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WORKING HORIZON AND LABOUR SUPPLY: THE EFFECT OF RAISING FULL RETIREMENT AGE ON MIDDLE-AGED INDIVIDUALS

by Francesca Carta* and Marta De Philippis*

Abstract

This paper analyses the effects of raising the statutory full retirement age on the labour force participation of middle-aged individuals and their partners. Identification relies on a difference-in-differences setting that exploits the large heterogeneous increase in the age eligibility for retirement caused by an unexpected Italian pension reform. We detect a sizeable increase in the participation rate of middle-aged women that spills over into their husbands' labour supply, who choose to postpone their retirement decision.

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1 Introduction[1]

Aging is one of the major challenges faced by developed economies in this century, as it puts enormous pressure on fiscal systems and it threatens the sustainability of Pay As You Go pension regimes. Since the '90s, governments responded by implementing different types of pension reforms. Delaying the statutory retirement age has been a widely adopted policy, with the ultimate goal of lowering the number of pension recipients and of enlarging the tax base through higher employment rates among older workers (OECD, 2015). Estimating the labour supply response to these reforms is therefore crucial to evaluate their success.

An active area of research explores whether, and by how much, an increase in the statutory retirement age affects the incentives to retire and to work, focusing on workers who otherwise would have been eligible to retire (we call it the *direct effect*). However, the existing studies tend to neglect possible effects on relatively younger individuals, who may adjust their current labour supply once an increase in retirement age is announced (we call it the *forward looking effect*). Indeed, raising the statutory full retirement age can affect the labour supply of non-myopic individuals also at younger ages through different channels. Among these, first, the postponed access to retirement reduces the number of periods over which the benefit is collected and, therefore, can decrease life-time income. This could have positive effects on participation and employment throughout the entire life-cycle. Second, if individuals know they have to work longer and their disutility from work increases with age, as usually assumed in models of optimal retirement, they may prefer to supply more labour when younger. In this case, the labour supply of relatively younger individuals would increase because of intra-temporal substitution of labour.[2]

In this paper we empirically investigate the forward looking effect, by evaluating the labour supply response of middle-aged individuals to changes in pension eligibility rules. The aggregate labour supply implications of reforms that raise the full retirement age crucially depend on establishing whether their effects are restricted on elderly individuals only, or if they involve also individuals at younger ages. Moreover, since there is increasing evidence that within household interactions may amplify or nullify the individual response, we enrich the individual-level analysis by investigating the existence of cross-partners spillovers.

Our analysis takes advantage of a pension reform implemented in Italy in 2012, which sharply and unexpectedly increased the pension eligibility requirements for full

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[2] The forward looking effect is instead negative when work efforts are concentrated later in life and individuals can live with their savings. We believe this channel would be less likely. A third possible mechanism for the existence of the forward looking effect relates to search theory, as investigated by Hairault et al. (2010). In their model, when looking for a job is costly, search effort increases with the the expected duration of a job. Since delayed retirement age increases the length of individuals' working horizon and expected working life, it may induce middle-aged unemployed individuals to pay the job seeking cost and start searching more actively.

retirement.[3] Since the mandated increase in the full retirement age[4] was highly heterogeneous, mainly depending on workers' gender, previous contributory history and year of birth, we source on detailed individual level data from the Bank of Italy's Survey on Household Income and Wealth (SHIW) to estimate a difference-in-differences model that exploits variation in the extension of full retirement age within narrowly defined cells. We separately estimate the labour supply effects by gender and by age, since labour supply elasticity and its determinants typically differ along these characteristics.

Moreover, to evaluate the magnitude of the forward looking effect on relatively younger individuals, relative to the more extensively studied direct effect on older individuals, we estimate the latter for the Italian context, using a difference-in-discontinuity approach. In particular, we study changes before and after the reform in the labour supply of individuals around the pre-reform eligibility threshold, who would have been eligible for retirement before the reform and had to postpone it under the new rules.

We find that an increase in the working horizon set by a delayed statutory retirement age has positive effects on labour supply for middle-aged women, far away from retirement, but not for middle-aged men. For women, the increase in the probability of participating in the labour market is different across ages, being larger for relatively older women (3.3 percentage points for 55-59 year-olds, 1.5 p.p. for 50-54 and 1.1 p.p. for women in their late 40s). While the higher participation translates into an increase in the employment probability for older women (55-59 years old), it mostly feeds the unemployment probability for younger women (45-55 years old). The effect is larger for those who experienced a bigger drop in expected pension wealth – those whose pension benefits are not linked to the length of the working activity (because computed under the Defined Benefit System). Moreover, we find that individuals respond also on the intensive margin, as they are more likely to be employed full time. No effects are found for middle-aged men, who are typically characterized by higher participation rates than women and have therefore less room to respond on the extensive margin of labour supply.[5]

Finally, we find that the effect on women's labour supply has significant spillover within the household. A one year increase in the wives' working horizon raises their husbands' labour supply by 2.9 p.p., mostly because they decide to postpone the retirement decision. Indeed, the response is concentrated on already-eligible-to-retire husbands, whose labour supply is very elastic, since they are older and at the margin of choosing when to retire.[6]

Our comprehensive set of estimates concerning the magnitude of the forward looking effect allows us to infer that about one third of the growth in the activity rate of Italian 15-64 year-old women between 2010 and 2014 can be attributed to the reform-induced increase in their working horizon, which also explains about 20% of the increase in the share of unemployed women observed in the same period.

When comparing these estimates with the magnitude of the direct effect, we find that the forward looking effect is non-negligible and it represents about one eight of the direct

[3]The policy raised the full retirement age consistently (by four years on average in our sample) and heterogeneously (the change ranges from two to seven years in our data).

[4]This is the age at which individuals can claim for the first time their full pension benefit, either under the old age or the seniority scheme. See Section 2 for further details.

[5]These estimates reflect short-run responses to increases in statutory retirement age; longer-term effects may differ since labour supply adjustment may occur over the entire working life (e.g. earlier labour supply increases can be compensated by later reductions approaching to the end of the career).

[6]The contrary does not hold: wives do not respond to changes in their husbands' labour supply, maybe because there is no effect on middle-aged men in the first place.

one. At the aggregate level, moreover, the forward looking effect accounts for a larger part of the increase in the participation rate observed in Italy after 2012, as it involves a wider share of the overall population. These results are relevant for the evaluation of the aggregate labour supply effects of pension reforms.

Despite the predictions of life-cycle models of labour supply (French, 2005; Hamermesh, 1984), there is limited empirical quasi-experimental evidence investigating the effects of increasing the statutory retirement age on the labour supply of middle-aged individuals, far away from retirement. Most of the existing studies analyze the response of older individuals, who would have been eligible to retire before the reform and eventually need to find an alternative source of income (direct effect). These papers find that individuals react to both changes in benefit generosity (Krueger and Pischke, 1992; Song and Manchester, 2007; Liebman et al., 2009; Manoli and Weber, 2016a) and to increases in the statutory retirement age (Mastrobuoni, 2009; Staubli and Zweimüller, 2013; Manoli and Weber, 2016b). Overall, these studies find positive employment responses; the magnitude of the effect mainly depends on the subgroup of the population studied (men or women) and on the country-specific institutional setting (for instance, the widespread adoption of private pension funds or the availability of a generous unemployment or disability subsidy program, which can substitute public pension benefits).[7] These analyses typically identify the effects by adopting a regression discontinuity approach, i.e. by comparing the first cohort affected by the pension reform with the cohort who retired just before the new policy was implemented.

Studying the forward-looking labour supply response of middle-aged individuals to an increase in the statutory retirement age is more demanding, since usually all individuals younger than a given age are affected by similar changes in the statutory retirement age; thus, there is no obvious control group. Moreover, to identify a forward-looking effect the shock must be large and well understood by the population, as individuals must form expectations about the variations in the pension eligibility rules. To our knowledge, only very few papers study similar anticipatory labour supply effects, and tend to often consider specific population subgroups and to find mixed results. Hairault et al. (2010) provide some evidence of the effects of changes in the statutory retirement age on individuals' labour supply quite before retirement. They take advantage of a pension reform implemented in France in the '90s, which increased the mandated retirement age for the old age pension by about one year per cohort and compare two cohorts of slightly younger individuals before and after the reform. Their analysis restricts to men older than 50 y.o. and shows some positive - but barely significant - effects on employment of individuals older than 56. The relatively small magnitude of the reform, together with the small sample size, do not allow them to find large (and precise) effects. Also Geyer and Welteke (2019), using administrative data for Germany, study the forward looking employment effect of a reform that introduced a 3-year increase in the age at which it is possible to opt for early retirement; possibly because the reform affected only a small portion of the population (those who opt for early retirement), they do not find any

[7] Some papers also explore the mechanisms behind the observed employment responses. Lalive et al. (2020) and Cribb et al. (2016) both look at women and they find that their employment decisions depend not only on the presence of financial incentives linked to retiring when reaching the legal retirement age, but also on the fact that workers consider the legal retirement age a focal point for the end of the working activity. Seibold (2019), using German data, finds that individuals respond to changes statutory retirement ages in a way that is seven times larger than that due to variations in pure financial incentives.

anticipatory effect on employment of 58-59 year old women.[8,9]

Additionally, our paper speaks to the strand of the literature evaluating how the effects of reforms are amplified by partners' interactions in retirement and labour supply decisions. Also in this case the previous literature has focused on the effect of pension reforms on older individuals, looking at partners' joint retirement decisions (Coile, 2004; Hospido and Zamarro, 2014; Bloemen et al., 2019; Lalive and Parrotta, 2017) and at changes in their time allocation after retirement (Stancanelli and Van Soest, 2012; Ciani, 2016).[10] These papers tend to find large positive within-household interactions, which importantly amplify the individual direct effects, consistently with models in which partners share leisure complementarities or they jointly choose overall family labour supply; there is mixed evidence on whether wives or husbands tend to respond more to their partner's decisions. While there exists a quite extensive literature estimating the magnitude of cross-partners labour supply elasticity also at younger ages (see, for instance, Goux et al., 2014; Blau, 1998), to our knowledge there is no evidence of how middle-aged partners interact when hit by some pension shocks. It is not obvious that the effect, if any, would be the same as the one acting at older ages: different mechanisms might be at play, depending on the presence of other family members or because different needs (or preferences) arise with age.

Our paper contributes to the above literature in several ways. First, the Italian setting allows us to overcome many of the reasons why the effect of an increase in the statutory retirement age on labour supply of middle-aged individuals is rarely estimated in practice. The increase induced by the 2011 pension reform in Italy was sizable and unexpected. It was also very well-understood by the majority of the population, probably because of the inflamed public debate around this reform, which, even if important to strengthen the sustainability of public finances, was considered too onerous for the population. Moreover, since the increase was largely heterogeneous, mainly depending on one dimension that we can observe in our data – which is the continuity of individuals' previous working life –, there exist a suitable control group. This allows us to adopt a difference-in-differences strategy and therefore to evaluate the effect in a broad set of age classes (in particular those in their 40s and 50s) and to include women in the analysis, the group with the highest expected elasticity to the policy change.[11] Furthermore, we do not limit our analysis to the effects at the individual level but we investigate how it is magnified or

[8]Some studies discuss the effect on relatively younger individuals of an increase in the statutory retirement age on other outcomes, like participation in training programs (Montizaan et al., 2010; Brunello and Comi, 2015), individuals' healthy behavior (Bertoni et al., 2018) and effort and effectiveness in the job (Bertrand et al., 2019).

[9]Some recent papers also explore forward looking labour supply effects in response to changes in the computation rules of pension benefits (Engels et al., 2017; Bovini, 2019; French et al., 2020). A more extensive literature studies the effect of changes in expected pension wealth or in future pension benefits on private wealth and savings over the entire life cycle (see, among the others, Attanasio and Rohwedder, 2003; Attanasio and Brugiavini, 2003; Bottazzi et al., 2006; Aguila, 2011).

[10]Other papers look at how eligibility for pension benefits affects other family members rather than partners; Battistin et al. (2014); Bratti et al. (2018) look at children's labour supply and the availability of informal childcare provided by grandmothers. Manacorda and Moretti (2006) investigate children's probability to leave parents' home; Duflo (2000) looks at how pension income, depending on the gender of the recipient, is spent towards granddaughters or grandsons and its impact on their health.

[11]Women are usually excluded because paid years of social contribution are rarely observed, and therefore difficult to estimate for women, who tend to have discontinuous working lives. Younger individuals are usually excluded because, in the absence of a control group, interpreting the difference in labour supply of individuals of similar age, but in very distant point in time, as an effect of the increased retirement age only requires too strong assumptions.

reduced by intra-household reactions; we show that participation and retirement decisions depend not only on partners' pension eligibility, but also on how far they are from it. Finally, to our knowledge, we are the first to provide a comprehensive assessment of the impact of the forward looking effect, compared to that of the more studied direct effect.

