old age pension. Increasing the FRA from 62 to 63 years raises the all pension claiming age to 62 years, or by about 0.5 years. This effects is smaller than the effect on the old age pension claiming age.

Increasing women's FRA might also affect their husband's labor supply. Figure 11 shows the average labor force exit age for spouses. Spouses leave the labor market on average just before celebrating their 64th birthday. Increasing the FRA from 62 to 63 years for their wives does not affect husband's decision to leave the labor market. We have also checked whether the reform affects

Figure 9: Effect on Old-Age Pensions Claiming Age, FRA 62 to 63
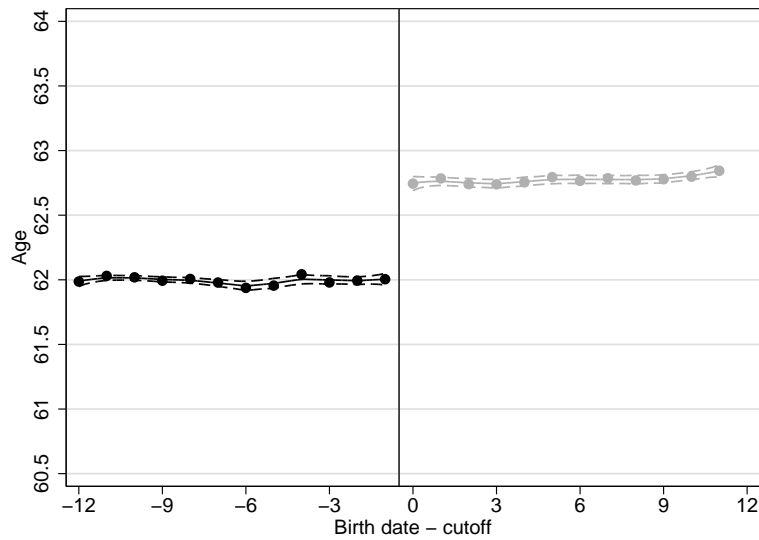
Notes: This figure reports the average age when women start claiming their old age pension. Women born in 1938 (dark line) do so exactly at age 62 years, the old FRA. Women born in 1939 (light line) do so at 62.7 years, about 3 to 4 months before reaching the new FRA.

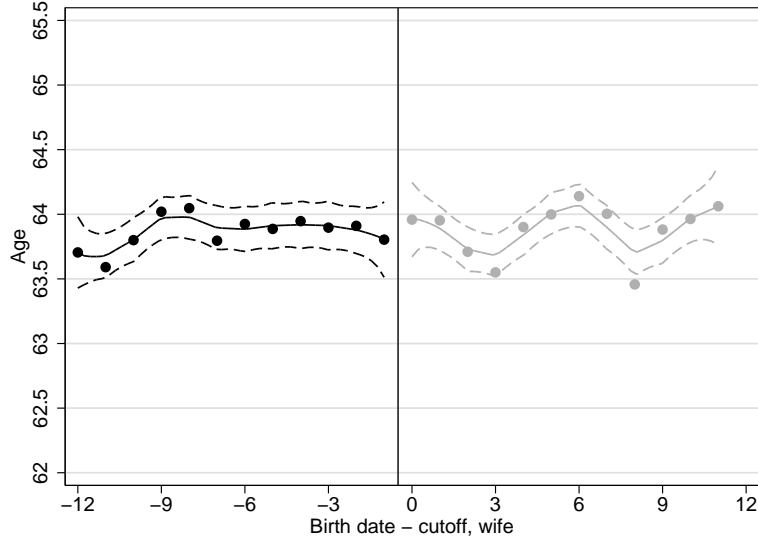Source: Own calculations, based on SSSD.

