Raising the Full Retirement Age: Defaults vs Incentives

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Abstract

Raising the full retirement age (FRA) helps pension systems, but whether this is through incentives, or through changing the default retirement age, is not well understood. We study a Swiss reform that increased women's full retirement age from 62 to 64 years, offering early claiming at a price of 3.4%. At this low price, incentives urge most women to to claim early while the FRA signals late claiming. We find that most women delayed claiming and labor supply strongly. The reform then increased the price of early claiming from 3.4% to 6.8%, leaving the FRA constant. At this high price, both incentives and default signal claiming at the FRA, but we find only little claiming at the FRA, much less than when the FRA increased. A model where some women are passive and claim when they reach the FRA, while other women are active and claim whenever it is optimal from a life-cycle perspective, suggests about 30% are passive. Passive individuals amplify the effects of FRA increases, and dampen the power of financial incentives.

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

JEL Classification: H55, J21, J26

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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.

A popular pension reform is to increase the full retirement age (FRA), the age at which individuals can draw a full pension. This policy is attractive to policy makers, but how it works is not yet fully understood. Policy makers raise the FRA by lowering the pension individuals can claim at the old FRA by the actuarially fair amount, and by publicizing the new FRA. Individuals may delay claiming a pension because claiming at the new FRA offers a higher pension, a financial incentive, or because they believe that the new FRA is the right moment to claim the pension, a default effect. In a world with rational, forward looking, and well informed individuals, the default nature of the FRA is, perhaps, less of a concern. But evidence is accumulating that individuals are overwhelmed with the complexity of pension decisions, and default effects might matter, especially among passive individuals.

We study pension claiming and exit from work decisions in Switzerland. The Swiss context is interesting from a conceptual point of view. In Switzerland, individuals have to contact local authorities to inform them when they want to start claiming a pension. Individuals that do not contact a local authority claim a pension automatically at the FRA. In Switzerland, the FRA is the default pension claiming age. In contrast, there is no mandatory retirement from work in Switzerland; the FRA is not a universal default labor market exit age. 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 over and above the disincentive effects through the tax system.

Specifically, we study the effects of a 1997 reform of the old age survivors' insurance (OASI) with two key elements. First, the reform increased the FRA in two steps, from 62 to 63 years, FRA63, and from 63 to 64 years, FRA64. Both FRA increases were implemented sharply for

all women born on the cut-off date January 1, 1939 or later for FRA63, and for women born on January 1, 1942 or later for FRA64. Second, the reform introduced early pension claiming at the early retirement age (ERA), 62 years, reducing pensions by 3.4%, for women born on January 1, 1939 or later, and by 6.8% for women born January 1, 1948 and later. A pension reduction of 3.4% is actuarially advantageous for a women with average life-expectancy, and discount rate of 2.5%, while 6.8% is considered actuarially fair (return to actuarially fair, RAF). Our analysis adopts a regression discontinuity design (RDD) comparing women born just after the cut-off dates to those born before.

The 1997 reform provides an interesting empirical design to study labor supply and pension claiming responses. Unlike standard increases of the FRA, the incentive effects of the reform are kept small, initially, when the FRA increases. Both FRA63 and FRA64 offer early retirement at conditions that appear attractive to a substantial proportion of women. During this phase, the default nature of the FRA pulls women to delay claiming while the financial incentive of the reform urges many of them to claim early. RAF raises the cost of early retirement to a level that is very expensive, triggering an incentive effect without changing the default. The 1997 reform offers an interesting design to understand better whether FRA increases work through financial incentives or through defaults.

Using data that contains the complete labor market and earnings histories of all women, we find that increasing the FRA delays pension claiming by 7 to 8 months, and only 20% of all women take-up early retirement. Increasing the FRA by one year delays labor market exit by about 6 to 7 months. Women who work near the retirement could find it optimal to delay pension claiming even if the present value of social security wealth is maximal at the early retirement age because of the additional tax levied on women who work and claim a pension. We also study women who have left the labor market before reaching the age of early retirement who are affected only by the financial effects from the pension system. We find that women who left work delay pension claiming by almost the same amount as all women. The pure financial incentive without the default, RAF, delays pension claiming by about 4 months, and has no effects on exit from work.

We rationalize this pattern of effects in a world where women can be active, or passive. Active women maximize life-cycle utility taking pension benefits, taxes, health, and mortality into account. Passive women maximize life-cycle utility as do active women, except for pension claiming. Passive

women claim an old age pension exactly at the FRA. We structurally estimate this model using data on pension claiming, earnings, consumption, taking the pension and tax rules into account. Preliminary evidence suggests about 30% of all women are passive, suggesting the presence of a considerably sized subgroup of women that does not respond to pension rules as we would expect from the textbook.

Being passive has important effects on the tools that shape pension claiming behavior. Changes to the FRA deliver stronger effects than they would in a world without passive individuals. Suppose the government raises the FRA at the actuarially fair rate, and suppose that one half of the population should delay claiming in response to this policy. Among active individuals about half will respond, but everyone will respond among the passive group. As a result of passive individuals, 65% of all individuals delay claiming instead of only 50%. In contrast, financial incentives that are not coupled with changes to the FRA are weaker with passive individuals.

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 first two steps of 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; Manoli and Weber, ming; and Gelber *et al.*, 2016) and the literature on the impact of retirement on health (Kuhn *et al.*, 2010; Coe and Zamarro, 2011; Hernaes *et al.*, 2013).[1]

This paper complements the existing literature in several ways. We study a context that allows people to deal with pension wealth shocks by timing their pension, working longer, or both. These decision margins are conceptually different, and understanding how retirement reforms affect these margins is important. Our empirical design is rich, embedding both wealth effects, and changes in the price of early claiming. This design allows learning about features the joint distribution of costs that prohibit people to adjust claiming and labor force exit, as well as their joint distribution is feasible. From the identification point of view, it is advantageous that increases in the FRA were implemented sharply, rather than more gradual increases of the FRA of a few months per age cohort, as in the UK for instance. The drastic increase in the FRA allows adopting the RDD, a transparent and powerful empirical design. Previous studies adopt a difference-in-differences or a interrupted time series design, both vulnerable to violations of identifying assumptions.

The outline of this paper is as follows. We next discuss the institutional background. Section 3 presents the data and descriptive statistics. Section 4 presents a descriptive preview of our main results. Section 5 discusses the RDD strategy and presents the main results. Section **??** describes the life-cycle model and presents model estimates. Section 7 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 Pension Wealth and Work

The Swiss OASI pays a full pension to anyone claiming at the full retirement age (FRA), 62 years for women (before 2001) and 65 years for men. Men and women need to contribute to the pension system by paying social security taxes of 8.4% on their wage, or their unemployment

[1] Chetty *et al.* (2014) discuss active and passive strategies in pension savings in Denmark, and identify the proportion of passive savers.

benefits. The contribution requirement is from age 20 until the FRA, reducing pensions by 2.3% per missing contribution year. Students, individuals living on disability benefits, and other non-employed individuals pay means-tested non-employment contributions to maintain a continuous contribution history.[2]

Women and men with full contribution history receive a pension whose level depends on average index mean annual earnings (AIME).[3] Individuals with AIME of 14,000 CHF, or lower, receive the minimum pension of 14,000 CHF, so the replacement rate is 100% or higher. Individuals with AIME of about 83,000 CHF, or higher, receive an annual pension of 28,000 CHF, so the replacement rate is 34% at the maximum pension. OASI benefits replace about 30% of pre-retirement earnings, and redistribute from high earners to low earners. Benefits are indexed to the average of price and wage inflation, adjustments taking place every other year.

Women and men who claim their old age pension later than the FRA earn an actuarially fair increase in their pension. For instance, a women who delays claiming benefits by one year receives a 5.2% higher pension than at the FRA, not capped at the maximum regular pension. But claiming late is an active decision, individuals have to inform their local OASI agency about late claiming in the year after they attain the FRA. Individuals who forget to inform an agency about delayed claiming receive the same benefits as individuals who claim at the FRA. Individuals who work beyond the FRA continue to pay social security taxes on any job with income that exceeds 1,400 CHF per month, the earnings disregard, even though the additional contribution years do not increase their pension level. Claiming before the FRA was not possible before the reform, as we discuss further below.

Married spouses are assessed as individuals until both spouses claim benefits. Couples are eligible for a joint pension that is equal to 150% of the husband's pension. A claiming husband whose wife is 55 years or older, but has not started claiming yet, receives a supplementary pension of 30% of his individual pension.

Individuals have access to two additional sources of pension wealth. The first source is an employer provided occupational benefit plan to guarantee the accustomed (pre-retirement) standards

[2]Voluntary contributions are means-tested and range from less than 500 Swiss Francs 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.

[3]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.

of living. Occupational benefits can differ enormously, as the government only regulates contributions and pay-outs. 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 heterogeneous regarding claiming and payout options.

The second additional source consists of tax deferred savings accounts, or life insurance policies, 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. Wealth in tax deferred savings account is taxed, albeit at a reduced rate.

Many OASI embed strong disincentives from working an extra year, through small or no adjustments of benefits for delays in claiming. In some systems, retiring from work and claiming are one and the same decisions. The Swiss OASI offers actuarial adjustment for delays in claiming. Claiming and retiring from work are separate decisions.

Switzerland has no mandatory retirement 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 company pensions are no longer mandatory.[4] But many employment relationships are implicitly understood to end at the FRA. On top, Employment protection legislation weakens at the FRA. Considering that workers have access to a pension after the FRA, the Swiss Supreme Court has ruled that dismissal was just in situations that would have been unjust for a worker

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

younger than the FRA. Effective employment protection is likely to be weaker beyond the FRA.

Unemployment insurance (UI) and disability insurance (DI) are income support programs that can serve to finance hidden forms of early retirement. The UI qualifying conditions are not easier for older workers on paper. But UI is more generous to individuals who are two years from the FRA, receiving extra benefits. Time on UI counts for the work requirement. DI pays higher benefits than UI. The process of receiving DI benefits is lengthier. Time on DI also counts for the work requirement.

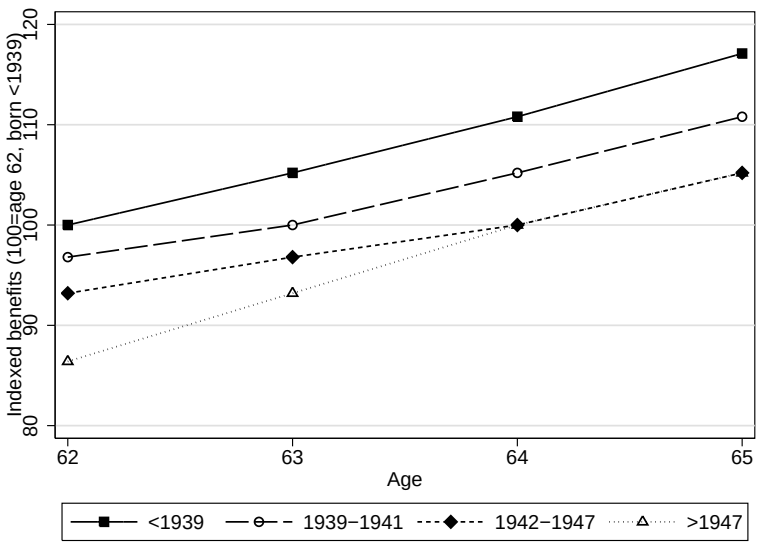
2.2 The 1997 FRA Reform

The Swiss government enacted a major reform of OASI 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 born January 1, 1939 or after. The FRA was further increased to age 64 for women born in 1942 or later, affecting women born January 1, 1942 or later.

The second major element of this reform was the introduction of early claiming. Women born January 1, 1939 or after could still claim benefits as early as age 62 subject to an adjustment of 3.4% of full benefits for each year of claiming prior to the FRA. The price for early retirement doubled, from 3.4% to 6.8%, for women born on January 1, 1948 or after. Women who wanted to claim pensions early had to inform a pension agency ideally several months in advance, one day ahead of their early retirement birthday latest. Early claimers continue to contribute to the system until the FRA, either through the social security tax, if working, or through a tax on their pension income, if not working. Importantly, there is no direct tax levied on incomes of early claimers, except for the fact that earning an income and a pension may place them in a higher tax bracket.

Figure 1 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. 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%. Women who delay 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, and it increases further for every year of delay.

Figure 1: Pension Adjustment Factor (PAF)



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. Base pension amount, 100, is the pension for a women born in 1938 or before, claiming a pension at age 62 years.

Source: Own calculations based on Swiss social security rules.

Figure 1 shows how the reform affected the PAF, in three steps. 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, with actuarially fair adjustments to pensions for those claiming later than the FRA at 63 years (the FRA63 step). 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 years, the 1942 to 1947 women were again eligible to a full pension; pensions for those delaying to claim beyond the FRA at 64 years adjusted at an actuarially fair rate (the FRA64 step). Both FRA63 and FRA64 generate a convex kink in the pension adjustment factor at the FRA. The light dotted line refers to women born 1948 or later. These women could take retirement at age 63 years at an adjustment of 6.8% to their pension, or at age 62 years at an adjustment of 13.6%. The early claiming adjustment for women born 1948 or later is double the adjustment of the older age groups. We refer to this element of the reform as the "re-instating actuarial fairness" (RAF).

Three other elements of the reform are important in our context. 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 claimed benefits, 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, and on-going pensions were re-calculated from January 1, 2001 onwards. Splitting came into effect in 1997, whereas the FRA increase affected new pensions from 2001 onwards. Splitting does not affect our analysis of the effects of the FRA on women's decisions.

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 FRA63, or RAF. Abolishing the supplementary pension may affect our estimate of increasing the FRA from 63 to 64 years, which we assess by studying single women, or women with a young husband.

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 adjustment 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. We document whether men take advantage of early retirement, at the price of 6.8%, or not.

2.3 Wealth Effects

We start with providing an overview of the shocks to pension wealth, and the price of early retirement, due to the reform (Table 1). Women born before 1938 were eligible for a full pension at age 62, and had no option to go on early retirement. Women born 1939-1941 could only attain a full pension when claiming at age 63, the default claiming age was increased by one year. But women born in 1939 could claim benefits already before the FRA, at age 62, at a price of 3.4% on their yearly pension which is quite attractive in terms of social security wealth.