From a policy perspective, our results support the effectiveness of policies aimed at postponing retirement and at boosting labour market participation, especially for those population groups less attached to the labour market – like women. We find that a higher statutory retirement age determines positive labour supply effects well beyond those expected on older workers. Also middle-aged individuals (and their partners) respond when informed about the pension shock. Our results suggest that the aggregate labour supply effects of pension reforms are larger than what commonly envisaged.

The remainder of the paper is organized as follows: Section 2 introduces the Italian pension system and describes the reform exploited in our empirical analysis for the identification of the estimated effects; Section 3 describes the data and explains our empirical strategy; Section 4 reports the results of the empirical analysis both at the individual and at the family level, and the estimates of the direct effect on older workers, in order to assess the magnitude of the forward looking effect. Finally, Section 5 concludes.

2 The Italian pension system

As many OECD countries, the Italian pension system is characterized by a large first pillar (public pension funds) and by almost negligible second and third pillars (respectively, compulsory and voluntary[12] private pension funds).

The public pension system offers two schemes under which claiming full retirement: the old age and the seniority pension schemes. Under the first, individuals retire after having achieved a certain minimum age; under the second, individuals retire after having accrued a given number of years of paid social security contribution. In Italy individuals usually retire as soon as they reach eligibility for full retirement. An early retirement scheme is available only for women, but it entails a rather large penalty in terms of pension benefits. On the other hand, while retirement is not mandatory and working after retirement is not prohibited,[13] the implicit tax on continuing to work after having reached eligibility[14] is rather high (Di Nicola et al., 2017). Thus, individuals have strong incentives to stop working as soon as they have reached the full retirement age. Our evidence (see Section 3.3), as well as other existing evidence for Italy (see among others Battistin et al., 2009; Ciani, 2016; Carta et al., 2020), indeed shows that about 70% of

[12]The legislative decree n. 252/2005, implemented in 2007, introduced an automatic enrolment mechanism for voluntary pension funds: if an employee does not make an active choice after a six-month period (counting from 1 January 2007 for old employees and from their hire date for new employees), the TFR (severance payment) will be automatically paid into an occupational pension plan (typically, the industry-wide occupational plan). However, according to COVIP (2018), in 2017 less than 30% of the Italian working population has signed a contract with a private pension fund; however, private pension benefits are conditional on the eligibility for a public pension.

[13]However, employees need to cease the job contract to access retirement. In order to continue to work with the same employer, a new job contract needs to be signed.

[14]The implicit tax rate on continuing working activity is the average effective tax burden on labour income once the individual is eligible for a public pension. The same labour income will be taxed at a marginal and average tax rates that are higher for an individual receiving a pension benefit than for an individual not eligible for it. Both OECD and Eurostat provide estimates for implicit tax rates at older ages; historically Italy has had very high implicit tax rates on labour income for 60+.

Italian workers retire as soon as they reach the first eligibility for full benefits. Throughout the paper we define the age at first eligibility for full retirement as Minimum Retirement Age (MRA): this is the minimum between the age at which the individual becomes eligibile for retirement under the old age scheme and the age reached by the individual to satisfy the seniority pension scheme requirements.

Starting from the early 1990s, the Italian pension system was severally revised through a long term reform process aimed at improving its financial sustainability. All the implemented reforms aimed at increasing the full retirement age and at curtailing pension benefits, by adopting benefit calculation methods that are more actuarially fair (that is, linking the life-time paid contributions to total future pension benefits). For instance, in 1995 the calculation of pension benefits moved from a Defined-Benefit (DB) basis – where the benefit is an average of the worker's last five years' gross earnings – to a Notional Defined-Contribution (NDC) basis – where the benefit is a fraction of the average earnings over the individuals' entire working life of an individual (Bovini, 2019).

2.1 The 2011 pension reform

At the end of 2011, at the utmost of the sovereign debt crisis when the tensions in sovereign debt markets reached unprecedented levels, a substantial pension reform passed at the end of 2011 (December 22), and it was effective from January 1, 2012 (Law 214/2011, known as "Fornero Reform").[15] The reform passed by decree and could not be anticipated by workers and firms; it became effective only ten days after its approval.

The reform introduced stricter eligibility rules both for the old age and for the seniority pension schemes. To reach eligibility for the old age pension scheme before the reform, the retirement age was 60 for women and 65 for men, and individuals must have had accrued at least 20 years of paid contribution if they had started to work before January 1 1996 and at least 5 years if they had started to work after January 1 1996. The Fornero reform smoothly increased the statutory retirement age for all workers up to 67 by 2020, both for men and for women, once they have accrued at least 20 years of paid contribution; moreover, the reform allowed all individuals to retire at 70, as long as they have accrued at least 5 years of paid contribution.

To be eligible for the seniority pension scheme before the reform, individuals must have accrued either 40 years of paid contribution (irrespective of their age) or a mix of age and years of contribution, the so called "quota system" (for instance the sum of age and years of paid contribution should have been 96 in 2006, with at least 59 years of age and 36 years of contribution; see Table 1). The rules were slightly different depending on the sector of employment (i.e. depending on whether individuals were public or private sector employees or whether they were self-employed). The Fornero reform abolished the "quota system" and raised the minimum number of years of paid contribution from 40 to 42 for men, to 41 for women in 2012.[16]

The new rules in place since 2012 allowed workers who were already eligible for a public pension when the bill passed to retire under the pre-reform rules, without loosing

[15] At the end of 2010 another pension reform was implemented only for public sector workers (Law 30 July 2010 n. 122, known as "Sacconi Reform"). Since we do not have data for 2011, we do not separately identify the two reform; our estimates compare the labour market outcomes in 2010 with those observed in 2014 and onward, after the Sacconi and the Fornero reform.

[16] In 2013 minimum required years of contributions rise to 43 for men and 42 for women; from 2014 onward to 44 for men and 43 for women, these thresholds adjust with changes in life expectancy.

their previous eligibility (*grandfathering clause*). This option was not available in any other year, either before or after the reform: workers could retire in a given year only if eligible under the rules in place that given year. Finally, the Fornero reform, in addition to changing the eligibility requirements for accessing pension benefits, modified the pension benefit formula for those who were still covered by the Defined-Benefit method of calculation (individuals with at least 18 years of accrued contribution by January 1996), moving them to the notional defined-contribution method for working years after 2011.

The reform left unaltered the early retirement scheme for women that was introduced in 2008 (named *women's option – opzione donna*). Despite its take-up increased after the reform, it is still at low values (less than 20% in 2015) mainly because the cost of opting entails a reduction of the full pension benefit of around 35% on average (INPS, 2016).

The different eligibility rules for retirement by gender, cohort, sector and by previously accrued years of contribution implies that individuals have been differently affected by the reform in terms of their age for first full retirement eligibility (what we previously defined as Minimum Retirement Age, MRA). To understand how, let's consider three groups of workers differing by the age at which they started to work and by the continuity of their working life; these characteristics determine the pension scheme according to which they will retire and, thus, the shock induced by the pension reform in their MRA. Those who started to work early and have worked continuously throughout their working life, would have retired before the reform under the seniority scheme requiring 40 years of accrued contribution (group 1). Workers with a slightly less continuous working life or who started to work later, would have retired under the "quota" system for the seniority scheme (group 2). Finally, workers with discontinuous working life or who started to work much later, would have retired under the old age scheme (group 3). Depending on gender, the reform differently affected these three groups. Among women, the most exposed were the ones who would have retired under the old age or the quota scheme, thus those with less continuous working life (groups 2 and 3). Most affected men were those with an "intermediate" continuity of their working life (group 2): those hit by the abrogation of the "quota" scheme.

Figure 1 illustrates the source of variation in the MRA increase induced by the reform that we exploit in the empirical analysis. In the example, we fix age at 58 and we see how the shock varies depending on previously accrued years of contribution. We consider private sector employees. Most affected women are those with fewer accrued years of contribution: they could have retired under the old age scheme at 60 before the reform and have to wait till 67 after the reform. Less exposed women are those who accrued more years of contribution, who could have retired with 40 contribution years before the reform and have to reach 42 years of contribution afterwards. The source of variation in the shock for men is different: those who experience a larger shock are men who would have retired under the quota system before the reform (with an intermediate number of contribution years); those who experience a smaller shock are instead men who would have retired under the old age scheme at 65 (and now have to wait two years more) or those who could have retired with 40 years of paid contribution before the reform, and 43 after the policy change (i.e. those with the most continuous or the least continuous working lives).

3 Empirical strategy

3.1 Data

In our analysis, the information on labour market status and expected MRA is obtained from the Italian Survey of Household Income and Wealth (SHIW). SHIW is a biannual survey administered by the Bank of Italy to a sample of Italian households and is the main source of information about family income and wealth in Italy. We use the most recent waves, from 2004 to 2016, which include the years around the pension reform we analyze. The sample of the most recent surveys comprises about 8,000 households (20,000 individuals) per year.

The SHIW data allow us to construct pension eligibility criteria because they include information on age, gender, sector and type of employment and, importantly, accrued years of contribution; this allows us to build for each individual the MRA on the basis of the eligibility rules in place each year. Moreover, there is an explicit question about the age at which the individual expects to retire, a crucial piece of information to support our identifying assumptions and the soundness of our approach. Furthermore, it provides information on the labour market status of both spouses within a household, necessary to test for within family interactions and not usually available in administrative data. Finally, thanks to the very rich and detailed information on earnings and welfare transfers, it is possible to evaluate the effect of the longer working horizon on income and saving, and the heterogeneity of the effect by individual wealth.

Despite there is a small panel component, for our analysis we only use repeated cross sections as the panel is short and covers only half of the original sample.

3.2 Identification strategy

Our identification strategy aims at evaluating the magnitude of the forward looking effect: it therefore studies the labour supply response of individuals who would not have been eligible to retire even under the pre-reform rules but whose MRA increased, due to the 2011 pension reform.

We compute the degree of exposure to the policy of each individual, by constructing cells (denoted as q) based on the full interaction of all the characteristics needed to determine the MRA in Italy (age, gender, years of contribution, whether public or private employee and whether self-employed).[17]

We then create a time invariant measure of exposure to the shock, by taking the difference between the expected MRA under the post-reform and under the pre-reform rules ($T_q = MRA_{q,2014} - MRA_{q,2010}$, which determines the cross sectional variation of our shock). We refer to MRA under the rules in place in 2014 since in that year the reform became fully effective - those who reached the pension eligibility by December 31, 2011 and still working in 2012 were allowed to retire under pre-reform rules (*grandfathering clause*).

In order to obtain the expected MRA before and after the reform for younger individuals ($MRA_{q,2010}$ and $MRA_{q,2014}$), we need to make assumptions about the expected number of accrued years of contribution at the end of their working careers. Throughout the paper we assume that individuals in our sample will accumulate years of contribution continuously from the year of the interview onward; this means we mainly exploit heterogeneity

[17] We obtain information on occupation by using the usual sector of employment.

in the continuity of their working life in place before the reform. Even if this assumption may appear problematic for women, whose working life is usually more fragmented, this is the most restrictive choice, as, if anything, we are overestimating the probability that they retire under the seniority regime and we are therefore underestimating their expected shock to MRA.[18] Table 2 describes with an example how MRA is computed.

The left panel of Figure 2 describes the distribution of the shock in MRA induced by the reform across the population of women. Figure 2 shows that the shock was heterogeneously distributed. The left panel indicates that, among women, roughly 30% experienced a 7-year shock and about 15% experienced a 2-year shock. The right panel of Figure 2 reports the distribution of the shock for men. The Figure confirms that, apart from rounding, the minimum T_q for men is 2 years (for men who retire under the old age system at 67 instead of 65); the maximum is 7 years (for men who could have retired under the 97 quota before 2012 – if they were aged at least 62 with at least 35 accrued years of contribution – and have to wait till they achieve 43 years of contribution after the reform).

To capture the variation in distance to MRA exclusively induced by the pension reform, we estimate the following empirical model separately for men and women and for different age classes. Let Y_{iqt} be a variable that indicates individual i's labour force status in year t within the same cell q. The reduced form specification for individual i's labour force status is:

$$Y_{iqt} = \beta_1 T_q * post2011_t + \beta_2 X_{iqt} + \alpha_t + \alpha_q + \epsilon_{iqt} \quad (1)$$

where T_q is the change in the distance to retirement imposed on the cell q by the reform ($MRA_{q,2014} - MRA_{q,2010}$, described in Figure 2), a time invariant measure of exposure to the policy; $post2011_t$ is a dummy that indicates the post reform period; X_{iqt} is a vector of controls at the individual level (marital status, region of residence, usual sector of employment); α_t are year fixed effects, absorbing long term or cyclical developments that affect all individuals in the same way, and α_q are the fixed effects for each cell q, absorbing cross sectional variation in labour supply that depends on years of experience, age or sector of employment. Moreover, α_q absorb all pre-reform differences in distance to MRA. Finally, ϵ_{iqt} is an error term. Standard errors are clustered at the cell q level.

