Retirement Behavior of Married Couples in Germany: Evidence from a Natural Experiment

by Thi Mai Van Bui (MSc.)
Universität Rostock
Max-Planck-Institut für Demografische Forschung

Abstract

This paper studies the effect of the exogenous introduction of a pension reform in 1992 as a "natural experiment" on retirement behavior among married couples in Germany, using the German Social Economic Panel data. In this reform retirement ages for full pensions of the unemployed, the long-term insured and women have been increased and early retirement was affected by reduced pensions. This reform had a financial impact on individuals at ages 60 and 63. Using a difference-in-difference approach, cohorts retiring after the reform (treatment group) are compared to cohorts retiring before the reform (control group) and differences in the share of retired person in the age groups 60 and 63 to other ages are analyzed. The estimation results show that the financial disincentives of the reform reduce significantly the retirement probability of women at age 60 by 23 percentage points (pp) and the retirement probability of men at the ages of 60 and 63 by 10 pp and 18 pp, respectively. The financial disincentives of the reform reduce significantly stronger the retirement probability of women and men at age 60 in East Germany than in the West. Additionally the reform has a significant impact on women in the East and men in the West to retire at age 63. Furthermore the study investigates the financial disincentives to retire for husbands and wives by the pension reduction of their partners. The estimation shows significant effects of financial constraints of wives on the retirement decisions of their husbands but not vice versa. After controlling for the own financial incentives and additional covariates, husbands are still responsive to the wives' financial disincentives but wives are not. The paper also indicates that women and men in East Germany with possible lower wages, earnings and wealth responds strongly to their own financial disincentives and their wives' financial constraints, compared to their counterparts in West Germany. The reaction of men in East Germany is much stronger to their wives' financial constraints than that of men in West Germany whose wives are exposed to the reform.

Key words *Retirement behavior, reform effect, financial incentives, financial disincentives, natural experiment.*

Contents

1 Introduction

As in many developed countries, declining fertility and rising life expectancy will enormously alter the future demographic structure of the German population (see Christensen et al. (2009)). The share of pensioners over the working population continuously increases. The proportion of pensioners aged sixty and older will increase to 36% in the year 2035, when the population aging will peak in Germany (Börsch-Supan and Schnabel (1999)). The rapid population aging will push the pension contribution rate past 40% by 2035 (Börsch-Supan and Wilke (2006)). At the same time, the pension receiving period also expands once old people live longer. This places pressure on the sustainability of pay-as-you-go pension system. Hence, in order to reduce the fiscal pressure from population aging, a reform of the current system is necessary.

Since the 1990s, there have been a number of attempts made to reform the pension system in Germany. One of the goals of these reforms is to reduce the early retirement incentives through a gradual increase of the normal retirement ages

and a reduction of pension benefits for early retirement (see Schulze and Jochem (2007)). In the paper, the German reform, the so-called "Growth and Employment Promotion Act" - Wachstums- und Beschäftigungsfrderungsgesetz- (WFG) is used as a *"natural experiment"* to identify the effect of financial incentives on retirement behavior in married couples at older ages.

The existing literature on retirement shows the financial incentives are important considerations for the retirement timing of individuals (for example, see Blau and Gilleskie (2006), Kapur and Rogowski (2007), Stock and Wise (1990), etc.). Most studies rely on the cross-sectional comparison of individuals with different benefit claims to identify the response behavior (see Gruber and Wise (2004)). This approach mostly neglects the possibility of individual unobserved determinants of retirement, which may be correlated with variation in the incentives. Therefore, in contrast to these studies, some studies reply on natural experiments to obtain estimates of the effect of financial incentives that are not biased by unobserved heterogeneity.

Krueger and Pischke (1992) estimate the effect of Social Security wealth on the labor supply of older men in the 1970s and 1980s, exploiting the impact of the 1977 amendments to the Social Security Act. The amendments of the reform in 1977 led to a reduction in benefits for individuals born in 1917-21 while benefits remained unchanged for identical retirees who were born slightly earlier. He indicates that labor supply continued to decline for birth cohorts born after 1916 (i.e., 1917-1921) who received lower Social Security benefits due to the 1977 amendments, compared with earlier cohorts that were unaffected by the amendments.

A recent paper by Mastrobuoni (2009) has exploited exogenous changes from pension reforms to estimate a causal effect of individual retirement incentives on own retirement behavior. He investigates whether the 1983 reform of the U.S., which is an increase in the normal retirement age of 2 months for cohorts born in 1938 and after, affects retirement behavior. He finds that every two-month-increase in the normal retirement age increases the mean of retirement age by one month. Similar to the above studies, a more recent paper by Hanel and Riphahn (2012) examines the 1991 reform of the Swiss mandatory retirement insurance to identify the effect of financial incentives on retirement behavior. The Swiss 1991 reform increased women's normal retirement age in two steps from age 62 to 63 first and

then to age 64. They find that a reduction of retirement benefits by 3.4% induces a decline in the age-specific annual retirement probability by over 50%. However, these authors only focus on the effect of the reform to a change in individuals' retirement incentives on own retirement behavior.

As labor force participation by married women grew rapidly in recent years, a growing literature recognizes that retirement decisions are made within the context of the family (e.g. Blau (1998); Coile (2004); Favreault and Johnson (2002); Gustman and Steinmeier (2000); Hurd (1990)). If the retirement decisions of couples are strongly connected, the reasons for their retirement must be an important input to any pension reforms. Alternatively, pension reforms would appear to have significant impact on the retirement decisions of couples. Understanding the effect of pension reforms to retirement incentives on married couples' retirement behavior is very important for policy markers, especially as a trend with two-earner couples in labor market is increasing.

Some papers examine a causal effect of one spouse's retirement incentives on the other spouse's retirement behavior. For example, Coile (2004) uses reduced-form retirement models to investigate how husbands and wives' retirement behavior is influenced by own financial incentives from Social Security and private pensions, and by spillover effects from their spouses' incentives. She finds that husbands and wives are similarly responsive to their own incentives: an increase of $1000 in the return to work is associated with a reduction of 0.9% of baseline retirement for husbands, and 1.3% of baseline retirement for wives. In addition, she provides evidence that husbands are very responsive to their wife's financial incentives but that wives are not responsive to their husband's incentives. Specifically, when the wife's social security wealth accrual increases, the husband's probability of retirement decreases. She suggests that this may due to asymmetric complementarity of leisure. Zweimüller et al. (1996) finds a similar asymmetric correlation where husbands react to changes in wives' legal minimum retirement age but wives don't react vice versa. They estimate a bivariate probit model for joint retirement in which the dependent variables are eligibility dummies for early and regular retirement and the earnings replacement ratios for both spouses. However, these studies, which reply on the cross-individual variation in benefit entitlement, may suffer from some identification problems because this variation in benefit entitlement is likely to be correlated with

unobserved determinants of labor market decisions.

Only a few studies (e.g. Baker (2002)) use a policy intervention rather than cross-individual variations in benefit entitlement. By relying on the variation over time in benefits that applies to certain cohorts or ages, the estimated results are more likely to be unbiased because unobserved determinants of labor market decisions are not correlated to the variation in incentives. Baker (2002) examines the introduction of the Spouse's Allowance (SPA) to the Canadian Income Security system in 1975 affecting the labor market decisions of the eligible couples. The empirical strategy is to compares separately changes in retirement behavior of couples including males (65-75) and females (60-64) who became eligible for the spouse's allowance to that of their counterparts of the same age, who due to the age of their spouse did not qualify for an allowance. He finds a reduction in labor force participation rates among eligible males and a relative reduction for eligible females.

In this study, I follow the approach of Baker (2002) to study some research questions. First, I investigate whether the retirement behavior of married women and men is affected by changes in their own pension financial incentives. Using the German Social-Economic Panel data (from 1992 to 2010), I examine the effect of the 1992 pension reform (WFG) in Germany to changes in own financial incentives on women and men's retirement decision. Specifically, I compare the difference in retirement behavior between individuals in later cohorts, who are exposed to the pension reform, and their counterparts at the same age in earlier cohorts, who are not affected by the WFG. Second, I explore how exogenous changes in financial incentives of spouses affects women and men's retirement probability. I separately compare changes in retirement behavior between women and men having spouses in later cohorts who are affected by the reform and those having spouses in earlier cohorts who are not exposed to the reform when retired at the same age. I also examine a causal indirect effect of the WFG to a change in spouses' financial incentives on women and men's retirement decision when isolating own financial incentives because potential biases may be raised via direct reform effects.