FRA64 raised FRA to 64 for women born 1942-1947, so the default retirement age was increased

Table 1: Empirical Design

Reform step Cohort	Before before 1938	FRA63 1939-1941	FRA64 1942-1947	RAF 1948 after
Full Retirement Age	62	63	64	64
Price of Early Claiming	–	-3.4%	-3.4%	-6.8%

Notes: Table displays the shocks to pension wealth due to the reform. FRA is the age a women receives a full pension, the full retirement age. The FRA Wealth Shock refers to the change in wealth at the FRA valid for a cohort. For instance, the figure -5.2% means that women born 1939-1941 are eligible for 5.2% life-time pension when claiming at age 63, their FRA, than women born 1938 or before. Early retirement price refers to the reduction in pension benefits per year of early retirement. For instance, the 1939-1941 cohort could go on early retirement at age 62 with a 3.4% lower pension.

by one year again, offering early retirement at the same price as FRA63. RAF doubles the price of early retirement, without changing the default retirement age, which remains 64. The RAF step offers a drastic incentive to delay early claiming.

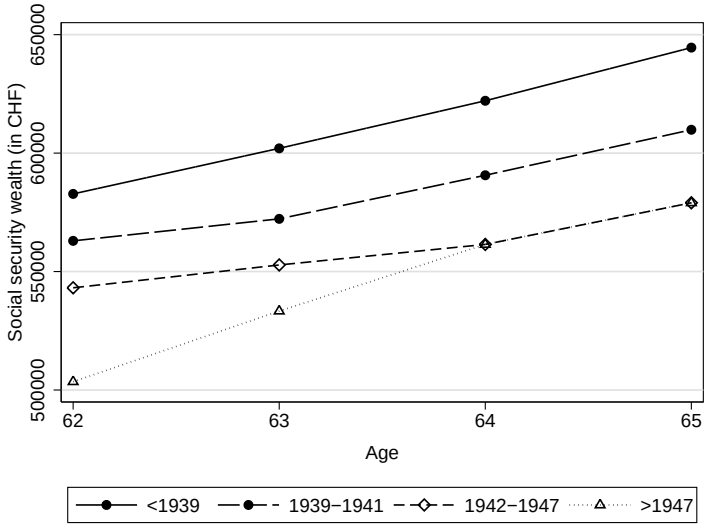
Figure 2 shows social security wealth (SSW), claiming OASI benefits between age 62 to 65, subject to the four policy regimes.[5] Social security wealth before the reform gradually increases from age 62 to 65.[6] The wealth shock triggered by FRA63 can be inferred comparing wealth at the new full retirement age to wealth that the system would have offered in the old system. FRA63 offers the same social security wealth at age 63, the new FRA, as the old system does at age 62, so women loose one year of pension benefits. Women who delay claiming of OASI benefits receive a pension that is 5.2% higher than the normal pension. The FRA wealth shock due to the FRA63 step is 5.2%. FRA64 reduces social security wealth by an additional 5.2% at the new FRA, age 64. RAF does not affect social security wealth at age 64, the FRA.

Starting from FRA63, women are not forced to claim benefits at the FRA. Figure 2 provides SSW for women claiming benefits earlier than the FRA. Women who claim benefits early, experience only a reduction in SSW of 3.4% when claiming at the FRA. Women can accommodate a part of the wealth shock by claiming benefits early, at the old FRA. FRA64 offers a similar opportunity to increase wealth by claiming benefits before the early retirement age. RAF offers an opportunity

[5] We calculate SSW as in Table 2 for a women with average life-expectancy and a discount rate of 2.5% per year.

[6] Pension adjustments are actuarially fair for the general population. Women have a higher life expectancy than the general population.

Figure 2: How the Reform Affects Social Security Wealth



Notes: Figure shows discounted social security wealth by age. We assume a discount rate of 2.5%, and average death hazard.

Source: Own calculations based on Swiss social security rules.

to fully accommodate the wealth shock that women who claim benefits early would incur. Women with high life-expectancy, or low discount rate, achieve higher SSW by delaying benefit claiming, regardless of the policy regime.

Figure 2 shows that all reform steps had sizeable effects on OASI wealth. The Swiss reform offers an interesting opportunity to study how women deal with these wealth shocks. Conceptually, we need to understand incentives for working one year longer, and incentives for claiming benefits early or late. Consider first the incentives to work and claim without liquidity constraints. Women who work just before the FRA, and leave the work force at the FRA, are likely to continue to work, because they are constrained by contracts, and employers. Increasing the FRA shifts the contract and dismissal constraint by one year. Women will work longer, at least for part of the year added to their potential work life.

Turning to incentives to claim, we have seen in Figure 2 that a women can accommodate parts of the shock to pension wealth by claiming early. Whether early, or late, claiming is optimal depends on whether the price of early retirement offered by OASI is actuarially fair. The actuarially fair price for one year of late claiming is equal to the discount rate, adjusted for mortality and benefit

indexation, or MIAD.[7] Individuals with a MIAD that is larger than the price of early retirement will take early retirement, and be better off than claiming at the FRA, so accommodate part of the pension wealth shock. Individuals with a MIADR that is smaller than the price of early retirement will take late retirement, again accommodating part of the pension wealth shock. A key advantage of our design is that we observe delays in pension claiming both at a low price, of $\alpha = 3.4\%$, and a high price, $\alpha = 6.8\%$.

With liquidity constraints, women may work until reaching the FRA because they lack the means to finance early labor market exit. Increasing the FRA, while offering early claiming, leaves labor supply of liquidity constrained women unchanged. Also, women who are liquidity constrained want to access pension benefits even if they are offered at a price that is more expensive than would be actuarially fair. Lack of liquidity or access to financial markets should not constrain reactions to FRA63 or FRA64 since claiming early appears an attractive investment for a substantial proportion of women. Women can fully accommodate the wealth effect triggered by doubling the early retirement price due to RAF by claiming benefits at the FRA. Liquidity constrained women who want to leave the labor market at the ERA, will delay both claiming and retiring from work, even though delayed claiming would be optimal.

Couples could accommodate pension wealth shocks to one spouse by adjustments made by the other spouse yet the scope for men to accommodate via labor supply reaction appears limited. Most men do not leave the labor force until the FRA, or via disability insurance, so there is little unused labor force before the FRA. Men could work beyond the FRA but face the same constraints of contracts and dismissals as do women. Men could delay claiming of pensions and earn the late claiming return on this decision. Late claiming is, however, virtually absent, perhaps due to labor supply constraints and liquidity constraints.

We have discussed retiring from work and claiming benefits as two separate decisions. This is justified from the Swiss context where the pension system allows individuals to claim a pension and work at the same time. But there are links between the two decisions. For instance, women

[7] We show this in a continuous time framework. Suppose b is the early retirement pension, i is the indexation of benefits, β is the discount rate, and γ is the average death hazard, and $\delta \equiv \beta + \gamma - i$ is mortality and indexing adjusted discount rate (MIAD). Social security wealth is $b \int_0^\infty exp(-\delta t)dt = b/\delta$. Delaying to claim benefits by one year increases benefits by $exp(\alpha)$, where α is the early retirement price (Table 1). Benefits start one period later, and social security wealth is $bexp(\alpha) \int_1^\infty exp(-\delta t)dt = b/\delta exp(\alpha - \delta)$. An individual is indifferent between claiming early, or delaying by one year, if social security wealth from early claiming equals social security wealth from late claiming, or $b/\delta = b/\delta exp(\alpha - \delta)$.

who claim a pension early, and continue to work until the FRA, will face a higher income tax bracket. This tax increase needs to be added to the price of early retirement, increasing it from 3.4% to about 4%, depending on progressivity of state and local tax. Recall that the contribution requirement extends until the FRA, not distorting the early claiming decision. Women who claim benefits early but work until the FRA contribute by continuing to pay social security taxes on the wage they earn. Women who claim early but do not work pay non-employment contributions, levied on their retirement income.

The FRA might affect claiming and retirement decisions because it is the default claiming age. Individuals who do not become active on their own will trigger the retirement claiming process automatically in the year they reach the FRA. Both early and late retirement pension claiming requires an active decision of the individual. In a situation where agents are not perfectly informed, or not perfectly forward looking, defaults can have important consequences on behavior. In particular, the FRA steps of the 1997 reform will affect pension claiming of all women who have not drawn a retirement pension before the FRA.

The FRA does not drive labor market exit decisions through universal retirement. But reductions in employment contracts, and implicit contracts, may lead to terminating employment relations at the FRA. Bur our empirical design provides key incentives to work more prior to reaching the FRA. We are optimistic that our analysis captures changes in labor supply decisions triggered by wealth shocks.

3 Data and Descriptive Analysis

Our empirical analysis uses Swiss Social Security data (SSSD) from three sources. The first data source covers all women born 1935 to 1948 and their labor market histories, starting in 1982 currently observed until the end of 2013. 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 week of birth, and nationality.

The second data source contains information on all disability and old age pension claims. 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. We match spouses to married women and have information on labor supply and pension claiming for them.

The third data source contains income tax records of individuals who live in a large region of Switzerland. These records cover the period between 2001 and 2015 and contain detailed information on income, asset holdings, and asset returns. We use these records to derive a measure of household consumption expenditure which is key for the estimation of the structural life-cycle model.

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, between 1941 and 1942, and between 1947 and 1948. We exclude the following sets of women: women who are never employed after age 50 and women who claim a disability pension before age 50.

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 2013, 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 2 reports summary statistics for the three 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), and re-

instating actuarial fairness (column 3). Panel A provides statistics on the key outcome variables. Women leave the labor force about one to two years before the FRA. The average claiming age is between 0.4 to 1.3 years below the FRA. Mortality is around 13.5% for the cohort affected by the reform increasing the FRA from age 62 to age 63 (in 2001), about 10% for the cohort affected by the increase from age 63 to age 64 (in 2005), and about 6% for the cohort affected by the doubling of the price for early claiming. Average social security benefits are around 19,000 CHF for one year. Discounted social security wealth is about 23 times larger than the annual pension benefit.

Panel B of Table 2 shows summary statistics on key background variables. About one in five or six women has a non-Swiss nationality. About 59% of women are married and wives are on average 2.6-3 years younger than their husband. About 30% of women in FRA63 sample get a supplementary pension. Supplementary pensions are less frequent in the FRA64 and RAF samples; only about 20% in the FRA64 sample and 8% in the RAF sample receive one because the 1997 reform abolished the supplemental pension for women born in 1942 or after. Indexed average earnings – the base for setting the benefit amount – are 50,956 CHF per year for the women affected by the FRA increase from 62 to 63, 1,500 CHF larger for women affected by the change in the FRA from 63 to 64 years, 2,500 CHF larger for women affected by the RAF change. Old age benefits replace about 37% (=18,999/50,956 * 100) of indexed earnings in the 62 to 63 years sample, and the replacement rate is similar for the FRA64 and RAF samples. Annual earnings at age 50 are about 40,000 CHF in the FRA63 sample and about 44,000 CHF in the FRA64 and RAF samples. 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 varies between 44.1% to 47.5%.

4 Descriptive Analysis

This section provides an overview of the effects of the 1997 reform to pension incentives. We contrast the cohort just affected by the reform with the cohort just not affected by the reform.

Table 2: Summary Statistics

	FRA 63 (1)	FRA 64 (2)	RAF (3)
A. Outcome variables			
Exit Age (years)	60.2	60.9	61.5
	(3.8)	(3.9)	(3.9)
Claiming Age (years)	61.6	62.2	62.7
	(2.4)	(2.8)	(2.9)
Mortality, Pr(die by 2013) (%)	13.5	9.9	6.1
SS benefits (CHF per year)	18,999	19,432	19,261
	(7,044)	(6,755)	(6,909)
SS wealth (CHF)	447,033	449,913	442,151
	(165491)	(155,709)	(157,835)
B. Characteristics			
% foreign	21.5	18.1	17.6
% married	58.5	59	59.1
Age wife - age husband (years)	-3	-2.8	-2.6
	(5.91)	(5.8)	(5.41)
% supplemental benefits spouse	30.6	20.7	7.9
Supplemental benefits amount (CHF per year)	1,979	1,229	128
	(3,339)	(2,796)	(966)
Average indexed earnings (CHF per year)	50,956	52,469	53,409
	(31,856)	(31,361)	(29,791)
Earnings at age 55 (CHF per year)	39,992	44,101	43,718
	(41,697)	(50,927)	(51,440)
Months employed until age 50	38.9	66.4	117
	(16)	(26.2)	(47.4)
Months unemployed until age 50	0.2	0.3	1.8
	(1.51)	(2.16)	(6.44)
Months contributing voluntary until age 50	0.3	0.4	0.8
	(3.16)	(4.71)	(6.91)
No. observations	58,932	67,015	80,663

Notes: This table reports summary statistics of key outcome variables in Panel A, and background characteristics in Panel B for the three samples we use to measure the effects of increasing the FRA and re-instating actuarial fairness (RAF). The FRA63 sample refers to the cohorts born 1938 and 1939, the FRA64 sample refers to the cohorts born 1941 and 1942, and the RAF sample refers to cohorts born 1947 and 1948.

Source: Own calculations, based on SSSD.

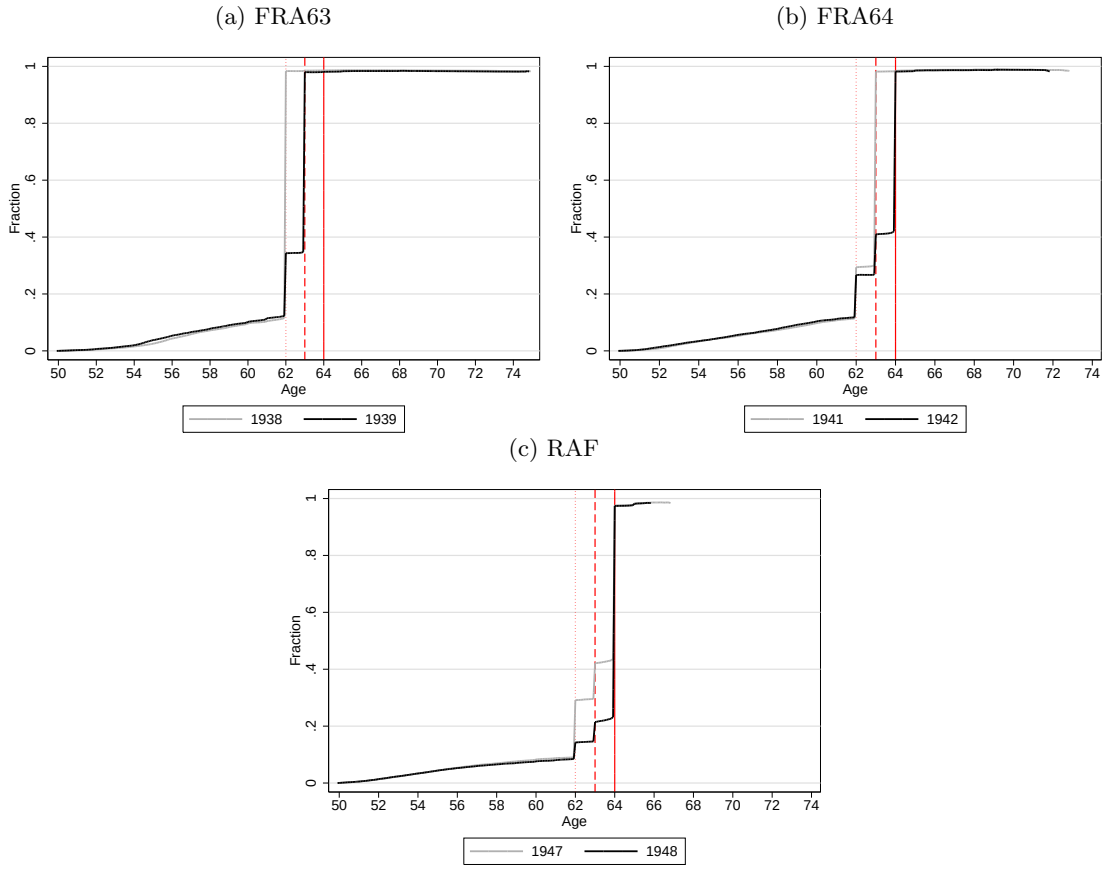
This comparison provides some first idea of the causal effect but may be confounded by trends or cohort composition effects.