In order to capture changes in labour force status of individuals who were actually exposed to the policy, we exclude from the sample retired individuals and those who could have retired but chose not to, because they represent a very selected sample of the population. In other words, we exclude cells whose distance to retirement (defined as $MRA_{qt} - age_{qt}$) is negative even before the reform.[19] Finally, in our regressions we only consider individuals belonging to cells q – i.e. combinations of age and accrued years of

[18] Using the administrative records of the Italian Social Security Institute, we find that the discontinuous spells in individuals' careers are concentrated before the age of 35 (because of maternity leave periods or longer study paths) and after the age of 60. Comparing the actual contributory histories obtained from the administrative records, we find that the error generated by assuming continuous working lives under a four-year horizon would be on average 1 year and 3 months for individuals in their mid 30s, about 1 year for individuals in their mid 40s and about 9 months for individuals in their mid 50s; the error is more than halved if we consider individuals with more continuous working lives (with at least 10 years of experience). To minimize the possible error generated by this assumption on future contribution years, we therefore exclude from our sample individuals aged less than 45 and those very little attached to the labour market, with less than 10 years of contribution.

[19] These are women older than 59, men older than 64, individuals with more than 40 years of contribution and individuals eligible to retire under the quota system.

contribution – reasonably close to retirement: we exclude women with less than 10 and men with less than 20 accrued years of paid contribution, as well as individuals younger than 45. Our results are robust to small changes in the considered sample.

Our coefficient of interest is β_1, which estimates the average labour supply differences between cells that experienced a larger or a smaller increase in MRA, exclusively depending on their degree of exposure to the policy.[20]

To fully evaluate the aggregate labour supply effect of increasing the time horizon, we also consider interactions within the family. For instance, a positive effect of a longer working horizon on female labour supply may affect also their husbands' participation or employment probability, positively in the presence of leisure complementarities or when partners share the burden of the wealth shock induced by the postponed retirement eligibility (or even only the husband may react); or negatively when the female labour supply response is stronger than the negative wealth/income shock. To study these interactions, we apply a strategy similar to that in equation (1) to married or cohabiting couples only. We estimate the labour supply effect, on each partner $s = \{w, h\}$ belonging to couple j, of an increase in the distance to retirement of partner $s' = \{w, h\}$, where $s \neq s'$. In particular, we run the following linear probability model, for both partners:

$$Y^s_{jq_sq_{s'}t} = \beta^s_1 T_{q_{s'}} * post2011_t + +\beta^s_2 X_{jt} + \alpha^s_{q_{s'}} + \alpha^s_t + \alpha^s_{q_st} + \epsilon^s_{jq_sq_{s'}t} \tag{2}$$

where $Y^s_{jq_sq_{s'}t}$ is a dummy that indicates the labour force status of spouse s in household j belonging to cell q_s and whose partner s' belongs to the age-contribution cell $q_{s'}$; $T_{q_{s'}}$ is the time invariant indicator of the cells more exposed to the policy based on the observable characteristics of partner s'; $post2011_t$ indicates the post reform period; X_{jt} is a vector of controls at the individual and at the household level (region of residence, the difference in distance to retirement and age among partners); α^s_t are year dummies and $\alpha^s_{q_{s'}}$ are fixed effects for the cell q based on the characteristics of partner s'. In order to absorb changes in partner s's labour supply induced by variation in her (his) own MRA, we include among our controls $\alpha^s_{q_st}$ fixed effects, which are the full interaction between $\alpha^s_{q_s}$ and α_t fixed effects; they absorb partner s's shock to distance to retirement. Finally, $\eta^s_{jq_{s'}t}$ is an error term. The coefficient β^s_1, our parameter of interest, estimates the labour supply response of partner s to a longer distance to retirement of partner s'.

We apply the same restrictions as in equation (1), for partner s'.[21] Instead, we do not impose any sample restrictions for partner s, so to capture their full labour supply response. In particular, for the regressions where we look at the husbands' response to shocks to their wives' working horizon, we consider all men cohabiting with women aged between 45 and 59 with at least 10 accrued years of contribution; for the regressions where we study the wives' response to shocks to their husbands' working horizon, we consider all women cohabiting with men aged between 45 and 64 with at least 20 accrued years of contribution. In this way we estimate the effect of a shock to one partner's working horizon on the other partner's labour supply, independently of her own distance to retirement or employment situation.

[20]Notice that β_1 can be positive both because inactive individuals may start looking for a job and because employed individuals, who would have exited the labour force when very close to retirement, decides to continue working if the length of their working horizon increases. Since we do not have panel data, we cannot disentangle these two mechanisms, we can only comment on the average increase in labour supply.

[21]We do not distinguish, however, by age classes, in order to enlarge the sample size, given the high number of controls.

3.3 Supporting evidence on the identifying assumptions

Our estimation strategy relies on three main identifying assumptions. The first is that individuals tend to retire as soon as they reach the MRA, so that changes in MRA truly affect the actual retirement age and the actual working horizon. Section 2 already explains why this is likely to be the case; Figure 3 provides some other evidence in support for this first hypothesis. It shows that a large fraction of individuals retires as soon as they become eligible (i.e. when $MRA = age$), meaning that changes in MRA translate into changes in actual retirement age. The figure plots the probability of being a pensioner, depending on each individual's distance to retirement eligibility ($MRA - age$) in year t, for women and men separately. It displays a sharp increase in the probability of retiring around 0 (see Battistin et al., 2009, Ciani, 2016 and Manacorda and Moretti, 2006).

Second, our empirical strategy relies on the assumption that individuals understand the reforms and actually modify their expected retirement age according to the new rules introduced by the pension reform. This would imply, for instance, that the expected retirement age of women more exposed to the reform increased more after 2011 than the expected retirement age of women less affected by the shock. Figure 4 supports this second assumption; it shows that, in our sample, most exposed individuals expect their retirement age to increase more after 2011 than least exposed ones. It seems reasonable to conclude that individuals were indeed familiar with the consequences of the new pension system with respect to their specific situations, also given the large public debate around the reform.

Third, as standard for the estimation of difference-in-difference models, we need to show that the trends in participation rates would have been parallel for individuals with different exposure to the shock, absent the change in the pension rules. In order to test this assumption, we show that the difference in the labour supply behaviour of individuals more or less exposed to the shock was constant before 2012 and started changing exactly after the introduction of the new pension rules in 2012, and especially in 2014, when the reform was fully effective. We estimate the following equation for men and women separately:

$$Y_{iqt} = \sum_{r=2004}^{2016} \gamma_r \left(T_q * \delta_r\right) + \gamma Z_{iqt} + \delta_q + \delta_t + \eta_{iqt} \tag{3}$$

where all variables are defined as in equation (1) and δ_r are year dummies.

We repeat the same exercise for the within family estimation, by estimating the following equation:

$$Y^s_{jq_sq_{s'}t} = \sum_{r=2004}^{2016} \zeta^s_r \left(T_{q_{s'}} * \alpha^s_r\right) + \beta^s Z_{jt} + \alpha^s_{q_{s'}} + \alpha^s_t + \alpha^s_{q_{st}} + u^s_{jq_sq_{s'}t} \tag{4}$$

where again all variables are defined as in equation (2) and α^s_r are year dummies.

The coefficients γ_r and ζ^s_r of equations (3) and (4) show how the difference in the outcomes Y_{iqt} (or in their spouse s outcomes $Y^s_{jq_sq_{s'}t}$) between individuals (i or s') belonging to the most and the least exposed cells q evolves over time, with respect to the omitted, pre-reform, year. If the parallel trend assumption holds, the coefficients should be close to zero for the years before the reform, implying that the difference in the outcomes is constant when compared to the omitted year, and positive after the reform, if the longer working horizon actually boosts individuals' labour supply. Figure 5 displays

the coefficients γ_r and the corresponding confidence intervals obtained from estimating equation (3) for women and men (panels a and b, respectively). It shows that for both women and men, the trend was parallel before the 2011 reform. Moreover, it is clear from the figure that after 2011 the labour supply of women more exposed to the reform increased relative to that of less exposed women, while that of men did not change differently. In the same way, the figure displays the coefficients ζ_r^s and the corresponding confidence intervals obtained from estimating equation (4) for wives and husbands (panels c and d, respectively). In particular, it displays the cross-partner effects and it shows that the trend in the participation probability of both wives and husbands, whose partners were differently exposed to the policy, was parallel before the reform.

3.4 Descriptive statistics

The top panel of Table 3 shows descriptive statistics for the groups of women and men, more and less exposed to the changes in the pension rules.[22] Columns 1 and 5 report statistics for the entire sample of women aged 45-59 and men aged 45-64, respectively; Columns 2 and 6 display descriptives for our sample (of individuals not eligible to retire either before and after the reform, and with at least 10 years of paid contribution). Individuals in our sample are slightly younger and display higher participation rates than the overall population, as we are excluding those eligible to retire and those relatively less attached to the labour market. Finally, Columns 3 and 4 (and 7 and 8) split the sample between those more or less exposed to the pension reform. Consistent with our discussion above, the table confirms that there is no large difference as for previously accrued years of contributions for most affected men, as the least affected among men are the ones who started to work very early and could retire with 40 years of contribution before the reform (very continuous working lives), or the ones with very discontinuous working lives, that would retire under the old age scheme. Among women, the most affected by the shock are those with more fragmented working lives (who accrued less years of contribution relatively to their age).

The bottom panel of Table 3 displays some descriptive statistics of the couples we consider for our analysis, distinguishing those treated because of a larger shock to the wife's distance to retirement (and the corresponding control group, Columns 1 to 4) and those treated because of a larger shock to the husband's distance to retirement (and the control group, Columns 5 to 8). The table confirms that the wives most exposed to the policy are those with more fragmented working lives, while the most exposed husbands are those who accrued average years of contribution during their working life. Importantly, partners belonging to couples in which either the wife or the husband is treated, are less likely to participate in the labour market than individuals directly treated (Columns 6 and 2 of the top panel). The reason is that we are not imposing any restriction on the sample of partners, therefore we are including also older individuals already eligible to retire and less attached to the labour market as well as housewives.

[22] We divide the sample in the following way: women more exposed to the shock are those whose variation in MRA due to the pension rules was ≥ 7 years and most exposed men are those whose change in MRA was ≥ 4 years.

4 Results

4.1 Individual level analysis

Table 4 reports the results obtained from estimating equation (1) on activity, employment and unemployment, as well as on the probability of being employed in a part-time or a full-time job. We split our analysis by gender, since men and women tend to have heterogeneous labour supply responses, and we consider different age classes: Columns 1, 2 and 3 report results for women aged 55-59, 50-54 and 45-49, respectively; Columns 4, 5 and 6 display results for men 55-64, 50-54 and 45-49.[23]

We find that increasing the length of the working life has a positive effect on female labour force participation for all the considered age classes. The effect is larger for individuals at the end of their working life. These are individuals who would not have been eligible to retire even before the reform, but who may probably respond more because they have less time to adjust their labour supply. In particular, we find that if the length of the working life increases by one year, the probability of participating in the labour market increases by 3.3 percentage points for women aged 55-59, by 1.5 ppt. for women between 50 and 54 and by 1.1 ppt. for younger women (45-50). The increased labour supply translates into higher unemployment (for younger individuals) and into higher employment (especially for older individuals). The type of employment also changes: women are more likely to switch to working full time, in all age classes. This evidence seems to suggest that workers respond also along the intensive margin of labour supply, and not simply by having a job in order to meet the stricter requirements in terms of accrued years of paid contribution. Finally, panel b shows that the positive labour supply response of women implies higher labour and disposable income.[24] Consistently with the existence of a negative pension wealth shock induced by the reform, we find that private savings increase as in Attanasio and Brugiavini (2003), mainly to compensate the drop in public pension wealth.

In line with the existing literature, which underlines that labour supply is much less elastic for men than for women, men do not seem to react much to changes in their working horizon. Indeed, they are already highly attached to the labour market and they have less room to further increase their labour supply.[25]

Overall, we estimate that the increase (by 4 years on average) in the working horizon for women aged 45-59 caused by the reform explains around one third of the increase in the activity rate of women 15-64 between 2010 and 2014 and 20% of the increase in the share of unemployed women.