The contribution of this paper is to investigate both the effects of individual's financial incentives and their spouses' on individuals' retirement behavior. Instead of using cross-section comparison of individuals with different benefit claims that may lead to a bias by unobserved heterogeneity, I rely on the introduction of the

German pension reform in 1992 to obtain estimates the effects of financial incentives. Using a difference-in-difference (DiD) framework to estimate the reduced-form effect of the pension reform also allows to control for all unobserved individual and couple characteristics that are time-invariant, and may affect retirement behavior such as tastes for retirement leisure between spouses in married couples. The effect of these unobserved factors on retirement may be misattributed to spousal effects without this control. The last contribution is that this paper analyzes the direct and indirect effects of the reform on retirement decisions of women and men in East and West Germany separately.

The results of this study indicate that the 1992 pension reform in Germany has strong and important direct effects on women and men's retirement decisions through changes in own pension financial incentives, and indirect effects via changes in spousal pension incentives. I find that women and men are similar responsive to their own pension incentives. The average probability of retirement at age 60 decreases 23 percentage points or about 54% for women born in 1940-1951 (i.e. after the reform), compared with that for women in the earlier cohorts who are unaffected by the WFG. The average probability of retirement at age 60 reduces by 10 percentage points or nearly 34% for men in the 1937-1951, and that of retirement at age 63 decreases by 18 percentage points or approximately 42% for the same cohorts, compared to men at the same ages in the earlier cohorts who are not exposed to the WFG. Moreover, rising the early retirement minimum ages of full benefits uniformly to 65 leads to an increase in the probability of withdrawing pensions at higher ages. The paper indicates that the financial disincentives of the reform reduce significantly stronger the retirement probability of women and men at age 60 in East Germany than in the West. In addition, the reform has a significant impact on women in the East and men in the West to retire at age 63.

Regarding the indirect causal effects of the reform, women are not responsive to changes in their husbands' financial incentives, but men are very responsive to their wives' financial incentives. Particularly, having wives at age 60 and born after 1939 (i.e. exposed to the WFG) reduces the probability of withdrawing pension for men by 18 percentage points or nearly 50%, compared to men whose wives at the same age in the earlier cohorts (i.e. not exposed to the reform). Also, the reaction of men in the East is much stronger to their wives' financial constraints

than that of men in the West whose wives are exposed to the reform. The estimates in the absence of direct reform effects indicate that men's responsiveness to changes in their wives' financial incentives becomes less statistically significant in model without adding other control covariates, and not significant in models with adding additional control covariates. The results are robust with using different definitions of retirement.

The remainder of this paper is organized as follows: The institutional settings in Germany and the Growth and Employment Promotion Act of German pension reform (WFG) are described in section 2. Section 3 describes the data as well as develops the empirical estimation strategy. The estimated results are presented in section 4. Section 5 concludes.

2 The growth and employment promotion Act of pension reform in Germany

In Germany, the pension system has built its retirement system on three pillars since 1974: 1) The first and most important pillar is state-provided public pension, 2) The second pillar is a voluntary occupational pension, 3)The third pillar is a voluntary private pension with a funding system. The first pillar (including the statutory old-age pension insurance - "Gesetzliche Rentenversicherung, GRV" - and its equivalent) is large because it is mandatory for every worker except that the self-employed and, until 1998 individuals with earnings below the official minimum-earnings threshold (Geringfügigkeitsgrenze).[1] For most pensioners in Germany, public pensions are the main source of income.[2] The second and the third pillar are relatively small in Germany as occupational and private pensions are not mandatory. Thus, neither occupational pension nor individual retirement accounts played a major role in the

[1]The old age-pension insurance (GRV) covers about 85 percent of the German workforce. They are blue-collar workers, white-collar workers, and mining workers. Most of these are private sector workers. The GRV also includes those public sector workers who are not civil servants. Civil servants, about 7 percent of the workforce, have their own pension system. The self-employed, about 9 percent of the workforce, are mainly self-insured although some of them also participate in the public retirement insurance system. Moreover, its equivalent means the retirement system of civil servants, the pension scheme for the agricultural sector, etc. (see Berkel and Börsch-Supan (2003)).

[2]$http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressdata/en/misc/75097.pdf$

German system of old-age provision until the recent reforms. A detailed description of the German public pension system is provided by Börsch-Supan and Schnabel (1999).

Before 1972 the minimum retirement age, as a matter of principle, was 65 years. Individuals can claim the standard old-age pension when they reach the minimum retirement age 65 provided that they have completed the 5-year general qualifying period. However, the 1972 pension reform has been introduced early retirement entry before age 65. Particularly, 1) the 1972 reform abolished the mandatory retirement age of 65 years for those with a long service life (at least 35 years) in favor of a flexible choice between age 63 and age 65. So individuals with a long service life can claim "pension for the long-term insured"; 2) women who aged 60 years and above, with more than fifteen years of compulsory contributions, and more than 10 years of contribution after the age of 40 can apply for "women" old-age pension; 3) unemployed workers who are at least 60 years old, unemployed (more than 12 months in the previous 18 months), with at least fifteen insurance years, and contributed to the retirement insurance for more than eight out of the last ten years can apply for "pension for the unemployed" (see Börsch-Supan and Wilke (2004)). There were no explicit benefit reductions following retirement prior to age 65 for those groups until 1997. The only reduction in pension benefits before 1997 was adjusted implicitly via years of services. Thus, along with a high replacement rate, the German pension system creates a strong incentive to retire at the earliest possible retirement ages. For example, about 79.9 percent of men and 47.4 percent of women born in 1931 started to draw benefits before they turned 65 (i.e. before 1996).[3] Of course, taking into account the demand side of labor, the number of people accepting early retirement surged since the labor market declined when the unification boom ended in 1992.

To reduce the early retirement incentives, a series of reforms during the 1990's go mainly in two directions: gradual increase of retirement ages and actuarial reductions of pensions for early retirement. Starting in the "1992 pension reform", adjustments to pension for early retirement were introduced with a relative long phase-in period. Specifically, "Growth and Employment Promotion Act (Wachstums- und

[3]Deutsche Rentenversicherung Bund, 2006, *Rentenversicherung in Zeitreihen*, DRV-Schriften Band 22, Berlin

Beschäftigungsfrderungsgesetz, WFG) of September of 25, 1996 were passed. The goal of this reform is that there would have no exceptions for the unemployed, long-term service employees and women anymore. The WFG took effect in the beginning of 1997 to speed up the process of raising the retirement age uniformly to 65.

Table 1: Early eligible ages for claiming pension benefits

Birth cohorts	Early retirement ages	
	with full pension	with reduction (%) of pension
For the unemployed		
Before 1937	60	-
1937 - 1941	60 (+ 1 month) - 65	60 (0.3% - 18%)
After 1941 until 1951	65	60 (18%)
For the long-term insured		
Before 1937	63	-
1937 - 1938	63 (+ 1 month) - 65	63 (0.3% - 7.2%)
After 1938	65	63 (7.2%)
For women		
Before 1940	60	-
1940 - 1944	60 (+ 1 month) - 65	60 (0.3% - 18%)
After 1944 until 1951	65	60 (18%)

Source: "Growth and Employment Promotion Act" - Wachstums- und Beschäftigungsfrderungsgesetz, (WFG) in Germany, own illustration. Note that according to the WFG, for people born in 1.1.1952 and later there is no possibility of early retirement access at age 60.

This reform entails fundamental changes in the ages for old-age pensions with full benefits as well as reductions in pension benefits for retiring prior to the age of 65. I summarize it in Table 1. The minimum age at which full pensions can be claimed was raised gradually to age 65 for all insured workers. Particularly, the WFG required the younger cohorts of individuals who were born after 1936 to contribute an increase of 1 to 60 months for claiming pension for the unemployed, and an increase of 1 to 24 months for claiming pension for the long-term insurance to the pension fund (depending on the month and year of birth) to be able to full pension benefit upon retirement. While the increase in the age limits to early retirement with receiving full pension benefits due to unemployment and long-term insurance affects both sexes equally, women can make use of their alternative choice. Women born after 1939 must contribute to the pension fund with an increase of 1 month to 60 months in order to receive full pension benefits.[4] For instance, for women born later than December 1944, the age with full pension benefits is of 65 years. Second,

[4]See the change in the early retirement rules for the unemployed, Altersrente wegen Arbeitslosigkeit, in §237 SGB VI and Anlage 19 SGB VI, and the long-term insured, Altersgrenze für

it is possible to withdraw pension benefits prior to the age of 65 but at the cost of benefit adjustments: a reduction is of 0.3% every month that retirement entry takes place prior to the adjusted minimum retirement age of eligibility for the full pension (a deduction of 18% at maximum) whereas the benefits for postponement of retirement beyond this age are increased 0.5% per month. Thus, between 1997 and 2004 the opportunities to go into retirement before age 65 without adjustments to the benefits were abolished successively. Only older people with a severe handicap receive full benefits paid at the age of 63. Table 1 reports the birth cohorts affected by the reform as well as the benefit reductions connected with early retirement.