Figure 3(a) reports effects of FRA63 on disability or old age pension claiming. Women born 1938 are eligible for a full old age pension at 62 years, with no possibility to draw an early retirement pension before. Pension claiming increases somewhat already between age 54 and 61 years reflecting transitions to disability insurance. Almost all women claim a pension exactly at age 62 years, so women perfectly comply with the full retirement age. Interestingly, very few women take-up the possibility to retire later than the full retirement age. We suspect this is due to the strong default rules built into the system as individuals need to actively opt out of retirement at the full retirement age. Raising the FRA to age 63 reduces pension claiming at age 62 years substantially, from about 100% to somewhat less than 40%. Women who do not claim a pension at age 62, now do so at age 63 years. But a sizeable proportion of women, about 20%, make use of the possibility to draw an early retirement pension at age 62. Raising the FRA to 63 years delays pension claiming substantially, but a sizeable proportion of women draw their pension also at the early retirement age.

How does increasing the FRA by one more year affect pension claiming? Figure 3(b) shows pension claiming for the 1942 cohort, eligible at age 64 years, and the 1941 cohort, eligible at age 63 years. The 1941 cohort has near universal pension claiming by age 63 years. Raising the FRA to 64 years reduces pension claiming from near 100% to about 40% at age 63 years. At age 64 years, nearly 100% of the treated cohort claim an old age pension. Raising the FRA by another year again substantially delays pension claiming to the FRA, but sizeable proportions of women claim an old age pension early, about 15% at 62 years or about 10% at age 63 years.

How does raising the adjustment to the actuarially fair rate affect pension claiming, the RAF step of the reform? Figure 3(c) shows pension claiming profiles for the 1948 cohort, subject to a adjustment of 6.8% for every year claimed early, and the 1947 cohort, subject to a reduced adjustment of 3.4%. Recall that sizeable fractions of women take retirement either at 62 years, about 15%, or 63 years, about 10%. The RAF reform reduces the extent of early retirement substantially, to only about 5% at age 62, and about 5% at age 63 years. The RAF reform delays pension claiming, removing early retirement incentives created by less than fair adjustments to pensions.

Figure 3: Effects on Pension Claiming



Notes: Figure shows proportion claiming an old age or disability pension, by age. Graph (a) shows the effect of increasing the FRA from 62 to 63 years, Figure (b) shows the effect of increasing the FRA from 63 to 64 years, and Figure (c) shows the effect of the double adjustment. Dark shading refers to the first cohort affected by the reform. Light shading refers to last cohort not affected by the reform.

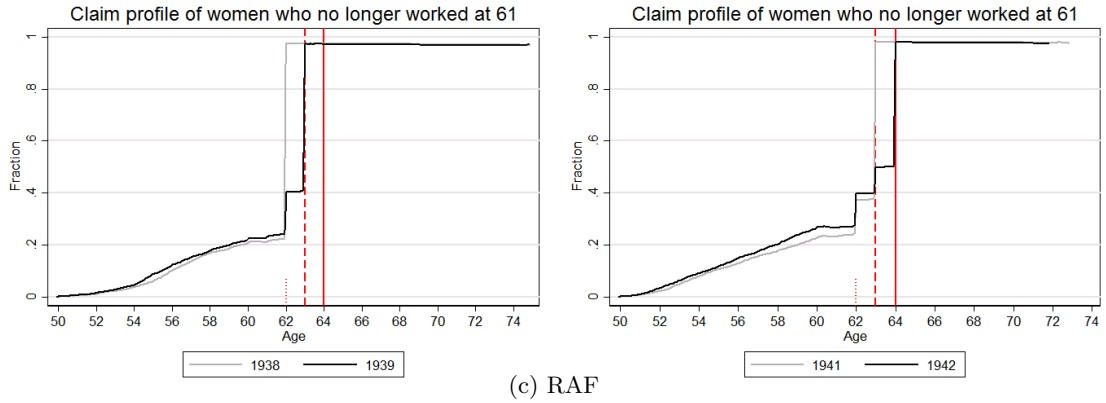
Source: Own calculations, based on SSSD.

Claiming and labor supply are linked through the tax system. Perhaps women delay pension claiming because claiming while working is expensive. But many women have left the labor market before the early claiming age, the tax costs to these women should be smaller. Figure 4 shows the claiming profile for women who left the labor market. Claiming responses are similar for these women as for the overall population, suggesting that the strong claiming response is not entirely driven by claiming and labor force interactions.

Figure 5(a) shows how the reform affected the timing of labor supply. Increasing the FRA by one year changes the timing of labor force exit around the old and new FRA in important ways. About 38% of women born in 1939, eligible for a full pension at age 63, work on the eve of their 63rd birthday but only about 12% of all women born 1938, eligible for a full pension at age 62

Figure 4: Proportion Claiming, Women Who Left the Labor Market

(a) FRA63 (b) FRA64



(c) RAF

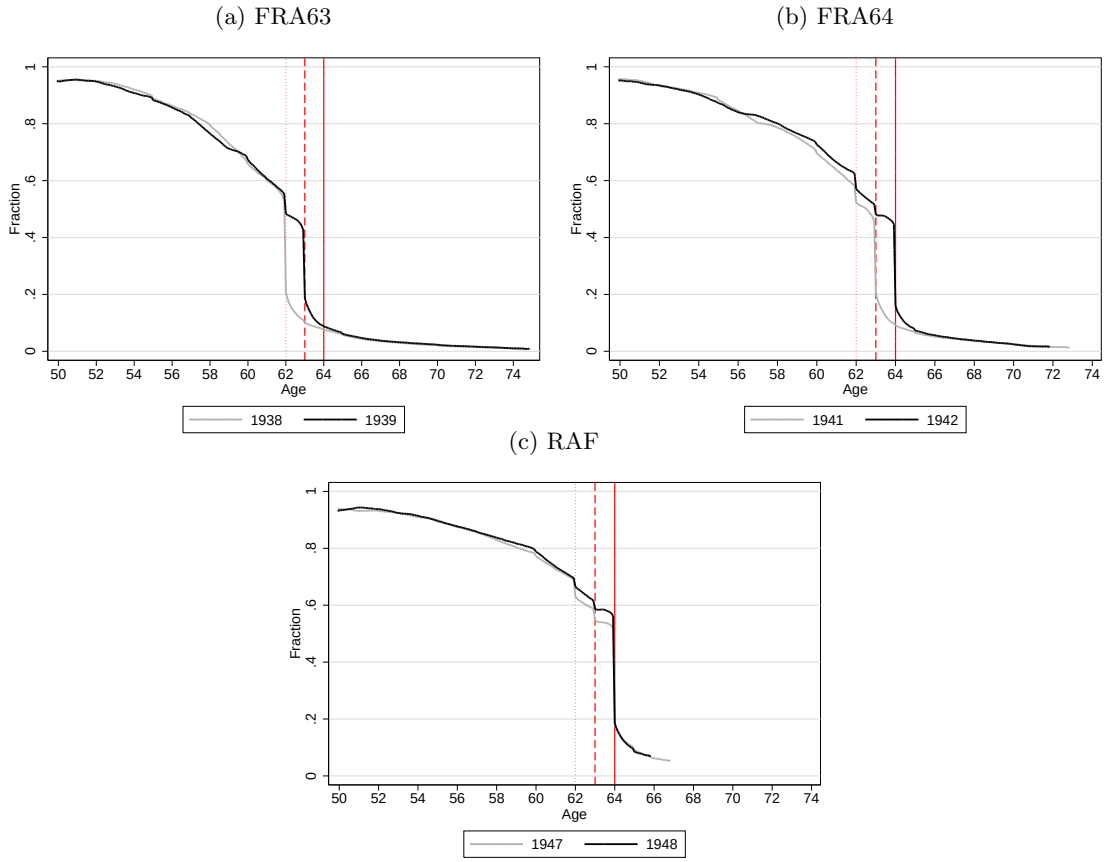


Notes: Figure (a) shows the proportion claiming by age for women who left the labor market before age 61. Figure (a) shows results for women born 1938 (with FRA 62 years; dark line) and women born 1939 (with FRA 63 years; light line). Increasing the FRA delays claiming decisions. Figure (b) shows results for women born 1941 (with FRA 63 years; light line) and women born 1939 (with FRA 64 years; dark line). Figure (c) shows results for women born 1947 (with early retirement penalty of 3.4% per year; light line) and women born 1948 (with early retirement adjustment of 6.8% per year; dark line). Increasing the FRA changes labor supply strongly in the age bracket between the old FRA and the new FRA. Increasing the adjustment has a smaller effect.
Source: Own calculations, based on SSSD.

years, 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 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%. FRA63 increases labor supply substantially, and the increase is concentrated around age 62 and 63.

Forward looking individuals might adjust labor supply already in advance of an increase in the full pension age. FRA63 was announced only four years before coming into effect, leaving little time to adjust. But FRA64, announced 8 years before coming into force, might leave enough time for anticipatory behavior. FRA64, in graph (b) of figure 5, reveals that the largest effect of increasing

Figure 5: Effects on Labor Supply



Notes: Figure (a) 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. Figure (b) shows the proportion working by age for women born 1941 (with FRA 63 years; light line) and women born 1939 (with FRA 64 years; dark line). Figure (c) shows the proportion working by age for women born 1947 (with early retirement penalty of 3.4% per year; light line) and women born 1948 (with early retirement adjustment of 6.8% per year; dark line). Increasing the FRA changes labor supply strongly in the age bracket between the old FRA and the new FRA. Increasing the adjustment has a smaller effect.

Source: Own calculations, based on SSSD.

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. This is, perhaps, some evidence for a small anticipatory behavior. Figure 5(c) shows the labor supply profile of women born 1947, the last cohort facing an early retirement adjustment of 3.4%, and of women born 1948, the first cohort facing the double adjustment. Labor supply patterns are fairly similar between the two groups, with the exception of the ages 62 and 63, the period when drawing retirement benefits became more expensive. RAF

raises labor supply but to a lesser extent than the two increases in the FRA we just discussed.

5 RDD Results

This section discusses how increasing the FRA affects labor supply, pension claiming, and income, in the regression discontinuity framework outlined earlier.

5.1 Empirical Strategy

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, and for RAF. 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:

$$y_i = \alpha + \beta D_i + f_0(Z_i - c) + D_i f_1(Z_i - c) + X_i'\delta + \varepsilon_i \tag{1}$$

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 woman's birth date, c is the cut-off date, January 1, 1939, for the FRA63, and $f_0()$ and $f_1()$ are unknown functions, allowed to differ across the threshold. The coefficient of interest is β which measures the impact of the increase in the FRA on the outcome variable y_i.

We adopt a local linear regression approach in estimating treatment effects. We present results for a bandwidth of 12 weeks, but we also present estimates for larger bandwidths. We probe sensitivity of our results to adopting a linear or quadratic specification for $f_0()$, and $f_1()$. Our baseline results adopt a linear specification.

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. There is no change in the number of women born in the weeks around the cutoff dates of January 1, 1939 (Appendix Table A.1).

We carefully examine the distribution of co-variates and see no evidence of a significant change in the means of background variables (Appendix Table A.2). These checks do not indicate concerns with the validity of the RDD. We have conducted the same statistical tests of the validity of the research design for FRA64 and RAF and find no indications that the RDD would fail.

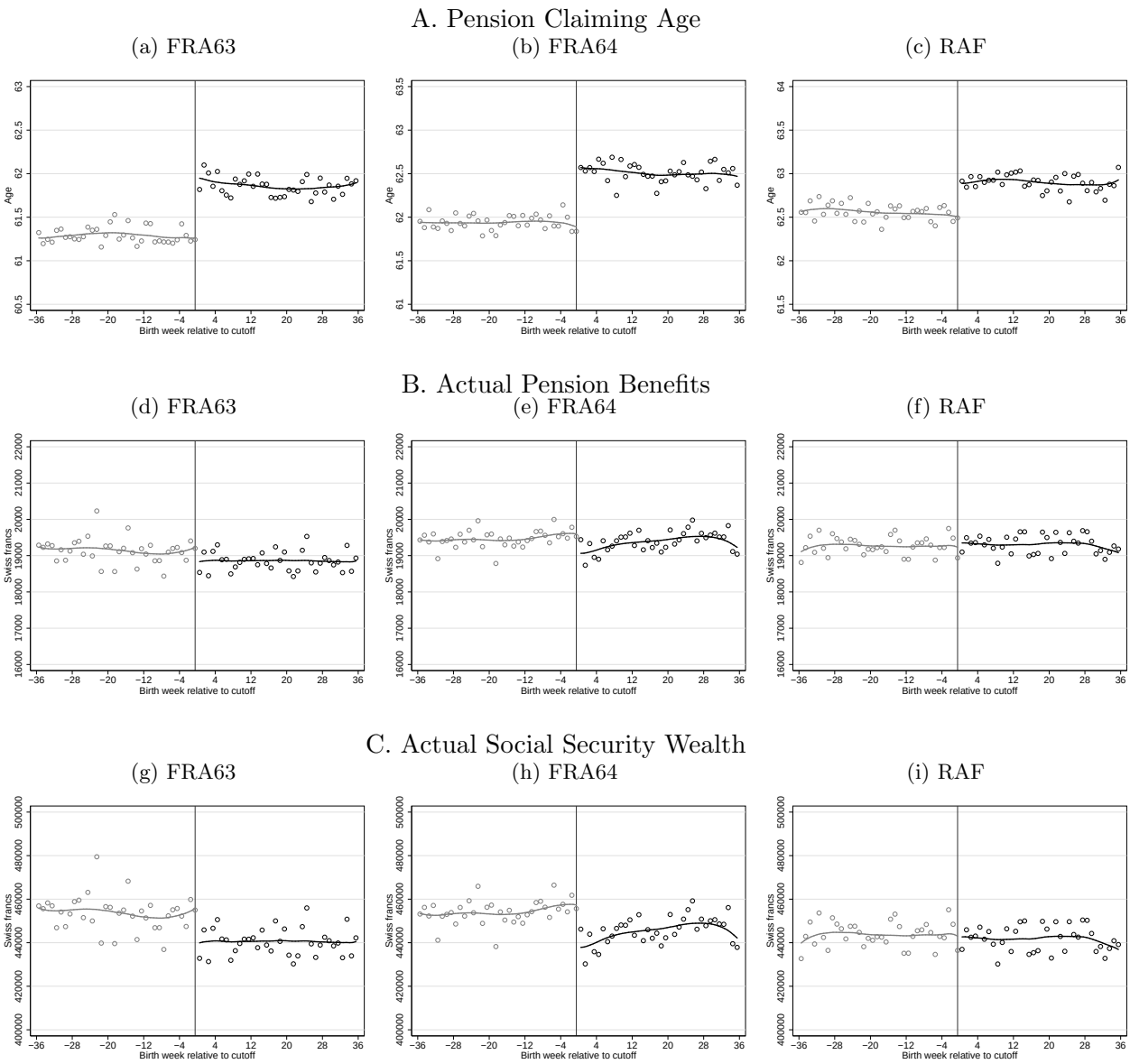
The RDD identifies the effects of an increase in the FRA only if there is no other policy change at the same age cutoff. The 1997 reform also introduced a new algorithm to separately calculate old age pensions for husbands and wives. This splitting algorithm does not affect our estimates of the effects 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. We explore sensitivity of our results for FRA64 in a sub-sample of women that were not affected by abolishment of the supplementary pension.