Note that such an important pension reform has probably generated some general equilibrium effects on wages and on labour demand. However, as long as these general equilibrium responses do not impact individuals differently depending on the length of their working horizon, our estimates of β_1 capture the results of changes in labour supply response only, net of general equilibrium effects. In Section 4.2 we provide some evidence

[23] We do not look at even younger individuals, on the one hand, because for them the working horizon effect is less likely to be at work, or it is probably very small; moreover, it is more difficult to make assumptions about their expected years of contribution at the end of their working life.

[24] We consider only employees since self-employed measures of income are rather not reliable in SHIW data (Brandolini, 2000).

[25] Table B.1 in Appendix B shows that our results are robust also to the inclusion of age-specific time trends, which absorb, for instance, cohort specific trends in labour market participation and employment prospects due to increasing level of women education and cultural changes.

indicating that these general equilibrium effects seem to be homogeneous among the treatment and the control group.

4.2 Mechanisms and heterogeneous effects

In Tables 5, 6 and B.2 we consider several relevant dimensions of heterogeneity across individual and labor market characteristics to shed light on the mechanisms driving our results.

First, we analyze differences in labour demand. It may be, for instance, that not only individuals adjust their labour supply in response to variations in the length of their working horizon, but also firms modify their labour demand towards workers with longer working lives. Our results may therefore be the effect of a combination of changes in the demand and in the supply of labour. We believe, however, that changes in supply represent the main reason behind our effects. Indeed, especially among younger individuals, most of the increase in participation is driven by an increase in unemployment, which is not consistent with a demand story. Moreover, Table 5 distinguishes between regions with a vacancy rate above or below the year-specific median.[26] It shows that there is an effect on participation independently of the overall regional labour demand, as proxied by its vacancy rate; the interaction coefficients are indeed never significant.

Second, to assess whether our effects are mostly driven by changes in expected pension wealth or by intra-temporal substitution of labour supply, we explore whether and by how much the labour supply response generated by the reform was stronger for individuals who experienced the largest reduction in pension wealth associated to the delay of pension benefits. The entity of the loss mainly depends on how pension benefits are calculated: as long as the benefit computation is actuarially fair, that is when the total flow of contributions paid to social insurance is equal to the total expected flow of retirement benefits received, the delayed retirement does not generate any loss in net pension wealth. It does instead generate a loss when the system is not actuarially fair, like in the case of a DB scheme, where the pension benefit strongly depends on the average labour earnings in the last x years, independently of the number of accrued contribution years. The delayed retirement age therefore reduces the number of periods over which individuals get an almost fixed pension benefit. The NDC scheme, despite being not completely actuarially fair, creates a stronger link between social contributions and pension benefits than what implied by the DB method, therefore generating a much smaller loss in expected pension wealth. Before the 2011 reform, pension benefits were computed in Italy according to different regimes, either the DB or the NDC system: for individuals with at least 18 years of contribution at the end of 1995, at the time of the implementation of the so-called Dini reform, benefits were computed according to the DB scheme; for all other individuals pension benefits were computed under the NDC scheme from 1995 onwards.[27] Table 6 distinguishes the effect for individuals who were under the DB scheme, for whom the wealth effects should be larger, from that for individuals under the NDC regime. Notice

[26] We use the ratio between vacancies and unemployed by region and year (taken from the Italian National Statistical Office) as a proxy for labour demand. We define as regions with high labour demand those with a vacancy rate higher than the highest third of the distribution of vacancy rates.

[27] For all years of contribution accrued after the Fornero reform, benefits are computed according to NDC rules for all individuals. Individuals with at least 18 years of contribution at the end of 1995 would therefore receive pension benefits according to the DB system for all years of contribution accrued before 2011 and according to the NDC system afterwards. The vast majority of their pension benefits is therefore computed under the DB system for these individuals.

that, since DB scheme is in place only for those with at least 18 years of paid contribution before the end of 1995, we do not find enough individuals under this regime in younger age classes; we therefore compute the heterogeneity only for the groups of individuals were there are enough individuals under both the DB and the NDC schemes, to allow us to estimate two different coefficients. The Table suggests that wealth effects represent an important mechanism in explaining the forward looking effect for older individuals since the positive results we find are mainly driven by those under the DB scheme. However, the fact that the delayed MRA positively affects the labour supply of younger individuals, who are almost entirely under the NDC system and for whom pension wealth did not (or only slightly) decrease, suggests that the change in pension wealth is not the only mechanism at place.

These results are also confirmed when we look at the heterogeneity of the effect by overall household wealth (panel b of Table 6, where household wealth is proxied by having net wealth above or below the year-specific median). Facing a reduction in pension wealth, we expect less wealthy individuals to have a stronger labour supply reaction than wealthier individuals, for whom pension wealth may matter relatively less. We do not find significant differences, which suggests that the change in pension wealth alone might not be the only mechanism at work in driving the labour supply response, but also intra-temporal substitution of labour matters.[28]

4.3 Within family interactions

Table 7 analyses the presence of cross elasticities within the couple. Panel a looks at the effect of a shock to the wife's working horizon, on the wife herself (odd columns) and on her husband (even columns), respectively. Panel b reports the effect of an increase in the husband's working horizon on the husband himself (odd columns) and on his wife (even columns). In this case we collapsed all age classes together, so to improve estimation power. Similarly to what found in Table 4, Column 1 confirms that there is a positive effect of an increase in one's own working horizon on female labour supply, while no effect on male labour supply. Column 2 shows that the longer wife's working horizon, and consequently higher participation, also increases her husband's participation. A one year increase in a wife's distance to retirement increases her husband's labour supply by almost 2 ppt., supporting the hypothesis of leisure complementarities (similarly to some of the available literature on joint labour supply decisions like, for instance, Blau, 1998). The opposite effect, that of an increase in the husband's distance to retirement on his wife's labour supply, does not seem to be in place (column 2 of panel b). Probably because men do not respond to their own shock in the first place.

What may appear puzzling is that husbands respond more to their wives' rather than to their own shocks (Column 2 panel a against Column 1 panel b of Table 7). We believe the reason is be that, as discussed before, the sample of men in Column 2 panel a is different from that considered in Column 1 panel b. The first group of men is much less likely to participate in the labour market (the share of participants over the reference population is, indeed, almost 25% lower than for the sample in Column 1 panel b), they tend to be older and some of them are probably already eligible to retire. Their labour

[28] As a further exercise, we evaluate how the effect differs by educational levels, in particular depending on whether individuals achieved at least a secondary school degree. The results in Table B.2 show that the effect is concentrated on individuals with lower levels of education, who typically have higher labour supply elasticity, being more at the margin of the labour market and with discontinuous working life.

supply elasticity is therefore higher: they may respond by supplying more labour and postponing retirement so to jointly retire with their partners (in line with the literature on joint retirement, see for instance Coile, 2004). Indeed in Column 7 of panel a we show that the higher participation of husbands is almost entirely explained by a corresponding reduction in their probability of retiring.

This result is also consistent with the findings of some existing papers, which point out that men are very responsive, more than women, to their partner's employment decision (Coile, 2004, Zweimüller et al., 1996, Bingley and Lanot, 2007 and Goux et al., 2014 find that men respond more to their wives's shocks than to their own shocks in working hours). Zweimüller et al. (1996) suggest this may be due to asymmetric preferences concerning joint leisure, as husbands in traditional families are not used to be alone and may have stronger preferences about spending their leisure time with their wives. Moreover, even if preferences towards joint leisure are identical across partners, a difference may arise because non-employment time for women is less likely to be only devoted to leisure as women are usually more involved in household production (i.e. by providing care to their grandchildren Battistin et al., 2014; Bratti et al., 2018 or to their elderly parents in case of younger women), while for men non-working time is more likely to be related to leisure.

Overall, we show that, once we take into account within household interactions, and we consider also possible spillovers on partners, the overall impact on labour supply is almost twice as large.

4.4 Magnitude: comparing the direct and the forward looking effects

In the Introduction we distinguished between two effects associated to the delaying of statutory retirement age: the *direct effect*, on individuals who would have met eligibility requirements under the previous rules but who are not eligible anymore under the new rules; and the *forward looking effect*, on individuals who would not have been eligible to retire under any scenario, but whose working horizon increases. The direct eligibility effect has been quite extensively estimated by the previous literature, in different institutional settings and for different countries (Staubli and Zweimüller, 2013, among many others). In this section we estimate it also for our setting, in order to better assess the magnitude of the forward looking effect.

Our identification strategy for the direct eligibility effect is inspired by the *difference in discontinuity* approach, proposed in the seminal work by Grembi et al. (2016). Let's denote E_i a variable that indicates whether individual i was eligible to retire under the pre-reform rules, in force in 2010:

$$E_i = \begin{cases} 1, & \text{for } d_{2010i} \leq 0 \\ 0, & \text{for } d_{2010i} > 0 \end{cases} \tag{5}$$

where $d_{2010i} = MRA_{2010i} - age_i$ indicates the distance to retirement under the pre-reform rules, equal to the difference the between minimum retirement age, computed according to the 2010 pension rules, and actual age. We estimate the following equation:

$$\begin{aligned} Y_{it} =& post2011_t[E_i(\beta + f_r(d_{2010i})) + (1 - E_i)f_l(d_{2010i})] + \\ &+ E_i(\delta + f_r^p(d_{2010i})) + (1 - E_i)f_l^p(d_{2010i}) + \psi_t + v_{it} \end{aligned} \tag{6}$$

where Y_{it} represents labour supply of individual i in year t; $post2011_t$ is an indicator for the post reform period; E_i indicates whether individual i was eligible to retire under the

pre-reform rules (see equation (5)); d_{2010i} is distance to retirement under the pre-reform rules (our running variable); f_r, f_l, f_r^p and f_l^p are some polynomials of d_{2010i}; ψ_t represent year fixed effects and v_{it} is an error term, which we cluster at the individual level. The coefficient β is our parameter of interest, that indicates to what extent labour market participation is higher after the reform, around the pre-reform eligibility threshold.

Moreover, we know that, after the reform, women adjusted their labour supply, even if off the eligibility cut-off, due to the forward looking effect. This would violate the identifying assumption of the difference-in- discontinuity estimator. Therefore, for the analysis of the direct eligibility effect we only consider women who previously belonged to the control group.

Our estimating equation compares the size of the discontinuity in the probability of being active around E_i before and after 2012; more specifically it compares the probability of being active in the pre-reform and in the post-reform years of individuals around the pension eligibility threshold according to the pre-reform pension rules. While in the pre-reform period there should be a large discontinuity around E_i, in the post-reform period individuals who loose their eligibility cannot retire and the portion of active individuals around the E_i should be larger. Figure 6 provides visual inspection of the variation we exploit. The blue (grey) dots are observations in years pre-2012 (post-2012). The top panel shows the evolution of the probability of being active in the labour market as a function of the distance to the MRA according to the 2010 pension rules, respectively for women and men. Individuals eligible to retire under the 2010 pension rules show a higher probability to participate in the post 2012 years than in the pre-2012 years. Moreover, while in the pre-reform years there is a clear discontinuity around 0 in the probability of being active, from 2012 onward this discontinuity does not longer exist.

Point estimates of equation (6) are reported in Table 8. We find that both women and men participate more in the labour market in response of the delay of pension eligibility; the effect comes from those who keep on working in response to the pension reform since we do not find any effect on the probability of being unemployed. The effects are sizable, larger for women, and about eight times larger than the forward looking effects estimated in the previous sections.[29]

As for intra-household interactions, we do not find any significant effect. The bottom panel of Figure 6 displays the probability of being active as a function of the partner's distance to retirement according to the 2010 pension rules. It shows that, partners of individuals would have been eligible to retire according to the 2010 rules and are not eligible anymore under the new rules, do not have a higher probability of being active after 2012. The second panel of Table 8 confirms this result.

If husbands want to coordinate their retirement decisions with their wives, we would expect them to increase their participation in response to their wives higher retirement age. However, the vast majority of husbands in this sample have already made their retirement decision (85% were already eligible to retire or already retired). Indeed, we do observe some positive labour supply response among not yet retired husbands.

Finally, we show some standard robustness tests for the difference in discontinuity

[29]Note, however, that the forward looking effect we elicited in the previous sections creates a downward bias in the estimation of the direct eligibility effect. Indeed, since it increases the participation rate of those who are slightly on the right of the E_i threshold for post-reform years in Figure 6, it reduces the difference in the probability of being active around the eligibility threshold before and after the reform. For this reason, in the case of women we estimate the direct eligibility effect only on those women who belong to our control group in our difference-in-differences analysis, for whom by construction the forward looking effect is absent.

approach in Appendix A and B. In Figure A.1 we shed some light on the timing of the effect to provide evidence that individuals just above and just below the threshold E_i were on parallel trends before 2012. The evidence shows that the trend was parallel both at the individuals level and for the cross-partner analysis. Figure A.2 checks how our results are sensitive to the bandwidth chosen. It plots the estimated coefficient (and the corresponding 95% confidence intervals), when imposing different bandwidth around the threshold. The estimated coefficients are always similar, independently of the bandwidth (the effect becomes slightly smaller for women as the bandwidth becomes larger). Finally, in Table B.3 we study whether observable characteristics are similar for individuals just above or below the threshold, before and after 2012. The Table shows that observable characteristics are quite balanced.

