Working longer or opting out? Women's costly response to a recent pension reform*

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Abstract

This paper assesses how a recent and unexpected Italian pension reform changed the incentive to early retirement for women. The analysis uses rich Italian administrative data and it is based on a differences-in-discontinuities design. Identification exploits the facts that (i) women with just above 35 years of contributions are eligible for early retirement; (ii) women born in 1952 are the first cohort affected by the retirement age increase, while women born in 1951 are unaffected. The results indicate that treated women above 35 years of contribution, for whom age increased unexpectedly from age 60 to 64, retire early by 8 months compared to the unaffected cohort (i.e. at age 61 vs. 61.8 months). As this option entails a penalty in the annuity, we also evaluate the reform's effect on women's pension amount. The findings indicate a reduction in the benefit of about 15% compared to the unaffected group. This paper shows how tightening pension rules could push close-to-retirement women to exit the labour market earlier at the price of smaller annuities.

JEL Classification: J16, J20, J22, J26, H55

Keywords: retirement; pension, women's labour market participation, policy evaluation

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1 Introduction

In the context of ageing societies, the length of working careers has become crucial for ensuring the sustainability of public pension systems. Western governments have intervened in the last decade by increasing the retirement age requirement to become eligible for a pension. However, the prolonged working path has come with costs for individuals about to retire, as disutility from work increases with age (Gruber & Wise 1998), especially for socio-demographic groups less attached to the labour market. Indeed, sudden pension reform may have critical implications for close-to-retirement women since their careers are already affected by labour market interruptions and weaker attachment due to caring activities.

In this paper, we exploit a unique and unexpected pension reform in Italy to identify how women about to retire respond to a sharp and sudden increase in retirement eligibility, which changed the incentive to early retirement. The reform increased the retirement age to reach the full pension by at least four years for the first cohort of affected women. On the other hand, it left the early retirement option unchanged. Using a Difference-in-Discontinuities design, we present causal estimates on the effect of the reform on the retirement age and the annuity of the first cohort treated, provided that they were eligible for early retirement.

The analysis focuses on women for two main reasons. First, the reform implied a larger increase in age for women than men: the requirement jumped from age 60 to 64 (and to 67 for following cohorts), while for men it increased only from age 65 to 67. Second, the early retirement scheme was available only for women.

Looking at women is particularly interesting. First, women tend to live longer than men (and to marry older men), so they are likely to spend much of their retirement in widowhood. However, this is not always coupled with sufficient savings accumulation or annuities (Bettio et al. 2013). In this setting, if the public system does not correctly cover longevity risks, women might end up in poverty. Second, although women's employment has risen throughout the 20th century (Olivetti & Petrongolo 2016), women value job attributes compatible with household responsibilities, such as flexible work schedules and shorter commutes, which may result in worse earning opportunities than those observed for men (Petrongolo & Ronchi 2020). This might translate later into smaller

pensions. Third, it has been shown that women have lower financial literacy compared to men (Lusardi & Mitchell 2008), as well as lower pension information awareness (Angelici et al. 2022), potentially due to lower educational attainment in the past (EUROSTAT 2022). For these reasons, it is key to understand how women respond to increasing pension requirements.

In this paper, we study women's response to increasing retirement eligibility and the effect on the annuity. To do that, we take advantage of the recent Monti-Fornero Italian pension reform enacted in December 2011 and implemented in January 2012.

The Italian case is fascinating since pensions account for about 16% of gross domestic product (GDP), thus being an essential part of public expenditure. Moreover, the reform was largely unexpected due to the swift implementation as it came into force only 25 days after its presentation in the Parliament. The quick application was due to the pressure Italy was facing from the European Union to keep public spending under control. Berlusconi's government resigned on 12th November, 2011; the Monti "technocratic government" stepped in on 16th November. The pension reform was presented on 6th December and approved on 22nd December. It came into force on 1st January, 2012.

In the Italian pension system, individuals are considered retired when they start claiming the first pension benefit. In this way, retirement and claiming coincide. The pension requirements were amended mainly and in particular for women. The reform changed the requirements for the old age pension, which is the full pension. It increased the statutory retirement age from 60 to 64 for the first cohort treated (women born in 1952) and from 60 to 67 for all subsequent cohorts.[1]. The number of years of contributions to access old age pension remained at a minimum of 20 years. The reform also left untouched the so-called "Opzione Donna" an early retirement path available from 2008: women could retire at 57 years of age and with at least 35 years of contributions. This option has a penalty in the annuity computation (from defined benefit to defined contribution scheme). This path is also an important way to retirement: a gender-specific option for women was thought to give them flexibility to exit the labour market, but

[1]In this study we do not consider subsequent cohorts for several reasons. First, the 1953 cohort became eligible for the old age pension only in 2020, when the pandemic hit, and this could confound the results. Second, subsequent cohorts from 1954 onward became eligible from 2021 onward and we do not have enough years available to observe if they enter retirement through the full pension scheme.

with a crucial annuity penalty. Table 1 summarises the requirements pre and post-reform for the 1951 and 1952 cohorts, which are considered in the analysis.

Table 1: Age requirements before and after the Monti-Fornero reform by cohort

		Cohort			
Type of pension	# contributions	1951		1952	
		before	after	before	after
Old age	c$\geq$ 20 years	60	60	60	64
Early retirement	c$\geq$ 35 years	57	57	57	57

Notes: This table provides the age required before and after the Monti-Fornero Reform to be eligible for the old age (c$\geq$ 20 years contribution) and the early retirement pension "Opzione Donna" ($\geq$ 35 years contribution) **Sources**. Authors' elaborations based on information from National Social Secuirity Institute (INPS), Circolare INPS n35 (2012)

The reform was immediately implemented, thus giving the quasi-experimental setting to study the causal effect of a sharp increase in the required pension age by exploiting cross-cohort heterogeneity induced by the pension's reform.

This study offers a comprehensive assessment by exploiting rich administrative data on working careers and information on retirement decisions and demographic characteristics. We use causal inference methods to understand women's response to early retirement after the sudden policy reform. We apply a Difference-in-Discontinuities design and evaluate the reform's effect on the age of retirement and on the annuity amount between affected and unaffected women. More precisely, identification exploits the facts that (i) women with a number of years of contributions just above the 35 years of contribution thresholds are eligible for early retirement; (ii) women born in 1952 are the first cohort affected by the retirement age increase, while women born in 1951 are unaffected.

To the best of our knowledge, we are the first to quantify the reform's effect on the first cohort of treated women and their annuity. The Difference-in-Discontinuities model provides us with the ideal setting to control for the pre-existing early retirement option rules ("Opzione Donna", retiring with 35 years of contribution) by including the 1951 cohort as a control. Beyond the causal effects, our investigation sheds light on the early retirement choice by career characteristics and the unintended effect of a sudden and sharp policy reform, potentially causing the sorting of women into a penalising retirement scheme.

Our analysis leverages the rich set of Italian administrative data on the private sector,

allowing us to observe women's working history and retirement choices. We also take advantage of individual demographic characteristics and career spell information such as sick leave, family leave, unemployment spell, sector and earnings evolution.

We provide two main sets of findings. First, when looking at the effect at the 35 cutoff, we find strongly significant results that women affected by the reform, above the cutoff, retire early by about 8 months compared to women untouched by the reform, with the same years of contribution. This means that treated women, eligible for the early retirement option, claim their pension at the age of 61 compared to the untreated women who retired at 61.8 year old, with the same years of contribution. This finding suggests that treated women, who were about to retire under the pre-reform rules when the reform was issued, responded to the increasing retirement age (from 60 to 64) by retiring earlier despite the monetary penalty. They started claiming the early retirement option soon after the reform came into force.

Second, when looking at the effect of retirement on the annuity amount, we find a negative effect for treated women above the cutoff, and the coefficient is statistically significant. Thus, we show a penalty of about 187 euros per month on the annuity for women above 35 years of contribution. This suggests a 15% lifetime reduction in their annuity compared to the untreated cohort. These results are robust to different fixed effects inclusion and bandwidth selection.

This paper contributes to several strands of the literature that seek to understand how individuals respond to pension reform. We make three main contributions.

As far as we know, we are the first to provide causal estimates of the impact of the increasing retirement age on close-to-retirement women and how this has affected women's incentive to early retirement. This is particularly important from a policy perspective, since in OECD countries, among individuals above the age of 50 who are providing informal care, 60 percent are women (OECD 2023)[2]. So, women are more likely to bear caring responsibilities at an older working age. Thus, understanding older working women's response to changes in incentives for early retirement is crucial.

Only a few recent studies have looked at the increase of statutory retirement age in other

[2]This percentage reaches 65 for Italy.

countries (Mastrobuoni 2009, Behaghel & Blau 2012, Staubli & Zweimüller 2013, Manoli & Weber 2016*a*, Seibold 2021, Lalive et al. 2023), while others have focused on changes in the benefit generosity close to retirement (Krueger & Pischke 1992, Song & Manchester 2007, Liebman et al. 2009, Manoli & Weber 2016*b*). These studies find that people react to pension reform by increasing the labour supply and delaying retirement.

For the Italian setting, most studies focus on the effect of the Monti-Fornero reform on the labour market attachment of relatively young women and find that women respond by increasing the labour supply (Carta & De Philippis 2023). Other scholars evaluate the spillover effects of the reform from older workers who were locked-in, to young workers who experienced a block in their career development (Bianchi et al. 2021, Carta et al. 2021, Boeri et al. 2022). One study focused on the reform's effect on individuals at least five years from retirement and found that sick leave increased only for women (Brunello et al. 2023).

Our paper differs from the previous studies since we assess the impact of the reform on women who were about to retire by the time the reform was enacted, and we evaluate their response, provided that they were eligible for early retirement.

Second, we contribute to the studies looking at changes in the computation rules of pension benefits (Boeri & Brugiavini 2008, French 2005, Engels et al. 2017, French et al. 2022); by focusing on the "Opzione Donna", which allows early retirement but under the defined contribution scheme, which differs from the defined benefit or mixed scheme available for the full pension.

Finally, our results align with the ones found in recent works of Behaghel & Blau (2012), Lalive et al. (2023), Seibold (2021), Laun et al. (2022), Atav et al. (2019), where individuals are found to respond to pension reforms in a behavioural fashion compared to the one suggested by the standard optimal retirement model. According to our evidence, the choice to retire early, even at a monetary cost, suggests that women do not respond to financial incentives.

The paper proceeds as follows. Section 2 describes the institutional setting. Section 3 presents the econometric analysis and discusses the main assumptions needed for identification. Section 4 describes the data, Section 5 the results and Section 6 shows the robustness analyses. Finally, Section 7 concludes.