5.2 Effects on Pension Claiming and Income

How does increasing the FRA affect pension claiming behavior? Figure 6A displays how increasing the FRA from 62 to 63 years affects the 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. Women also respond strongly to the increase of the FRA from 63 to 64 years (figure 6(b)). Women born before the January 1, 1942 cutoff draw an old age or disability pension on average at age 62.5 years. Women born just after the reform cutoff draw a pension at 63 years on average, a delay of about 0.5 years in pension claiming. Women also respond to doubling the adjustment factor an old age pension early (figure 6(c)). Women born before the January 1, 1948

cutoff, facing a reduced adjustment of 3.4%, start claiming an old age pension at about 63.1 years. Women born just a month later, facing an adjustment of 6.8%, start claiming a pension at about 63.4 years. The RAF reform delays pension claiming considerably, but not to the extent as the two FRA reforms.

Figure 6: Wealth Shocks Cause Claiming Responses



Notes: This figure reports the average age when women start claiming any pension (A), actual pension benefits when claiming (B), and actual social security benefits (C). The x-axis reports the date of birth minus the reform cutoff. The light line refers to women born just not affected by the reform, the solid line refers to women just affected by the reform.

Source: Own calculations, based on SSSD.

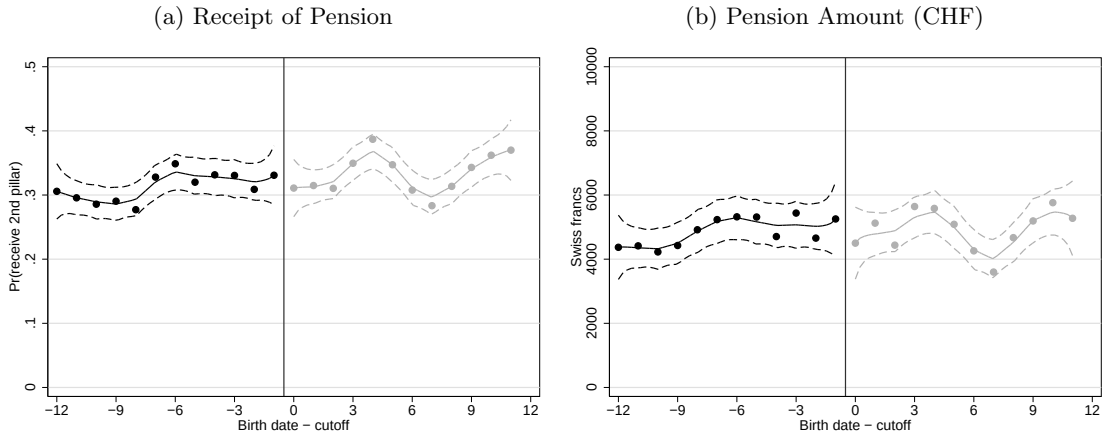
Comparing women born just before or after a January 1 cutoff date may be problematic if there are other elements of the pension system that change. We have explored cohort contrasts on January 1 in all years covered by our data (Appendix Figure A.2). We do not find any significant effect at Placebo reform dates. On actual reform dates, the effects we document clearly stand out. We are confident that main estimates do not pick up other changes at the January 1 cutoff date.

Figure 6B shows how the reform affects social security pensions. Women born in 1938, not affected by the reform, earn about 19,000 CHF per year in old age pension benefits. Increasing the FRA from 62 to 63 years reduces annual pension benefits to somewhat less than 19,000 CHF. Increasing the FRA to 64, FRA64, appears to decrease social security benefits somewhat, but the effect might be driven by upward trends to either side of the birthdate cutoff. The double adjustment reform RAF does not affect social security benefits. This is remarkable as the doubling of the pension adjustment factor introduced strong reductions in pension benefits for those taking up early retirement. But we have seen earlier that the RAF reform eliminated almost all early retirement.

Social security benefits were not strongly affected by the reform. How about social security wealth? Figure 6C shows that the annuity value of social security benefits is on the order of 450,000 CHF to women born just before the reform cutoff; that value decreases to about 435,000 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 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). Increasing the FRA by one more year, FRA64, also reduces social security wealth. The reduction in social security wealth appears larger than for the first increase in the FRA, FRA63, but this might, again, be due to upward trends on either side of the threshold. Re-instating actuarial fairness, RAF, has no impact on social security wealth, because it triggered substantial adjustment in pension claiming.

Women also receive retirement income from the occupational benefit plan (second pillar). Figure 7 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 7(a)) and occupational benefits add about 5000 CHF to the

Figure 7: Occupational Pension Benefits, FRA63

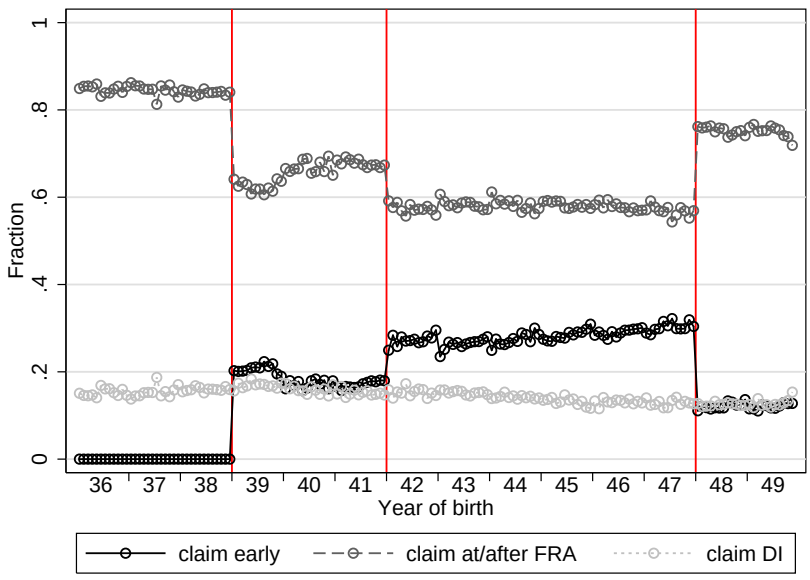


Notes: This figure reports receipt of an occupational pension benefit (a) and its level (b) for women born just before (dark line) and just after (light line) the January 1, 1939 cutoff for raising the FRA from 62 to 63 years.
Source: Own calculations, based on tax records.

annual income of retired women in Switzerland (Figure 7(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.

The proportion claiming at the ERA, when early claiming is available at the low price of 3.4%, could be low because early claiming was not available before the 1997 reform. People might have lacked information to fully exploit it initially, or have had little experience with early claiming. Figure 8 reports the fraction of women claiming before the FRA, at the FRA, or claiming DI pensions, by month of birth. The proportion of women claiming benefits before the FRA is zero for cohorts born before January 1939 because claiming before the FRA was not possible. The FRA63 change, increases early claiming to 20%, a proportion resting stable, or declining a bit. The FRA64 policy change immediately increases early claiming to 25%, a proportion that increases gradually to somewhat more than 30%. The cohorts born 1942 to 1947 may have benefitted from some learning over time. RAF reduces early retirement immediately to about 10%, the proportion increasing somewhat to 14% for women born in 1949. Overall, Figure 8 does not suggest that lack of information, or learning over time, explains why comparably few women take early retirement.

Figure 8: Claiming DI, before the FRA, on or after the FRA



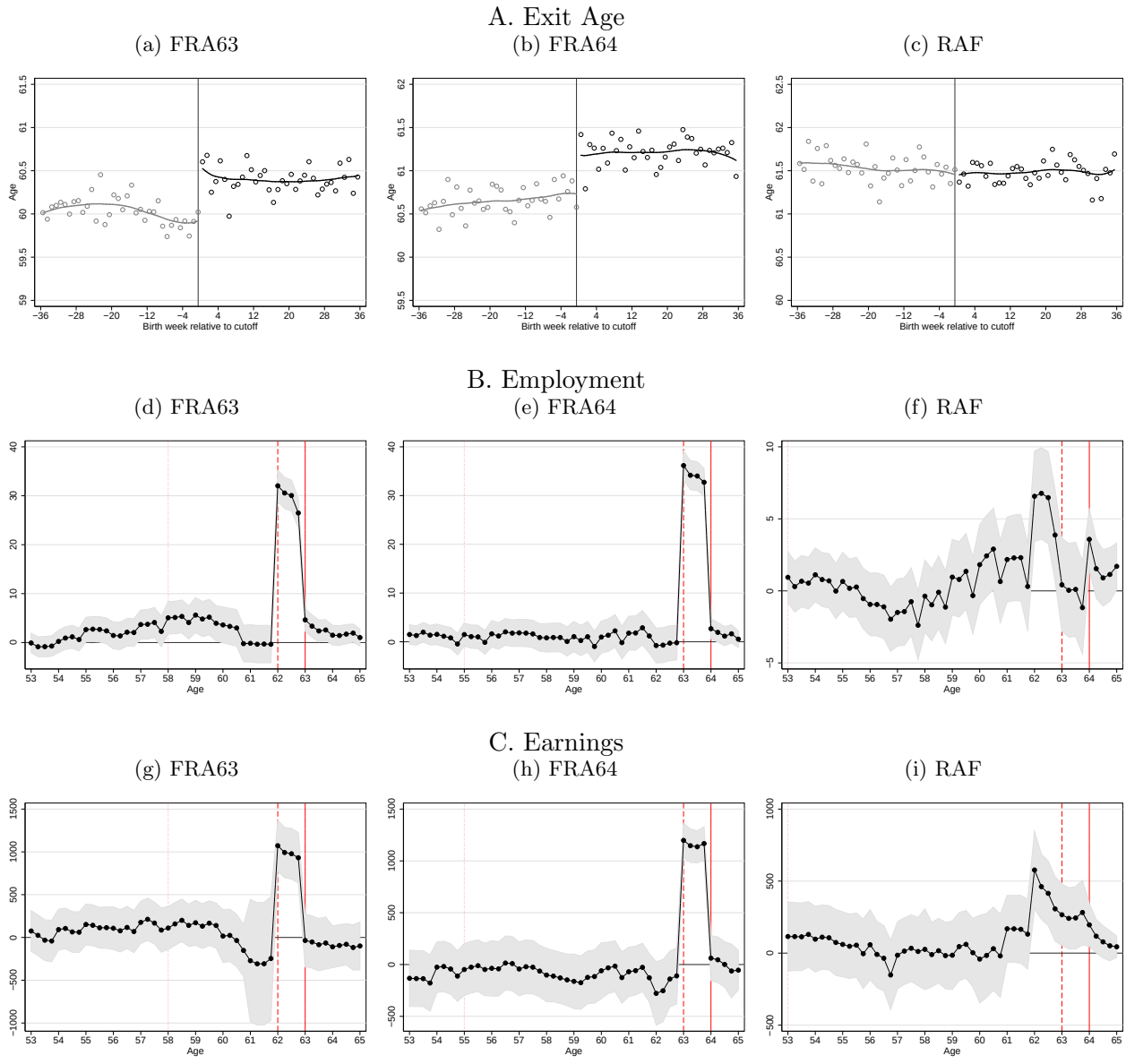
Notes: This Figure shows the proportion of women claiming before the FRA, claiming at or after the FRA, and claiming a disability insurance pension, for all women born between 1936 and 1949.
Source: Own calculations, based on SSSD.

5.3 Labor Supply Effects

We document the effects of increasing the FRA, or re-instating actuarial fairness, in graphs that show the labor force exit age by month of birth (Figure 9A). Increasing the FRA from 62 to 63 years affects women's decision to leave the labor force. To deal with considerable noise, we focus on changes in the age bracket 60 to 66 years, setting exit ages below 60 years to 60 years, and exit ages above 66 years to 66 years. Women who were born in 1938 and eligible for a full pension at age 62 (solid line) leave the labor force at age 61.5 years. In contrast, women who were born in 1939 and subject to the new FRA at age 63 years leave the labor force at age 61.8 years. Women born early in 1939 delay labor force exit by about 0.5 years compared to women born late in 1938. Increasing the FRA from 63 to 64 years, FRA64, also raises the labor force exit age. Women born before the birth date cutoff, January 1, 1942, leave the labor force at 62, whereas women born just after the cutoff date work for about 0.4 more years. Re-instating actuarial fairness, the RAF step of the reform, does not affect labor force exit.

When, in their life cycle, do women work more? Figure 9B reports RDD effects on employment,

Figure 9: Wealth Shocks Cause Labor Market Responses



Notes: This figure reports the average labor force exit age (A), employment (B), and quarterly earnings (C). Leftmost vertical line indicates when women heard first about the reform. The two remaining lines highlight the old FRA, and the new FRA. Points refer to RDD estimates adopting the specification in **??**.