Some examples for illustration are: a person born in January 1939, who claim "pensions for the unemployed", would get full pension benefit if s/he retires in February 2001 at the age of 62 years and one month. In other words, this person cannot receive full old-age pension benefits in January 1999 at the age of 60 year as individuals born in earlier cohorts (i.e. before 1937). For the long-term insurance benefits, a person born in June 1937 will get full pension benefit if s/he retires in December 2000 at the age of 63 years and 6 months. S/he cannot receive a full old-age pension in June 2000 at the age of 63 years as those born before 1937. Last, a woman born in April 1941 will get full pension benefit if she retires in August 2002 at the age of 61 years and 4 months. In case she retires prior to August 2002, she cannot receive full old-age pension.

The latest reform (2007) in Germany also introduced a gradual increase of the statutory retirement age from 65 to 67 in order to stabilize the German pension system after 2030. From the year 2012, the normal retirement age will increase initially by one month per year and birth cohort, and later cohort by two months per year and birth cohort. Particularly, individuals who born in 1947 can be claimed full pensions if they retire at age 65 years and one month, etc., and individuals who born in 1957 can claimed full benefits if they retire at age 65 years and 11 months. Individuals born in birth cohorts from 1958 to 1963 have to work up to the age of 66 years, 66 years and 2 months, etc., and 67 years, respectively. Thus, individuals born in 1964 and later face a normal retirement age of 67. This law will take full effect until 2029. The minimum ages for other old-age pensions such as the long-term

langjährig Versicherte: §236 SGB VI, and Anlage 21 SGB VI. See Altersrente für Frauen: §237a SGB VI and Anlage 30 SGB VI.

insured, women, the unemployed, and the (severely) disabled are also to increase accordingly. There are some exceptions for other old-age pensions. For example, the insured persons who have accumulated at least 45 years of contributions can continue to claim an unreduced old-age pension prior to age 65, or it is possible for miners with at least 25 years of contributions. However, the 2007 reform falls outside the sample period and will not be examined here.

3 Data and empirical approach

3.1 Selection of the sample

This paper uses the data from German Social-Economic Panel (SOEP). The SOEP data was started in 1984 as a representative longitudinal survey of households and persons in the Federal Republic of Germany and was extended to residents in the former German Demographic Republic in 1990. The SOEP data is well-suited for the analysis because of some reasons. First, the SOEP provides information on individual's characteristics such as date of birth, age, gender, occupations, and etc. so that it allows us to compare the retirement probability caused by changes in financial incentives between those who are exposed to the reform and those who are not, before and after the implementation of the reform. Second, the SOEP collects information of their spouses such as birth date and age, thereby allowing to compare the probability of retirement behavior between women and men with spouses exposed to the pension reform and those with spouses not exposed. Third, the SOEP data is a longitudinal survey, allowing for observations of each individual over a long time period (not only cross-sectional data).

In the analysis, I first select a sample of married couples from the 1992-2010 SOEP data. The SOEP data provides information on the partner indicator (Partz$$) and partner person number (Partnr$$) in XPGEN.dta file in which $$ indicate the interview year. These variables reveal whether a person in the SOEP household has a partner in that household, and if so, the type of relationship existing between partners. For instance, "code 1" means married couples and living together, and "code 2" indicates they are partners and living together, etc. Since I focus on formally married couples, I only keep "code 1". Missing couples were those where

one couple died during the observation period or left the survey, or married but separated or divorced later. Second, I restrict the data to individuals born between 1934 and 1951, aged 55-65. Excluding individuals aged below 55, I avoid the part of early retirement that is associated with a limited job career and loose labor market attachment. The legal early retirement age for the unemployed and women is 60 and that for the long-term insured is 63. Individuals who retire early need to wait at least until age 60 before claiming their old-age pension benefits. Thus, differences in retirement rates before the age of 60 are unlikely to be related to the increase in the retirement age limit with full pension benefits.

The SOEP data provides some ways to identify a retired person that is based on self-reported employment status (in PBIOSPE.dta file) or receipt of pension income (in XPEQUIV.dta file), reduction of working hours, etc. Since I focus on the effect of financial incentives on individuals' retirement behavior, individuals who received a positive amount of statutory pension insurance are classified as retirees (Definition I of retirement). The variable IGRV1$$ in the XPEQUIV.dta file represents income from statutory pension insurance of individuals in the household 16 years of age and older. Note that the statutory pension insurance also includes the social miners insurance pension (ISMP1$$) and farmers pensions (IAGR1$$) since 2002.[5] This retirement definition also has a drawback. This definition may consider partial retirees as fully retirees. This is because some people retired partially and received a small amount of pension income, i.e. they still stay in the labor market. They may report both positive pension income and positive working hours at the same time. Fortunately, unlike the U.S., the problem is somewhat less severe in Germany where there are few people who are partially retired. Since I restricted the data to individuals aged 55 and above, they are rarely to come back the labor market after retiring. In order to check the sensitivity of results, another definition of retirement, self-reported of retirement, is used (Definition II of retirement).

The dichotomous dependent variable describes whether an individual receives a statutory pension benefit in a given year or not. The model focuses on the first transition into retirement state. This avoids the problems of round-tripping, i.e. individuals moving in and out of the retirement states in a certain period of time.

[5]Since the pathways to retirement for civil servants are quite different from the employees in statutory pension insurance (Gesetzliche Rentenversicherung - GRV), I exclude civil servants in the sample.

In the weighted data from the SOEP, I observe a transition to retirement among 7.6% and 10.1% of observations for women and for men, respectively. The sampled individuals were followed from 1992 until they transited into the retirement state. For example, if an individual retired in, for instance, 2000, she or he is represented with 9 observations. If they do not retire in or before 2010 I follow every year until 2010. Thus I consider retirement to be an absorbing state and censor observations thereafter. All the observations from 1992 until the year of retirement are pooled. Individuals who were coded as retired in the first year observed will be dropped. Given this definition of retirement, the final sample sizes in the cross-section are 1965 married couples in women's sample and 1760 married couples in men's sample. Since the panel structure of the data set allows us to observe each individual more than once, the pooled sample consists of 10205 person-year observations in the women's retirement estimation and 9170 person-year observations in the men's.

3.2 Graphical analysis

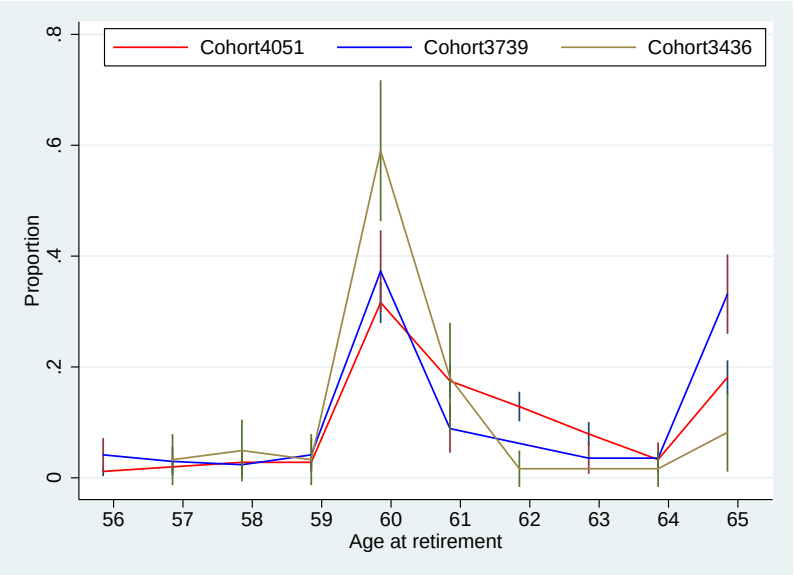

Figure 1: Distribution of retirement age by birth cohorts for women
Note that they are surrounded by confidence bands at the 95% level. Source: own calculations based on the SOEP data, for 1937-1951 birth cohorts from 1992 to 2010