2 Institutional framework

The Italian pension system is primarily based on public pension provision, as alternative, mandatory or voluntary, pension funds play a negligible role (COVIP 2022). Individuals can claim their pension by taking either the "old age pension", which is based on the age of retirement and a minimum number of years of contribution, or the "seniority" scheme, based on the years of contribution only. Both schemes ensure the full annuity benefit to retirees. In the Italian system, individuals are considered retired when they start claiming the first pension benefit.

The Italian pension system has been largely reformed since the 90s in order to ensure its sustainability. A critical reform was enacted in 1995, the so-called "Dini Reform", which changed the pension computation method. Indeed, before the 1995's reform, individuals retired under the defined-benefit scheme: the annuity was an average of the last five to ten years of gross earnings. After the reform, the calculation changed: individuals who had accrued at least 18 years of contribution by 1995 were exempted from the changes; individuals with less than 18 years of contribution fell under the "mixed scheme", while those starting working from 1996 were put under the full notional defined-contribution scheme, which is based on the amount of social security contributions accrued during the careers (OECD 2021). Finally, the individuals under the "mixed scheme" had their pension computed according to the defined-benefit scheme until 1995 and under the notional defined-contribution scheme from 1996 onwards.

After the 1995 Reform, governments gradually increased the retirement age.[3] In this paper, we consider the so-called Monti-Fornero reform, from the name of the Prime Minister and of the Ministry of labour who enacted it. The Reform was approved at the beginning of December 2011 and became effective on January 1, 2012, and was characterised by a sharp and unexpected increase in the eligibility requirements for pensions, which aimed at reducing the pension burden on the public balance sheets.

The Italian pension system has usually secured generous pension benefits to its contributors

[3]The reforms were frequent: Amato (1992), Dini (1995), Maroni (2004), Prodi (2007) and Fornero-Monti (2011). The Amato's reform (1992) increased the aged of retirement for women in the private sector from age 55 to 60, gradually; and also the minimum number of years of contribution from 15 to 20. The Dini's reform (1995) introduced the defined-contribution scheme and change the annuity computation. Finally, both the Maroni (2004), Prodi (2007) and Sacconi(2010) reforms gradually increase the retirement age for the seniority pension.

and this is part of the reason why workers retire as soon as they reach the eligibility requirements (Brugiavini 1997, 2001, Battistin et al. 2009). Moreover, working after retirement is possible but with a high tax cost (Nicola et al. 2017).

For private sector workers, under the pre-reform regime (Sacconi 2010), the *old age* pension scheme allowed women to retire at age 60, conditional on having at least 20 years of contributions. Under the new reform rules, the age requirement swiftly increased from age 60 to age 67 for women by 2020. Women who were eligible to retire under the pre-reform rules by December 31, 2011, were considered as exempted from the Reform, and thus, could still retire at age 60, provided that they had 20 years of contributions.[4] This exemption was valid until the 1951 cohort, who turned 60 in 2011, and was thus eligible to retire according to the pre-reform rules. Women born the next year, in 2012, were instead the first cohort affected by the reform, and, for them, the retirement age was increased to 64.[5] Women born in 1953 or later were fully affected by the increase in retirement age, because for them retirement age was postponed to 67 years.[6]

Table 2 summarises the changes in age requirements for statutory retirement introduced by the Monti-Fornero reform for women. It should be noticed that women faced the most sizeable increase in statutory retirement age (SRA): even the smallest change in SRA for women was 4 years between the 1951 and the 1952 cohorts.[7]

Importantly, the reform did not change the early retirement option available for women, which is called "Opzione Donna" (OD henceforth) and is still in place. Since 2008, women could retire with 35 years of contributions and at least 57 years of age, if working in the private sector.[8] This early retirement scheme comes with a penalty in the annuity obtained, as under

[4]This clause is known as the "Grandfathering clause".

[5]This peculiar treatment for women born in 1952 was specified in *Circolare INPS 35* (2012), and was meant to provide a temporary implementation of the reform.

[6]Some categories were exempted from the increase in retirement age induced by the reform, and could retire under special ad-hoc rules. This group included individuals who were placed in mobility, solidarity contracts, those belonging to the public train service, the flight service, the maritime service and strenuous jobs. In our analysis, we drop these special categories.

[7]The reform intervened also on the *seniority* pension scheme. Under pre-reform rules, individuals could retire with at least 60 years of age and 35 years of contributions, the so-called "quota system", or 40 years of contribution and no minimum age. The new rules abolished the quota system, and the paid contribution was raised from 40 to 42 for women. For this reason, in our analysis we exclude individuals with 40 years of contributions or more.

[8]The age requirements for the self-employed was 58 years, and it was raised by one additional year for all women in 2018.

Table 2: Statutory retirement age in the private sector by cohort

Cohort	Women		
	Before	After	Reform
1951	60	60	NO
1952	60	64	YES
1953	60	66+11m	YES

Notes. This table summarises the statutory retirement age in place before and after the Monti-Fornero for private sector workers, faced by different cohorts who were affected or not by the reform (as indicated by the column *Reform*). In order to retire with the *old age* pension scheme, individuals had to reach the age thresholds indicated above and to have at least twenty years of contributions. **Sources**. Authors' elaborations based on information from National Social Security Institute (INPS), Circolare INPS n35 (2012)

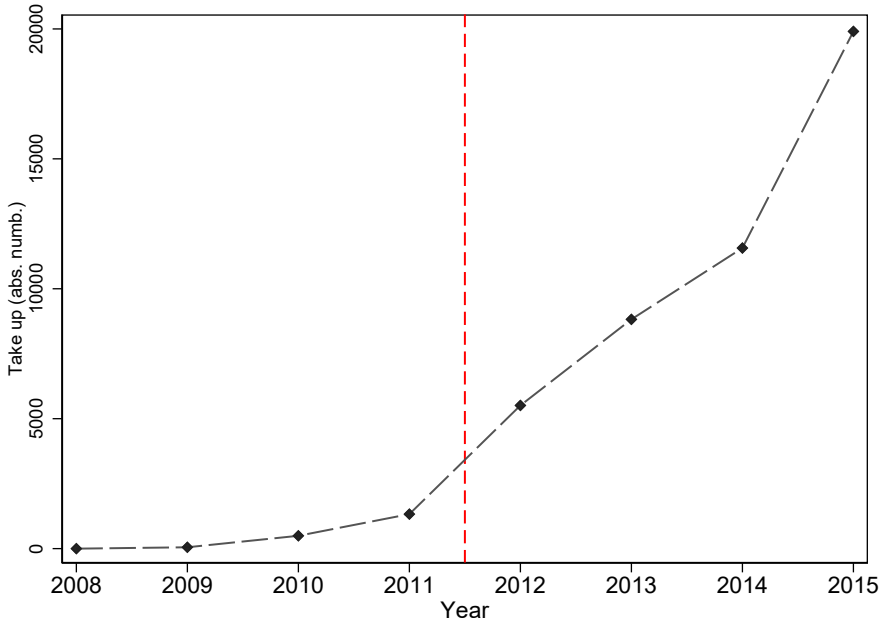
this option, women have to retire following the defined-contribution scheme, which translates into a permanent penalty of the annuity of about 35% (INPS 2016). The National Social Security Institute (INPS) reports this figure based on the difference between the average pension received by women under "Opzione Donna" scheme and the pension paid to women who took the seniority scheme in 2015. This computation does not account for cohort differences or other individual characteristics.

In this paper, we exploit the implementation of the Monti-Fornero reform and the fact that OD was not changed, to analyze whether women responded to the increase in SRA by exiting the labour market earlier thanks to the OD availability. The focus on women is motivated by the fact that (i) they faced the largest increase in statutory retirement age (see Table 2); (ii) an early retirement scheme similar to OD is not available for men. Intuitively, despite the monetary penalty associated with the early retirement scheme, the increase in SRA represents a strong incentive for a woman to exit the labour market earlier than requested. Figure 1 shows the increase in the take up of OD over time, since its implementation in 2008, and indicates that the largest increase in take up seems to have occurred after the enactment of the Monti-Fornero reform at the end of 2011.

The reform was sharp and unexpected, after its implementation the public debate was intense as it is documented by the media attention that the reform's obtained. This suggests

that women were aware of the changes of the retirement eligibility and understood the stakes of the reform. Recent evidence suggest indeed that individuals understand pension reforms and keep up with the changes in regulations (Ciani et al. 2022). However, Italian women have been found to lack awareness of their pension rights and have limited retirement planning (Angelici et al. 2022).

Figure 1: Take up of early retirement scheme *Opzione donna*



Notes. The graph reports the number of women working in the private sector who retired with the *Opzione Donna* early retirement scheme from 2008 until 2015. The red dashed line indicates the year (2012) in which the Monti-Fornero reform took place. **Source**: own elaborations on INPS (2016, Table 3.1)

3 Identification Strategy

This paper aims at assessing the effect of the Monti-Fornero pension reform on the likelihood that women retire early and on the annuity they eventually obtain.

To this purpose, we implement a Difference-in-Discontinuities and exploit two features of the Italian pension system described above, that uniquely characterises our setting.

Since having 35 years of contribution is the minimum requirement for eligibility to "Opzione Donna" (OD), we want to understand how women around the 35 years cutoff responded to the

reform. Thus we focus on women born in 1952, i.e. affected by the increase in SRA induced by the Monti-Fornero reform, around the 35 threshold. However, if we were to use a classic regression discontinuity design, we could not capture the reform effect, since both women born in 1952 above and below the threshold were treated by the reform.

Furthermore, given that OD was in place from 2008, we could see a jump at the 35 year threshold which is due by the fact that the early retirement policy was in place before the enactment of the Monti-Fornero reform.

To overcome these issues, we apply a Difference-in-Discontinuities (Diff-in-Disc) approach and include the 1951 cohort as a control group. The 1951 cohort was not treated by the reform and this strategy allows us to account for the *baseline* take-up of OD, which would have occurred in absence of the reform.

This methodology compares the change in retirement behaviour from below to above the 35-year-of-contribution cutoff of women who were treated by the reform (i.e. born in 1952) with the same change occurred for women who were not treated (i.e. born in 1951).