5 Conclusion

This paper challenges whether the labour supply response to reforms that raise the full retirement age goes well beyond the intuitive effect on older workers, who would have been eligible to retire under the previous eligibility rules while they need to wait under the new rules. We explore whether also middle-aged individuals, not yet eligible to retire, adapt their labour supply decisions when informed about the delayed pension eligibility. Moreover, following the growing evidence of the relevance of within household interactions, we assess whether labour supply spillovers among partners amplify or nullify the individual-level response.

To answer these questions we exploit a pension reform implemented in Italy in 2012 that increased the full retirement age by four years on average according to our data. We estimate a difference-in-differences model that compares the labour supply of otherwise similar individuals, with heterogeneous exposure to the policy because of differences in the continuity of their pre-reform working life. We find positive effects on participation and job search behaviour of middle-aged individuals, far from their pension eligibility threshold. The effect is concentrated on women, whose labour supply is more elastic and it involves also the intensive margin of labour supply, as workers are more likely to be employed full-time. We find moreover that husbands respond to the higher labour supply of their wives by postponing their own retirement.

Our findings have important policy implications, in the light of assessing the aggregate labour supply effects of policies that increase the statutory age for full retirement. We stress the importance of not only focusing on older workers but of also studying the response of individuals who are further away from actual retirement but whose working horizon increases. According to our estimates, the labour supply response of middle-aged plays an important role – even larger than the effect on older individuals – in increasing the aggregate labour force participation rate.

Moreover, our findings point out that the usual way of estimating the labour supply responses of older workers to pension reforms – i.e. by evaluating their probability of being active after the reform, around the pre-reform eligibility threshold – may deliver biased estimates of the effect. Indeed, also individuals far away the pre-reform cut-off respond to the new retirement rules, therefore violating the standard identifying assumptions in a regression in discontinuity framework.

Finally, we show how within household interactions extensively amplify individual effects. We find that middle-aged men do not respond to an increase in their own working

horizon, as they are already very attached to the labour market and their labour supply is not elastic. However, husbands of middle-aged women tend to be older and have much more elastic labour supply (since they are at the margin of deciding when to retire). We find that they do respond to an increase in their wives working horizon, by postponing their own retirement, consistently with models of leisure complementarities within the family or those in which partners jointly choose the overall family labour supply.

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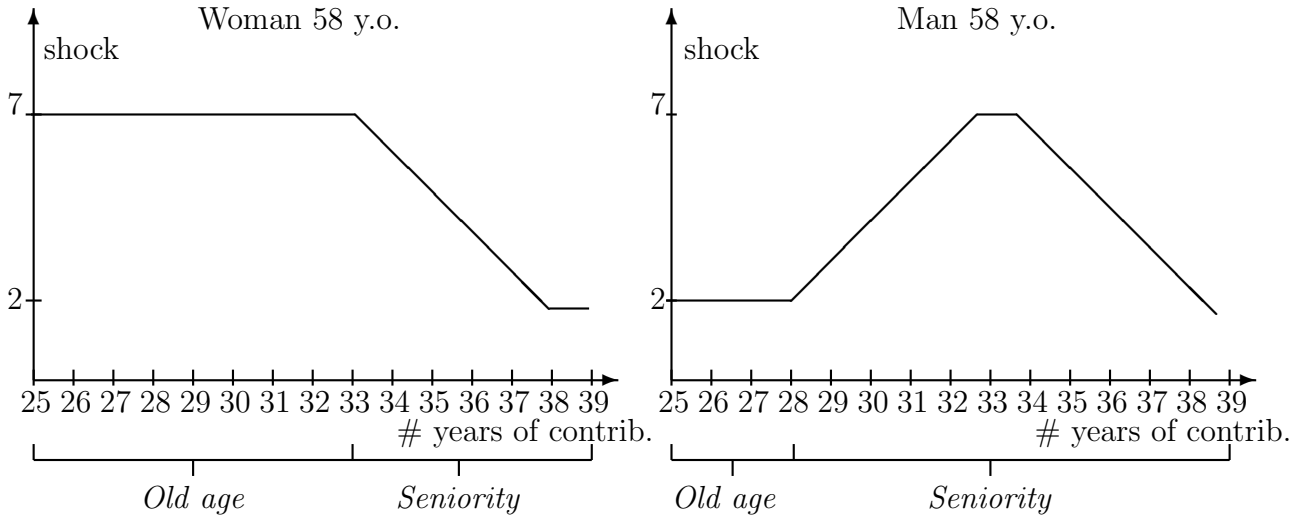
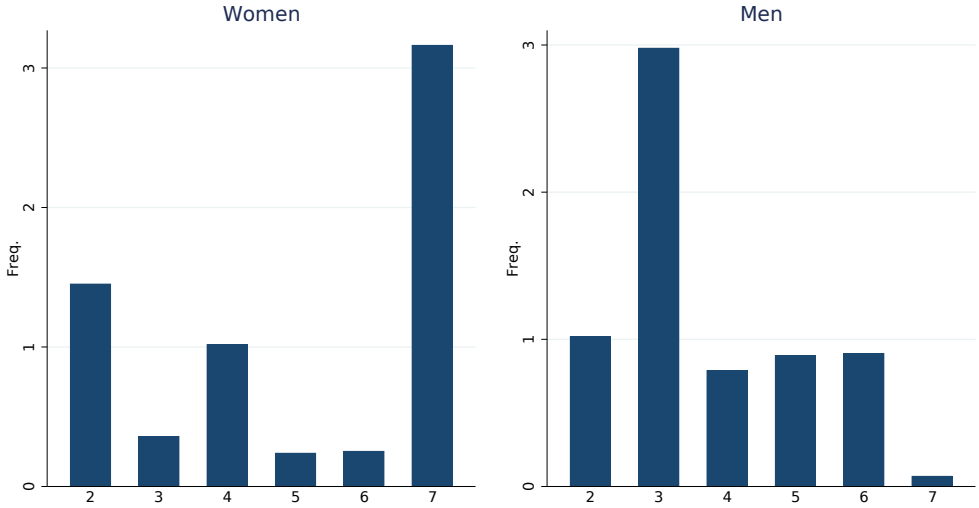
Figures and Tables

Figure 1: Reform-induced variations in the eligibility rules, by gender (variation in pension rules between 2014 and 2010)



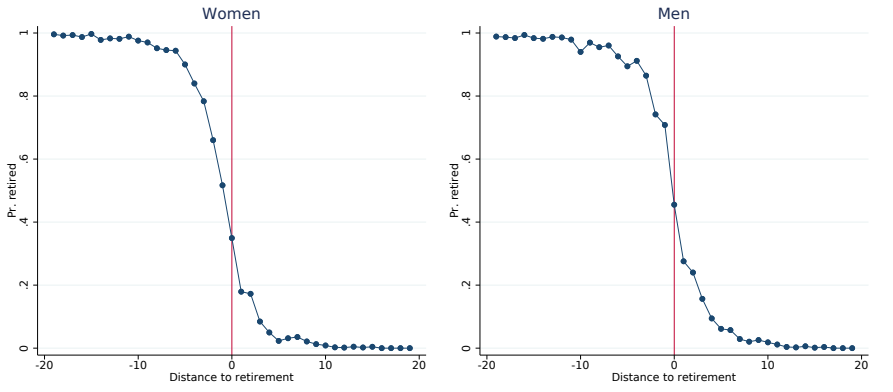
Notes: The Figure depicts the heterogeneity of the reform-induced shock for an individual, either woman or man, aged 58 years old. The source of variation within the gender-age cell is given by the number of accrued years of contribution. Depending on this variable, the considered 58-years-old woman would retire under either the old age scheme (if with less than 34 years of paid contribution) or the seniority scheme (if at least 34 years of paid contribution). The different variation of the shock between genders is given by the fact that before the Fornero reform women were required to reach a lower minimum age than men for the pension eligibility.

Figure 2: Distribution of the shock in the length of the working horizon by gender (variation in pension rules between 2014 and 2010)



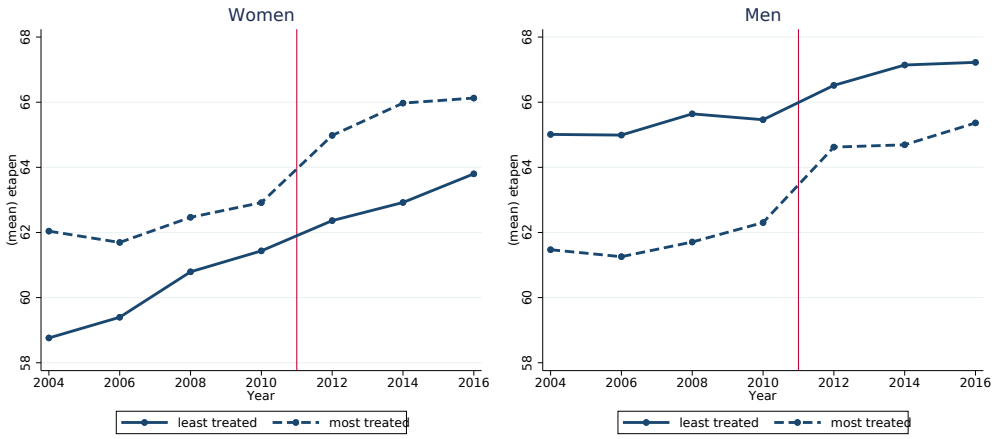
Source: SHIW, from 2010 to 2016.
Note: The Figure displays the distribution of the reform-induced shock to the working horizon by gender. It shows the distribution of the difference between the minimum retirement age (MRA, the age at which individuals can claim for the first time the pension benefit at full retirement, either under the old age or the seniority pension scheme) under the post reform pension rules and the MRA under the pre-reform rules in our sample. Our sample consider women aged between 45 and 59, with at least 10 and less than 40 accrued years of contribution, eligible to retire neither before nor after the reform; men aged between 45 and 64, with at least 20 and less than 40 accrued years of contribution, eligible to retire neither before nor after the reform. Data are at the individual level, the y axis reports the probability of observing a given value of shock. This is the variation used to compute the analysis.

Figure 3: Probability of retiring and distance to the minimum retirement age, by gender



Source: SHIW, from 2010 to 2016.
Note: The Figure plots the probability of being retired as a function of the distance to the minimum retirement age (MRA, the age at which individuals can claim for the first time the pension benefit at full retirement, either under the old age or the seniority pension scheme). Distance to MRA is the difference between the minimum retirement age according to the rules in place at the year of the interview and the individual's age in the same year. The Figure shows that individuals actually retire when they reach their MRA, i.e. when their distance to retirement approaches 0.

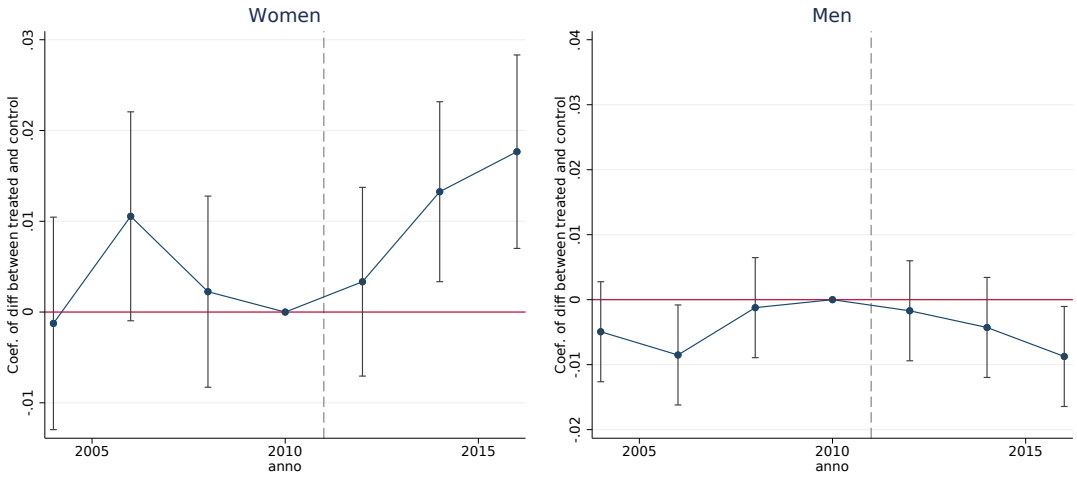
Figure 4: Declared expected retirement age over time, by gender and exposure to the policy shock



Source: SHIW, from 2004 to 2016, question on expected retirement age.
Note: The Figure shows that the declared expected retirement age increases more around the reform (2012) for women and men more exposed (most treated) to the change in the minimum retirement age (MRA, the age at which individuals can claim for the first time the pension benefit at full retirement, either under the old age or the seniority pension scheme). We consider: only individuals with at least 10 (for women) or 20 (for men) and less than 40 accrued years of contribution; women aged 50-59; men aged 55-64, not eligible to retire either before or after the 2011 pension reform. The question on expected retirement age is asked only to employed individuals.