In this part, I present some exploratory graphical analysis of retirement for women and men in the main samples. Figures 1 and 2 show the distribution of

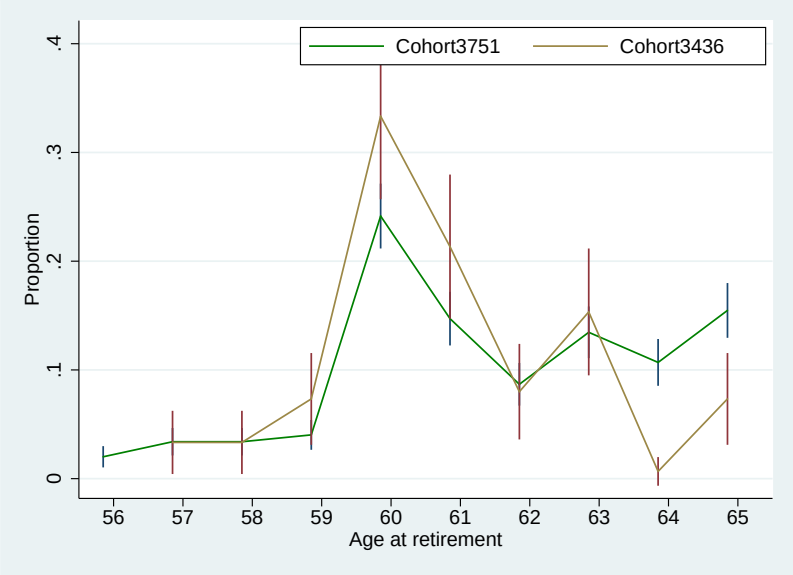

Figure 2: Distribution of retirement age by birth cohorts for men
Note that they are surrounded by confidence bands at the 95% level. Source: own calculations based on the SOEP data, for 1934-1951 birth cohorts from 1992 to 2010

retirement by ages for women and men born in different cohorts. These figures provide some first insights supporting the expectations: when the WFG increases a step-by-step in minimum ages of early retirement with full pension benefits from the ages of 60 (for women and the unemployed) to the standard retirement age 65, the retirement proportion of 60 year-old women and men in later cohorts drops. It substantially reduces from about 60% for women born before 1937 to 37% for those in 1937-1939 cohorts and further declines to about 30% for women born after 1939. The proportion of retirement at age 60 declines from about 33% for men born before 1937, to about 23% for men born in and after 1937. In 1997, the WFG also increases the early possible age of claiming full pension at age 63 due to a long-time service (at least 35 years of contribution to the pension system) to age 65. The proportion of retirement at age 63 reduces from 15% for men born before 1937 to about 13% for those in later cohorts while it increases for women born after 1936. The occurence of "spike" in retirement at age 63 is well documented for men, but not women in many previous studies in Germany. Thus, the increase in the proportion of retirement at age 63 for women is difficult to be blamed for those who claim pensions for long-time service. Instead, it might be that the early retirement age shifts to age 65 that

induces an increase in retirement at age 63 to avoid benefit cuts.

3.3 Method and analytical procedure

In order to identify the shift in the probability of retirement of individuals in specific birth cohorts at a certain age age following the pension reform, I apply the difference-in-difference approach (DiD). The focus of this analysis is how the WFG separately impacts on women and men's retirement behavior through changes in own pension financial incentives and their spouses' financial incentives. In empirical economics, the DiD approach is popularly used to evaluate a policy that does not affect everyone at the same time, and in the same way.[6] The reform effects are identified by a comparison of the probability of retirement at the earliest possible ages 60 and 63 with full pension benefits between individuals in later cohorts exposed to the reform and those in earlier cohorts unaffected by the WFG. This suggests running the following linear probability regression:

$$Y = \alpha_0 + \alpha_1 I + \alpha_2 C + \alpha_3 A + \alpha_4 X + \epsilon. \tag{1}$$

where the outcome variable (Y) is a dummy variable describing whether an individual retires in a particular year. (C) is a birth cohort dummy for own individuals or their spouse. (A) are age dummies for own (in estimation of direct effect of reform) or his/her spouse (in estimation of indirect effect of reform). (I) indicates the interaction terms between "treatment" group dummy and relevant age dummies 60 and 63 for own (in estimation of direct effect of reform) or his/her spouse (in estimation of indirect effect of reform). An individual in the "treatment" group would be one who is exposed to the pension reform in measuring a direct effect of the reform, and would be one with a spouse who is exposed to the pension reform in measuring indirect effect of the reform. The interaction terms (I) are of main interest. The interaction terms, which are the same as a dummy variable, equal one for those observations in the "treatment" groups aged 60 or 63. Additionally, I include other

[6]Discussions of the DiD approach are available in the literature, for example, Angrist and Pischke, 2009, Blundell and Costa Dias, 2009; and Imbens and Wooldridge, 2009; as well as Brüderl and Ludwig (2011). Even though structural estimation has some advantages, I am not concerned with estimating behavioral parameters.

explanatory variables such as German nationality dummy, years of education, industry dummies, geographic residence dummies and log of household post-government income. Descriptive statistics of the explanatory variables are provided in Appendix Table 17.

In equation 1, the coefficient α_0 captures the outcome for individuals born in the reference cohort, reaching at the reference age. The coefficient α_2 captures the difference in outcome for individuals born in each cohort (excluding the reference cohort, i.e. the cohort 1936) and that for individuals born in 1936, reaching the reference age (i.e. at age 59). The coefficient α_3 captures the age effects, or the change in retirement behavior that would have occurred at a particular age relative to at age 59 for individuals born prior to the WFG reform, who are not affected by the reform. Finally, the coefficient of interest, α_1, captures the difference in the probability of retiring at age 60 (or 63) and at other ages for each birth cohort before and after the reform. The coefficient α_1 is expected to be significant and negative.

Let $\overline{Y}_{T,1}$ be the sample average probability of retirement for individuals born in "treatment" cohort group at other ages (age 60 or 63 is excluded). Let $\overline{Y}_{T,2}$ denote the sample average probability of retirement for individuals born in "treatment" cohort group at age 60 (or 63). Thus, $\overline{Y}_{T,2} - \overline{Y}_{T,1}$ indicates a change in the average probability of retirement at age 60 (or 63) relative to other ages for individuals exposed to the reform. Similarly, let $\overline{Y}_{C,1}$ be the sample average probability of retirement for individuals born in "control" cohort group at other ages (age 60 or 63 is excluded) and $\overline{Y}_{C,2}$ be the sample average probability of retirement for individuals born in "control" cohort group at age 60 (or 63). Then $\overline{Y}_{C,2} - \overline{Y}_{C,1}$ displays a change in the average probability of retirement at age 60 (or 63) relative to other ages for individuals not exposed to the reform. Hence, $\widehat{\alpha_1}$ can be expressed as

$$\widehat{\alpha}_1 = (\overline{Y}_{T,2} - \overline{Y}_{T,1}) - (\overline{Y}_{C,2} - \overline{Y}_{C,1}) \tag{2}$$

or

$$\widehat{\alpha}_1 = (\overline{Y}_{T,2} - \overline{Y}_{C,2}) - (\overline{Y}_{T,1} - \overline{Y}_{C,1}) \tag{3}$$

This estimator is called the difference-in-difference (DiD) estimator by comparing

the changes in the means of the treatment and control groups as the reform was implemented (Wooldridge (2010)).

All the assumptions of the OLS model apply to DiD equally. In addition, DiD approach requires a parallel trend assumption or "common trend". Specifically, the DiD approach estimates the causal effect of the institutional change if no contemporaneous shock rather than the WFG affects retirement behavior of the treatment group relative to the control group. Thus, any change in retirement behavior should be identical for treatment group and control group in the absence of the WFG. I assume that this condition holds, i.e. the paths of retirement outcomes for "treatment" birth group and old "control" birth groups would not be systematically different in the absence of the reform. Theoretially, this assumption is not testable yet. Instead, I can perform a "Placebo" test in later section. Tables 18 and 19 in Appendix compare the characteristics of treatment group and control group for women and men at ages 60 and 63. While the increase in the age limits to early retirement with receiving full pension benefits due to unemployment and long-term insurance affects women and men equally, there is a separate application for women who born after 1939. Thus, I obtain three treatment and control group pairs for women: i) women aged 60 who were born in 1934-1936 vs. women born in 1937-1939, ii) women aged 60 who born in 1937-1939 vs. women born in 1940-1951, iii) women aged 63 who were born 1934-1936 vs. women born in 1937-1951; and two treatment and control group pairs for men: i) men aged 60 who were born in 1934-1936 vs. men born in 1937-1951, ii) men aged 63 who were born in 1934-1936 vs. men born in 1937-1951. Tables 18 and 19 show changes in means and standard errors between treatment and control groups. In general, I do not see substantial differences for those treatment and control groups, except of the difference in years of education between treated and untreated cohorts.