We estimate the model parametrically. The baseline Diff-in-Disc analysis is defined as follows:

$$\begin{aligned} Y_{ij} = \gamma_0 + \gamma_1 Above35_{ij} + \gamma_2 f(C_{ij} - c) + \gamma_3 f(C_{ij} - c)(Above35_{ij}) \\ + \gamma_4 f(C_{ij} - c)(Above35_{ij} - 1) + \gamma_5 Treat_{ij} + \gamma_6 Above35_{ij} Treat_{ij} + \xi_{ij} \end{aligned} \tag{1}$$

Where Y_{ij} is the outcome for woman i born in cohort j, which can be either the retirement age or the pension annuity. The variable C_{ij} is our running variable, it is the number of months of contributions at age 60, which is measured on 31st December 2011 for the 1951 cohort, and on 31st December 2012 for the 1952 cohort.[9] It is normalized around the cutoff, so that $c = 0$. The dummy variable $Above35_{ij}$ indicates whether the woman has more than 35 years of contributions

[9]We also decided to use only the 1951 and 1952 cohorts because these are the cohorts to which the laws adopted for the implementation of the Monti-Fornero reform explicitly refers to. In fact, the text of the Laws 214/2011 is reported by INPS interpretative norms number 35/2012, at the paragraph 6.(b) Exceptional provisions (Art. 24(15-bis)):"female employees in the private sector who are members of the A.G.O. (Compulsory General Insurance) and its substitutes may alternatively receive old-age benefits:upon having contributions at 31st December 1995; and upon reaching the age of 64, if they have, as at 31 December 2012, a contribution period of at least 20 years and an age of at least 60."

at age 60. $Treat_{ij}$ is a binary variable indicating whether the woman belongs to the 1952 cohort, affected by the Monti-Fornero reform. In the specification, we allow for different slopes on both sides of the cutoff, which are captured by the coefficients γ_3 and γ_4.

The coefficient for the interaction term $Above35_{ij}Treat_{ij}$, i.e. γ_6, captures the effect of being affected by the reform and of having more than 35 years of contributions. This coefficient identifies the effect of the reform. This analysis allows us to assess whether the reform induced an early retirement behaviour for women who, at age 60, had more than 35 years of contributions and could opt for the early retirement scheme OD, at the cost of a penalty in the annuity induced by the defined-contribution scheme.

We expect that women with less than 35 years of contributions who are not eligible for any form of early retirement scheme, are thus forced to stay in the labour market. On the contrary, women who are just above the 35-year-of-contribution cutoff have the option to exit from the labour market before reaching the new SRA.

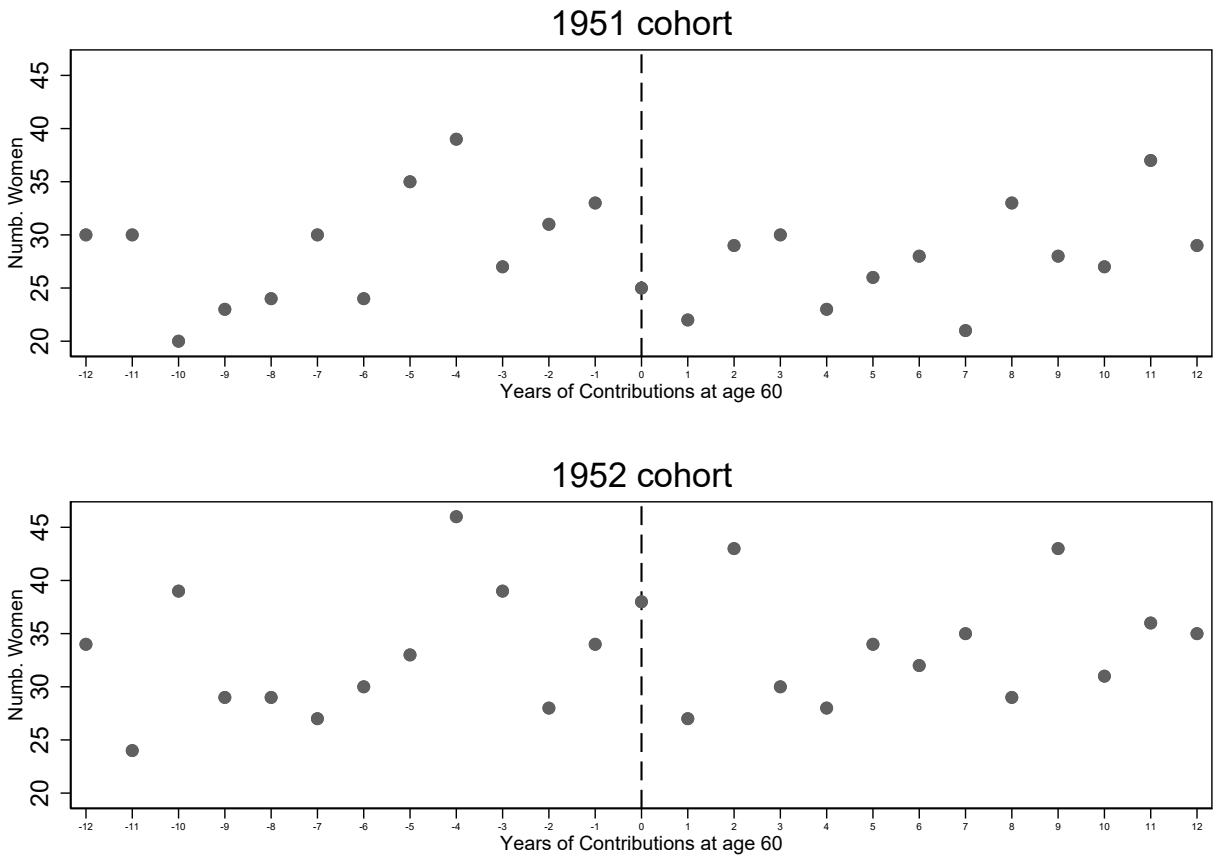
The model is estimated using first-order polynomial (Gelman & Imbens 2019), and we use a triangular kernel (Cheng et al. 1997). Standard errors are clustered at the running variable level.

Given that we estimate the effect of the reform parametrically, the choice of the bandwidth is of crucial importance. In the baseline analysis, we adopt a bandwidth of one year of contribution , but we repeat the analysis using a bandwidth of 9 to 15 months of contribution.

The coefficients of the interaction terms give the effect of the Monti-Fornero reform γ_6 in Equation 1, under the assumptions that (i) the running variable is continuous at the cutoffs, (ii) women below and above each cutoff are similar on many dimensions, and (iii) the 1951 and 1952 cohorts are similar in observed and unobserved characteristics (Grembi et al. 2016).

We test the first assumption by plotting the running variable (months of contributions) separately for the 1951 and the 1952 cohorts. Figure 2 shows no discontinuity in the number of years of contributions at both cutoffs and for both cohorts. A complementary assumption requires that there is no manipulation in the running variable, but given that our running variables depend on the actual months of work performed during the woman's life cycle we do

Figure 2: Density of the running variable



Notes. The graphs report the number of women by cohort at the years of contribution at age 60, following the running variable specification. The cutoff of 35 year is reported at 0, and correspond to the dashed line. We consider 12 months at each side of the cutoff. **Source**: own elaborations on INPS data

not expect this to be easily manipulated once retirement age approaches.[10]

In order to check for the second assumption, we conduct a balance test and run a regression-discontinuity by cohort and use the same contribution threshold of Equation 1. We use as dependent variables the woman's characteristics that we observe in the administrative data, such as geographical residence, whether married, whether having a survival pension, the presence of sick leave, of family leave, the education level, whether in a high paid job and whether the woman had any unemployment spell [11] Results are available in Appendix in Figure A-1, and do not indicate differences among cohorts in most cases considered. Notice also that in the baseline specification we control for regional and sector fixed effects, where the sector is the sector of the last job before retirement, as well as for the woman's marital status and for the information on whether she receives a survival pension. Furthermore, we perform robustness analysis in which we control for all the variables reported in Figure A-1.

4 Data

For the analysis, we use two sources of administrative data from the Italian Social Security Institute (*Instituto Nazionale di Previdenza Sociale*, INPS): (i) data on the universe of retirees, and (ii) data on the working careers history of a representative sample of individuals.

The first dataset includes all retired individuals from 1998 to 2021. It provides information about the type of pension (old age, seniority, survival, invalidity and disability), the month and year in which the pension has started, its monetary value, and the pension fund that provides the annuity.

[10]We also consider whether the reform introduced other instruments that could be used to retire early. The Italian pension system gives the possibility to workers to pay out the years spent in tertiary education in order to consider them as "years of contributions", from 1974 (Law 114/1974). However, this feature is unlikely to matter in our context, considering that we focus on women born at the beginning of the 1950s, and that very few of them completed tertiary education. According to EUROSTAT, only 10% of Italian women between 55 and 64 years of age had completed tertiary education (ISCED levels 5-8) in 2011; the same figure in France or Germany was about 20%. Furthermore, the Monti-Fornero reform's did not change this possibility of accounting for years spent in tertiary education, and, in our data, we can control for this information because it is available for individuals who decided to count these years of contributions. Other forms of early retirement scheme such as the so called "APE" (State Pension Advance, Social or Voluntary) was introduced only in 2017, when women born in 1952 were already eligible for the old age pension. Thus, they were not affected by this early retirement option.

[11]More details on the data will be provided in the next session 4.

The second dataset, instead, comprehends 13% of the Italian working population born from 1950 onward[12]: it describes the working career of workers from the non-agricultural private sector, starting from the first to the last job spell available. It includes periods of sickness, maternity, parental and family leave. Information about the salary and hours worked are also present. We use this dataset to construct information on the years of contribution accrued by each individual at any age, as well as to recover information on unemployment, sick leave and family leave.

For our analysis, we select women who retire with the old age or seniority pension, between 2011 and 2020.[13] Further, we only consider women who are also observed in the working careers dataset, which covers only 13% of the population.

4.1 Descriptive evidence

Before describing our sample selection and variables definition in detail, we present some preliminary evidence that motivates our analysis. The figures below refer to women born in 1951 and 1952 who retired between 2011 and 2020.