Figure 10: Effect on All Pension Claiming Age, FRA 62 to 63
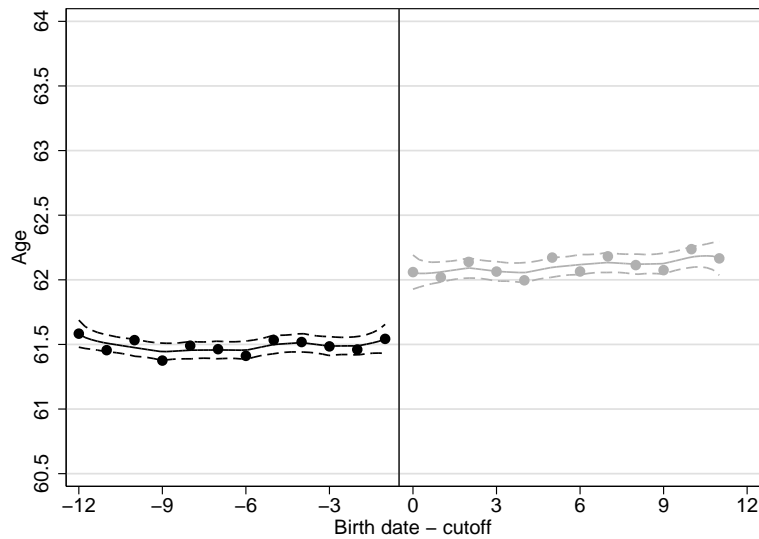
Notes: This figure reports the average all pension claiming age, i.e. the age a women starts claiming either an old age or a disability pension. Women born in 1938 (dark line) claim their first pension at age 61.5. Women born in 1939 (light line) claim their first pension at age 62. Increasing the FRA raises the all pension claiming age by about 0.5 years.

Source: Own calculations, based on SSSD.

Figure 11: Effects on Spouse's Exit Age, FRA 62 to 63

Notes: This figure reports the average labor force exit age of married women's spouse. Increasing women's FRA from 62 to 63 years does not affect labor supply of their spouse.

Source: Own calculations, based on SSSD.

spouse's pension claiming behavior and find no effect. Cribb *et al.* (2013) show that increasing the U.K. state pension age for wives by one year increases their husband's employment rate by 4-5 percentage points, a result we do not find for the Swiss reform. But recall that the financial incentive to delay retirement for Swiss women was substantially lower than the incentive for women in the U.K. The shock to household wealth is smaller for the Swiss reform compared to the U.K. reform.

5.2 Health and Income Effects

We now turn to discussing two welfare aspects of increasing the FRA. First, the original Bismarckian rationale for retirement is to provide people with the means to leave the world of work who suffer from a reduced ability to work. Does forcing women to work longer harm their health? Second, does increasing the FRA lower retiree incomes?

We first study health effects of increasing the FRA. Figure 12 reports mortality, i.e. the probability to die by December 2012 (the last year we observe in our data). Mortality is lower for younger women because we observe them for a shorter time period and because they are healthier.

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Figure 12: Effects on Mortality, FRA 62 to 63
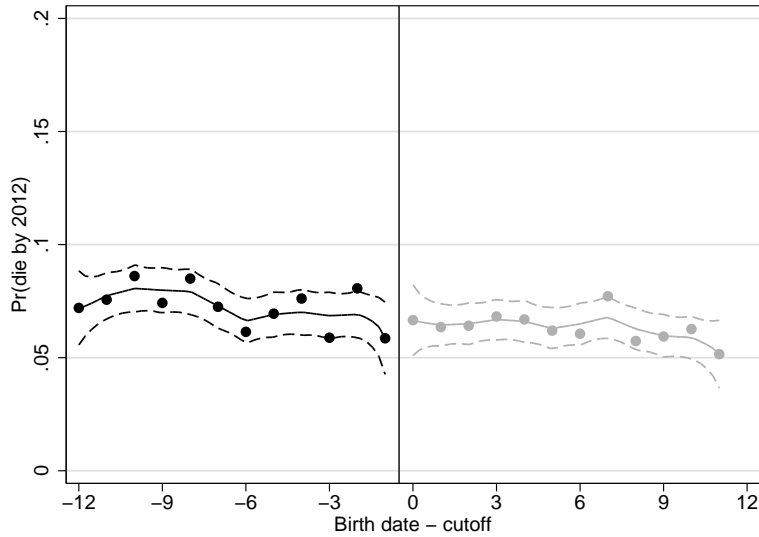
Notes: This figure shows mortality risk, the probability to die between 2001 and December 2012. Women born in 1938 (dark line) face a mortality risk of 7 to 8 percent, women born in 1939 (light line) face a risk of 5 to 8 percent. Increasing the FRA slightly but insignificantly increased mortality risk.
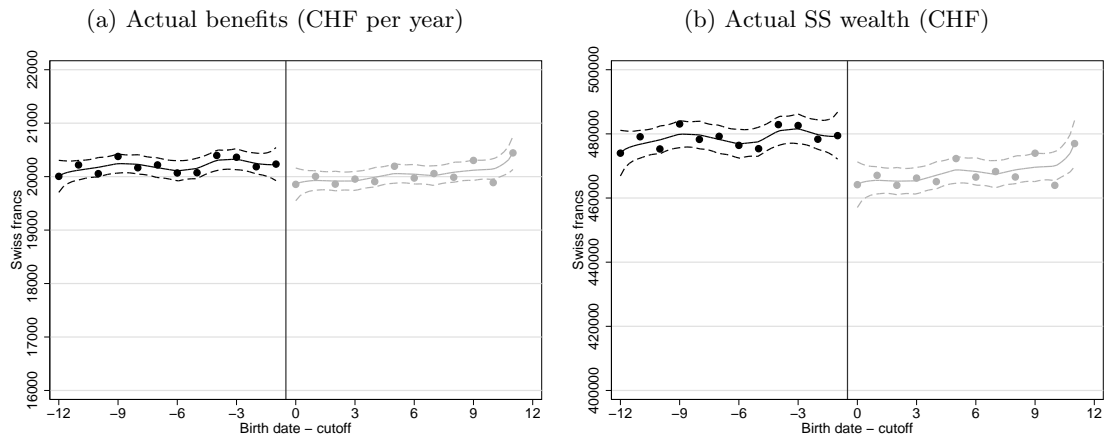
Source: Own calculations, based on SSSD.