Tables 2 and 3 give the first insights on a reform effect on women and men's retirement decision. They indicate cell-mean comparisons. The information in "Control" and "Treatment" columns contain the mean outcome for each group. The first and second rows of the column "Difference" indicate the difference of average outcome. The last row of the column "Difference" is the difference in differences. For example, that is -0.231-(-0.021)=-0.210 in column (6) of Table 2 which is statistically significant at 1% level. This shows that 60 year-old women, who claim pension for women,

in treatment group experiences at 23.1 percentage point decline in mean retirement while the mean retirement of women at other ages reduces 2.1 percentage point. The DiD estimate is thus that there is a significant 21 percentage point relative fall in retirement in treatment group. In other words, the simple difference-in-difference shows a substantial decline in retirement for 60 year-old women when the WFG reform is in effect. In Panel A of Table 3, the overall effect of the reform is a relative decline in retirement for 60 year-old men who are exposed to the reform by 7.8 percentage point when they claim pension for the unemployed. In Panel B, there is a significant 14 percentage point relative decline in retirement for 63 year-old men who are affected by the reform once they claim pension for the long-term insured.

Table 2: Difference-in-difference (DiD) with no covariates for women

	Panel A			**Panel B**		
Retirement	C1: Control (1934-1936)	T1: Treatment (1937-1939)	Difference1 T1 - C1	C2: Control (1937-1939)	T2: Treatment (1940-1941)	Difference2 T2 - C2
	(1)	(2)	(3)	(4)	(5)	(6)
At age 60	0.456	0.423	-0.033	0.423	0.192	-0.231
	(0.033)	(0.024)	(0.041)	(0.022)	(0.008)	(0.023)
At other ages	0.058	0.079	0.021	0.079	0.058	-0.021
	(0.014)	(0.008)	(0.016)	(0.007)	(0.003)	(0.008)
Change in mean	0.398	0.344	**-0.054**	0.344	0.134	**-0.210*****
retirement	-	-	(0.045)	-	-	(0.079)

Source: Own calculations based on the SOEP data, from 1992-2010. Standard errors in parentheness. Means and standard errors are estimated by linear regression. Inference: *** p<0.01; ** p<0.05; * p<0.1

The objective to this strategy is that individuals belonging to treatment cohort group might behave differently from those belonging to control cohort group in both observed and unobserved ways. The DiD approach controls for all unobserved effects that are time-invariant. The empirical strategy proceeds in three steps. First, I consider the causal direct effects of the WFG to a change in individuals' financial incentives on own retirement behavior because the pension reform caused an exogenous shock to their pension financial incentives. Second, given that an exogenous shock to pension financial incentives correlated with individuals' retirement, and its differential impact on individuals' retirement I can exploit it to identify and estimate the indirect effect of the pension reform. The other words, I estimate the effect of the pension reform to a change in spouses' financial incentives on individual's retirement behavior. Finally, I check the robustness of estimated results over different

Table 3: Difference-in-difference (DiD) with no covariates for men

Retirement	C: Control (1934-1936)	T: Treatment (1937-1951)	Difference T - C
	(1)	(2)	(3)
Panel A			
At age 60	0.316	0.204	-0.112
	(0.024)	(0.010)	(0.026)
At other ages	0.118	0.083	-0.034
	(0.010)	(0.004)	(0.011)
Change in mean	0.198	0.121	**-0.078*****
retirement	-	-	(0.028)
Panel B			
At age 63	0.426	0.242	-0.184
	(0.041)	(0.014)	(0.043)
At other ages	0.133	0.089	-0.044
	(0.010)	(0.003)	(0.010)
Change in mean	0.293	0.153	**-0.140*****
retirement	-	-	(0.045)

Source: Own calculations based on the SOEP data, from 1992-2010. Standard errors in parentheness. Means and standard errors are estimated by linear regression. Inference: *** p<0.01; ** p<0.05; * p<0.1

samples and another definition of retirement as well as perform a "Placebo" test. In the "Placebo" analysis proposed by Angrist and Krueger (1999), I test whether the retirement probability for 60 or 63 year-old women and men also changes significantly for "fake" treated cohorts which are not exposed to the reform in reality. Additionally, I test whether the probability of retirement at other ages instead at ages 60 and 63 for the treated cohorts changes significantly.

4 Estimation results

4.1 Direct effect of reform on married women and men's retirement

The first purpose of this study is to consider the responses of women and men to the pension reform via changes in pension financial incentives on own retirement probability. I identify the shift in birth-cohort-specific retirement propensities at certain ages: the difference of a change in an average probability of retirement at 60 (or 63) relative to other ages between individuals who are themselves exposed to the reform and those not exposed. If an increase in minimum ages (60 for women

Table 4: Linear probability DiD estimation of direct reform effect on women's retirement

	(1)		(2)		(3)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Cohort 1937-1951*Age 60	-0.066	(0.070)	-0.066	(0.070)	-0.072	(0.069)
Cohort 1937-1951*Age 63	0.086***	(0.022)	0.085***	(0.021)	0.078***	(0.022)
Cohort 1940-1951*Age 60	-0.234***	(0.042)	-0.234***	(0.042)	-0.230***	(0.042)
Cohort 1934	0.003	(0.043)	0.002	(0.043)	0.000	(0.040)
Cohort 1935	0.052*	(0.031)	0.050	(0.031)	0.056*	(0.029)
Cohort 1936 (ref.)						
Cohort 1937	0.061***	(0.021)	0.058***	(0.021)	0.070***	(0.020)
Cohort 1938	0.052**	(0.022)	0.048**	(0.021)	0.060***	(0.020)
Cohort 1939	0.043**	(0.021)	0.038*	(0.021)	0.056***	(0.020)
Cohort 1940	0.060***	(0.020)	0.056***	(0.020)	0.070***	(0.019)
Cohort 1941	0.059***	(0.020)	0.055***	(0.020)	0.068***	(0.018)
Cohort 1942	0.073***	(0.020)	0.071***	(0.020)	0.085***	(0.018)
Cohort 1943	0.066***	(0.020)	0.062***	(0.020)	0.076***	(0.019)
Cohort 1944	0.064***	(0.019)	0.059***	(0.019)	0.068***	(0.018)
Cohort 1945	0.061***	(0.020)	0.055***	(0.019)	0.075***	(0.018)
Cohort 1946	0.027	(0.020)	0.022	(0.002)	0.043**	(0.018)
Cohort 1947	0.048**	(0.020)	0.043**	(0.019)	0.061***	(0.018)
Cohort 1948	0.036*	(0.019)	0.031	(0.019)	0.046**	(0.018)
Cohort 1949	0.054***	(0.020)	0.049**	(0.019)	0.064***	(0.019)
Cohort 1950	0.052***	(0.019)	0.047**	(0.019)	0.069***	(0.018)
Cohort 1951	0.045**	(0.018)	0.038**	(0.018)	0.062***	(0.018)
Age 55	-0.020***	(0.003)	-0.018***	(0.004)	-0.016***	(0.004)
Age 56	-0.008*	(0.004)	-0.007	(0.004)	-0.005	(0.004)
Age 57	-0.005	(0.005)	-0.004	(0.005)	-0.002	(0.005)
Age 58	-0.001	(0.005)	-0.001	(0.005)	-0.000	(0.005)
Age 59 (ref.)						
Age 60	0.470***	(0.057)	0.469***	(0.057)	0.471***	(0.057)
Age 61	0.144***	(0.013)	0.143***	(0.013)	0.148***	(0.013)
Age 62	0.108***	(0.014)	0.108***	(0.014)	0.115***	(0.013)
Age 63	0.012	(0.015)	0.013	(0.015)	0.030*	(0.016)
Age 64	0.053***	(0.014)	0.052***	(0.014)	0.066***	(0.014)
Age 65	0.545***	(0.028)	0.544***	(0.028)	0.560***	(0.028)
German			0.028***	(0.008)	0.017**	(0.008)
Years of education			0.000	(0.000)	-0.002**	(0.001)
log of household income					0.010**	(0.004)
Industry dummies (9)					yes	
Residence dummies (15)					yes	
R-squared	0.198		0.199		0.218	
Observations	10205		10205		10205	
Number of couples	1965		1965		1965	
Number of parameters	30		32		57	

Note that linear probability models with dependent variable: retired. Standard errors are clustered to account for intra-person correlation. *significant at 10%; **significant at 5%; ***significant at 1%. All regressions include an intercept.

and the unemployed and 63 for the long-term insured) with full benefit claims for early retirement leads to a postponement of retirement after the implementation of the reform, the difference should be negative.