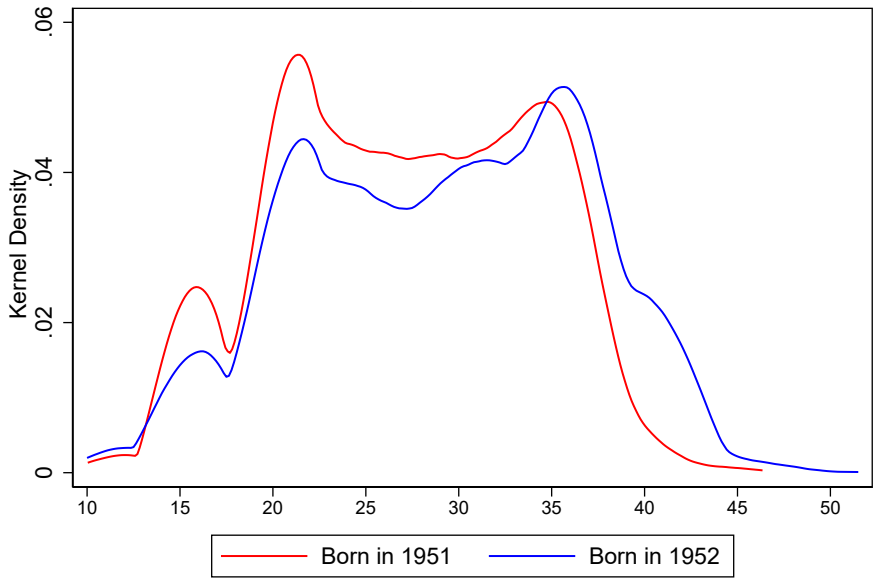
Figure 3 shows the distribution of the years of contribution at retirement age by cohort. First, women born in 1952 display a more right-skewed distribution than those born in 1951, suggesting that they stayed in the labour market longer than the reform envisioned. Second, at the 20 years of contributions, the 1951 shows a higher bump than the 1952 cohort. This aligns with the "Grandfathering rule", which enabled women born in 1951 with at least 20 years of contribution to retire under the ex-ante reform rules. Finally, looking at the 35-year threshold, both cohorts have similar densities. However, women born in 1952 show a slightly higher level, which may be due to the Monti-Fornero reform. This also indicates that by focusing on women at the top part of the contributions-history distribution, we refer to similar cohorts in terms

[12]The sample selection has been conducted by the Social Security Institute and ensure the representative of the population of workers in Italy by sampling individuals based on 24 date of birth per year.

[13]As pointed out in Section 3, a crucial variable for our analysis is the number of months of contributions obtained by each woman at age 60, which is the threshold used by the Monti-Fornero law to identify treated and untreated cohorts. As women born in 1951 become 60 in 2011, we focus our analysis on women who are not yet retired in 2011, i.e. who haven't used any forms of early retirement schemes before the Monti-Fornero reform was enacted.

of distribution (while at the 20-year cutoff the density is not similar by cohort, as mentioned above).

Figure 3: Distribution of years of contribution at retirement age, by cohort

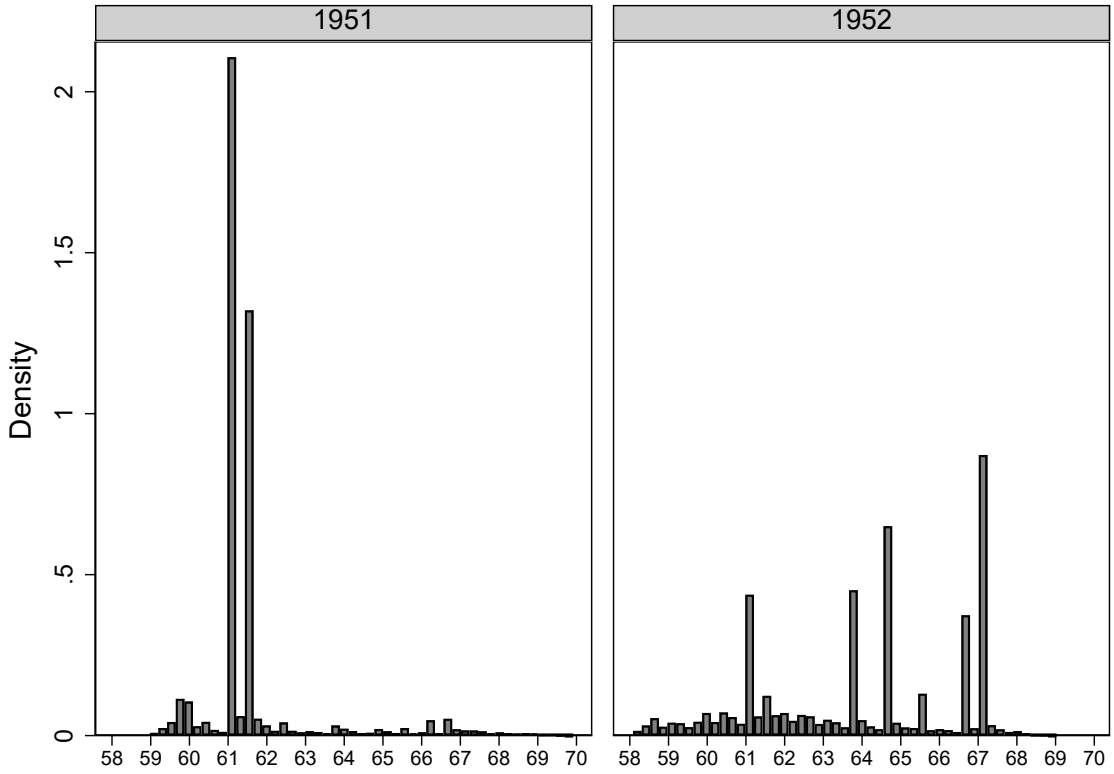


Notes: The graph show the number of years of contribution by cohort at the retirement age. We select women who retired from 2011 to 2020. **Source**: own elaborations on INPS data

When looking at the age of retirement, the density graphs displayed in Figure 4 for women retired from 2011 to 2020, we see interesting evidence: on the left, women born in 1951 have a higher density around age 61 and 62, while on the right, women born in 1952 have several peaks at 61, about 64, 65 and around 67. There are also 1952 women distributed between age 61 and 64. These pictures show that while women born in 1951 were exempted and retired as soon as possible after the Monti-Fornero reform, women born in 1952 retire early and respond to the reform.

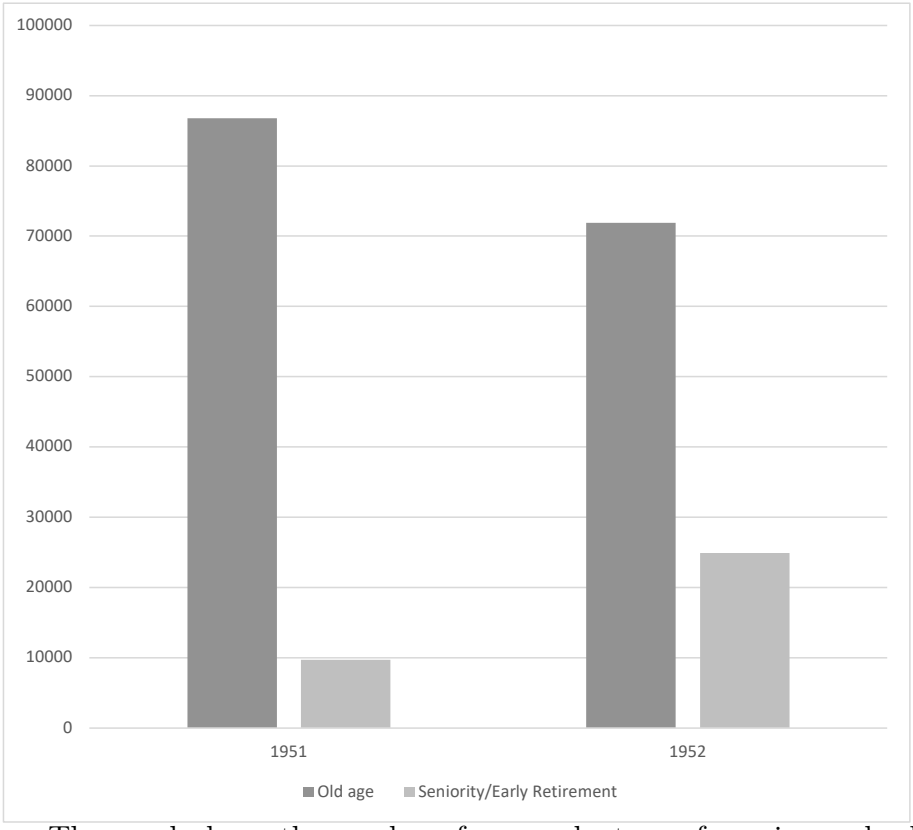
Following on, in Figure 5, we present the type of pension these women have: the graph shows each cohort who retired from 2011 to 2020, and the type of pension by number of women. For the old age pension (the one with no penalty), the figures translate into a percentage of 89.95% for 1951 and 74.27% for 1952; the seniority pension or early retirement scheme (the one with a penalty) shows a higher percentage for the 1952 cohort, with a 15.65 percentage point difference between 1951 and 1952 (10.05% vs 25.7%, respectively). The higher percentage for 1952 suggests that these women were more likely to retire early despite the monetary penalty.

Figure 4: Age of retirement by cohort



Notes: The graphs show the distribution of the retirement age for each cohort, for women who retired from 2011 to 2020. **Source**: Own elaborations on INPS data.

Figure 5: Retirement by type of pension and cohort



Notes. The graph shows the number of women by type of pension and cohort. We take women born in 1951 and 1952, who retired from 2011 to 2020, with either old age or seniority/early retirement scheme pension. **Source**: Own elaborations on INPS data.

4.2 Variables definition and sample selection

The main outcome variables for our analysis are the age at retirement, measured in months, and the monthly annuity the woman receives upon retirement, expressed in 2020 Euro.

As specified above, the running variable is defined as the months of contributions each woman has obtained at age 60, which means we consider December 31st, 2011 for the 1951 cohort, and December 31st, 2012 for the 1952 cohort. In the baseline specification, we control for regional and sector-fixed effects.[14]

From the data, we can recover additional information for the robustness checks presented below. We know the marital status of the women[15], whether they received a survival pension and the place of residence at the time of the first pension received. We control for the type of contribution scheme by checking the first year of contribution available in the data and the accrued contribution at 31st December 1995 (following the Dini's reform). Thus, we know whether they are under the defined-benefit, mixed or defined-contribution scheme. We compute a set of dummy variables equal to one if the woman has family, sick or unemployment leave spells in the last ten years of work above the median value of the overall sample of women who retired from 2011 to 2020.

In addition, we compute a dummy variable equal to one if the differential salary from the first to the last year of work in the sector was above the median value of the differential salary of the overall sample of women working in the same sector. Since we do not have the first/last salary information available for a few women, we lost about 81 observations.

Furthermore, we control for the level of education, particularly whether women had reached higher education (degree or above). Notice that the information about the woman's level of education is available only from a separate dataset, which gathers compulsory communications of firms regarding changes in job positions and is available from 2010 onward. For this reason, we do not use the education information in the baseline analysis but only in a robustness check.