Figure 5: The effect of reform-induced changes in the working horizon: evolution of the difference in the probability of being active between more and less exposed individuals

(a) Prob of being active: individual effects

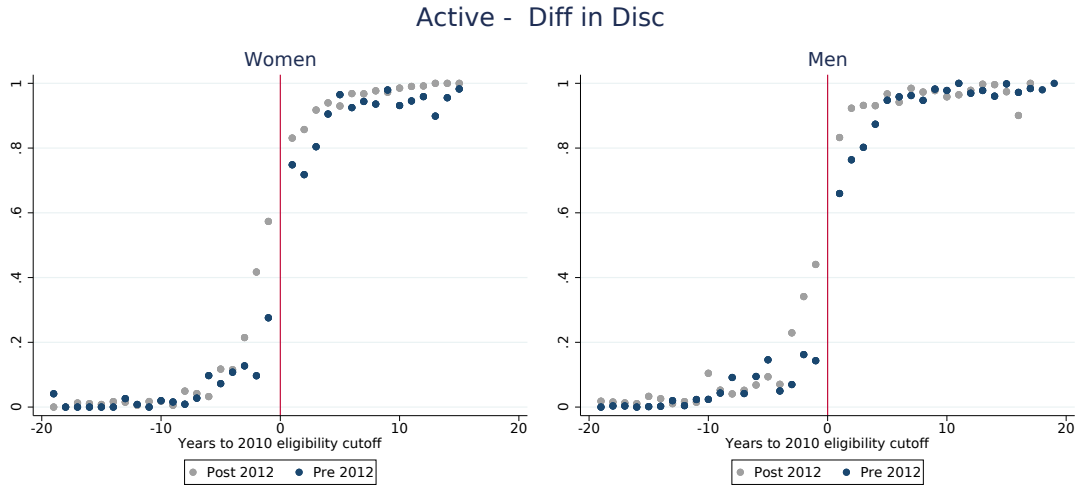


(b) Prob of being active: within family interactions

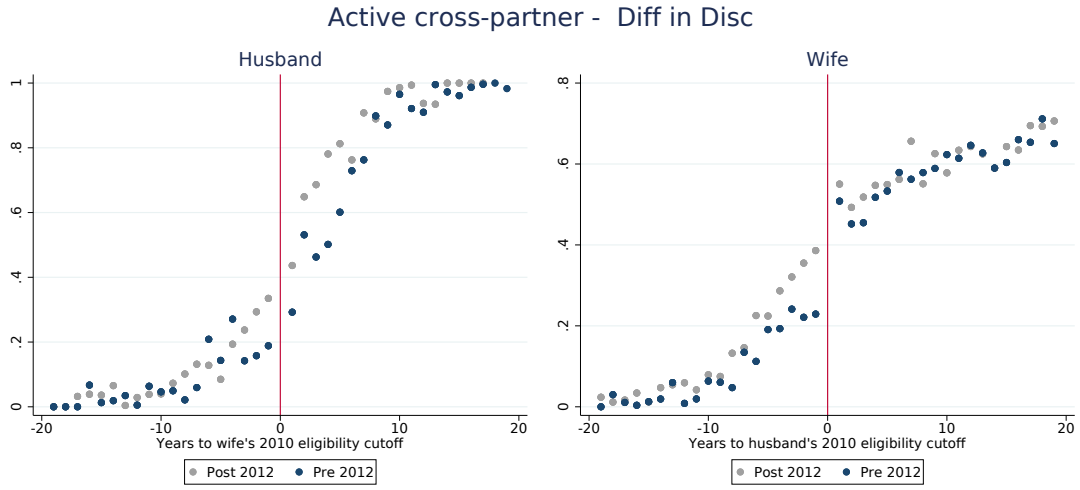
Source: SHIW, from 2004 to 2016.
Note: The graphs test the parallel trend assumption by plotting the coefficients γ_r and ζ_r^s (and the corresponding 5% confidence intervals) obtained from estimating equations 3 and 4. Pre-reform years: 2004-2006-2008-2010, post-reform years: 2012-2014-2016. The omitted year is 2010. Sample: individuals with at least 10 (for women) or 20 (for men) and less than 40 accrued years of contribution; women aged 50-59; men aged 55-64, not eligible to retire either before or after the 2011 pension reform.

Figure 6: The direct effect: the labour supply effect of postponing the pension benefit eligibility

(a) Individual effect



(b) Cross partner effect



Source: SHIW, from 2010 to 2016.
Note: The top panel shows the evolution of the probability of being active in the labour market as a function of the distance to the minimum retirement age according to the 2010 pension rules (that is the difference between the minimum retirement age under 2010 rules and the age at the interview). The bottom panel displays the probability of being active as a function of own partner's distance to retirement according to the 2010 pension rules. The blue (grey) dots are observations in years pre-2012 (post-2012). The sample for women only includes those less affected by the change in the working horizon, in order to avoid estimation biased determined by the forward looking effect. The top panel shows that after 2012 individuals eligible to retire under the previous pension rules have a higher probability of being active in the labour market than in pre-reform years, and that the discontinuity around zero (which means that the individual would have reached the pension eligibility according to the 2010 rules) does not longer hold. The bottom panel shows that after 2012 partners of those individuals who would have been eligible to retire according to the 2010 rules do not have a higher probability of being active.

Table 1: Seniority pension eligibility rules

	Private & Public		Self-employed	
Year	A, C, Q	only C	A, C, Q	only C
Before Fornero reform				
2007	57, 35	39	58, 35	40
2008	58, 35	40	59, 35	40
2009-2010	59, 35, 95	40	60, 35, 96	40
2011	60, 35, 96	40	61, 35 97	40
2011-2012	60, 35, 96	40	61, 35, 97	40
2013 onwards	61, 35, 97	40	62, 35, 98	40
After Fornero reform				
2012- (men)		43		43
2012- (women)		42		42

Notes: A stands for age, C for number of years of paid contribution, $Q = A + C$ is the so-called "quota", the sum of age and years of paid contribution must be larger or equal than Q to reach retirement eligibility. Independently from actual age, retirement eligibility is also granted when the number of accrued years of contribution is sufficiently high (39 in 2007, 40 in the following years, 42 or 43 after the reform).

Table 2: The construction of the Minimum Retirement Age variable: an example

	2010		2014		Shock
	Seniority	Old	Seniority	Old	(2014 - 2010)
Women, 58 years old					
Maria, $C = 38$	**60**	60	**62**	67	2
Valeria, $C = 26$	67	**60**	73	**67**	7

Notes: The Table displays the age at which individuals can claim the full-retirement pension benefit either the old age or the seniority scheme, assuming that individuals will work continuously from the age they are surveyed until they reach their retirement age. The minimum retirement age takes the first age of eligibility among the two pension schemes. C is the number of accrued years of contribution. *Shock* is the difference between the minimum retirement age after and before the reform implemented in 2012.

Table 3: Descriptive statistics

	Individual level analysis							
	Women				Men			
	All 45-59 [1]	Sample not elig [2]	Control $T_q < 7$ [3]	Treated $T_q \geq 7$ [4]	All 45-64 [5]	Sample not elig [6]	Control $T_q < 4$ [7]	Treated $T_q \geq 4$ [8]
Age	51.665	51.336	50.479	51.670	53.877	52.107	52.172	52.019
	(4.280)	(4.108)	(3.645)	(4.229)	(5.728)	(4.626)	(4.925)	(4.179)
Y. contrib	15.852	23.950	31.580	20.976	28.120	28.707	29.502	27.617
	(13.343)	(7.696)	(3.891)	(6.699)	(11.331)	(5.195)	(5.401)	(4.685)
Married	0.762	0.718	0.732	0.712	0.830	0.840	0.836	0.845
	(0.426)	(0.450)	(0.443)	(0.453)	(0.376)	(0.367)	(0.370)	(0.362)
High edu	0.497	0.616	0.638	0.608	0.484	0.538	0.467	0.636
	(0.500)	(0.486)	(0.481)	(0.488)	(0.500)	(0.499)	(0.499)	(0.481)
If children	0.660	0.632	0.603	0.643	0.640	0.617	0.626	0.605
	(0.474)	(0.482)	(0.489)	(0.479)	(0.480)	(0.486)	(0.484)	(0.489)
Active	0.583	0.881	0.978	0.843	0.795	0.979	0.973	0.989
	(0.493)	(0.324)	(0.147)	(0.364)	(0.404)	(0.142)	(0.163)	(0.105)
Unempl.	0.043	0.044	0.022	0.052	0.071	0.050	0.052	0.048
	(0.204)	(0.205)	(0.147)	(0.223)	(0.257)	(0.218)	(0.221)	(0.214)
Part time	0.102	0.147	0.142	0.149	0.022	0.017	0.017	0.018
	(0.302)	(0.354)	(0.349)	(0.356)	(0.146)	(0.130)	(0.128)	(0.132)
Observations	16156	9036	2516	6520	19313	10732	6178	4554
	Family level analysis							
	Couples with treated Wives				Couples with treated Husbands			
	All wife 45-59 [1]	Sample not elig [2]	Control $T_q^w < 7$ [3]	Treated $T_q^w \geq 7$ [4]	All husb 45-64 [5]	Sample not elig [6]	Control $T_q^h < 4$ [7]	Treated $T_q^h \geq 4$ [8]
Age w	51.654	51.761	51.051	52.349	50.240	50.499	50.240	50.846
	(4.264)	(4.026)	(3.781)	(4.127)	(6.752)	(3.663)	(3.669)	(3.628)
Age h	55.089	55.286	54.524	55.917	54.052	52.984	52.545	53.569
	(5.702)	(5.149)	(4.926)	(5.245)	(5.682)	(3.912)	(4.145)	(3.494)
Y. contrib w	15.128	24.715	30.813	19.668	14.581	24.434	24.584	24.235
	(13.447)	(7.663)	(4.204)	(6.036)	(13.519)	(7.492)	(7.522)	(7.449)
Y. contrib h	30.286	33.839	33.934	33.759	29.026	30.734	31.651	29.510
	(10.517)	(6.415)	(5.826)	(6.864)	(10.698)	(4.486)	(4.708)	(3.846)
High edu w	0.486	0.603	0.672	0.545	0.501	0.664	0.615	0.729
High edu h	0.483	0.558	0.599	0.523	0.493	0.627	0.548	0.732
If children	0.705	0.690	0.665	0.712	0.678	0.654	0.654	0.654
Active w	0.523	0.841	0.971	0.733	0.508	0.859	0.838	0.886
Active h	0.768	0.777	0.820	0.741	0.794	0.987	0.984	0.991
Unempl w	0.035	0.039	0.019	0.055	0.037	0.037	0.037	0.036
Unempl h	0.058	0.025	0.020	0.030	0.060	0.030	0.034	0.024
Observations	11842	5510	2566	2944	15204	3825	2166	1659

Notes: For the top panel: Column 1 (5) reports the entire sample of women (men) aged between 45-59 (45-64); Column 2 (6) only individuals in our sample (not eligible to retire either before and after the reform and with at least 10 for women, or 20 for men, and less than 40 accrued years of contribution); Columns 3 and 4 (7 and 8) split the sample between treated and control individuals (women (men) are defined as treated if experienced a shock to minimum retirement age of ≥ 7 (≥ 4) years after 2011 reform). High edu is a dummy indicating whether individuals have at least secondary education. w stands for wives, h stands for husbands. For the bottom panel: the same above sample restrictions are imposed only on the treated spouse.