Women born late in 1938 (dark line) face a mortality risk of about 6 to 7 percent. The risk is of similar magnitude for women born early in 1939 (light line). Mortality risk is somewhat higher for women born just after January 1, 1938 than for women just before that date. This result suggest that increasing FRA might have had adverse health consequences.

Figure 13 shows how the reform affects pension benefits and social security wealth. Figure 13(a) reports social security benefits. Women born in 1938 (dark line) who were not affected by the reform earn about 20,300 CHF per year in old age pension benefits. Increasing the FRA from 62 to 63 years reduces annual pension benefits somewhat to about 20,000 CHF. Increasing the FRA reduces pension benefits by about 1.5 percentage points, a reduction that is about half as large as the original early retirement penalty because women delay labor force exit and increase NE contributions.

Figure 13(b) shows social security wealth. The annuity value of social security benefits is on the order of 480,000 CHF to women born just before the reform cutoff; that value decreases to about 465,000 CHF for women born just after the reform cutoff. Interestingly, increasing the FRA reduces social security wealth by about 3 percentage points, an effect that is substantially larger than the

Figure 13: Effects on Pension Benefits and Social Security Wealth, FRA 62 to 63

(a) Actual benefits (CHF per year)   (b) Actual SS wealth (CHF)

Notes: This figure reports pension benefits (a) and social security wealth (b) for women born just before (dark line) and just after (light line) the January 1st, 1939 cutoff for raising the FRA from 62 to 63 years.
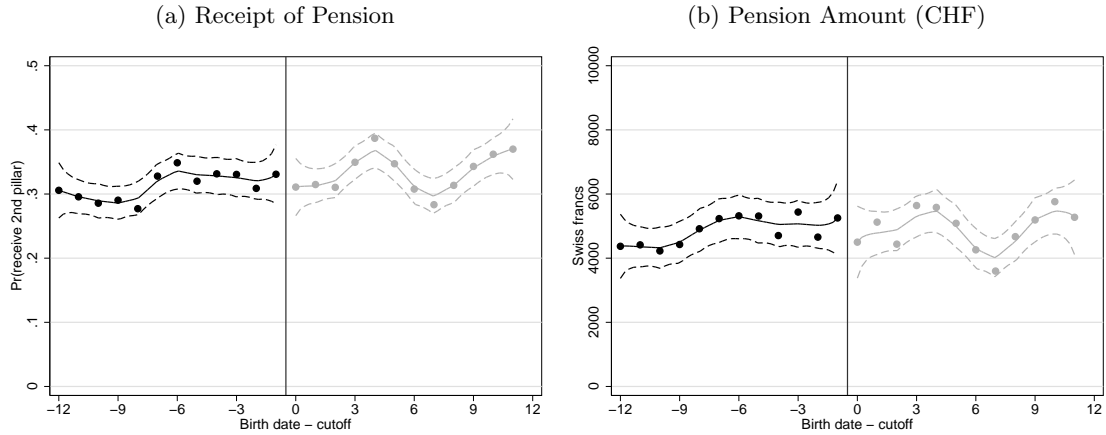Source: Own calculations, based on SSSD.

effect of that reform on pension benefits. This is because social security wealth not only looks at pension benefits (which decrease only marginally) but also at the duration of benefit receipt (which decreases due to the later claiming).