[14] in Italy, there are 20 regions. The sector refers to the last job the woman had before retirement and comprises 127 categories

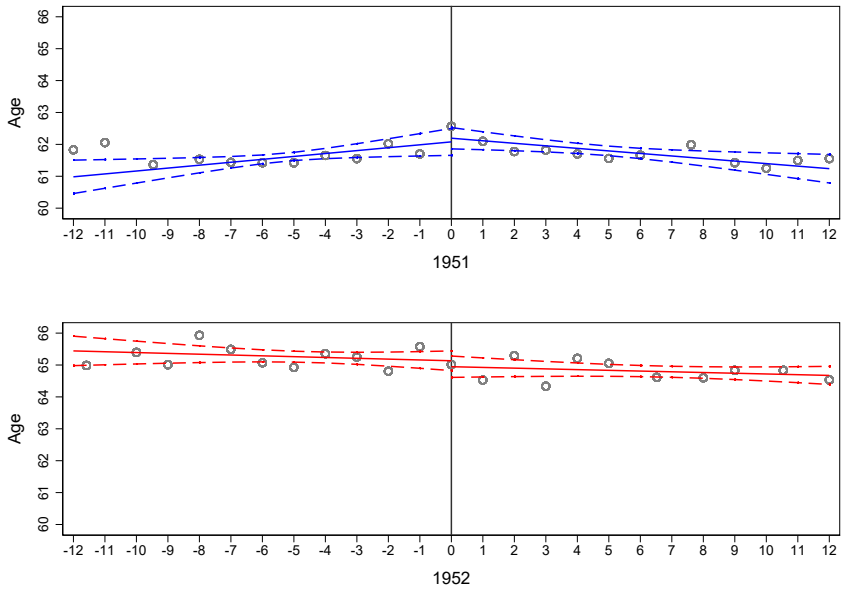
[15] Although we know that couples could have joint decisions to retire (Banks et al. 2010, Stancanelli & Soest 2012, Hospido & Zamarro 2014, Ciani 2016, Stancanelli 2017), we cannot identify the partner in the data due to privacy reason.

The baseline analysis is conducted on a sample of women within one year from the 35-year-of-contribution cutoff, which comprises 764 observations for the 1952 cohort and 645 observations for the 1951 cohort, for which we observe all the variables of interest. Table A in Appendix compares the characteristics of the sample used for the analysis with the ones of the entire sample of women born in 1951/1952 and retired between 2011 and 2020, for which we have information in the career dataset. The Table shows that the characteristics are similar in terms of the distribution. Only the annuity amount is slightly higher for the sample selected, but this is in line with our sample selection and the fact that the entire sample also contained women with very few years of contribution who have small pensions.

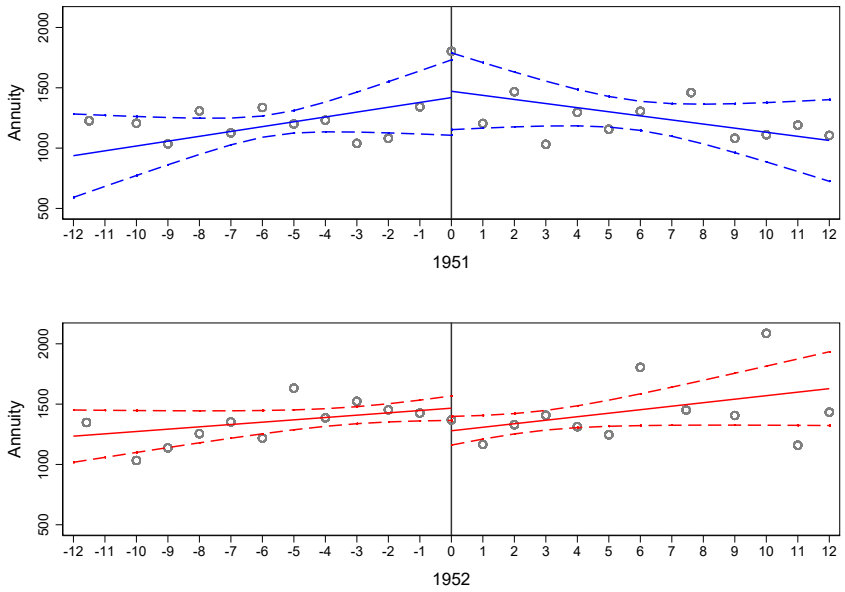
Finally, Figure 6 shows, graphically, the variations in age at retirement and annuity induced by the 35-year-of-contribution cutoff for each cohort. Regarding retirement age in Panel (a), we do not observe any jump in the retirement age for the 1951 cohort. This suggests that women not affected by the Monti-Fornero reform have no incentive to retire early, i.e. their SRA was 60. For women born in 1952, for whom SRA was increased until 64, we observe a slight decrease in retirement age once the 35-years-of-contribution threshold is passed from below, which may indicate that for these women, early retirement may be more appealing despite the penalty. The implications of such a decision become more apparent in Panel (b), in which we observe that women of the 1952 cohort treated by the Monti-Fornero reform, which had more than 35 years of contributions at age 60, face a drop in the annuity they receive, compared to women with less than 35 years of contributions which were forced to stay in the labour market longer.

Figure 6: Graphical evidence at the 35-year-of-contribution cutoff: age at retirement and annuity

(a) Retirement age



(b) Annuity



Notes: These graphs show the variation in the age of retirement (a) and the annuity (b) by cohort. We centred the analysis at 35 years of contribution, represented at 0 in the pictures. We consider a 12-month bandwidth from each side of the cutoff. **Source**: Own elaborations on INPS data.

5 Results

Table 3 report the baseline results of the analysis. We refer to age at retirement (defined in months) in column (I), and to the monthly annuity women receive upon retirement in column (II).

The coefficient of the variable $BelowCutoff * TreatedCohort$ refers to coefficient γ_5 in Equation 1 and identifies the effect of belonging to the 1952 cohort and thus being affected by the Monti-Fornero reform, provided that these women have less than 35 years of contributions at age 60, and are not eligible for early retirement with OD. In other words, the coefficients of the variable $BelowCutoff * TreatedCohort$ give us the *intended* effect of the Monti-Fornero reform. Results show that women born in 1952, who have less than 35 years of contributions, retire 43.3 months (3 years and 7 months) later than the control group, which is represented by the 1951 cohort with less than 35 years of contributions. Considering that the average retirement age for the control group is 61.7 years, this result implies that the 1952 cohort without an early retirement option retires at age 65.2, which suggests a full compliance with the intentions of the reform. The longer working career implies that these women earn 193 Euros more per month, which corresponds to a 16% increase in monthly annuity compared to the average annuity received by women born in 1951 who have less than 35 years of contributions at age 60.

The coefficient of the variable $AboveCutoff$ refers to coefficient γ_1 in Equation 1, and represents the effect of having more than 35 years of contributions for the 1951 cohort; in other words, this coefficient captures any potential take-up of the early retirement scheme OD for the 1951 cohort. The coefficients reported in Table 3 suggest that OD was barely adopted by the cohort not affected by the Monti-Fornero reform: in fact, the coefficient on age at retirement is small and positive, and the one on annuity is not statistically significant. This finding is not surprising: OD can be adopted from age 57 onward, and the SRA before the Monti-Fornero reform was implemented was 60; considering the monetary penalty induced by the take-up of OD, and the very small distance between the two age limits (57 vs. 60), most women may have decided to just wait for the statutory age to retire in order to obtain the full annuity. Another potential explanation for this finding may be due to our sample selection, because we only keep

women who are not yet retired in 2011. In other words, if a woman born in 1951 decides to opt for OD and retires in 2010 at age 59, she is no longer in our sample. However, it should be noticed that if she could do that, that means that she had more than 35 years of contributions at age 59, e.g. 35+1 month. At age 60 she would have 36+1 months of contributions, and would be still out of our sample because we use a bandwidth of 1 year. Hence, our small bandwidth ensures that the results are not driven by this type of behaviour. Finally, another explanation is that before the Monti-Fornero reform, individuals had to wait a time window to retire after they became eligible, this time window was about 6 months, which would be reflected in the age of retirement.

The coefficients of interest for our analysis are the ones of the interaction variable $AboveCutoff * TreatedCohort$, which correspond to coefficients γ_6 in Equation 1. They identify the effects of being treated by the Monti-Fornero reform on the take-up of the early retirement scheme OD and on the subsequent annuity. More precisely, these coefficients represent the effect of having more than 35 years of contributions, and thus being eligible for OD, for the 1952 cohort who was affected by the Monti-Fornero reform. Our results indicate that women affected by the postponement in SRA, retire early by 7.87 months: considering that the average age at retirement for the control group (1951 cohort with less than 35 years of contributions) is 739 months, this coefficient implies that the 1952 cohort who can retire early does so at age 739-7.8=731.2 months, corresponding to age 61. In other words, women of the 1952 cohort seem to opt out for the early retirement scheme as soon as they can at age 60. This early retirement behaviour implies that the monthly annuity decreases by 186.3 Euros, which corresponds to a reduction of 15% compared to the average annuity of the control group. The monetary penalty associated with the take-up of *Opzione Donna* is substantial, even if we only consider the monthly annuity received immediately upon retirement. In section 6.1, we will assess whether such penalty is confirmed in the woman's lifetime earnings.

Table 3: Baseline results on the age of retirement and the annuity

Dep. Variable:	age in months	annuity in €
	(I)	(II)
	(Diff-in-Disc)	(Diff-in-Disc)
$AboveCutoff$	4.832**	69.889
	(1.734)	(100.836)
$BelowCutoff * TreatedCohort$	43.539***	192.948***
	(1.458)	(65.660)
$AboveCutoff * TreatedCohort$	-7.874***	-186.299*
	(2.313)	(95.386)
Average Dep.Var. Below Cutoff Cohort 1951	739.329	1192.279
Region FE	✓	✓
Sector FE	✓	✓
Married and survival pension FE	✓	✓
N	1409	1409

Notes: The table reports the results of a parametric estimation of Equation 1 (baseline specification), with the age of retirement as dependent variables in column (i) and the annuity amount in columns (ii). The variable *AboveCutoff* indicates whether the woman has more than 35 years of contributions at age 60. We control for region and sector. Standard errors are clustered at the months of contribution. The bandwidth is 12 months. p-values: * p<0.10, ** p<0.05, *** p<0.01
Source: Own elaborations on INPS data.

6 Robustness

We test the robustness of our results under three main dimensions: (i) the bandwidth selection, (ii) the inclusion of control variables, and (iii) the choice of the cutoff.

First, we test the sensitivity of the choice of bandwidth. To do that, we run the baseline model with different bandwidth specifications. We select bandwidth from 9 to 15 months and report the results in Figures 7 and 8. We report only the coefficient of interest for the Diff-in-Disc ($AboveCutoff * TreatedCohort$) estimates, respectively.