I estimate the retirement equation 1 separately for women and men (see in Appendix for detailed explantions). Tables 4 and 5 report the estimated coefficients of the interaction terms which capture the changes in financial incentives of women and men on own retirement probabilities, respectively. In addition to the interaction terms, columns (1) in Tables 4 and 5 contain age and birth cohort dummies, columns (2) additionally control for nationality and education, and columns (3) additionally add industry dummies, geographic residence dummies and log of household post-government income. Additional control covariates can account for some of variations in the outcome variable that may not be only explained by the dummy variables of the interaction terms, age and cohort dummies. Specifically, the years of education have been trending upward for both women and men that may be correlated with the labor force participation. Not controlling for this may bias the results. The geographic residence dummies may capture the local labor conditions such as unemployment rates in the regions. In addition, individuals usually working outdoors, who are exposed to many types of hazards such as miners, construction workers and so on, are more likely to claim early retirement as possible while individuals working indoors are more likely to stay longer in the labor market, thus delaying retirement. Lastly, changes in pension benefits due to the reform could have more effect on a family with low income than the family with high income. All the factors could potentially confound the results.

Since changes in individual's financial incentives are caused by the pension reform, the coefficients of the first interaction terms (Cohort1937 − 1951*Age60) in Tables 4 and 5 can be also interpreted as an estimate of the direct causal effect of the pension reform on the retirement probabilities of women and men who apply "pension for the unemployed" at age 60. The coefficients of the second interaction terms (Cohort1937−1951*Age63) can be also interpreted as an estimate of the direct effect of the reform on the retirement probabilities of women and men who apply "pension for the long-term insured" at age 63. The coefficient of the last interaction term (Cohort1940 − 1951*Age60) in only Table 4 can be interpreted as an estimate of the direct causal effect of the reform on the retirement probabilities of women

who apply "pension for women" at age 60. These direct effects are quantified in Table 6.

Table 4 displays negative coefficients of the first and third interaction terms, but it is insignificant for the first interaction. The significant interaction term indicates that the average probability of withdrawing pension benefits at age 60 relative to other ages for women in 1940-1951 cohorts decreases by about 23 percentage points in comparison with that for women at the same age 60 in 1937-1939 cohorts. This result suggests that the probability of retirement at age 60 for women born in 1940-1951 exposed to the reform reduces substantially relative to that for women born before 1940, who are not exposed to the reform. The coefficients of the second interaction term is positive and significant. The probability of retirement at age 63 relative to other ages increases by approximately 8 percentage points for women born after 1936, compared to those in earlier cohorts. This result seems to be opposite to the expectation that the step-in-step increase in early age with full pension benefits for claiming the long-term insurance reduces the propensities of retirement at age 63. However, it should be very careful to interpret that the increase in the probability of withdrawing pensions at 63 relative to other ages for women in the treatment cohorts is caused by the WFG. This is because men but not women dominate to retire at the age of 63 when they meet criteria for claiming pension benefits for the long-term contributions. The increase in the probability of retirement at age 63 for women might be caused by the early retirement age shifts from age 60 to age 65. This would be tested in "Placebo" analysis. Adding additional control variables does not induce a substantial change in the estimated results of the interaction terms.

The estimates of the birth cohort dummies (17 dummies) are positive and almost significant across columns in Table 4. These coefficients of the birth cohort dummies capture the difference in the average probability of withdrawing pension at age 59 between each birth cohort (except of the 1936 cohort) and the 1936 cohort. The results indicate that the average probability of retirement at age 59 for each birth cohort (from 1934 to 1951, not including the 1936 birth cohort) is higher than that for the 1936 birth cohort. Note that individuals who retire early need to wait at least until age 60 before claiming pension benefits for women, the unemployed and the long-term insured. Thus, the difference in retirement rates before 60 are unlikely to be related to the increase in early retirement age limits with full pension

benefits. The dummies for ages from 55 to 58 (4 dummies) display changes in average retirement probability of individuals born in each cohort (from 1934 to 1951) who are aged between 55-58 and 59. The dummies for ages from 60 to 65 (6 dummies) display changes in average retirement probability of individuals born in each cohort (from 1934 to 1936, i.e. before the WFG reform) who are aged between 60-65 and 59. The dummies of ages from 55 to 58 are negative but not all significant, which indicates the average retirement probability of women in each cohort at ages from 55-58 is lower than that at age 59. The dummies of ages from 60 to 65 are positive and highly significant. This means that the average retirement probability of women in cohorts not exposed to the reform who are aged from 60 to 65 is higher than that of 59 year-old women in the corresponding cohorts. The possible explanation is that individuals who are aged 60 and above are more likely to be eligible for claiming old-age pension benefits. The positive effect can also be interpreted as increasing disutility of work in later stages of the working life. Moreover, the estimated coefficients on age dummies at 60 and 65 are greatly higher than that on other age dummies. This suggests that women in the pre-reform period tend to retire at an early possible age 60 and a standard retirement age 65 which is in line with the results in previous studies.

Columns (2) and (3) in Table 4 display the estimates of other control variables. The German dummy variable, which is equal to one for those who hold a German citizenship, is positive and significant. This result means that German women are more likely to retire earlier than women without German nationality. The coefficient of years of education is positive and insignificant in column 2, but negative and significant in column 3. However, its magnitude is very small. The retirement probability of women living in West German regions such as Schleswig-Holstein, Hamburg, North-Rhine-Westphalia and Bavaria is lower than that of those living in Berlin whereas the retirement probability of women living in East German regions such as Saxony-Anhalt is higher than that of those living in Berlin.[7] The coefficient of log of household post-government income is positive and statistically significant at 5%. Particularly, as expected women in high-income families have a higher propensity of early retirement than those in low-income families. Note that due to the panel structure of the data, the error terms may not be independent.

[7]They are available upon request.

Therefore, the standard errors in Table 4 as well as in following Tables are clustered in order to take into account for intra-person correlation.

For men, Table 5 shows the negative and significant coefficients of financial incentives. The average probability of withdrawing pension benefits at age 60 relative to other ages for men in the 1937-1951 cohorts decreases by about 10 percentage points in comparison to the probability of withdrawing pensions at age 60 relative to other ages for men born before 1937. This result suggests that men in the 1937-1951 cohorts, affected by the WFG reform when claiming pensions for the unemployed, are less likely to retire at the age of 60 in order to avoid a reduction of pension benefits in comparison with men in the earlier cohorts that are not exposed to the reform. Also, the average probability of withdrawing pension benefits at age 63 relative to other ages for men born in years 1937-1951 reduces by 18 percentage points in comparison to that for men at the same age in earlier cohorts. This suggests that men in treated cohorts delay to claim pensions for the long-term insurance and the unemployment. The coefficients of these interaction terms do not change substantially in columns (2) and (3) as I include additional control variables.