Women also receive retirement income from the occupational benefit plan (second pillar). Figure 14 reports receipt of an occupational pension benefit (a) and its level (b) for a sub-set of women who live in a large region in Switzerland. About one in three women receives income from the occupational benefit plan (Figure 14(a)) and occupational benefits add about 5000 CHF to the annual income of retired women in Switzerland (Figure 14(b)). Coverage of occupational benefit plans is low because only incomes above an upper threshold of about 20,000 CHF need to be insured. Increasing the FRA from 62 to 63 years neither affects the probability of receipt nor its level.

5.3 Anticipation Effects in the 2005 Reform?

We discussed the effects of increasing the FRA from 62 to 63 years. This reform generated large responses in the period around the old and new FRA ages but few anticipatory responses. One reason for the absence of anticipation effects might be the short time span of only four years between announcing the increase of the FRA in the 1997 reform and its implementation in 2001.

Figure 14: Occupational Pension Benefits, FRA 62 to 63

(a) Receipt of Pension

(b) Pension Amount (CHF)

Notes: This figure reports receipt of an occupational pension benefit (a) and its level (b) for women born just before (dark line) and just after (light line) the January 1, 1939 cutoff for raising the FRA from 62 to 63 years. Source: Own calculations, based on tax records.

Yet the 1997 reform mandated a further increase of the FRA from 63 years to 64 years taking effect only in 2005, after a period of 8 years. The 63 to 64 increase in the FRA allows us to study whether anticipation effects are present with a longer information window. Figure 15 shows the labor supply profile for women born in 1941 (eligible for a full pension at age 63 years) and for women born in 1942 (eligible for a full pension at age 64 years). Contrasting the labor supply profiles reveals that the largest effect of increasing the FRA again takes place at age 63 years, the year when the younger cohort lost eligibility to a full pension. But the two profiles also indicate much higher labor supply already at age 62 years, one year before the old cohort could reaches the FRA, and at age 64 years, the year after the young cohort became eligible for a full pension.

Figure 16 reports RDD effects of increasing the FRA from 63 to 64 years on employment and earnings. Figure 16(a) shows results on employment. There are no differences in employment before women were informed that the FRA would increase (to the left of the vertical line). Interestingly, raising the FRA from 62 to 63 appears to decrease employment somewhat between age 58 and 59 years but this pattern is only marginally significant. Raising the FRA encourages women to remain employed between age 62 and 63 years. The additional employment effects are sizeable: about 33 percent more women work at age 63 years, and 10 percent more women work at age 62 years, and 5 percent more women work at age 64 years. More women work at age 62 years since increasing

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Figure 15: FRA 63⇒64: Labor Supply, FRA 63 to 64
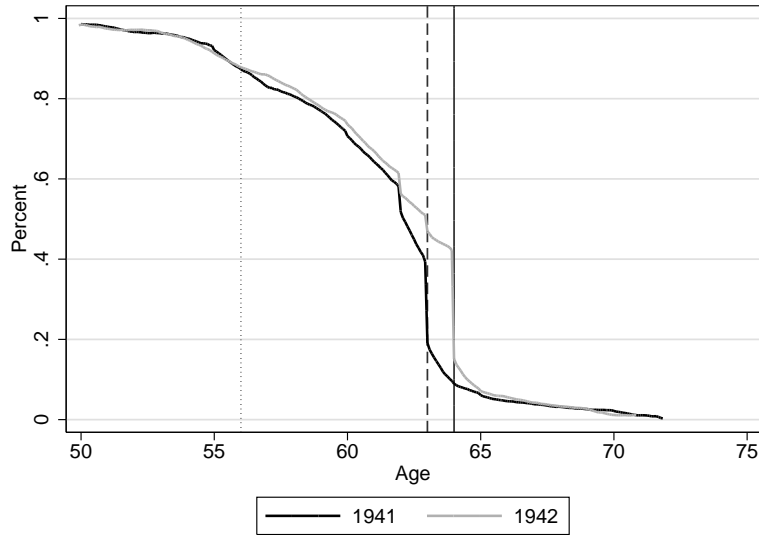
Notes: This figure shows the proportion working by age for women born 1941 (with FRA 63 years; dark line) and women born 1942 (with FRA 64 years; light line). Increasing the FRA changes labor supply strongly in the age bracket between the old FRA and the new FRA.