Source: Own calculations, SSSD.

between age 53 and age 65, at quarterly frequency. Women affected by the FRA63 worked about at the same rate before age 57. From age 57 there is a small, but significant increase in the employment rate that would be consistent with forward looking extension of work to accommodate an anticipated wealth shock. But the bulk of the response is between age 62 and 63 when women

in the old system left the labor market, and women in the new system staid on to recoup part of the loss in wealth. The employment rate remains somewhat higher after age 63 due to women who work beyond the FRA delaying exit by one year as well. Women affected by the FRA64 show a very similar employment pattern as women affected by FRA64, expect for the anticipated employment response. Women affected by RAF work significantly more between age 62 and 63, when the price of early retirement was doubled. The employment response to RAF is about six times smaller than the corresponding response to FRA.

From the point of view of the individual, the additional earnings, due to more work, are central. Figure 9C shows effects on quarterly earnings, from age 53 to age 65. Increases in the FRA by one year add about 1000 CHF per quarter to the earnings of affected women, or about 4000 CHF. The additional earnings are about 25% of the wealth shock remaining after claiming adjustment. Earnings profiles are not affected before the FRA, suggesting that women do not adjust employment patterns in a way to affect earnings, even before reaching the old FRA. RAF employment responses increase earnings significantly, by about 250 CHF per quarter, on average, adding about 1000 CHF to life time earnings.[8]

5.4 RDD Estimates

Table 3 presents an overview of the effects of FRA increases, and the change in the price of early retirement on the wealth shock (A), before accommodation, benefit claiming (B), and labor supply (C).[9] Increases in the FRA considerably lower social security wealth, FRA63 by about 16,000 CHF (or 3.3%), and FRA64 by about 19,000 CHF (or 4.1%). RAF also lowers social security wealth, by about 15,000 CHF (3.2%). Effects on social security wealth are robust to the choice of bandwidth for FRA63 and RAF, and somewhat sensitive to bandwidth for FRA64.

These wealth shocks trigger considerably delays in pension claiming, by 0.6 years for FRA63 and FRA64, and by 0.4 years for RAF (Table 3B). The reform delayed the average age of pension claiming by about 1.6 years, an almost one for one delay in pension claiming. Changes to claiming moderate the shock to social security wealth by about 1,600 CHF, 10% of the FRA63 shock, or

[8] We have also explored how the 1997 reform affected flows into UI, and DI, and find statistically significant but economically small effects.

[9] All specifications use a local linear or quadratic regression with triangular kernel with a bandwidth of 12 weeks on each side of the cut-off birthdate.

Table 3: Labor Supply and Claiming Effects

	FRA63		FRA64		RAF	
	linear	quadratic	linear	quadratic	linear	quadratic
	(1)	(2)	(3)	(4)	(5)	(6)
A. Wealth Shock						
SSW, no adj.	-16,485***	-16,147***	-25,596***	-18,917***	-16,098***	-15,607***
	(6,157)	(2,834)	(5,470)	(2,444)	(4,751)	(2,190)
B. Benefit claiming						
Claiming age (years)	0.682***	0.6***	0.588***	0.562***	0.323***	0.391***
	(0.089)	(0.042)	(0.098)	(0.044)	(0.093)	(0.042)
SSW, observed	-14,419**	-14,314***	-21,051***	-14,113***	-2,041	-334
	(5,953)	(2,738)	(5,460)	(2,444)	(4,851)	(2,232)
C. Retiring from work						
Exit age (years)	0.57***	0.475***	0.408***	0.471***	0.033	-0.032
	(0.139)	(0.063)	(0.134)	(0.062)	(0.121)	(0.055)
Bandwidth (weeks)	12	12	12	12	12	12
Obs	14,581	14,581	16,224	16,224	19,937	19,937

Notes: This table reports RDD estimates of the effects of FRA63, FRA64, and RAF, adopting a 12 weeks bandwidth.
Source: Own calculations, SSSD.

4,000 CHF, or 20% of the FRA64 shock. Observed social security wealth is not affected by RAF. The RAF claiming response therefore exactly offset the initial RAF wealth shock.

FRA wealth shocks lead to substantial delay in labor market exit (Table 3C). FRA63 increases work by about 0.5 years, and FRA64 adds about 0.45 years. Women respond to the uninsured part of the wealth shock by working longer. In contrast, RAF does not trigger a significant labor market response, consistent with our earlier finding that claiming adjustments suffice in dealing with the RAF wealth shock.

We have explored estimates with larger and smaller bandwidths, or with control variables to assess the sensitivity of our results to bandwidth choice. Our estimates are robust to these alternative specifications. Figure A.1 reports estimates of the effects on labor market exit, and claiming age, varying bandwidth between 4 and 38 weeks. Effects are broadly robust to varying the bandwidth. We have also looked into Placebo and real RDD estimates (Figure A.2). Reform effects are orders of magnitude larger than effects of Placebo reforms.

Recall that the reform abolished supplementary pensions for couples with a retired husband,

Table 4: Household Considerations

	FRA63		FRA64		RAF	
	linear	quadratic	linear	quadratic	linear	quadratic
	(1)	(2)	(3)	(4)	(5)	(6)
A. Single or Age Balanced						
Exit age (years)	0.337*	0.443***	0.398**	0.464***	0.087	0.085
	(0.187)	(0.086)	(0.178)	(0.081)	(0.16)	(0.073)
Claiming age (years)	0.632***	0.548***	0.582***	0.578***	0.445***	0.457***
	(0.135)	(0.063)	(0.141)	(0.063)	(0.131)	(0.059)
Obs	7968	32487	9220	37903	11372	45970
B. Husband's response						
Exit age (years)	-0.115	0.09	0.021	0.091	0.095	-0.003
	(0.165)	(0.075)	(0.159)	(0.072)	(0.153)	(0.071)
Claiming age (years)	-0.038	-0.034	-0.086	-0.008	-0.087	-0.158***
	(0.11)	(0.05)	(0.11)	(0.049)	(0.132)	(0.061)
Bandwidth (weeks)	12	12	12	12	12	12
Obs	7,885	7,885	9,106	9,106	11,104	11,104

Notes: This table reports RDD estimates of the effects of FRA63, FRA64, and RAF, adopting a 12 weeks bandwidth.
Source: Own calculations, SSSD.

and a non-retired wife older than 55 years and born after 1942. Supplementary pensions were abolished at the same time as the FRA was increased for wives whose husbands were older. We assess sensitivity of our results for FRA63 by considering single women, or women living with a husband who is at most two years older. Indeed, supplementary pensions are much less frequent among women born 1942 or later, compared to women born at the end of 1941 (Appendix Figure A.3(a)). But single women and age balanced couples were not affected by the reform, since these couples had no access to a supplementary pension (Appendix Figure A.3(a)).

We assess robustness of our results for the FRA64 element of the reform in the sub-sample of single or age balanced couples (Table 4A).[10] Results for this sample are virtually identical to main results (Table 3). Abolishing the supplementary pension does not appear to affect labor supply and claiming decisions.

We also assess to what extent spouses react to their partner's wealth shock (Table 4B). Partners

[10]We have explored how different sub-groups react to pension wealth shocks (see Tables A.3 and A.4 in the appendix.

do work longer to help accommodate the pension wealth shock, nor do they adapt pension claiming in response to the FRA increases. Interestingly, husbands whose wife was affected by the substantial increase in the price of early retirement, RAF, decided to claim benefits somewhat earlier, by about one month. We speculate that RAF, by offering early retirement at the same price to both spouses, might have facilitated early retirement coordination, but hesitate to draw strong conclusions as the estimate is only significant in one specification.[11]

How did the reform affect the government's social insurance budget? Table 5 shows effects on benefits and contributions, both for OASI and unemployment insurance (UI).[12] We report the present discounted value of benefits and contribution, discounted to the FRA for a women with average life expectancy. Increasing the FRA to 63 reduces social security benefits, by about 15'000 CHF in present discounted value terms, or by about 3%, and FRA63 raises contributions by about 4500 CHF in present value terms, raised on the extra work triggered by the reform. Unemployment benefits do not increase, but contributions to the unemployment insurance fund do, again levied on the extra work triggered by the reform. On net, increasing the FRA lowers the present discounted cost of one women by 20'000 CHF. FRA64 has a somewhat stronger effect, reducing the net cost by at least 24'000 CHF. In contrast, doubling the price of early retirement, RAF, reduces social security benefits by about 6'000 CHF, and raises social security contributions and unemployment insurance somewhat, even though effects are not statistically significant.

Taken together, the reform decreased the cost of one claimant by about 50'000 CHF, or a bit more than 10% of the cost of one claimant. Interestingly, increases in the FRA generated about 75% of the savings, despite offering early retirement at a fairly low price. This is because an FRA increase, removing an entire year of pension payments, triggers a strong reduction in pension benefits that cannot be accommodated through claiming adjustments. Women reacted to the increases in the FRA by delaying pension claiming, contributing additional savings in benefit payments. The RAF step, abolishing early retirement at a low price, contributes 25% to the savings, reducing early claiming. RAF would have contributed more, if more women had found it in their interest to claim benefits earlier.

[11] 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, perhaps because wealth shocks were smaller for Swiss women, compared to U.K. women.

[12] The reform also affects income tax receipts, not shown in the table. Our estimates are a lower bound for the effect on the budget.

Table 5: Fiscal effects

	FRA63		FRA64		RAF	
	(1) linear	(2) quadratic	(3) linear	(4) quadratic	(5) linear	(6) quadratic
A. Effects on OASI						
Benefits (A)	-15,013***	-13,784***	-25,619***	-18,881***	-5,818***	-5,962***
	(5,379)	(2,471)	(4,818)	(2,181)	(1,029)	(466)
Contributions (B)	4,375**	5,050***	4,238**	4,969***	1,422	1,139
	(1,949)	(685)	(1,675)	(876)	(1,440)	(701)
B. Effects on UI						
Benefits (C)	-289	-93	531	539**	-280	-5
	(559)	(268)	(533)	(243)	(560)	(253)
Contributions (D)	296	260***	93	292***	235	102
	(209)	(74)	(167)	(84)	(160)	(74)
C. Net Effects						
Expenditures (A+C-B-D)	-19973***	-19,187***	-29,419***	-23,602***	-7,754***	-7,207***
	(5,530)	(2,422)	(4,736)	(2,191)	(1,868)	(884)
Bandwidth (weeks)	12	12	12	12	12	12
Obs	7,885	7,885	9,106	9,106	11,104	11,104

Notes: This table reports RDD estimates on the present discounted value of benefits and contributions to the old age and survivors' insurance (OASI), and unemployment insurance (UI). We assume a discount rate of 2.5% per year, and discount to the FRA, 63 years in FRA63, and 64 years for both FRA64 and RAF.
Source: Own calculations, SSSD.

6 The Role of the Default Option

The reduced form evidence may be inconsistent with individuals making claiming decisions optimally, individuals appear to delay claiming more than they should. However, reduced form evidence alone can not assess whether claiming behavior is optimal, or not, because optimal claiming depends on mortality, tax incentives, and labor market opportunities in complex ways.

In this section, we develop a simple estimable life cycle model of claiming and labor supply. This model provides an optimal claiming date for rational forward looking optimizing individuals, but it also allows for two types of individual in the population. Active individuals who make choices to maximize discounted expected utility at each point in time given preferences and constraints, and passive individuals who claim at the FRA regardless of their preferences and constraints, but make all other choices optimally. Note that this model nests a world without passive decision makers, without departures from optimality, and a world where some individuals are passive. Structural estimates of the model will then indicate to what extent behavioral responses to the reform were consistent with optimizing behavior, or not.

We first describe the model. We then illustrate that the model is identified, and discuss estimation of the model. Finally, we present model estimates.

6.1 Model estimation and identification

6.1.1 Model

A forward looking individual, who lives for at most T periods, decides each period $t < T$ whether to retire from the labor force $r_t \in \{0, 1\}$, whether to claim benefits $b_t \in \{0, 1\}$, and how much to consume, C_t; t indexes the individual's age.[13] Let retirement and claim status *entering* period t be given by R_t and B_t respectively. We assume that the retirement decision is irreversible–there is no re-entry to the labour market once the individual has exited. Formally:

$$R_t = R_{t-1} + r_{t-1}(1 - R_{t-1}) \tag{2}$$

[13] While t indexes both time *and* the individual's age in most structural studies of retirement (i.e., French 2005), we must keep the variables separate as we rely on institutional changes over time as a key source of variation. We will also keep track of the individual's birth cohort so that we can exploit variation induced by the policy reform.

We also assume that the decision to claim is irreversible–an individual who has made a claim may not "un-claim." However, motivated by the apparent tendency in the data of individuals to claim at the default retirement age in spite of financial incentives to do otherwise, we assume that there are two subpopulations of individuals. The first are *active* individuals, those who are fully rational and optimally claim based on their preferences and the constraints they face. Denote this subpopulation by $\mathcal{A}$. The second subpopulation is comprised by *passive* individuals. These individuals claim with probability 1 at the default age regardless of their preferences and the constraints they face. Denote this subpopulation by $\mathcal{I}$. Let $a \in \{0, 1\}$ indicate that the individual is active, that is, $a = 1 \Leftrightarrow i \in \mathcal{A}$. Then, letting FRA denote the default full-retirement age, we can express the claim status as:

$$B_t \quad = \quad a(B_{t-1} + b_{t-1}(1 - B_{t-1})) + (1 - a)\mathbf{1}\{FRA < t\} \tag{3}$$

So individuals who are passive ($a = 0$) have claimed iff they are past the default claiming age. Active individuals ($a = 1$), on the other hand, make claim decisions optimally as a function of their preferences and constraints. We describe this in more detail below. The proportion of active individuals in the population is given by $P(i \in \mathcal{A}) = \pi$ where $0 < \pi < 1$. There are no restrictions on the retirement decisions of the passive other than the indirect restriction through claiming.

The individual obtains utility from consumption and leisure. Formally, we assume a per period utility associated with decisions b, r:

$$U_t(C_t, b, r) = \frac{C_t^{1+\gamma}}{1+\gamma} - \delta(M_t) * (1 - R_t) + \varepsilon_t(b, r) \tag{4}$$

The function $\frac{C_t^{1+\gamma}}{1+\gamma}$ represents the utility obtained from current period consumption C_t, while $\delta(\cdot)$ denotes the disutility form working, a function of current health status M_t. Note that the disutility from work is paid if the individual is in the labor force *entering* the current period.[14] Individuals have two possible health states M_t at age t, "good" and "bad." We allow the disutility of work to

[14]The individual's retirement decision does not take effect until the subsequent period. This is a "time to build" assumption, motivated in part by what we observe in the data, that individuals retire part way through a year and thus work and earn labor income in the year they decide to retire, and do not actually exit the labor force until the following year.

depend on an individual's health in the following way:

$$\delta = \delta_0 + \delta_1 \mathbf{1}\{M_t = bad\}$$

Finally, ε_t is an unobservable (to the econometrician) choice specific component of utility.