The coefficients of the cohort dummies are only significant from birth cohort 1945 to cohort 1951 in column (1), from birth cohort 1946 to 1951 in column (2), and only birth cohort 1948 in column (3). The negative and significant coefficients of the cohort dummies indicate that the retirement probability of 59 year-old men in each of these birth cohorts is lower than the retirement probability of 59 year-old men in the 1936 birth cohort. The dummy variables at ages 55-58 are negative but not all significant. By contrast, the dummies at ages 60-65 are positive and all significant. The positive coefficients of the dummies at ages 60-65 suggest that the probability of retirement for men born before 1937, i.e. not affected by the pension reform, is higher than that in the corresponding cohorts at the age 59. The magnitudes of the dummies at ages 60, 63 and 65 are much greater than that of other ages, suggesting that men in the pre-treatment period have a propensity to retire at early possible ages 60 and 63, and at the standard retirement age 65. Adding additional covariates, I find that German men are more likely to retire earlier than non-German one, which is similar to women. Men with more years of education are more likely to retire later. Almost coefficients of the residence dummies are not statistically significant. The variable log of household post-government income

Table 5: Linear probability DiD estimation of direct reform effect on men's retirement

	(1)		(2)		(3)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Cohort 1937-1951*Age 60	-0.103**	(0.041)	-0.102**	(0.041)	-0.091**	(0.040)
Cohort 1937-1951*Age 63	-0.181***	(0.070)	-0.178***	(0.069)	-0.209***	(0.066)
Cohort 1934	-0.030	(0.027)	-0.026	(0.026)	-0.014	(0.023)
Cohort 1935	-0.008	(0.025)	-0.008	(0.025)	0.022	(0.022)
Cohort 1936 (ref.)						
Cohort 1937	0.018	(0.020)	0.017	(0.020)	0.030*	(0.017)
Cohort 1938	0.006	(0.020)	0.005	(0.019)	0.024	(0.016)
Cohort 1939	-0.000	(0.019)	0.002	(0.019)	0.018	(0.017)
Cohort 1940	-0.011	(0.019)	-0.010	(0.019)	0.005	(0.017)
Cohort 1941	-0.013	(0.019)	-0.011	(0.019)	-0.005	(0.017)
Cohort 1942	-0.023	(0.020)	-0.021	(0.019)	-0.004	(0.018)
Cohort 1943	-0.032	(0.020)	-0.030	(0.019)	0.003	(0.018)
Cohort 1944	-0.010	(0.019)	-0.007	(0.019)	0.012	(0.017)
Cohort 1945	-0.028*	(0.020)	-0.029	(0.020)	-0.017	(0.018)
Cohort 1946	-0.048**	(0.020)	-0.045**	(0.020)	-0.010	(0.018)
Cohort 1947	-0.041**	(0.020)	-0.038*	(0.020)	-0.006	(0.018)
Cohort 1948	-0.072***	(0.018)	-0.071***	(0.018)	-0.041**	(0.017)
Cohort 1949	-0.047**	(0.020)	-0.043**	(0.020)	-0.009	(0.019)
Cohort 1950	-0.044**	(0.020)	-0.040**	(0.020)	-0.013	(0.021)
Cohort 1951	-0.031*	(0.018)	-0.026	(0.018)	0.000	(0.018)
Age 55	-0.035***	(0.005)	-0.034***	(0.005)	0.001	(0.006)
Age 56	-0.023***	(0.006)	-0.023***	(0.006)	0.001	(0.006)
Age 57	-0.010	(0.007)	-0.010	(0.007)	0.005	(0.007)
Age 58	-0.010	(0.007)	-0.010	(0.007)	0.001	(0.007)
Age 59 (ref.)						
Age 60	0.271***	(0.039)	0.271***	(0.039)	0.251***	(0.038)
Age 61	0.145***	(0.014)	0.145***	(0.014)	0.146***	(0.013)
Age 62	0.089***	(0.014)	0.091***	(0.014)	0.094***	(0.013)
Age 63	0.382***	(0.067)	0.383***	(0.067)	0.411***	(0.063)
Age 64	0.236***	(0.026)	0.224***	(0.026)	0.239***	(0.024)
Age 65	0.670***	(0.033)	0.676***	(0.033)	0.669***	(0.033)
German			0.029***	(0.009)	0.044***	(0.009)
Years of education			-0.006***	(0.000)	-0.001**	(0.000)
log of household income					-0.021***	(0.006)
Industry dummies (9)					yes	
Residence dummies (15)					yes	
R-squared	0.187		0.191		0.257	
Observations	9170		9170		9170	
Number of couples	1760		1760		1760	
Number of parameters	29		31		56	

Note that linear probability models with dependent variable: retired. Standard errors are clustered to account for intra-person correlation. *significant at 10%; **significant at 5%; ***significant at 1%. All regressions include an intercept.

is negative and highly significant. This indicates that men in high-income families have lower probability of retirement. A possible explanation may be that men are main earners in high-income families.

Table 6 shows the direct effect of the WFG in a quantified analysis in which I calculate the difference in average predicted probabilities of withdrawing pension for women and men in the treated cohorts exposed to the reform and that of those in the untreated cohorts. Note that I show only the comparison between treatment and control groups for the significant effects of financial incentives in Tables 4 and 5. The predicted probability of retirement for 60 year-old women changes by about 23 percentage points or 54% in column 1 of Panel A. Specifically, it amounts to 42.1 percentage points for women in the control cohorts that are not exposed to the reform and drops to 19.2 percentage points for women in later cohorts affected by the reform. The predicted probability of retirement at 63 is nearly zero for women in the control group and increases by 12.1 percentage points (or 100%) for women in the treatment group. This result supports my argument that the increase in the probability of retirement at age 63 is caused by the shift from the minimum retirement age of full penefits 60 to age 65. In Panel B, the predicted probability of retirement for 60 year-old men changes from 31.7 percentage points in the control group to 20.6 percentage points for the treatment group, or it drops by about 34%. The responsiveness of men at age 63 is relatively larger. The drop in retirement probabilities amounts to 18.2 percentage points or 42% (from 42.7 percentage points to 24.4 percentage points). The decline in retirement probabilities is highly significant for men aged 60 and 63, suggesting that the WFG reform had significant effects on retirement behavior of men. The results with additional control variables in columns (2) and (3) for women and men do not differ substantially: the changes in retirement probabilities are of similar magnitudes and still significant. In generaly, both women and men respond strongly to shift in own pension financial incentives. These findings are consistent with the results in a paper by Börsch-Supan et al. (2004) who use a structural model and simulate a reduction in the retirement propensity of German women at age 60 by between 50% and 70% when normal retirement age is raised from 60 to 65 at a benefit discount of 6% per year of early retirement.

In the last step of the this section, I investigate the heterogeneity of the direct

Table 6: Trend in predicted probabilities of retirement: direct reform effect

	(1)	(2)	(3)
	Coef.	Coef.	Coef.
	Std. err.	Std. err.	Std. err.
Panel A: Women's sample			
Control: cohort 1937-1939, Age 60	0.421	0.426	0.393
	(0.002)	(0.002)	(0.010)
Treatment: cohort 1940-1951, Age 60	0.192	0.192	0.178
	(0.001)	(0.001)	(0.003)
Difference: Treatment - Control	-0.229***	-0.234***	-0.215***
	(0.002)	(0.003)	(0.001)
Control: cohort 1934-1936, Age 63	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Treatment: cohort 1937-1951, Age 63	0.121	0.121	0.112
	(0.001)	(0.001)	(0.003)
Difference: Treatment - Control	0.121***	0.121***	0.112***
	(0.001)	(0.001)	(0.003)
Panel B: Men's sample			
Control: cohort 1934-1936, Age 60	0.317	0.317	0.305
	(0.002)	(0.003)	(0.018)
Treatment: cohort 1937-1951, Age 60	0.206	0.210	0.210
	(0.002)	(0.003)	(0.007)
Difference: Treatment - Control	-0.111**	-0.106***	-0.095***
	(0.003)	(0.005)	(0.019)
Control: cohort 1934-1936, Age 63	0.427	0.428	0.409
	(0.005)	(0.007)	(0.027)
Treatment: cohort 1937-1951, Age 63	0.244	0.250	0.248
	(0.002)	(0.004)	(0.011)
Difference: Treatment - Control	-0.182***	-0.178***	-0.160***
	(0.005)	(0.008)	(0.029)
Own cohort dummies (17)	Yes	Yes	Yes
German		Yes	Yes
Years of education		Yes	Yes
log of household income			Yes
Industry dummies (9)			Yes
Residence dummies (15)			Yes

Note: Own calcuations using weighted data from the SOEP (1992-2010). Random effects probit model of retirement decision. I calculate the average retirement probability across individual predictions. Due to the timing of the reform, individuals born before 1937 (if they claim pensions for the unemployed and the long-term insured) and after 1940 (if women claim pension for women) are the control groups. Individuals born in or after 1937 (or 1940), who experience a reduction of benefits, are the treatment groups. *, **, *** indicate statistical significant at the 1%, 5% and 10% of difference between the probabilities of retirement at ages 60 and 63 under old and new regulations. No control variables are included in model 1. Model 2 includes additionally German citizenship dummy and years of education. Model 3 includes Model 2 and industry dummies, residence dummies and log of household income. All regressions include an intercept.

reform effects on women's and men's retirement decisions in East and West Germany. This anlaysis starts from the different distribution of employment and education in these two regions that might affect the response to the retirement incentives. The estimation results in Table 20 show asymmetric effects of the pension reform on women and men in East and West Germany. The financial disincentives of the reform reduce significantly stronger the retirement probability of women at age 60 in the East than that in the West. While the pension reform does not affect women's retirement at age 63 in West, the financial disincentives of the reform increases significantly the retirement probability of women at age 63. This implies that prior to the reform more women in the East than in the West retire at the age of 60 and that an increase in the retirement probability of women in East at age 63 is likely due to the increase in retirement ages for full pensions from 60 to 65. Panel B of Table 20 also shows the heterogeneity of the treatment effects on men in East and West Germany. The estimation shows significant effects of the financial disincentives on men in East to retire at the age 60 and on men in West to retire at the ages 60 and 63.