From the figure 7, the effect of $AboveCutoff * TreatedCohort$ is always significant, and the results are stable across different bandwidths, confirming the robustness of our results. Women retire early and the age of retirement ranges between 8.03 to 8.52 months earlier compared to the control group.

Regarding the results on the annuity, in Figure 8 we see a significant effect for bandwidth 9 to 12 (this last one is our baseline, which is significant at 10% level). This is in line with the fact that the penalty should be higher for women closer to the cutoff of 35 years, who decided to retire early and did not work many additional years in the labour market. Also, even if not significant, the effect of the Diff-in-Disc coefficient is still negative in each bandwidth above 12 months.

Second, we compute the baseline analysis by including different fixed effects. On top of those already included which are being married, receiving a survival pension, sector and region, we include additionally, one by one, further individual characteristics. Table 4 shows the results. We focus on (i) whether the women have family or sick leave above the median, (ii) whether they have differential earning above the median within the sector, (iii) if they had unemployment spell above the median[16], (iv) tertiary education attained and (v) if followed under the mixed contribution scheme.

In Table 4, Panel A shows the results for the age of retirement for the coefficient of interest: the results for the Diff-in-Disc are significant and confirm the effect of 7 to 8 months of early

[16]For these controls, we recall that we select the last 10 years of work and compute the related measures of family and sick leave, unemployment and earnings

Figure 7: Retirement Age

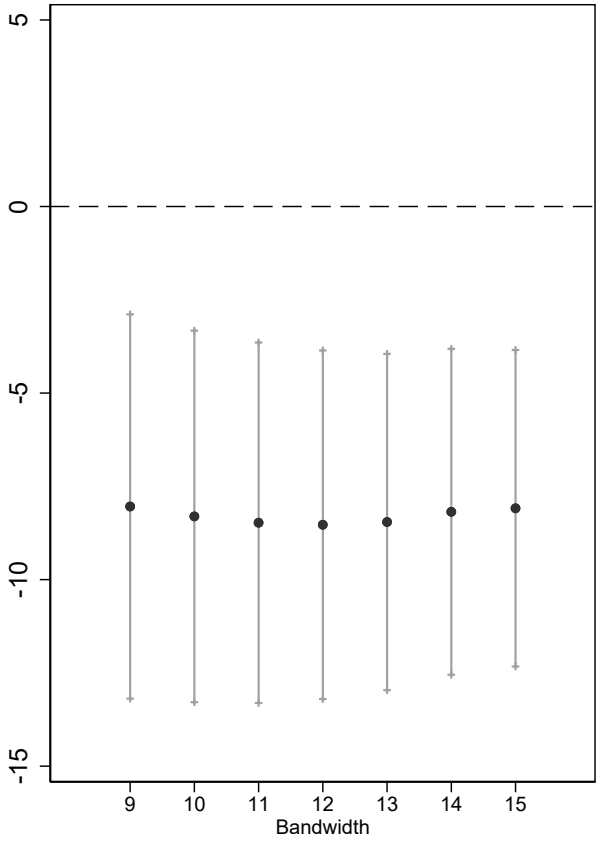
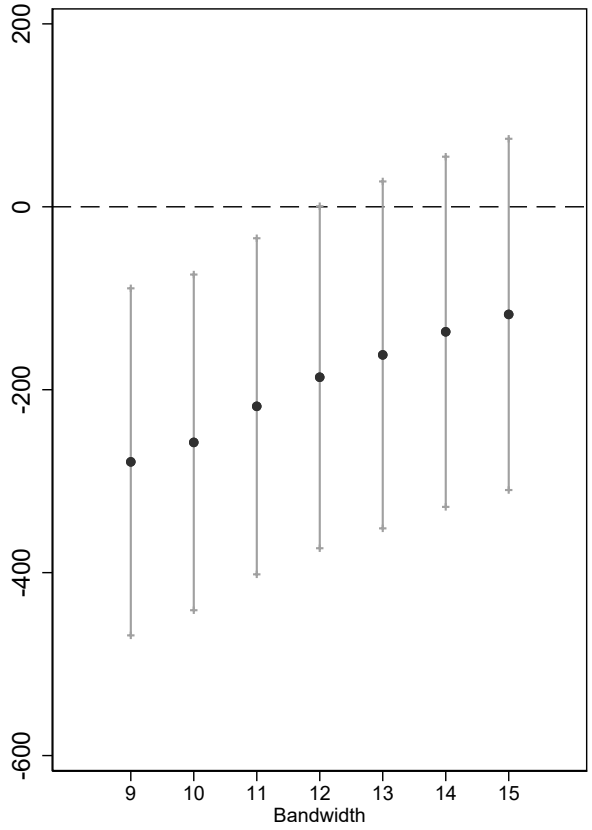


Figure 8: Annuity



Notes The figures report the results of a parametric estimation of Equation 1 (baseline specification), with the age of retirement as dependent variables in Figures (a) and the annuity amount in Figures (b). We report the coefficient of interest for the Diff-in-Disc ($AboveCutoff * TreatedCohort$) estimates. We select bandwidth from 9 to 15 months on each side of the cutoff, as reported on the horizontal axis. We control for marital status, survival pension, region and sector. Standard errors are clustered at the months of contribution. **Source**: Own elaborations on INPS data.

retirement for the treated cohort. This evidence is in line with the baseline found in Table 3 and confirms the robustness of our strategy.

Panel B of the Table reports evidence for the annuity: the penalty of the reform is present in each specification considered, and the range is between 185 to 292 euros (again, this last result for the education fixed effect). The coefficient is significant at the 10% level. Overall, our findings are robust to the test of different fixed effects, thus confirming the soundness of our strategy.

As a further check, we run the analysis by excluding women with tertiary education from the sample. This is to be sure that our results are not driven by only highly educated women. These women can also include their years of higher education in their years of contribution by paying a monetary amount for each year included (this option was introduced in 1974 in Italy). After excluding these women (81 overall), we estimate equation 1 again, confirming the baseline findings. Results are reported in the Appendix in Table A-2.

Table 4: Results on the age of retirement and the annuity, for the Diff-in-Disc with different fixed effects

	(i)	(ii)	(iii)	(iv)	(v)
Panel A. Age at retirement					
Diff-in-Disc estimate	-7.911***	-7.754***	-7.957***	-8.613**	-7.798***
	(2.172)	(2.108)	(2.21)	(3.548)	(2.211)
Panel B. Annuity					
Diff-in-Disc estimate	-185.495*	-193.990*	-189.530*	-292.214*	-183.612*
	(95.195)	(95.921)	(92.860)	(154.332)	(91.008)
Family/Sick leave	✓				
Differential Earnings		✓			
Unemployment			✓		
High Education				✓	
Mixed Contribution scheme					✓
N	1409	1322	1409	604	1409

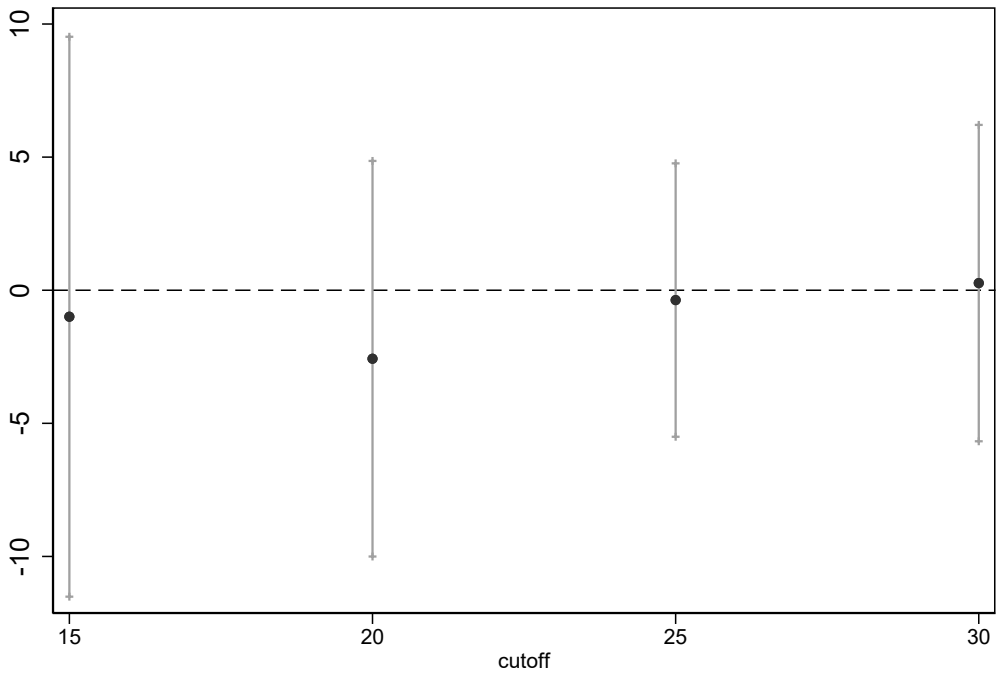
Notes: The table reports the results of a parametric estimation of Equation 1 (baseline specification), with the age of retirement as dependent variables in Panel A and the annuity amount in Panel B. We report the coefficient of interest for the Diff-in-Disc ($AboveCutoff * TreatedCohort$) estimates. We include additional fixed effects as the legend report for each column. We also control for region, sector and being married and receiving a survival pension in each column. The number of observations varies in columns (ii) and (iv) due to information availability of the FE included. Standard errors are clustered at the months of contribution. The bandwidth is 12 months. p-values: * p<0.10, ** p<0.05, *** p<0.01
Source: Own elaborations on INPS data.

Finally, we perform a set of placebo tests to assess the possibility that our results arise from random chance rather than the causal effect of the Monti-Fornero reform. Figures 9a and 9b show the results of the models on the age of retirement and annuity, respectively, for the cutoff 15, 20, 25 and 30 years of contributions. At these thresholds, we expect to find no effect of the reform on the outcomes considered, given that the reform did not consider them for the early retirement option.