Table 4: Effects of the longer working horizon on working status

	Women			Men		
	55-59	50-54	45-49	55-64	50-54	45-49
	(1)	(2)	(3)	(4)	(5)	(6)
			Participation			
T*post2011	0.033***	0.015***	0.011***	-0.002	-0.003	0.005*
	(0.006)	(0.004)	(0.004)	(0.004)	(0.002)	(0.003)
N	2456	3332	3091	3577	3856	3194
			Unemployment			
T*post2011	0.012**	0.009***	0.006**	-0.004	-0.001	0.009
	(0.006)	(0.004)	(0.003)	(0.006)	(0.005)	(0.008)
N	2456	3332	3091	3577	3856	3194
			Employment			
T*post2011	0.022***	0.006	0.004	0.001	-0.002	-0.004
	(0.006)	(0.004)	(0.005)	(0.007)	(0.006)	(0.009)
N	2456	3332	3091	3577	3856	3194
			Full-time employment			
T*post2011	0.024***	0.015**	0.018**	-0.000	0.004	-0.010
	(0.008)	(0.007)	(0.008)	(0.007)	(0.007)	(0.012)
N	2456	3332	3091	3577	3856	3194
			Part-time employment			
T*post2011	-0.003	-0.009	-0.016**	-0.001	0.000	0.004
	(0.007)	(0.006)	(0.007)	(0.003)	(0.004)	(0.006)
N	2456	3332	3091	3577	3856	3194
			For employees only			
			Labour income			
T*post2011	461.679***	-117.927	156.931	37.509	-133.892	-275.212
	(172.064)	(165.291)	(119.276)	(289.677)	(277.224)	(447.801)
N	1831	2730	2548	2708	2967	2470
			Total income			
T*post2011	578.846***	-17.615	138.773	-103.342	-275.824	136.327
	(219.123)	(190.717)	(143.599)	(335.452)	(406.235)	(597.895)
N	1831	2730	2548	2708	2967	2470
			Savings			
T*post2011	752.686*	273.928	139.661	382.444	-317.404	280.112
	(389.635)	(220.401)	(231.913)	(272.291)	(336.174)	(322.087)
N	1831	2730	2548	2708	2967	2470

Notes: T*post2011 is the estimated difference-in-differences coefficient of the longer working horizon. Additional controls: year and cell q fixed effects (each cell is defined by age, gender, number of years of accrued contribution and sector of employment), region and sector fixed effects, time fixed effects, marital status. The sample consists of individuals that are not eligible for a public pension both before and after the reform and have accrued a number of years of contribution of at least 10 for women or 20 for men, and smaller than 40. Robust standard errors clustered at the cell q level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Effects of the longer working horizon on working status by regional vacancy rate

	Women			Men		
	55-59	50-54	45-49	55-64	50-54	45-49
	(1)	(2)	(3)	(4)	(5)	(6)
			Participation			
T*post2011	0.033***	0.006	0.010*	0.001	0.001	0.003
	(0.010)	(0.008)	(0.006)	(0.006)	(0.004)	(0.004)
T*post2011*high lambda	0.003	0.013	0.002	-0.007	-0.008	0.003
	(0.012)	(0.010)	(0.007)	(0.009)	(0.005)	(0.006)
N	2456	3332	3091	3577	3856	3194
			Unemployment			
T*post2011	0.010	0.011	0.011*	-0.008	-0.009	-0.001
	(0.007)	(0.007)	(0.006)	(0.008)	(0.008)	(0.012)
T*post2011*high lambda	-0.001	-0.001	-0.008	0.010	0.016	0.018
	(0.010)	(0.009)	(0.007)	(0.009)	(0.011)	(0.012)
N	2456	3332	3091	3577	3856	3194
			Employment			
T*post2011	0.022**	-0.005	-0.000	0.009	0.010	0.004
	(0.010)	(0.010)	(0.007)	(0.010)	(0.009)	(0.013)
T*post2011*high lambda	0.004	0.014	0.009	-0.017	-0.023**	-0.014
	(0.013)	(0.011)	(0.010)	(0.012)	(0.011)	(0.012)
N	2456	3332	3091	3577	3856	3194

Notes: T*post2011 is the estimated difference-in-differences coefficient of the longer working horizon. High lambda is a dummy equal to one if the regional-year vacancy rate is above the median. Additional controls: year and cell q fixed effects (each cell is defined by age, gender, number of years of accrued contribution and sector of employment), region and sector fixed effects, time fixed effects, marital status. The sample consists of individuals that are not eligible for a public pension both before and after the reform and have accrued a number of years of contribution of at least 10 for women or 20 for men, and smaller than 40. Robust standard errors clustered at the cell q level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Effects of the longer working horizon on working status of individuals under the defined contribution scheme before the pension reform and change in pension wealth

	Women			Men		
	55-59	50-54	45-49	55-64	50-54	45-49
	(1)	(2)	(3)	(4)	(5)	(6)
By type of benefit computation (DB or NDC)						
			Participation			
T*post2011	0.009	0.009**	0.011***	0.004	0.000	0.002
	(0.006)	(0.004)	(0.004)	(0.005)	(0.003)	(0.003)
T*post2011*DB	0.072*	-	-	-0.004	-0.002	-
	(0.038)	-	-	(0.007)	(0.012)	-
N	2456	3332	3091	3577	3856	3194
			Unemployment			
T*post2011	0.007	0.007**	0.006**	0.000	-0.002	0.008
	(0.006)	(0.004)	(0.003)	(0.008)	(0.008)	(0.007)
T*post2011*DB	0.007	-	-	-0.007	-0.026	-
	(0.022)	-	-	(0.012)	(0.025)	-
N	2456	3332	3091	3577	3856	3194
			Employment			
T*post2011	0.002	0.001	0.004	0.004	0.003	-0.007
	(0.007)	(0.005)	(0.005)	(0.009)	(0.008)	(0.009)
T*post2011*DB	0.064**	-	-	0.003	0.023	-
	(0.030)	-	-	(0.013)	(0.026)	-
N	2456	3332	3091	3577	3856	3194
By household wealth						
			Participation			
T*post2011	0.042***	0.023***	0.010**	-0.007	-0.007	0.005
	(0.010)	(0.007)	(0.005)	(0.006)	(0.004)	(0.005)
T*post2011*rich	-0.015	-0.013	0.000	0.008	0.007	-0.000
	(0.011)	(0.009)	(0.006)	(0.007)	(0.005)	(0.006)
N	2456	3332	3091	3577	3856	3194
			Unemployment			
T*post2011	0.013	0.012**	0.012**	-0.002	-0.008	0.014
	(0.012)	(0.006)	(0.005)	(0.009)	(0.009)	(0.010)
T*post2011*rich	-0.003	-0.006	-0.010	-0.000	0.012	-0.011
	(0.012)	(0.007)	(0.006)	(0.011)	(0.013)	(0.010)
N	2456	3332	3091	3577	3856	3194
			Employment			
T*post2011	0.029**	0.010	-0.002	-0.004	0.001	-0.009
	(0.013)	(0.008)	(0.006)	(0.010)	(0.010)	(0.013)
T*post2011*rich	-0.012	-0.007	0.011	0.009	-0.005	0.011
	(0.015)	(0.010)	(0.008)	(0.012)	(0.015)	(0.012)
N	2456	3332	3091	3577	3856	3194

Notes: T*post2011 is the estimated difference-in-differences coefficient of the longer working horizon. In the defined contribution system the expected pension wealth is closely linked to the length of the working activity; in this scheme the expected pension wealth is not reduced by the delaying of the minimum retirement age. For some age classes we could not estimate the interaction because of very few middle-aged individuals under the defined benefit system (DB, i.e. those with at least 15 years of contribution in 1995). Rich is a dummy equal to 1 if the household wealth is above the yearly median. Additional controls: year and cell q fixed effects (each cell is defined by age, gender, number of years of accrued contribution and sector of employment), region and sector fixed effects, time fixed effects, marital status. The sample consists of individuals that are not eligible for a public pension both before and after the reform and have accrued a number of years of contribution of at least 10 for women or 20 for men, and smaller than 40. Robust standard errors clustered at the cell q level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Cross effects among partners of the longer working horizon (FL effect) on working status

	Participation		*Unemployment*		*Employment*		*Retirement*
	own	partner	own	partner	own	partner	partner
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Spillover effects of wife's FL response: couples with middle-aged wives							
	on wife	on hubs	on wife	on hubs	on wife	on hubs	on hubs
T wife*post2011	0.022***	0.018**	0.013***	0.006	0.010**	0.012	-0.017**
	(0.003)	(0.007)	(0.003)	(0.004)	(0.004)	(0.008)	(0.007)
N	5326	4060	5326	4060	5326	4060	3865
Spillover effects of husb's FL response: couples with middle-aged husb							
	on hubs	on wife	on hubs	on wife	on hubs	on wife	on wife
T husb*post2011	-0.011	-0.002	-0.008	-0.001	-0.003	-0.001	0.000
	(0.010)	(0.003)	(0.006)	(0.005)	(0.011)	(0.006)	(.)
N	3565	3819	3565	3819	3565	3819	3610

Notes: T wife*post 2011 is the estimated difference-in-differences coefficient of the wife's longer working horizon; T husband*post 2011 is the estimated difference-in-differences coefficient of the husband's longer working horizon. Additional controls: year and cell $q_{s'}$ and q_s fixed effects (separately for each dimension; each cell is defined by age, gender number of years of accrued contribution and sector of employment), region and sector fixed effects, age difference across partners (also squared) and difference in distance to retirement across partners (also squared), partner s change in distance to retirement. The sample in Columns 1 and 2 (3 and 4) consists of individuals belonging to couples where the wives (husbands) are not eligible for a public pension both before and after the reform and have accrued a number of years of contribution of at least 10 (20), and smaller than 40. The results for labour and pension incomes refer to the sample of employees only. Robust standard errors clustered at the cell $q_{s'}$ level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: The direct effect of postponing pension eligibility

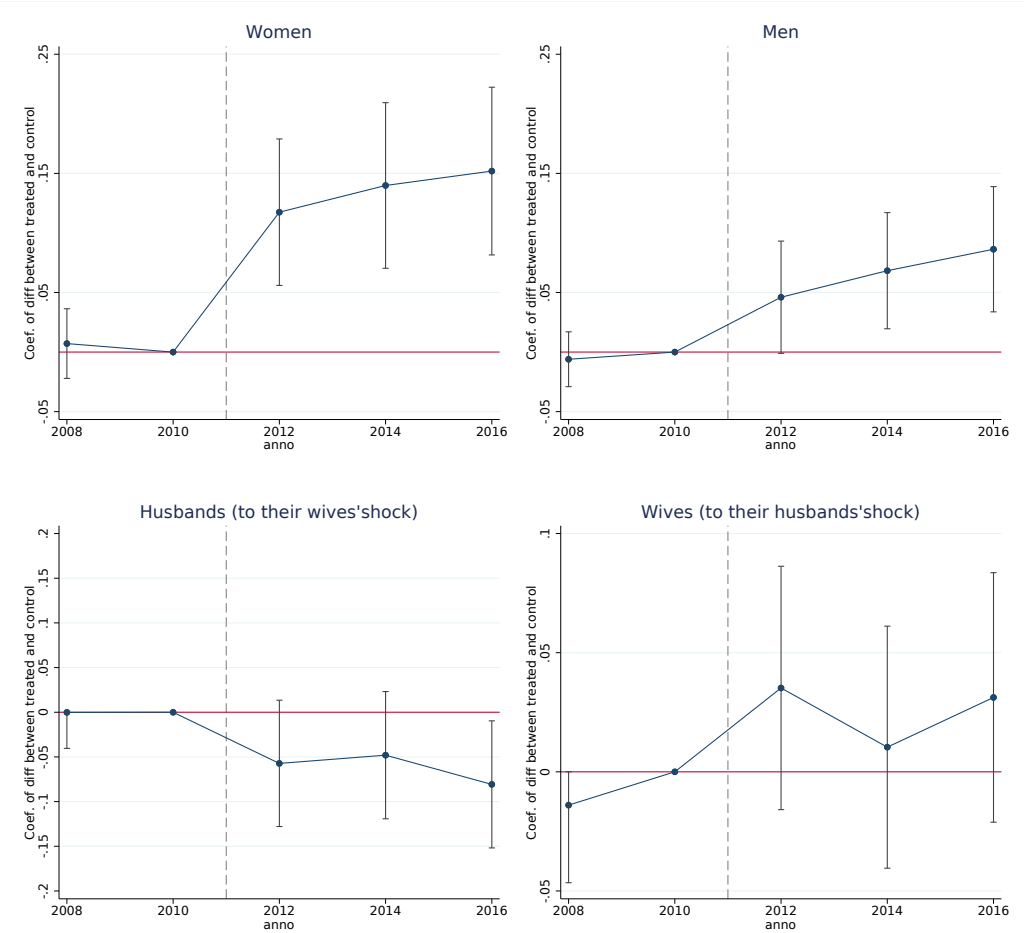
	Women			Men		
	linear	quadratic	cubic	linear	quadratic	cubic
	(1)	(2)	(3)	(4)	(5)	(6)
Individual effect						
			Participation			
E_{2010}*post2011	0.215***	0.249***	0.239**	0.083**	0.107*	0.111
	(0.047)	(0.072)	(0.100)	(0.036)	(0.056)	(0.083)
N	6417	6417	6417	12320	12320	12320
			Unemployment			
E_{2010}*post2011	-0.002	-0.000	-0.016	-0.022	-0.021	-0.067
	(0.019)	(0.034)	(0.053)	(0.019)	(0.034)	(0.054)
N	6417	6417	6417	12320	12320	12320
			Employment			
E_{2010}*post2011	0.216***	0.250***	0.255**	0.105***	0.129**	0.178*
	(0.049)	(0.079)	(0.112)	(0.039)	(0.062)	(0.094)
N	6417	6417	6417	12320	12320	12320
Cross-partner effect						
	on husbands (wives' shock)			on wives (husbands' shock)		
			Participation			
$E^{s'}_{2010}$*post2011	-0.061*	-0.061	-0.049	0.032	-0.007	-0.037
	(0.033)	(0.051)	(0.073)	(0.022)	(0.034)	(0.048)
N	7808	7808	7808	18146	18146	18146
			Unemployment			
$E^{s'}_{2010}$*post2011	0.003	-0.004	0.017	-0.012	-0.005	-0.009
	(0.014)	(0.021)	(0.029)	(0.009)	(0.014)	(0.020)
N	7808	7808	7808	18146	18146	18146
			Employment			
$E^{s'}_{2010}$*post2011	-0.064*	-0.057	-0.066	0.044**	-0.002	-0.028
	(0.034)	(0.053)	(0.075)	(0.022)	(0.034)	(0.046)
N	7808	7808	7808	18146	18146	18146