We make the following assumption, which greatly simplifies the solution and estimation of the model.

A1 *Each period t, the individual decides whether to claim and whether to retire, and then* conditional *on these decisions, decides on consumption.*

Assumption A1 does not place any restriction on the dynamics of the problem. In particular, all choices (retirement, claiming, consumption/savings) are dynamic in the sense that they have implications for payoffs and constraints in future periods. Our assumption here just imposes that the individual commits to a retirement/claiming decision prior to deciding on how much to consume. Although the assumption does restrict behavior in the data generating process, it yields closed form solutions of the model, which makes Maximum Likelihood estimation feasible. We see this as a major advantage of this approach.

The decisions to claim and retire are made jointly. As such, we compress the decision pair (b_t, r_t) into a single decision $d_t \in \mathcal{D} = \{0, 1, 2, 3\}$ where:

$$d_t = \begin{cases} 0, & \text{if } b_t = 0 \quad \text{and } r_t = 0 \\ 1, & \text{if} \quad b_t = 0 \text{and } r_t = 1 \\ 2, & \text{if } b_t = 1 \quad \text{and } r_t = 0 \\ 3, & \text{if } b_t = 1 \quad \text{and } r_t = 1 \end{cases}$$

Formally, define the sets $\mathcal{D}_R^* \equiv \{1, 3\}$ and $\mathcal{D}_B^* \equiv \{2, 3\}$. Then we can re-write the evolution of B_t, R_t as:

$$\begin{aligned} B_t &= a(B_{t-1} + \mathbf{1}\{d_{t-1} \in \mathcal{D}_B^*\}(1 - B_{t-1})) + (1 - a)\mathbf{1}\{FRA < t\} \\ R_t &= R_{t-1} + \mathbf{1}\{d_{t-1} \in \mathcal{D}_R^*\}(1 - R_{t-1}) \end{aligned}$$

We can also re-write the individuals utility associated with decision profile d:

$$U_t(C_t, d) = \frac{C_t^{1+\gamma}}{1+\gamma} - \delta * \mathbf{1}\{d \notin \mathcal{D}_R^*\} + \varepsilon_t(d) \tag{5}$$

Define the observable choice specific component of utility to be $u_t(C_t, d) \equiv \frac{C_t^{1+\gamma}}{1+\gamma} - \delta * \mathbf{1}\{d \notin \mathcal{D}_R^*\}$ so that:

$$U_t(C_t, d) = u_t(C_t, d) + \varepsilon_t(d)$$

The individual's consumption decision is made to maximize lifetime utility subject to an asset constraint, taking as given retirement and claiming choices:

$$A_{t+1} = (1 + r_t)A_t + W_t + pb_t + oi_t + (B_t \times ss_t) - C_t + \zeta_{t+1}, A_{t+1} \quad \geq 0 \tag{6}$$

where A_t denotes the individual's asset holdings at t, r_t is the rate of return on assets, W_t is after tax labor income, pb_t is the occupational pension, ss_t is social security, and oi_t is other income, including income of the spouse. ζ_{t+1} is a shock to assets that is not observed by the econometrician (assumed to be iid over time); it contains the part of next period assets that are not known to the agent at time t.[15] This equation makes explicit that the individual's consumption decision depends on his claim status B_t, and also depends on retirement status through W_t. We assume that wages W_{it} are a flexible function of age, health and individual level unobservable heterogeneity:

A2

$$W_{it} \quad = \quad f_t^w(M) + \xi^w$$

Occupational pension and social security are flexible functions of age and the AIME:

[15] Although ζ_{t+1} is not known to the agent at period t, he does have rational expectations about it.

A3

$$\begin{aligned} ss_{it} &= f_t^{ss}(AIME_i) \\ pb_{it} &= f_t^{pb}(AIME_i) \end{aligned}$$

Given the timing assumption, when the agent is deciding on retirement/claiming, he takes into account that he will behave optimally in terms of his consumption choice in the subsequent subperiod. We make the following assumption on this policy.

A4 The agent's consumption policy can be expressed as:

$$C_t = f_t^c(d, \mathbf{x}_t; \beta) + \eta_t$$

We let $f_t^c(\cdot, \cdot)$ be a flexible function of the state variables and the decision d.

We make a further assumption here to simplify the solution and estimation of the model:

A5 The unobservable (to the econometrician) component of consumption and the unobservable component of flow utility are uncorrelated:

$$cov(\varepsilon_t(d), \eta_t) = 0$$

We interpret $\varepsilon_t(d)$ as a shock to the value of retiring/claiming relative to the value of not doing so, that is unrelated to the unobserved determinants of consumption. As the vector $\mathbf{x}_t$ is a relatively rich collection of individual specific variables, we do not view Assumption A5 as especially strong.

In sum, the full vector of payoff relevant state variables S_t, for the agent at the time of retirement/claim decision, is given by:

$$\mathbf{S}_t = (t, B_t, R_t, M_t, A_t, aime_t, c, Q, \eta_t, \varepsilon_t)$$

Q_i is the marital status of individual i. As marriage status almost never changes for the women in our sample, we assume this to be a time-invariant variable. The variable C_i denotes the cohort that the individual belongs to. The cohort variable takes four values, $c_i \in \{1, 2, 3, 4\}$:

$$c_i = \begin{cases} 1, & \text{if } birthyear_i < 1939 \\ 2, & \text{if } 1939 \leq birthyear_i \leq 1941 \quad \text{(FRA63)} \\ 3, & \text{if } 1942 \leq birthyear_i \leq 1947 \quad \text{(FRA64)} \\ 4, & \text{if } birthyear_i > 1947 \quad \text{(RAF)} \end{cases}$$

The sub vector X_t of observable (to the econometrician) state variables that the agent conditions his retirement and claiming decisions on is given by:

$$\mathbf{X}_t = (t, B_t, R_t, M_t, A_t, aime_t, C, Q, \eta_t)$$

and so we can write $\mathbf{S}_t = (\mathbf{X}_t, \varepsilon_t)$. Note that we treat η_t as observable to the econometrician. As we describe below, we recover η_t from the data before solving and estimating the dynamic discrete retirement/claim choice model.

The set of outcome variables, which are functions of the state vector and individual choices, is given by:

$$\mathbf{Y}_t = (C_t, W_t, oi_t, ss_t, pb_t)$$

Solving and estimating the model seems formidable from a computational point of view. There are 9 state variables in the vector $\mathbf{x}_t$, and there are 6 different outcome variables whose evolution must be tracked. The problem is in fact simplified by two important facts:

1. The outcome variables W_t, ss_t and pb_t are deterministic functions of other observables in the state vector, and are not informative for the decision problem once we condition on the other state variables.

2. Cohort and marital status C and Q do not vary over time in our sample.

So the dynamic vector of states, which is the vector we should really be concerned about from

the perspective of computation, is given by:

$$\mathbf{X}_t^* = (t, B_t, R_t, M_t, A_t, aime_t, \eta_t)$$

The variables t (age), B_t, R_t M_t are all discrete random variables. The variables A_t, $aime_t$ and η_t are continuous, and we discretize these to keep the problem computationally feasible. While the computational cost of solving and estimating the model is reduced, there is still a significant burden.

Individuals are finitely-lived, and at the end of each period t, the individual dies with probability $g_t(\mathbf{X}_t)$. In the event that the individual dies, he leaves a bequest next period, which is a function of his assets at time t, $B(A_t)$.[16] We follow French (2005) and assume the utility from bequests take the form:

$$B(A_t) = \frac{\theta_B}{1+\gamma} A_t^{1+\gamma}$$

γ is the same parameter as in the utility of consumption. We specify $g_t(\mathbf{X}_t)$ in detail below.

6.1.2 Identification

The unobservability of a, the agent's type, makes the identification problem slightly non-standard. With π identified, the identification of the other parameters is straightforward. In this section then, we focus on how we exploit the variation induced by the policy reform to sharpen the identification of π. In fact, formally, our model is identified without the variation induced by the policy reform,[17] but in practice that identification may be weak, and the policy reform can significantly improve identification. Moreover, we want the estimated structural model to be consistent with data generated by the policy reform, so disciplining the identification of the model with restrictions implied by the reform will be useful.

The reform can be viewed as exogenously assigning individuals to cohorts (based on their birthdate), with different cohorts having different incentives to claim and retire. To see how this

[16] We do not observe bequest decisions in the data, but we must have some utility to carrying assets until period T in order to rationalize this behavior in the data.

[17] Our model satisfies the conditions of Proposition 4 in Kasahara and Shimotsu (2009).

exogenous assignment helps with identification, consider the cohorts FRA64 and RFA. The only difference in the incentives that these groups face is the price of claiming early, as the FRA is the same for both. As passive individuals always claim at the FRA, any difference in behavior between otherwise identical individuals across the two cohorts is attributable to active individuals. Then empirically observed differences in the rate of claiming across these two cohorts is proportional to the difference in the rate of claiming of active individuals, where the proportionality constant is π.

In fact any of the cohorts that have an "Early Retirement Age," an age where the individual has the option of claiming earlier than the FRA but at a price, and an FRA, can be used to identify π. Consider an otherwise identical 63 year old in cohorts FRA63 and FRA64. A passive individual in cohort FRA63 claims with probability 1, while the same individual in cohort FRA64 claims with probability 0. The policy reform switches behavior of *every* passive person with certainty, but only probabilistically switches behavior of active individuals.

A more formal discussion of how we can use the policy reforms for identification is presented in Appendix A.1.

6.1.3 Model Solution

We assume that the unobservable ε_t is type I extreme value distributed, and is independently distributed over time (and across individuals). With this assumption, the model for claiming and retirement has a well-known closed form solution, which we now describe. Let the lifetime discounted expected utility, or *value*, associated with following the optimal decision rule for an individual of type a at age t be given by:

$$V_t(\mathbf{x}, a) = \max_d \left\{ U_t(C_t, d) + \beta \sum_{x'} V_{t+1}(\mathbf{x}', a) F_{t+1}(\mathbf{x}'|d, \mathbf{x}, a) \right\} \tag{7}$$

where $F_{t+1}(\mathbf{x}'|d, \mathbf{x}, a)$ is the transition probability $Prob(\mathbf{x}_{t+1} = \mathbf{x}'|d, \mathbf{x}_t \mathbf{x}, a)$. It is important to note that a enters this transition probability, because of how it enters the transition for claim status B_t in equation 3. And it then enters in the value functions because of this. $U_t(C_t, d)$ contains an unobservable random variable, and it does not depend on type a. We can take the expectation over

$V_t(\mathbf{x}, a)$ with respect to this unobservable to obtain the "integrated value function"

$$V_t^P(\mathbf{x}, a) = E_\varepsilon \max_d \Big\{ U_t(C_t, d) + \beta \sum_{x'} V_{t+1}^P(\mathbf{x}', a) F_{t+1}(\mathbf{x}'|d, \mathbf{x}, a) \Big\} \tag{8}$$

We refer to $V_t^P(\mathbf{x}, a)$ interchangeably as the "integrated" value function and the "ex-ante" value function in what follows. Note that we are explicit in including the now probabilistic choice rule, P, the choice probabilities, in the expression for $V_t^P(\mathbf{x}, a)$. The value function depends on choice probabilities, and we exploit this relationship in the estimation of the model. Notice as well a key property of our problem that we will exploit is that the agent's type only enters through the transition probabilities and does not affect utility directly.

The agent's *choice specific value* - the value associated with choosing action d today and following the optimal rule thereafter - associated with choice d is:

$$\begin{aligned} v_t^P(d, \mathbf{x}, a) = u_t(C_t, d) \quad &+ \quad (1 - g_t(\mathbf{x}))\beta \sum_{\mathbf{x}'} F_{t+1}(\mathbf{x}'|d, \mathbf{x}, a) \mathbf{V}_{t+1}^P(\mathbf{x}') \\ &+ \quad g_t(\mathbf{x})\beta \sum_{\mathbf{x}'} F_t(\mathbf{x}'|d, \mathbf{x}, a) B(A_{t+1}) \end{aligned}$$

The choice specific value and integrated value function are linked in a compact way through the relation:

$$\mathbf{V}_t^P(\mathbf{x}, a) = E_\varepsilon \max \Big\{ \sum_{d=0}^{3} v_t^P(d, \mathbf{x}, a) + \varepsilon_t(d) \Big\}$$

Exploiting the Type I extreme value assumption, we have the following condition:

$$\mathbf{V}_t^P(\mathbf{x}, a) = \ln \Big(\sum_{d=0}^{3} \exp \big\{ v_t^P(d, \mathbf{x}, a) \big\} \Big) \qquad \text{if } t \leq T$$

and:

$$\mathbf{V}_t^P(\mathbf{x}, a) = B(A_t) \qquad \text{if } t = T + 1, \quad \text{for} \quad a \in \{0, 1\}$$

and the probability that an individual of type a takes decision d in state $\mathbf{x}$ (the conditional

choice probabilities) satisfy:

$$P_t(d|\mathbf{x},a) = \frac{\exp\left\{v_t^P(d,\mathbf{x},a)\right\}}{\sum_{j=0}^{3}\exp\left\{v_t^P(j,\mathbf{x},a)\right\}}$$

6.1.4 Estimation

The parameters to be estimated are π, the proportion/probability of active types, and the vector $\theta = (\gamma, \theta_B, \delta_0, \delta_1)$. The structure implies a finite mixture likelihood because the whether somebody is active or passive is unobserved. We develop the likelihood function formally and then discuss how we estimate the parameters (π, θ'), and in particular, how we use the exogenous variation induced by the changes in full retirement age in the data. [18]

Each individual can be of one of two types, active ($a_i = 1$) and passive ($a_i = 0$). Note that we observe individuals in the data for different lengths of time. Let the initial period of observation for individual i be given by $t0_i$ and the final period of observation be given by T_i. Let the sequence of decisions of an individual be given by $\mathbf{d}_i \equiv (d_{t0_i}, ..., d_{T_i})$ and similarly define $\mathbf{x}_i \equiv (\mathbf{x}'_{t0_i}, ..., \mathbf{x}'_{T_i})$. Denote the contribution of individual i at time t to the likelihood *given* he is of type a to be $f_a(\mathbf{x}_{it}, d_{it}; \theta)$. Given the model we described above, we have that:

$$\begin{aligned} f_a(\mathbf{x}_{it}, d_{it}; \theta) &= \prod_{d=0}^{3} P_t(d|\mathbf{x}_{it}, \theta, a)^{\mathbf{1}\{d_{it}=d\}} \\ &= \prod_{d=0}^{3} \Big(\frac{\exp\left\{v_t(d, \mathbf{x}_{it}, a)\right\}}{\sum_{j=0}^{3}\exp\left\{v_t(j, \mathbf{x}_{it}, a)\right\}} \Big)^{\mathbf{1}\{d_{it}=d\}} \end{aligned}$$

Now define

$$\tilde{f}_a(\mathbf{x}_t, d_t; \theta) = \prod_{t=t0_i}^{T_i} f_a(\mathbf{x}_{it}, d_{it}; \theta) \tag{9}$$

This is the likelihood of observing individual i take the sequence of decisions d_{it}, $t = t0_i, ..., T_i$

[18] As is standard in the literature, the conditional transition probabilities can be non parametrically estimated outside of the likelihood procedure, and so we treat these as known in what follows.