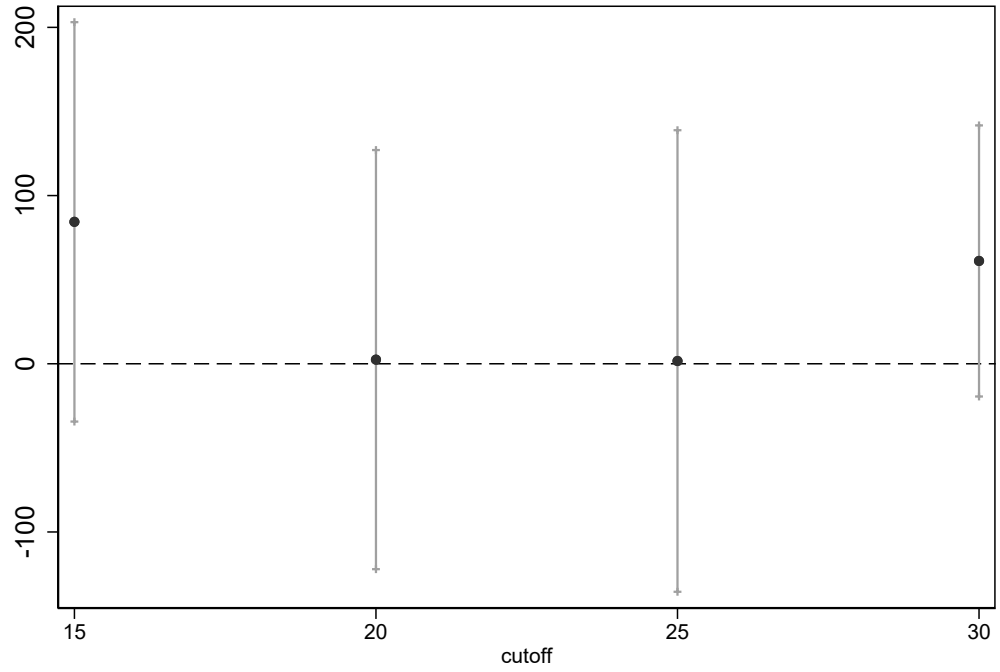
Looking at Figures 9a, the Diff-in-Disc show no significant effect on the retirement age at different cutoffs. Indeed, the coefficients are also close to zero in both models, suggesting no effect of the reform. Finally, Figures 9b show no significant effect of the coefficients on the annuity amount. This is reassuring and confirms that the result found at the 35 year threshold captures the effect of the Monti-Fornero reform. Overall, these placebo tests strongly support the soundness of our main results on the reform.

Figure 9: Results on the age of retirement and the annuity with different cutoffs

(a) Retirement age



(b) Annuity



Notes The figures report the results of a parametric estimation of Equation 1 (baseline specification), with the age of retirement as dependent variables in Figures (a) and the annuity amount in Figures (b). We report the coefficient of interest for the Diff-in-Disc ($AboveCutoff * TreatedCohort$) estimates. We select cutoffs 15-20-25-30 years of contribution, as reported on the horizontal axis. We control for marital status, survival pension, region and sector. Standard errors are clustered at the months of contribution level. **Source**: Own elaborations on INPS data.

6.1 Further evidence on the labour supply semi-elasticity and the Social Security Wealth

In this section, we focus on the semi-elasticity of the labour supply of women treated by the reform. We refer to semi-elasticity instead of elasticity because we do not know the respective monetary amount of the additional years of contribution that the reform had foreseen.

The main concept is that the reform aimed at keeping women born in 1952 at least an additional four years in the labour market, by simply increasing the retirement age for the old age pension of four years. However, as we show in section 5, women just above the 35 year cutoff respond to the reform and retire early. So, we proceed by computing the semi-elasticity of the labour supply to understand how (in)elastic the response was to the reform.

To do that, we follow Bozio (2008) and compute the semi-elasticity as follow:

$$Semi - elasticity = \frac{\Delta Age}{\Delta Years of Contribution} \tag{2}$$

Where $\Delta Age = \widehat{Age_{52}}$ - $\widehat{Age_{51}}$, it is the difference between the estimated age for the cohort 1952 and 1951 of Equation 1, below and above the cutoff respectively. $\Delta Years of Contribution$ equals four, which is the minimum number of additional years required by the reform to access the old age pension

If women align their labour supply to the reform's requirements, we should see a *semi-elasticity*=1. If women supply less (more) than what the reform aimed, then the *semi-elasticity*$<$ ($>$)1.

Table 5 reports the results. We show the estimated age by cohort below and above the cutoff, the difference and the relative semi-elasticity. We compute the analysis for the baseline sample and by group based on marital status and geographical residence.

Starting from the top of the Table, women below the cutoff display a higher semi-elasticity compared to women above the cutoff in the bottom of the Table. This result is consistent with the evidence that women above the cutoff retire early and exit the labour market earlier. In particular, the semi-elasticity below the cutoff is 0.90, while above the cutoff is 0.74. The

difference is 0.16, suggesting that women below the cutoff stay longer and align more with the reform's goal than women above the cutoff.

Another interesting result is by marital status. For women below the cutoff we see them staying longer in their job, with a semi-elasticity of 0.95 vs 0.84 for not-married women, and this is also found for married women above the cutoff, where the semi-elasticity is 0.76 vs 0.68 for the not married group. This evidence supports that not married women exit earlier the labour market potentially due to their family composition status or the availability of a survival pension benefit.

Finally, by geographical residence, we show that while there are no main differences for women below the cutoff (0.89 in north vs 0.91 in centre-south), important differences are present above the cutoff. Here, women in the north show a semi-elasticity of 0.68 vs 0.77 for women in the centre-south.

Overall, this Table suggests that women with more than 35 years of contribution who are not married and live in the north are those who tend to retire earlier compared to the other groups. This result is important because it shows that those who are not married and are potentially exposed to poverty or financial hardship in the long run, due to the (potential) lack of other partner's income, tend to retire early and likely end up with smaller pensions.

As a second step, we focus on the reform's effect on the social security wealth (SSW). The social security wealth is the expected discounted value of future benefits. We follow the literature (Feldstein 1974, Gruber & Wise 1998, 2004, 2008, Belloni et al. 2020) and define the SSW following Lalive et al. (2023):

$$SSW_i = \sum_{j=R}^{\Omega} P_{i,j}\pi(j|a)\beta^{(a-j)} \tag{3}$$

Where i is the individual, R her age of retirement, Ω is the maximum age alive (set at 110 years), a is the age after retirement, $\pi(.)$ are the survival probabilities and β is the discount factor. $P_{i,j}$ is the public annuity at the annual level. The survival probabilities are computed following the Human Mortality Database (2023). The β is set at 0.98. Understanding the effect

Table 5: Semi-elasticity of the labour supply

	(i)	(ii)	(iii)	(iv)
below 35	1952	1951	difference	semi-elasticity
baseline	65.763	62.134	3.628	0.907
married	65.226	61.406	3.820	0.955
not married	65.624	62.240	3.385	0.846
north	65.183	61.622	3.560	0.890
south	65.648	61.983	3.665	0.916
above 35	1952	1951	difference	semi-elasticity
baseline	65.575	62.603	2.972	0.743
married	64.883	61.814	3.069	0.767
not married	65.496	62.738	2.758	0.689
north	64.832	62.088	2.744	0.686
south	65.635	62.535	3.102	0.775

NOTE: The ages in column (i) and (ii) are computed using the estimated age from the results of Table 3 of Equation 1. The elasticity is computed dividing the difference by 4, which is the difference between the estimated new and old retirement age.

of the reform on the SSW is particularly interesting because, as other scholars have pointed out, SSW is essential to understand retirement behaviours (Stock & Wise 1990), or the erosion of private savings (Gale 1998, Attanasio & Brugiavini 2003, Kapteyn et al. 2005, Alessie et al. 2013, Belloni & Alessie 2013). We run the analysis of Equation 1 on the SSW as outcome. Results are shown in Table 6. The same approach is used with 1 year bandwidth and errors clustered at the running variable level.

Looking at the Table, in the result of the Diff-in-Disc analysis, the coefficient of $AboveCutoff*Treated$ is negative and significant at 10% level. The magnitude of the effect is a reduction of 58,635 euro, which suggest that women born in 1952 above the cutoff have a reduction of 58,635 euros compared to women born in 1951 below the cutoff, with a SSW of 414,137. The reduction is about 14.15% compared to those born in 1951.

Our results align with the one found for the annuity and confirm the penalty for women who opt for the early retirement option.

Table 6: Results on the Social Security Wealth for the RD/Diff-in-Disc

	SSW/1000
	(Diff-in-Disc)
$AboveCutoff$	21.987
	(32.081)
$BelowCutoff * TreatedCohort$	47.687*
	(20.781)
$AboveCutoff * TreatedCohort$	-58.635*
	(28.953)
Average Dep.Var. Below Cutoff Cohort 1951	414
Reduction of SSW	14.15%
Region FE	✓
Sector FE	✓
Married and survival pension FE	✓
N	1407

Notes. The table reports the results of a parametric estimation of Equation 1 (baseline specification), with the social security wealth (SSW) as dependent variable. We control for marital status, survival pension, region and sector. Standard errors are clustered at the months of contribution. p-values: * p<0.10, ** p<0.05, *** p<0.01
Source: Own elaborations on INPS data.

6.2 Heterogenous effects

In this section, we investigate the presence of further heterogeneity in the results. In particular, we start with the analysis of Table 4 and proceed by including an interaction term between the fixed effect and the coefficient of interest, i.e. $AboveCutoff * TreatedCohort$. Results are reported in Table 7 for both outcomes. We report the Diff-in-Disc coefficient of interest, the interaction and the FE alone. Each column reports a different set of fixed effects.

Starting from Panel A, in column (i), we find a negative significant effect for the interaction of having family/sick leave above the median (9.6 months earlier). The effect of the interaction with family/sick leave adds up to the Diff-in-Disc one of 4.9 months. This suggests an additional early retirement on the age of retirement for women with more sick and family leave, in line with precarious health status and more caring activities. In column (ii), the interaction terms of having differential earnings above the median is significant and negative (8.2 months early). However, it should be noted that the coefficient of the Diff-in-Disc estimate is no longer significant in this analysis, suggesting that the effect of the interaction term is capturing the one of the

baseline, as the number of months of early retirement is in line with the previous finding.

Moving towards the results on the annuity in Panel B, in column (i) we have the only significant interaction effect for family or sick leave above the median. The result is 229.45 euros, while the effect of the Diff-in-Disc estimate is no longer significant. This suggests no additional effect of having more sick/family leave on the annuity amount. In column (ii), we find no additional effect for the interaction term with having a differential salary above the median, and the FE coefficient per se is positive and significant. This advises that women with higher earnings tend to have higher annuities later, in line with expectations. Finally, from column (iii) to (v), we find no additional effect of the interaction terms, and the coefficient of the Diff-in-Disc estimate remains always significant.