Source: Own calculations, based on SSSD.

the FRA to 64 years doubles the early claiming penalty at age 62 from 3.4 to 6.8 percent. More women work at age 64 since leaving the labor market is a process that takes time, at least for some women, and increasing the FRA delays that process by one year.

Figure 16(b) shows the effects of raising the FRA from 63 to 64 years on earnings. As for employment, there are no effects on earnings before the reform was announced (to the left of the vertical line). Increasing the FRA from 63 to 64 years decreases earnings at age 58 and 59, by about about 500 CHF (marginally significant). Increasing the FRA leads to significantly higher earnings at age 63 consistent with more women remaining in employment at that age. Interestingly, earnings do not increase significantly at age 62 and 64 years despite positive employment effects at those ages. This result suggests that those women who remain in the labor force work fewer days or hours.

Figure 17 shows effects on UI inflow (a), DI inflow (b), and NE contributions (c). The effect on UI inflows is about 1 percentage points, an effect of about twice the magnitude as in the previous reform. DI inflows are not affected. NE contributions are about 7 to 8 percentage points higher at age 58 and 59 years (consistent with fewer women working during those two years) and remain

Figure 16: Effects on Employment and Earnings, FRA 63 to 64
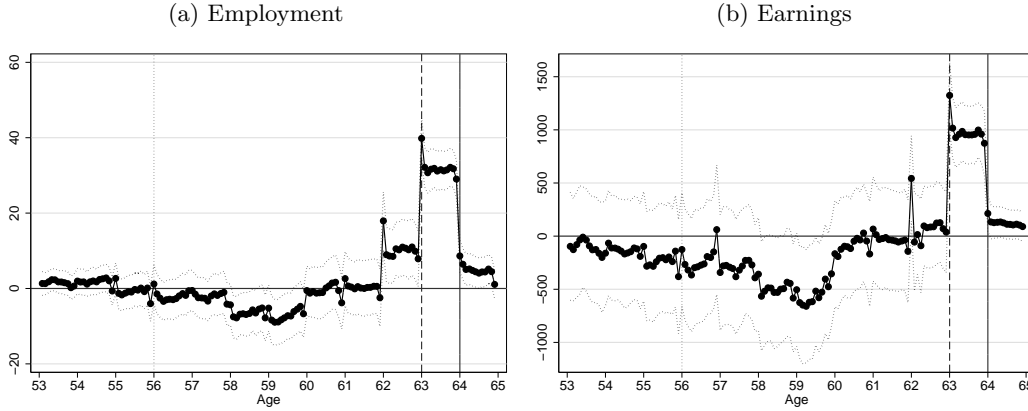
(a) Employment

(b) Earnings

Notes: This figure reports RDD estimates of the effects of increasing the FRA from 63 to 64 years on employment (a) and monthly earnings (b) along with the 95 % confidence interval. The vertical line indicates the age when women were informed of the reform.

Source: Own calculations, based on SSSD.

higher later on. NE contributions increase by 5 to 6 percentage points (not insignificantly different from zero) at age 60 and 61 years, and by a whopping 31 and 37 percentage points at age 62 and 63 years.

Our results indicate that women do not expand labor supply long before reaching the FRA. We find some evidence for anticipatory behavior for NE contributions. Women contribute to the pension system at a higher rate in order to compensate for the reduction in pension benefits. Our results also highlight that increasing the FRA affects labor supply not only in the year lost but also in the years just before the previous FRA and the year after the new FRA.