Table 6: **Preliminary Structural Estimates**

Parameter	Estimate
π	0.699
γ	-3×10^{-4}
θ_B	0.052
δ_0	-0.604
δ_1	-0.598

given the sequence of states x_{it}, $t = t0_i, ..., T_i$. Integrating out the unobserved heterogeneity, the unconditional contribution of individual i to the likelihood is then given by:

$$g(\mathbf{x}_i, \mathbf{d}_i; \theta, \pi) \quad = \quad \pi \tilde{f}_1(\mathbf{x}_t, d_t; \theta) + (1 - \pi)\tilde{f}_0(\mathbf{x}_t, d_t; \theta) \tag{10}$$

The (full information) constrained maximum likelihood problem is:

$$\max_{\theta, \pi} \sum_{i=1}^{N} \ln \left(g(\mathbf{x}_i, \mathbf{d}_i; \theta, \pi) \right) \qquad \text{s.t.} \qquad 0 \leq \pi \leq 1 \tag{11}$$

This is a finite mixture likelihood. The parameters are estimated using a Nested Fixed Point algorithm.

6.2 Results

In table 6 we present preliminary estimates of the structural parameters. The estimates all have the expected sign. Interestingly, the estimate of γ suggests that utility is almost linear in consumption. The disutility of work is estimated to be twice as large for individuals in poor health relative to healthy individuals, and we estimate a small preference for bequests. The primary parameter of interest, π, is estimated to be about 0.7. That is, about 70% of the population of women are estimated to make claiming decisions optimally as a function of preferences and constraints, while the other 30% simply claim at the FRA.

7 Conclusion

We study how a two year increases in the full retirement age (FRA) affects labor supply, pension claiming, and retirement income. Whether FRA increases affect behavior through defaults or financial incentives is not well understood. We identify the causal impact of changes in the FRA in the context of a large pension reform in Switzerland where the FRA default and the financial incentive conflict. The reform increased the FRA for women from 62 to 64 in two one-year increments. The reform offered early claiming, at age 62, initially at the price of reducing social security benefits by 3.4% per every year of early claiming, then doubling the early claiming price to 6.8%. These changes affected women at the sharp cohort cutoffs, 1939, 1942, and 1948. The sharp discontinuities in the FRA by birth date allow us to analyze the impact of sizeable pension wealth shocks on labor supply, and the sizeable changes in the price of early claiming inform on how women trade off future income with current income.

We find that the FRA has a strong effect on claiming behavior. Women delayed pension claiming by about 7 to 8 months in response to the FRA increase, even though early claiming was available at a very attractive price. Doubling the price of early retirement delays pension claiming but the effect is somewhat smaller than the effects triggered by the FRA increase. The FRA increase also affected labor supply behavior of affected women. A one year increase in the FRA delays labor market exit by 7 to 8 months, and 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).

We rationalize this pattern of effects in a world where women can be active or passive. Active women maximize life-cycle utility taking pension benefits, taxes, health, and mortality into account. Passive women maximize life-cycle utility as do active women, except for pension claiming. Passive women claim an old age pension exactly at the FRA. We structurally estimate this model using data on pension claiming, earnings, consumption, taking the pension and tax rules into account. Preliminary evidence suggests about 30% of all women are passive, suggesting the presence of a considerably sized sub-group of women that does not respond to pension rules as we would expect from the textbook.

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A Appendix

A.1 Identification of exploiting policy reform

This section illustrates how we can use the policy reform to sharpen the identification of the life cycle model. We think of the reform as exogenous creation of cohorts. We would not have cohorts without the reform, and the reform assigned individuals to cohorts based purely on their birthdate. To understand how the exogenous assignment of individuals to cohorts can help with identification, we start by showing why identification can be difficult without this assignment. In our model, $a \in 0, 1$ denotes the type of individual; $a = 1$ means the individual is active, and $a = 0$ means the individual is passive. Active individuals are rational and make claiming and retirement decisions optimally given their preferences and constraints, and the information available to them. Passive individuals simply claim at the default age for claiming, whatever the default age is. The default age is determined by cohort. Thus, due to the reform we essentially have exogenous assignment of the default age across individuals, which affects the behavior of passive individuals much more than it affects the behavior of active individuals. This is the core piece of variation we will use to figure out the relative frequency of active and passive types in the data, and ultimately the other primitives of the model.

For notational simplicity, define:

$$Q_t(d|\mathbf{x}) \equiv Prob(d_{it} = d|\mathbf{x}_{it} = \mathbf{x}) \tag{12}$$

$Q_t(d|\mathbf{x})$ is the *total* probability that an individual with observable characteristics $\mathbf{x}$ chooses option $d \in \{0, 1, 2, 3\}$. Recall our definition of the choice space for d:

$$d_t = \begin{cases} 0, & \text{if } b_t = 0 \quad \text{and } r_t = 0 \\ 1, & \text{if } b_t = 0 \quad \text{and } r_t = 1 \\ 2, & \text{if } b_t = 1 \quad \text{and } r_t = 0 \\ 3, & \text{if } b_t = 1 \quad \text{and } r_t = 1 \end{cases}$$

where b_t and r_t represent binary claiming and retirement decisions respectively. Under very mild assumptions (random sampling of $(d, \mathbf{x})$ over i given t), $Q_t(d|\mathbf{x})$ is identified from the data for any $(d, \mathbf{x})$.[19] Key to identification of the model is knowledge of the **conditional choice probabilities** (CCPs): $P_t(d|\mathbf{x}, a)$ (if we could identify these, we could identify the whole model under standard assumptions). The problem is we can not identify these, because we don't know a for a given individual. However, we do know that, for any individual i and any time period (age) t we have the following restriction:

$$Q_t(d_t|\mathbf{x}) \quad = \quad \pi P_t(d|\mathbf{x}, 1) + (1 - \pi) P_t(d|\mathbf{x}, 0) \tag{13}$$

where π is the unknown probability that an individual is active. Notice that for a given vector of characteristics $\mathbf{x}$, there are 3 linearly independent equations of this form, one for each value of d (the fourth is one minus the sum of the other three, as the probabilities must sum to one across d). However there are 7 unknowns: there are 3 choice probabilities for each value of a, which makes a total of 6, plus the unknown π, which makes 7 in total. The model is severely underidentified if we rely on these equations to identify choice probabilities.[20]

The policy reform closes the gap between the number of unknowns and the number of restrictions. To illustrate this point, we begin by defining the cohorts that the reform generates: The cohort

[19] For example, using a raw frequency estimator:

$$\hat{Q}_t(d|\mathbf{x}) = \frac{\sum_i \mathbf{1}\{d_{it} = d\}\mathbf{1}\{\mathbf{x}_{it} = \mathbf{x}\}}{\sum_i \mathbf{1}\{\mathbf{x}_{it} = \mathbf{x}\}}$$

and under random sampling simple LLN applies and $\hat{Q}_t(d_t|\mathbf{x}) \to_p Q_t(d_t|\mathbf{x})$

[20] The model is actually identified, but the researcher must exploit not only the equations for $Q_t(d|\mathbf{x})$ but also equations for the joint distribution of sequences of actions of an individual. For example, $Q(d_1, d_2, ...d_T|\mathbf{x})$ is known, and we can express this probability as a function of CCPs and transition probabilities (which are themselves identified under some assumptions). All the combinations of sequences $(d_1, d_2, ...d_T)$ give many more equations. This is the argument in Kasahara and Shimotsu (2009) (the proposition relevant for us is Proposition 4, that permits non-stationary models. So the model is identified, at least in theory, but we would like to exploit exogenous policy variation instead, as the identification argument will be cleaner in both theory and practice.

variable c_i is individual specific and fixed over time, and takes four values, $c_i \in \{1,2,3,4\}$ where:

$$c_i = \begin{cases} 1, & \text{if } birthyear_i < 1939 \\ 2, & \text{if } 1939 < birthyear_i < 1941 \quad \text{(FRA63)} \\ 3, & \text{if } 1942 < birthyear_i < 1947 \quad \text{(FRA64)} \\ 4, & \text{if } birthyear_i > 1947 \quad \text{(RAF)} \end{cases}$$

Consider an individual i with cohort and age combination $(c_i, t) = (4, 64)$. Suppose the individual is yet to claim and yet to retire, so that $(B_t, R_t) = (0, 0)$. The system of three equations for a given state $\mathbf{x}$ (including claim and retirement status) is given by:

$$\begin{aligned} Q^4_{64}(1|\mathbf{x}) &= \pi P^4_{64}(1|\mathbf{x},1) + (1-\pi)P^4_{64}(1|\mathbf{x},0) \\ Q^4_{64}(2|\mathbf{x}) &= \pi P^4_{64}(2|\mathbf{x},1) + (1-\pi)P^4_{64}(2|\mathbf{x},0) \\ Q^4_{64}(3|\mathbf{x}) &= \pi P^4_{64}(3|\mathbf{x},1) + (1-\pi)P^4_{64}(3|\mathbf{x},0) \end{aligned} \tag{14}$$

There are three equations and seven unknowns. However, this individual is in the RAF cohort, meaning that the default claiming age is 64. A passive individual in this cohort claims with certainty at age 64. This gives us two restrictions on the system 14:

$$P^4_{64}(1|\mathbf{x},0) = 0 \tag{15}$$

$$P^4_{64}(2|\mathbf{x},0) + P^4_{64}(3|\mathbf{x},0) = 1 \tag{16}$$

The second restriction is due to the fact that at the default claiming age a passive individual will either claim and not retire ($d = 2$) or claim and retire ($d = 3$). So we impose these restrictions on the system 14 and we get:

$$\begin{aligned} Q^4_{64}(1|\mathbf{x}) &= \pi P^4_{64}(1|\mathbf{x},1) \\ Q^4_{64}(2|\mathbf{x}) &= \pi P^4_{64}(2|\mathbf{x},1) + (1-\pi)\big(1 - P^4_{64}(3|\mathbf{x},0)\big) \\ Q^4_{64}(3|\mathbf{x}) &= \pi P^4_{64}(3|\mathbf{x},1) + (1-\pi)P^4_{64}(3|\mathbf{x},0) \end{aligned} \tag{17}$$

This system consists now of three equations and five unknowns. We have reduced the number of unknowns by two by exploiting our behavioral assumption together with the fact that the reform creates a default age for this cohort. However, we still do not have identification. To get identification, we exploit the variation in default age *across* cohorts generated by the reform together with our behavioral assumptions. Consider a 64 year old individual in cohort 3, which is the FRA64 cohort. The same restrictions apply and we have the analogous set of equations:

$$\begin{aligned} Q^3_{64}(1|\mathbf{x}) &= \pi P^3_{64}(1|\mathbf{x},1) \\ Q^3_{64}(2|\mathbf{x}) &= \pi P^3_{64}(2|\mathbf{x},1) + (1-\pi)\big(1 - P^3_{64}(3|\mathbf{x},0)\big) \\ Q^3_{64}(3|\mathbf{x}) &= \pi P^3_{64}(3|\mathbf{x},1) + (1-\pi) P^3_{64}(3|\mathbf{x},0) \end{aligned} \tag{18}$$

Note also that active individuals of age 64 in cohorts 3 and 4 with the same $\mathbf{x}$ face the exact same decision problem, since they are both at the FRA in both cases. They face the same incentives to delay claiming/retirement because they are at the same $\mathbf{x}$ and have reached the FRA in both cases. Similarly, passive individuals face the same decision problem (claim and retire or claim and not retire). So we have:

$$P^3_{64}(d|\mathbf{x},1) = P^4_{64}(d|\mathbf{x},1) \tag{19}$$

$$P^3_{64}(3|\mathbf{x},0) = P^4_{64}(3|\mathbf{x},0) \tag{20}$$

So if we combine systems 17 and 18, we have a total of 6 equations and 6 unknowns. The system is just identified.

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A.2 Additional Tables and Figures

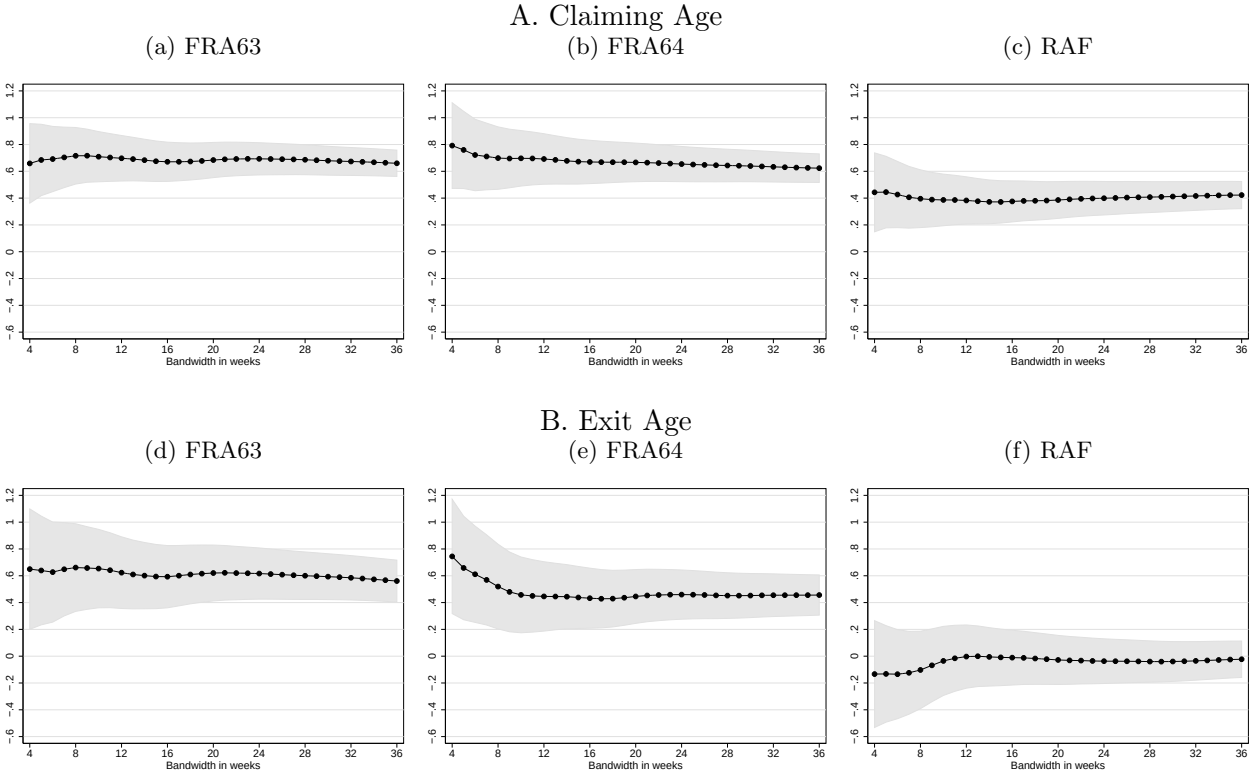
Table A.1 in the Appendix shows RD estimates of a regression with the dependent variable being the number of individuals in a bin for different bandwidth.