Table 7: Results on the age of retirement and the annuity, for the Diff-in-Disc with different fixed effects and interaction terms

	(i)	(ii)	(iii)	(iv)	(v)
Panel A. Age at retirement					
Diff-in-Disc estimate	-4.900*	-3.767	-7.510***	-8.939**	-7.503**
	(2.617)	(2.609)	(2.160)	(3.661)	(3.288)
Interaction	-9.673**	-8.174**	-2.905	2.429	-0.432
	(4.128)	(3.320)	(4.221)	(5.989)	(4.300)
FE	1.287	-9.992***	-8.929***	10.054***	5.961***
	(2.076)	(1.182)	(1.814)	(3.197)	(1.564)
Panel B. Annuity					
Diff-in-Disc estimate	-114.665	-93.956	-185.332*	-310.501*	-202.015**
	(105.291)	(116.386)	(99.012)	(152.527)	(75.949)
Interaction	-229.458***	-205.107	-27.284	137.026	27.009
	(78.372)	(130.859)	(92.578)	(222.121)	(103.800)
FE	68.952	187.072***	-372.553***	1051.727***	275.664***
	(41.706)	(63.726)	(67.728)	(180.968)	(79.661)
Family/Sick leave	✓				
Differential Earnings		✓			
Unemployment			✓		
High Education				✓	
Mixed Contribution scheme					✓
N RD	764	718	764	355	764
N Diff-in-Disc	1409	1322	1409	604	1409

Notes: The table reports the results of a parametric estimation of Equation 1 (baseline specification), with the age of retirement as dependent variables in Panel A and the annuity amount in Panel B. We report the coefficient of interest for the Diff-in-Disc ($AboveCutoff * TreatedCohort$) estimates. We include additional fixed effect as the legend report for each column. We include and interaction for each fixed effect with the coefficient of interest in each specification, separately. We also control for region, sector and being married and receiving a survival pension, in each column. The number of observation varies in column (ii) and (iv) due to information availability of the FE included. Standard errors are clustered at the months of contribution. The bandwidth is 12 months. p-values: * p<0.10, ** p<0.05, *** p<0.01

Source: Own elaborations on INPS data.

7 Conclusion

The increasing retirement age for pensions has been crucial in many Western countries in the last decades. However, understanding how older workers responded to those reforms is crucial to better designing social security systems.

This paper investigates the response of close-to-retire women affected by a sharp increase in the statutory retirement age. The design of the reform pushed the treated women to work for at least four more years. Otherwise, the only possibility to exit the labour market was with penalised annuities for a lifetime.

Our empirical strategy focused on women with the same years of contribution, namely around the 35 year cutoff, but with different demographic ages. Indeed, the reform exempted women born in 1951, who were already 60 years old, and hit instead women born in 1952, the first treated cohort. Provided with this setting, we apply a Difference-in-Discontinuities, which compares treated and control groups based on differences in the years of contribution. We find that treated women were more likely to retire early before the statutory retirement age, about 8 months before than the control group. When we look at the retirement choice on the annuity amount, we find a significant negative effect for women treated by the reform, eligible for the early retirement option, and the penalty is about 15%. This evidence is only a lower bound of the penalty because we focused on women who were about to retire and were pushed to stay an additional four years. After the reform, the average woman was forced to stay an additional seven years (since the age of retirement for the old age pension shifted from 60 to 67). Thus, future research could focus on the average annuity penalty for women with a longer retirement gap and decide to retire early with OD.

Our most striking result is the early retirement for the first cohort treated of the decision to retire. This evidence is particularly important for several reasons. First, the reform was meant to push women to stay longer in the labour market, with the intent of reducing the budget spending for the pension system. However, this result suggests that the first cohort anchored as much as possible to ex-ante pension rules and retire early. Second, the choice of retire early came with a monetary cost for these women, who would retire without penalty under the pre-reform

rules. Finally, claiming early with a great monetary cost suggests that women respond to the reform without following financial incentive motives. This suggests that women do not act as the classical option value model would predict, but instead, they are moved by other types of preferences and or behavioural responses. This aligns with recent evidence by Behaghel & Blau (2012), Seibold (2021), Lalive et al. (2023).

Our results have important policy implications. Women live longer than men and are more likely to spend part of their retirement in widowhood. However, sudden and unexpected pension reform might act against them and their decision to remain in the labour market longer. In particular, if the only early retirement option includes a monetary penalty, women close to retirement might be inclined to leave the labour market earlier, even at a penalty, not to stay many years more in the labour market. This choice might pose concerns and expose them to difficult financial situations later in life. Policymakers should consider this evidence when implementing welfare reforms.

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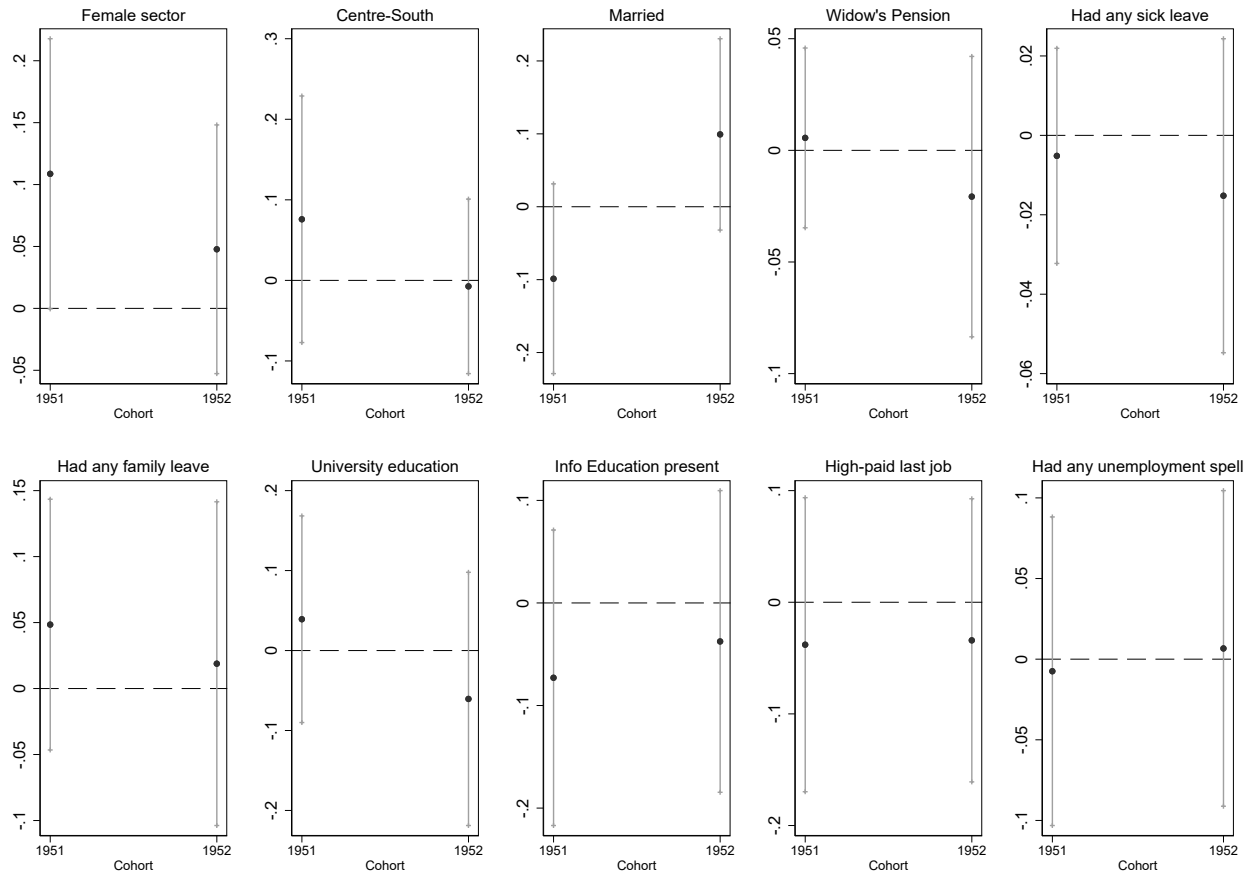
A Appendix A

Figure A-1: Continuity of the covariates at the 35-year-of-contribution cutoff by cohort



Notes: The Figures report the test for the continuity of the individuals' characteristics in the baseline analysis. We plot the RD coefficient of interest followinq equation **??**, with its confidence intervals. We run the analysis separately by cohort. Each sub-figure report the dependent variable in the Title.
Source: Own elaborations on INPS data.

Table A-1: Descriptive statistics for the variable of interests

Variable	Sample 35 Mean	Entire Sample Mean	T stat	Sample 35 N	Entire Sample N
Age at retirement	762.137	759.205	3.5	1409	24250
Annuity	1323.818	1184.845	5.35	1409	24250
Nord	0.54	0.511	2.15	1409	24250
Centre-South	0.46	0.489	-2.15	1409	24250
Married	0.577	0.608	-2.3	1409	24250
Survival pension	0.025	0.032	-1.35	1409	24250
Sick leave	0.022	0.038	-3.15	1409	24250
Family leave	0.275	0.271	0.3	1409	24250
Unemployment	0.146	0.144	0.2	1409	24250
Strenuous job	0.225	0.141	8.7	1409	24250
Differential salary above median	0.592	0.506	6.15	1356	23538
Full Time last job	0.342	0.182	14.9	1409	24250
College education	0.134	0.135	0	604	8520
Education missing	0.479	0.389	6.8	1409	24250

Notes: This table reports the mean by sample for women born in 1951 and 1952 who retired from 2011 to 2020. Sample 35 refers to women included in the estimated sample with 34 to 36 years of contribution. Entire Sample refers to all the women available in the career dataset who retired from 2011 to 2020, with any years of contributions. **Source**: Own elaborations on INPS data.

Table A-2: Baseline results on the age of retirement and the annuity without women with high education

Dep. Variable:	age (I) (Diff-in-Disc)	annuity (II) (Diff-in-Disc)
$AboveCutoff$	4.896***	26.575
	(1.292)	(76.395)
$BelowCutoff * TreatedCohort$	44.364***	191.856**
	(1.585)	(73.099)
$AboveCutoff * TreatedCohort$	-8.459***	-171.892*
	(2.200)	(89.681)
Region FE	✓	✓
Sector FE	✓	✓
Married & survival pension FE	✓	✓
N	1328	1328

Notes: The table reports the results of a parametric estimation of Equation 1 (baseline specification), with the age of retirement as dependent variables in columns (i)-(ii) and the annuity amount in columns (iii)-(iv). The variable $AboveCutoff$ indicates whether the woman has more than 35 years of contributions at age 60. We control for marital status, survival pension, region and sector. We exclude women with higher education. Standard errors are clustered at the months of contribution. The bandwidth is 12 months. p-values: * p<0.10, ** p<0.05, *** p<0.01
Source: Own elaborations on INPS data.