Notes: E_{2010}*post2011 is the estimated difference-in-discontinuity coefficient for pension eligibility according to the rules in place in 2010; $E^{s'}_{2010}$*post2011 is the estimated difference-in-discontinuity coefficient for partner s' pension eligibility according to the rules in place in 2010. Additional controls: year fixed effects, polynomial of the running variable (linear in columns 1 and 4, quadratic in columns 2 and 5, cubic in columns 3 and 6). The sample consists of individuals whose distance to retirement according to the pre-reform rules was between 20 and -20. The sample for women only includes those less affected by the change in the working horizon, in order to avoid estimation biased determined by the forward looking effect. Robust standard errors clustered at the individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix

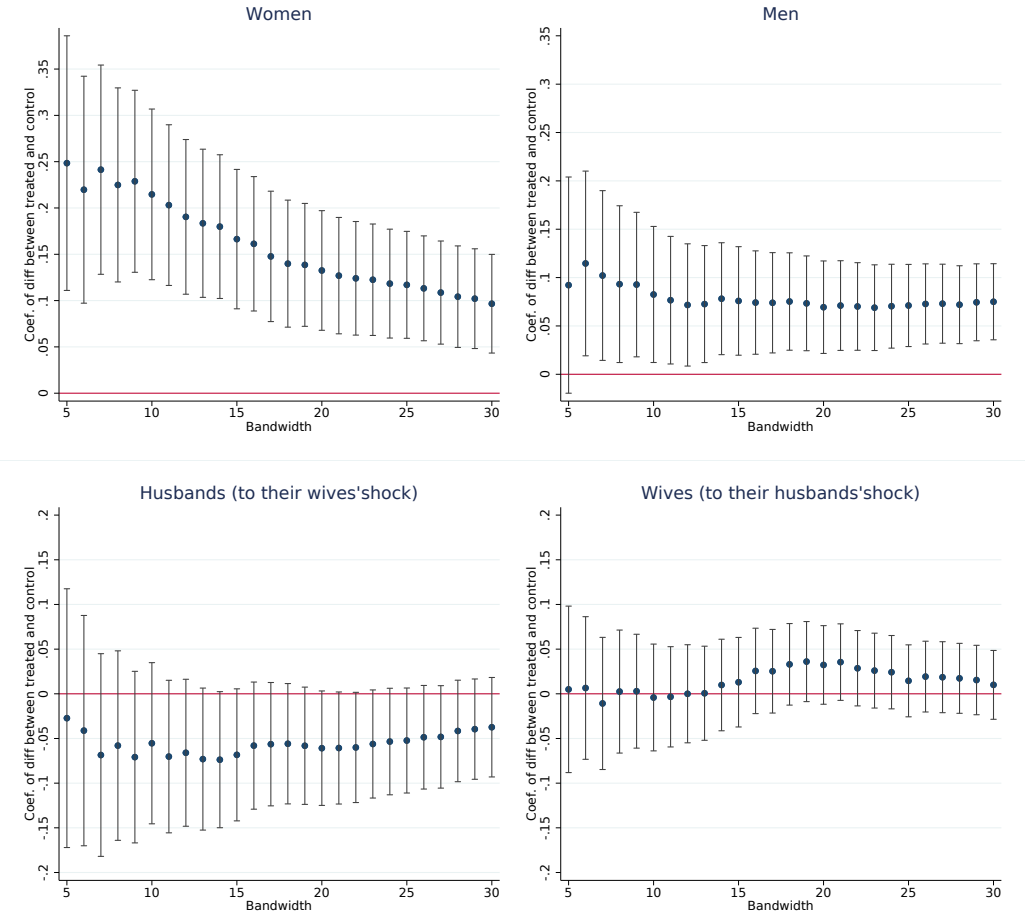
A Additional figures

Figure A.1: Parallel trend difference-in-discontinuity



Source: SHIW, from 2004 to 2016. Specification with linear running variable. The graphs test the parallel trend assumption by plotting the coefficients of the interaction between the treatment E_i and year dummies (and the corresponding 5% confidence intervals), omitting 2010. Pre-reform years: 2004-2006-2008-2010, post-reform years: 2012-2014-2016. The sample consists of individuals whose distance to retirement according to the pre-reform rules was between 20 and -20. The sample for women only includes those less affected by the change in the working horizon, in order to avoid estimation biased determined by the forward looking effect.

Figure A.2: Changing the bandwidth of the difference-in-discontinuity



Source: SHIW, from 2004 to 2016. The graph plots the coefficients (and the corresponding 95% confidence intervals) obtained from estimating equation 6, changing the bandwidth. Specification with linear running variable. The sample consists of individuals whose distance to retirement according to the pre-reform rules was between 20 and -20. The sample for women only includes those less affected by the change in the working horizon, in order to avoid estimation biased determined by the forward looking effect.

B Additional tables

Table B.1: Effects of the longer working horizon on working status, controlling for cohort trends

	Women			Men		
	55-59	50-54	45-49	55-64	50-54	45-49
	(1)	(2)	(3)	(4)	(5)	(6)
			Participation			
T*post2011	0.030***	0.015***	0.011***	-0.005	-0.003	0.004*
	(0.006)	(0.004)	(0.004)	(0.004)	(0.002)	(0.003)
N	2456	3332	3091	3577	3856	3194
			Unemployment			
T*post2011	0.010*	0.009***	0.006**	-0.001	-0.002	0.009
	(0.006)	(0.004)	(0.003)	(0.007)	(0.005)	(0.007)
N	2456	3332	3091	3577	3856	3194
			Employment			
T*post2011	0.020***	0.006	0.005	-0.005	-0.002	-0.005
	(0.007)	(0.004)	(0.005)	(0.008)	(0.006)	(0.008)
N	2456	3332	3091	3577	3856	3194
			Full-time employment			
T*post2011	0.020**	0.015**	0.018**	-0.005	0.004	-0.011
	(0.008)	(0.007)	(0.007)	(0.008)	(0.007)	(0.012)
N	2456	3332	3091	3577	3856	3194
			Part-time employment			
T*post2011	-0.002	-0.009	-0.016**	-0.001	0.000	0.004
	(0.007)	(0.006)	(0.007)	(0.003)	(0.004)	(0.006)
N	2456	3332	3091	3577	3856	3194

Notes: T*post2011 is the estimated difference-in-differences coefficient of the longer working horizon. Additional controls: year and cell q - defined by age, gender, number of years of accrued contribution and sector of employment - fixed effects, region and sector fixed effects, time fixed effects, marital status, age specific trends. The sample consists of individuals that are not eligible for a public pension both before or after the reform and have accrued a number of years of contribution of at least 10 for women (20 for men), and smaller than 40. Robust standard errors clustered at the cell q level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B.2: Effects of the longer working horizon on working status by education level

	Women			Men		
	55-59	50-54	45-49	55-64	50-54	45-49
	(1)	(2)	(3)	(4)	(5)	(6)
			Participation			
T*post2011	0.053***	0.027***	0.017**	-0.005	-0.005	0.005
	(0.009)	(0.007)	(0.008)	(0.007)	(0.003)	(0.007)
T*post2011*high edu	-0.041***	-0.023***	-0.009	0.009	0.005	-0.001
	(0.010)	(0.009)	(0.009)	(0.009)	(0.005)	(0.008)
N	2456	3332	3091	3577	3856	3194
			Unemployment			
T*post2011	0.020**	0.021***	0.010	-0.006	-0.001	0.008
	(0.010)	(0.007)	(0.006)	(0.011)	(0.010)	(0.018)
T*post2011*high edu	-0.011	-0.018**	-0.005	0.005	0.000	0.001
	(0.012)	(0.007)	(0.007)	(0.012)	(0.011)	(0.020)
N	2456	3332	3091	3577	3856	3194
			Employment			
T*post2011	0.033***	0.006	0.007	0.001	-0.004	-0.004
	(0.012)	(0.009)	(0.010)	(0.012)	(0.009)	(0.020)
T*post2011*high edu	-0.029**	-0.005	-0.004	0.004	0.005	-0.001
	(0.013)	(0.011)	(0.012)	(0.015)	(0.011)	(0.022)
N	2456	3332	3091	3577	3856	3194

Notes: T*post2011 is the estimated difference-in-differences coefficient of the longer working horizon. High edu is a dummy equal to 1 if individuals obtained at least the secondary school degree. Additional controls: year and cell q fixed effects (each cell is defined by age, gender, number of years of accrued contribution and sector of employment), region and sector fixed effects, time fixed effects, marital status. The sample consists of individuals that are not eligible for a public pension both before and after the reform and have accrued a number of years of contribution of at least 10 for women or 20 for men, and smaller than 40. Robust standard errors clustered at the cell q level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B.3: Balancing tests around the discontinuity cut-off

	linear (1)	quadratic (2)	cubic (3)	linear (4)	quadratic (5)	cubic (6)
			Individual effect			
		Women			Men	
			Household wealth			
E_{2010}*post2011	0.036	-0.042	-0.126*	0.005	0.063*	0.115**
	(0.032)	(0.048)	(0.067)	(0.025)	(0.037)	(0.053)
N	12136	12136	12136	23792	23792	23792
			Whether kids			
E_{2010}*post2011	-0.009	0.012	0.096	-0.094***	-0.001	-0.012
	(0.028)	(0.043)	(0.060)	(0.021)	(0.031)	(0.045)
N	12136	12136	12136	23792	23792	23792
			High education			
E_{2010}*post2011	0.031	0.026	0.021	0.067***	0.084**	0.089
	(0.036)	(0.055)	(0.075)	(0.026)	(0.040)	(0.057)
N	12136	12136	12136	23792	23792	23792
			Cross-partner effect			
	on husbands (wives' shock)			on wives (husbands' shock)		
			Household wealth			
$E^{s'}_{2010}$*post2011	-0.021	-0.092*	-0.197**	0.015	0.040	0.052
	(0.038)	(0.055)	(0.079)	(0.027)	(0.041)	(0.058)
N	7818	7818	7818	18152	18152	18152
			Whether kids			
$E^{s'}_{2010}$*post2011	-0.037	0.014	0.036	-0.092***	0.023	-0.000
	(0.031)	(0.047)	(0.065)	(0.019)	(0.029)	(0.041)
N	7818	7818	7818	18152	18152	18152
			High education			
$E^{s'}_{2010}$*post2011	0.006	0.009	0.048	0.057**	0.064	0.070
	(0.041)	(0.058)	(0.078)	(0.028)	(0.044)	(0.062)
N	7818	7818	7818	18152	18152	18152

Notes: E_{2010}*post2011 is the estimated difference-in-discontinuity coefficient for pension eligibility according to the rules in place in 2010; $E^{s'}_{2010}$*post2011 is the estimated difference-in-discontinuity coefficient for partner s' pension eligibility according to the rules in place in 2010. Additional controls: year fixed effects, polynomial of the running variable (linear in columns 1 and 4, quadratic in columns 2 and 5, cubic in columns 3 and 6). The sample consists of individuals whose distance to retirement according to the pre-reform rules was between 20 and -20. The sample for women only includes those less affected by the change in the working horizon, in order to avoid estimation biased determined by the forward looking effect. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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