Table A.1: Testing smoothness of number of individuals

	FRA 63		FRA 64		RAF	
	linear	quadratic	linear	quadratic	linear	quadratic
	(1)	(2)	(3)	(4)	(5)	(6)
Number of individuals	-17	-22	26	40	34	9
	(13)	(19)	(22)	(29)	(21)	(29)
Bandwidth (weeks)	12	12	12	12	12	12
Obs.	24	24	24	24	24	24

Notes: Table shows results of the McCrary test for balance of the distribution of the weeks of birth at the cohort cut-offs, 1939, 1942, and 1948.
Source: Own calculations, based on SSSD.

Figure A.1: Sensitivity to Changes in Bandwidth



Notes: Figure shows the RDD estimates, by varying the bandwidth from 4 to 36 weeks. Optimal bandwidth is 12 weeks.

Source: Own calculations, based on SSSD.

Table A.2: Testing smoothness of covariates

	FRA63		FRA64		RAF	
	linear	quadratic	linear	quadratic	linear	quadratic
	(1)	(2)	(3)	(4)	(5)	(6)
% Foreign	0.6	2.4	1.8	2	1.8	3.6**
	(1.5)	(2.3)	(1.3)	(1.9)	(1.2)	(1.7)
% Married	1.9	2.1	-0.2	-0.1	0.8	0.1
	(1.8)	(2.6)	(1.7)	(2.5)	(1.5)	(2.2)
Age difference to husband (years)	0.4	0.4	0.3	0.4	0.1	0
	(0.3)	(0.4)	(0.2)	(0.4)	(0.2)	(0.3)
% Husband born 1933	0.3	-0.4	-0.4	-0.4	0	-0.1
	(0.7)	(1)	(0.4)	(0.6)	(0.2)	(0.2)
% Husband born 1938	0.1	0.9	0.6	-0.1	-0.5*	-0.8*
	(0.9)	(1.3)	(0.8)	(1.1)	(0.3)	(0.4)
% Spousal benefits	-0.2	-1.6	-19.5***	-18.4***	0.6	1
	(1.7)	(2.5)	(1.3)	(1.9)	(0.8)	(1.2)
% Spousal benefits, age difference<2	-0.6	-1.5	0.7	1.3	-0.6	-1.1
	(1.3)	(2)	(1.1)	(1.6)	(0.9)	(1.3)
Average annual indexed earnings	-664	-2,304	-1,325	45	100	95
(2013 CHF)	(1,103)	(1,643)	(1,094)	(1,587)	(922)	(1,389)
Monthly earnings at age 50	-112	-87	-128	-150	192	388
(2013 CHF)	(123)	(179)	(118)	(163)	(375)	(615)
Months employed until age 50	-0.8	-1.1	0.3	1	0.8	0.9
	(0.6)	(0.8)	(0.9)	(1.3)	(1.5)	(2.2)
Months unemployed until age 50	0.1	0.1	0	0	0	-0.3
	(0.1)	(0.1)	(0.1)	(0.1)	(0.2)	(0.3)
Months contributing voluntary	0.1	0.1	-0.2	-0.3	0.2	0.1
until age 50	(0.1)	(0.2)	(0.2)	(0.2)	(0.2)	(0.4)
Bandwidth (weeks)	12	12	12	12	12	12
Obs	14,581	14,581	16,224	16,224	19,937	19,937

Notes: This Table reports the RDD estimate for a number of covariates, testing for smoothness of the mean of these covariates at the cohort cut-offs 1939, 1942, and 1948. Estimates adopt a linear and quadratic specification for functions $f_0()$ and $f_1()$, see section **??**.
Source: Own calculations, based on SSSD.

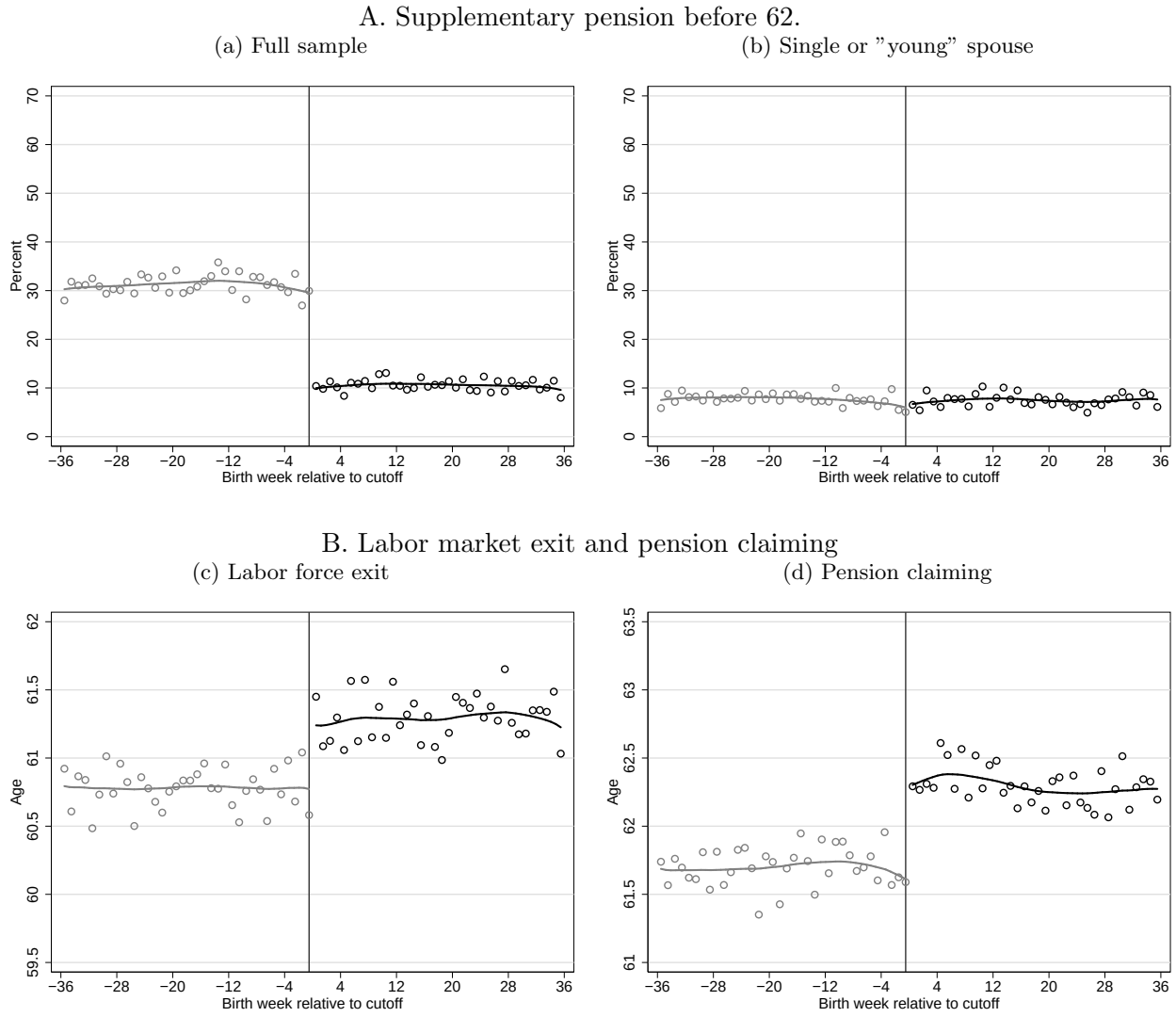
Figure A.2: Placebo RDD Estimates



Notes: Figure shows RDD estimates at the true cohort cut-offs, 1939, 1942, and 1942, along with Placebo cut-offs, before 1939, and between the policy changes. Bandwidth is 36 weeks.

Source: Own calculations, based on SSSD.

Figure A.3: Sensitivity of FRA64 Results



Notes: Women born in 1942 were not eligible anymore for spousal supplemental benefits whereas those born in 1941 still were eligible, panel A. To see whether the effects are sensitive to the abolishment of spousal benefits, we focus on women who are single or whose husband is "young", i.e. at most two years older. These women are not affected by the policy change, panel A. (Note that women who are on the disability program are still eligible for spousal benefits.) Claiming and labor market exit for single women, or women living in age balanced couples respond similar to the entire sample to FRA64, see panel B.

Source: Own calculations, based on SSSD.

Table A.3: Heterogeneity in Claiming Age

	FRA63		FRA64		RAF	
	linear	quadratic	linear	quadratic	linear	quadratic
	(1)	(2)	(3)	(4)	(5)	(6)
Full sample	0.697***	0.719***	0.692***	0.722***	0.383***	0.413***
	(0.087)	(0.129)	(0.096)	(0.141)	(0.09)	(0.131)
Singles	0.503***	0.58**	0.641***	0.662**	0.359**	0.38
	(0.176)	(0.263)	(0.182)	(0.265)	(0.164)	(0.237)
Married	0.802***	0.78***	0.731***	0.769***	0.391***	0.435***
	(0.079)	(0.115)	(0.098)	(0.145)	(0.1)	(0.147)
Swiss citizens	0.707***	0.71***	0.712***	0.68***	0.488***	0.521***
	(0.075)	(0.111)	(0.09)	(0.134)	(0.086)	(0.123)
Foreign citizens	0.701***	0.904**	0.764**	1.1**	0.045	0.218
	(0.261)	(0.379)	(0.318)	(0.455)	(0.303)	(0.438)
German region	0.792***	0.861***	0.698***	0.724***	0.493***	0.502***
	(0.086)	(0.129)	(0.102)	(0.152)	(0.103)	(0.15)
Latin region	0.643***	0.652***	0.746***	0.657**	0.22	0.312
	(0.158)	(0.229)	(0.201)	(0.296)	(0.178)	(0.256)
Private sector	0.696***	0.748***	0.636***	0.673***	0.389***	0.368**
	(0.098)	(0.146)	(0.107)	(0.157)	(0.099)	(0.144)
Public sector	0.683***	0.578**	0.996***	1.01***	0.351	0.664**
	(0.179)	(0.266)	(0.215)	(0.321)	(0.219)	(0.309)
Avg. earnings below median	0.658***	0.708***	0.898***	0.912***	0.406***	0.528***
	(0.109)	(0.159)	(0.121)	(0.175)	(0.113)	(0.165)
Avg. earnings above median	0.737***	0.721***	0.432***	0.466**	0.351**	0.298
	(0.133)	(0.201)	(0.152)	(0.226)	(0.139)	(0.2)
Dies before age 74	0.265	0.322	0.437	0.868	-0.102	-0.139
	(0.411)	(0.605)	(0.478)	(0.698)	(0.54)	(0.776)
Dies after age 74	0.764***	0.805***	0.757***	0.73***	0.38***	0.417***
	(0.071)	(0.105)	(0.085)	(0.127)	(0.081)	(0.117)

Notes:

Table A.4: Heterogeneity in Exit Age

	FRA63		FRA64		RAF	
	(1) linear	(2) quadratic	(3) linear	(4) quadratic	(5) linear	(6) quadratic
Full sample	0.623***	0.686***	0.446***	0.575***	-0.003	-0.147
	(0.136)	(0.199)	(0.132)	(0.191)	(0.12)	(0.176)
Single	0.583***	0.662**	0.245	0.435	0.048	0.189
	(0.222)	(0.325)	(0.208)	(0.298)	(0.19)	(0.273)
Married	0.653***	0.705***	0.592***	0.685***	-0.035	-0.384*
	(0.173)	(0.25)	(0.171)	(0.249)	(0.156)	(0.23)
Swiss citizens	0.536***	0.638***	0.551***	0.65***	0.001	-0.194
	(0.144)	(0.21)	(0.134)	(0.195)	(0.122)	(0.178)
Foreign citizens	0.968***	1.068**	0.233	0.528	0.242	0.529
	(0.307)	(0.439)	(0.355)	(0.509)	(0.345)	(0.501)
German region	0.656***	0.759***	0.681***	0.843***	0.007	-0.147
	(0.154)	(0.224)	(0.15)	(0.217)	(0.139)	(0.204)
Latin region	0.431	0.453	0.067	0.155	-0.297	-0.316
	(0.277)	(0.404)	(0.259)	(0.377)	(0.232)	(0.335)
Private sector	0.582***	0.627***	0.424***	0.593***	-0.054	-0.231
	(0.147)	(0.214)	(0.139)	(0.201)	(0.124)	(0.182)
Public sector	0.952***	0.95**	0.349	0.238	0.162	0.104
	(0.325)	(0.476)	(0.343)	(0.502)	(0.341)	(0.496)
Avg. earnings below median	0.719***	0.881***	0.471**	0.682**	-0.202	-0.451*
	(0.186)	(0.267)	(0.188)	(0.27)	(0.17)	(0.251)
Avg. earnings above median	0.538***	0.489*	0.441**	0.482*	0.194	0.135
	(0.199)	(0.292)	(0.189)	(0.275)	(0.17)	(0.246)
Dies before age 74	0.616	0.664	-0.097	-0.149	-0.127	0.217
	(0.424)	(0.618)	(0.497)	(0.735)	(0.522)	(0.753)
Dies after age 74	0.631***	0.716***	0.534***	0.667***	-0.022	-0.197
	(0.14)	(0.202)	(0.132)	(0.191)	(0.12)	(0.175)

Notes: This table reports RDD estimates of the effects of FRA63, FRA64, and RAF, adopting a 3 months bandwidth, and a 12 months bandwidth. Full sample repeats our main analysis. Then we present results from sample splits by gender, nationality, language region, sector, average earnings, and death before, or after age 74.
Source: Own calculations, SSSD.