5.4 Overview

Table 2 presents an overview of the effects of increasing women's retirement age on labor supply, health, and income. Columns (1)-(3) show estimates of equation (1) for the increase in the FRA from 62 to 63 while columns (4)-(6) report analogous estimates for the increase in the FRA from 63 to 64. All specifications use a local linear regression with triangular kernel but differ in the choice of bandwidth. We report estimates for three different bandwidths: 3, 6, and 9 months on each side

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Figure 17: Effects on Unemployment, Disability, and Contributions, FRA 63 to 64

(a) UI Inflow   (b) DI Inflow   (c) NE Contributions
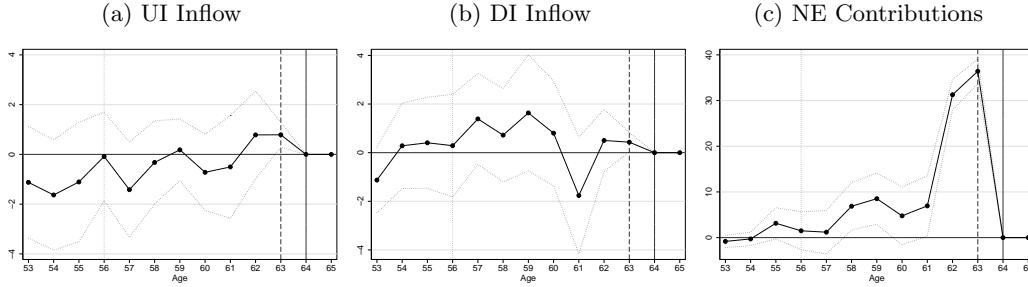
Notes: This figure reports RDD effects of increasing the FRA from 63 to 64 years on UI inflow (a), DI inflow (b), and NE contributions (c). We report average effects by age in years since monthly figures are extremely noisy (DI and UI) or because the timing of NE contributions within age years is not informative. The vertical line indicates the age when women were informed of the reform.

Source: Own calculations, based on SSSD.

of the cut-off birthdate.[5]

Column (1) of the first row shows that raising the FRA from 62 to 63 increases the exit age by 0.512 years. The effect is not very precisely estimated and statistically insignificant since the bandwidth is only 3 months on each side of the cut-off. The size of the increase in the exit age is somewhat larger, 0.662 to 0.663 years, and statistically significant for the bandwidths of 6 and 9 months, as shown in columns (2) and (3) of the first row. Columns (4)-(6) show that the estimated effect on the exit age is very similar for the second increase in the FRA from 63 to 64. This finding suggests that labor supply adjustments were similar for both increases in the FRA.

Table 2A also examines the labor supply effects in more detail by estimating the effects of increasing the FRA on employment between 61 and 64 years. Estimates indicate that most of the labor supply adjustment takes place at the old FRA (62 for the first and 63 for the second FRA increase). Employment increases by 30.1 percentage points for the FRA increase from 62 to 63 years and by 31 percentage points for the FRA increase from 63 to 64 years. Employment increases by 6.3 to 10.9 percentage points in the year before the old FRA, at age 61 for the FRA increase from 62 to 63 years, and at age 62 for the FRA increase from 63 to 64 years. Employment also increases by 4.5 to 6.2 percentage points in the year of the new FRA. Both results show that increasing the

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[5]Imbens and Kalyanaraman (2012) and Calonico *et al.* (2014) present methods for bandwidth choice in the RDD. Optimal bandwidth is between two and three months according to both approaches. We present estimates with larger bandwidths to assess the sensitivity of our results to bandwidth choice. Our preferred estimates use a bandwidth of 6 months as estimates are not sufficiently precise with only three months.

FRA affects labor supply already in the year before the previous FRA and also in the year after the new FRA.

Table 2A presents results on the all pension claiming age. Columns (1) to (3) of row 6 show that women delayed benefit claims by 0.525 years as a response to the increase in the FRA from 62 to 63. The estimated increase in the claiming age is slightly larger for the FRA increase from 63 to 64, as illustrated in columns (4) to (6) of row 6. Women delay pension benefit claiming by about as much as they delay labor force exit.

Panel B of Table 2 reports RDD estimates for the impact of the reform on mortality, social security benefits, and social security wealth. The estimates for the probability to die by 2012 are positive and on the margin of statistical significance, probably due to the lack of precision. Increasing the FRA reduces annual social security benefits only marginally by 278 to 329 CHF. The effect is small since many women delay old age pension claiming to avoid any reduction in benefits. However, increasing the FRA reduces social security wealth substantially, by 13,300 to 14,500 CHF or about 2.9 percent, because women delay benefit receipt by about half a year.

Panel C of Table 2 reports the effects of increasing the FRA for women on the government expenditures for social security and unemployment insurance. We discuss the present discounted value of future social security and unemployment insurance payments along with worker contributions to both social insurance programs. Increasing the retirement age from 62 to 63 years lowers social security payments by between 11,800 CHF and 15,400 CHF.[6] Delaying labor market exit has a second beneficial effect on the government budget. Women work longer and thereby contribute longer to social security. The additional work generates social security contributions of about 7,400 to 7,600 CHF, and unemployment insurance contributions of 400 CHF for the increase in the FRA from 62 to 63 years (there is no effect on unemployment insurance contributions for the increase in the FRA from 63 to 64 years). Some women delay labor force exit by entering unemployment. The additional unemployment benefit payments amount to 358 CHF to 1000 CHF in present discounted value. The overall effect of raising the FRA on social security and unemployment insurance is between 19,100 CHF and 21,900 CHF. The combined effect of the two increases in the FRA about 40,000 CHF or about 10 % of the present discounted cost of a retiree.

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[6]Note that we discount all values to age 57 so the present discounted value of social security benefits is not identical to social security wealth.

Table 2: Overview of Main Effects

	FRA 62 to 63 years			FRA 63 to 64 years		
	(1)	(2)	(3)	(4)	(5)	(6)
A. Labor supply and claiming effects						
Exit age (years)	0.512	0.663***	0.662***	0.556*	0.577***	0.604***
	(0.336)	(0.19)	(0.15)	(0.295)	(0.168)	(0.128)
Employed, 61 years	6.6	6.3***	8.7***	0.2	1.1	2.9*
	(4.1)	(2.3)	(1.8)	(3.8)	(2.1)	(1.6)
Employed, 62 years	23.2***	30.1***	34.1***	10.5***	10***	10.9***
	(3)	(1.9)	(1.4)	(3.9)	(2.1)	(1.7)
Employed, 63 years	3.6	6.8***	9.6***	32***	31***	32***
	(2.6)	(1.4)	(1.1)	(2.8)	(1.6)	(1.2)
Employed, 64 years	-2	0.4	1.9**	4.9**	4.5***	5.4***
	(2.1)	(1.3)	(0.9)	(2.1)	(1.2)	(1)
Claiming age (years)	0.406***	0.525***	0.514***	0.548***	0.549***	0.539***
	(0.139)	(0.082)	(0.064)	(0.153)	(0.086)	(0.067)
B. Health and income effects						
Mortality, prob(die by 2012)	0.028	0.004	0.002	0.023*	0.016*	0.011*
	(0.018)	(0.011)	(0.009)	(0.013)	(0.008)	(0.006)
SS benefits	-416	-329	-390**	-533	-278	-284*
	(377)	(219)	(166)	(342)	(204)	(149)
SS wealth	-16189*	-14489***	-15639***	-19820**	-13296***	-13571***
	(8887)	(4939)	(3911)	(8476)	(4439)	(3487)
C. Fiscal effects						
PDV SS benefits (A)	-11591	-11746**	-13468***	-14213*	-15348***	-14472***
	(9544)	(5160)	(4233)	(8354)	(4562)	(3461)
PDV SS contributions (B)	9941***	7348***	7273***	8636***	7591***	7273***
	(2372)	(1457)	(1140)	(3099)	(1962)	(1415)
PDV UI benefits (C)	1257	358	207	654	1135*	1012**
	(1195)	(673)	(555)	(966)	(588)	(459)
PDV UI contributions (D)	253	405**	383***	-80	77	7
	(309)	(179)	(141)	(329)	(197)	(140)
PDV net expenditures (A+C-B-D)	-20529**	-19142***	-20916***	-22115***	-21880***	-20740***
	(9055)	(5295)	(3886)	(8279)	(4644)	(3594)
Bandwidth (months)	3	6	9	3	6	9
Obs	5575	11329	17319	6674	13912	21325

Notes: This table reports RDD estimates of equation 1 for three different bandwidths: 3, 6, and 9 months. Columns (1)-(3) shows the estimates for the increase in women's FRA from 62 to 63 years and columns (4)-(6) shows estimates for the increase in women's FRA from 63 to 64 years. Source: Own calculations, based on SSSD.

6　Conclusion

We study how two one year increases in the full retirement age (FRA) for women affect labor supply, income, and mortality. We identify the causal impact of changes in the FRA in the context of a large pension reform in Switzerland that became effective in 1997. This reform increased the FRA for women from 62 to 64 in two one-year increments by reducing social security benefits by 3.4 % for every year of early claiming. Specifically, women born in 1938 or before were unaffected by the reform, while the FRA was increased by on year for women born between 1939 and 1941, followed by an additional one year increase for women born after 1942. The sharp discontinuities in the FRA by birth date allow us to analyze the impact of an increase in the FRA using a regression discontinuity design. Analyzing this reform is interesting because it delays the FRA substantially using a relatively modest financial stimulus.

We find that the FRA has a strong effect on the labor supply behavior of affected women. A one year increase in the FRA delays labor market exit by 7.9 months and increases the claiming age of retirement benefits by about 6.6 months. Most of the adjustment in labor supply takes place in the year women reach the pre-reform FRA (age 62 for the first and age 63 for the second FRA increase). Labor force participation also increases in in the year before the pre-reform FRA and in the year of the new FRA, suggesting that labor market exit does not adapt immediately. We find no effects on labor supply and benefit claiming of affected women's spouses, suggesting that husbands and wives do not coordinate retirement dates. We also study two welfare aspects of the reform. Delayed labor force exit increased mortality among affected women somewhat but the effect is not precisely estimated. Increasing the FRA using financial incentives reduces social security wealth mainly because women delay benefit claiming.

We conclude that strongly increasing the FRA using a modest financial stimulus is an effective policy, delaying both labor market exit and claiming of retirement benefits. Delaying labor force exit may have an adverse effect on health but its effect on retirement incomes is small. The combined present discounted savings are 40,000 CHF or about 10 % of the total present discounted cost of a retiree.

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Figure A.1: Are Covariates Smooth Around Cutoffs?

(a) Earnings Age 55 (CHF per Year)

(b) Married (%)

(c) Foreign (%)

(d) Age Difference (years)
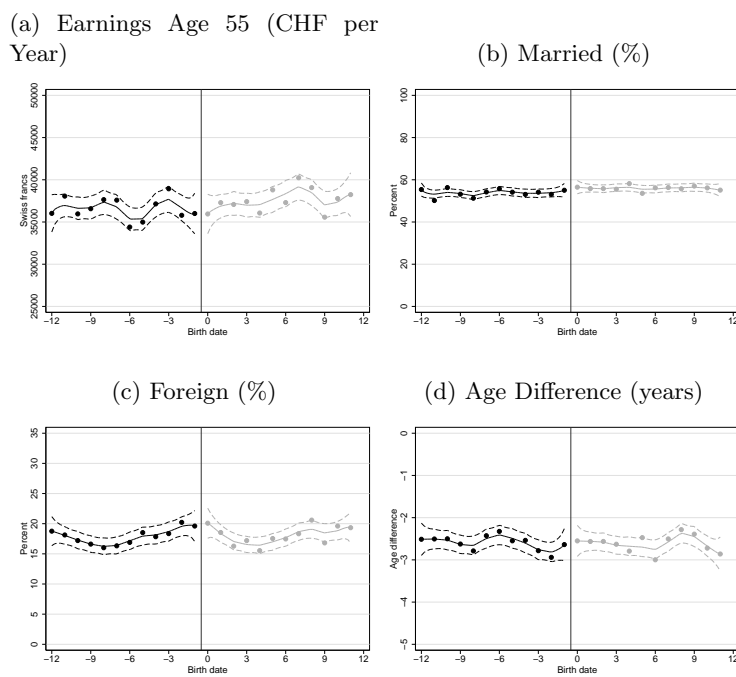
Notes: This figure shows averages of background characteristics as a function of distance to the cutoff. None of these background characteristics shows a discontinuity at the reform cutoff, suggesting that the composition of women just affected and just not affected by the increase in the FRA from 62 to 63 years is identical.

Source: Own calculations, based on SSSD.