4.2 Indirect effect of pension reform on married women and men's retirement

The second main purpose of this study is to examine the "indirect" causal effects of the pension reform via changes in spouses' financial incentives on women and men's retirement behavior. The pension reform, which caused an exogenous shock to pension financial incentives correlated with individuals' retirement, can be exploited to identify and estimate the effect of spouses' financial incentives on women and men's retirement decision. Given that the differential impact of the pension reform on individuals' retirement incentives, I use the difference-in-difference approach in order to examine whether a change in pension financial incentives of a spouse affects the retirement probability of women and men separately. I re-estimate equation 1 in which the outcome variable (Y) is a dummy variable describing whether an individual retires in a particular year. (C) are dummies for birth cohorts of spouses. (A) are age dummies for spouses. (I) denotes the interaction terms between "treatment" cohort dummies and the dummy variables at age 60 (or 63). The "treatment"

cohort dummy indicates whether or not an individual has a spouse who is affected by an increase in minimum ages for early retirement with full pension benefits after the implementation of the reform. Again, a vector of control variables X include individual characteristics such as German nationality, years of education, industry dummies, residence dummies, log of household post-government income as well as own individual pension incentives so as to control the direct reform effect.

Table 7: Linear probability DiD estimation of indirect reform effect on women's retirement, controlling direct reform effect

	(1)		(2)		(3)		(4)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Spouse cohort 1937-1951*Age 60	-0.040	(0.030)	-0.030	(0.027)	-0.031	(0.027)	-0.030	(0.027)
Spouse cohort 1937-1951*Age 63	-0.055	(0.038)	-0.030	(0.033)	-0.030	(0.032)	-0.026	(0.032)
Spouse cohort dummies (17)	Yes		Yes		Yes		Yes	
Spouse's age dummies (31)	Yes		Yes		Yes		Yes	
Cohort 1937-1951*Age 60			-0.063	(0.071)	-0.063	(0.071)	-0.068	(0.070)
Cohort 1937-1951*Age 63			0.090***	(0.024)	0.088***	(0.024)	0.082***	(0.024)
Cohort 1940-1951*Age 60			-0.230***	(0.042)	-0.231***	(0.042)	-0.226***	(0.042)
Age 55			-0.156***	(0.025)	-0.156***	(0.025)	-0.122***	(0.025)
Age 56			-0.109***	(0.019)	-0.110***	(0.019)	-0.085***	(0.019)
Age 57			-0.073***	(0.013)	-0.074***	(0.013)	-0.056***	(0.013)
Age 58			-0.035***	(0.008)	-0.035***	(0.008)	-0.026***	(0.008)
Age 59 (ref.)								
Age 60			0.499***	(0.058)	0.499***	(0.058)	0.493***	(0.058)
Age 61			0.214***	(0.018)	0.215***	(0.018)	0.203***	(0.018)
Age 62			0.213***	(0.022)	0.214***	(0.022)	0.198***	(0.022)
Age 63			0.147***	(0.031)	0.150***	(0.031)	0.136***	(0.031)
Age 64			0.228***	(0.033)	0.229***	(0.033)	0.205***	(0.034)
Age 65			0.753***	(0.046)	0.755***	(0.046)	0.724***	(0.047)
German					0.028***	(0.008)	0.017**	(0.008)
Years of education					0.000	(0.000)	-0.002**	(0.001)
log of household income							0.009**	(0.004)
Own cohort dummies (17)			Yes		Yes		Yes	
Industry dummies (9)							Yes	
Residence dummies (15)							Yes	
R-squared	0.034		0.201		0.201		0.221	
Observations	10205		10205		10205		10205	
Number of couples	1965		1965		1965		1965	
Number of parameters	51		81		83		108	

Note that linear probability models with dependent variable: retired. Standard errors are clustered to account for intra-person correlation. *significant at 10%; **significant at 5%; ***significant at 1%. All regressions include an intercept.

Table 8: Linear probability DiD estimation of indirect reform effect on men's retirement, controlling direct reform effect

	(1)		(2)		(3)		(4)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Spouse cohort 1937-1951*Age 60	0.089	(0.073)	0.088	(0.068)	0.090	(0.068)	0.080	(0.065)
Spouse cohort 1937-1951*Age 63	0.045	(0.086)	0.054	(0.083)	0.056	(0.082)	0.066	(0.080)
Spouse cohort 1940-1951*Age 60	-0.181***	(0.054)	-0.160***	(0.050)	-0.160***	(0.050)	-0.150***	(0.047)
Spouse cohort dummies (17)	Yes		Yes		Yes		Yes	
Spouse's age dummies (31)	Yes		Yes		Yes		Yes	
Own cohort 1937-1951*Age 60			-0.099**	(0.041)	-0.099**	(0.041)	-0.088**	(0.040)
Own cohort 1937-1951*Age 63			-0.156**	(0.070)	-0.154**	(0.070)	-0.189***	(0.067)
Age 55			-0.264***	(0.011)	-0.259***	(0.011)	-0.241***	(0.011)
Age 56			-0.196***	(0.009)	-0.192***	(0.009)	-0.180***	(0.010)
Age 57			-0.125***	(0.008)	-0.123***	(0.008)	-0.115***	(0.008)
Age 58			-0.068***	(0.007)	-0.067***	(0.007)	-0.059***	(0.007)
Age 59 (ref.)								
Age 60			0.325***	(0.039)	0.323***	(0.039)	0.308***	(0.038)
Age 61			0.260***	(0.015)	0.258***	(0.015)	0.267***	(0.014)
Age 62			0.260***	(0.016)	0.255***	(0.016)	0.274***	(0.016)
Age 63			0.582***	(0.068)	0.578***	(0.067)	0.629***	(0.064)
Age 64			0.520***	(0.029)	0.518***	(0.029)	0.538***	(0.028)
Age 65			1.004***	(0.035)	1.001***	(0.035)	1.021***	(0.035)
German					0.029***	(0.009)	0.046***	(0.009)
Years of education					-0.006***	(0.000)	-0.001*	(0.001)
log of household income							-0.021***	(0.006)
Own cohort dummies (17)			Yes		Yes		Yes	
Industry dummies (9)							Yes	
Residence dummies (15)							Yes	
R-squared	0.062		0.194		0.198		0.264	
Observations	9170		9170		9170		9170	
Number of couples	1760		1760		1760		1760	
Number of parameters	51		80		82		107	

Note that linear probability models with dependent variable: retired. Standard errors are clustered to account for intra-person correlation. Note that *significant at 10%; **significant at 5%; ***significant at 1%.All regressions include an intercept.

The indirect effects of the pension reform are shown in Tables 7 and 8 for women and men. Columns (1) in Tables 7 and 8 only consist of age dummies, cohort dummies and interaction terms for spouses without controlling individuals' characteristics as well as financial incentives. In columns (2), (3) and (4) of Tables 7 and 8, all other control variables used in the estimation of direct reform effects are additionally added correspondingly.

I do not find any responsiveness of women's retirement behavior to changes in their husbands' financial incentives caused by the reform. In column (1) of Table 7, the coefficients of spousal financial incentives are negative. However, they are not statistically significant. This result is still consistent as I add additional control variables in columns (2)-(4). These results are in line with a large body of literature that finds no effects of husbands' financial incentives on their wife's retirement decision. In columns (2)-(4) of Table 7, I add additional control variables that capture some changes in own financial incentives on women's retirement behavior. Again we see that the first interaction term is not significant whereas the second and the third terms are still significant. The average probability of withdrawing pension at age 63 relative to other ages rises by 9 percentage points for women born after 1936 compared to women at the same age in the earlier cohorts. The probability of claiming pensions at age 60 relative to other ages for women born after 1939 reduces by 23 percentage points in comparison to that for women in the same age but born in or before 1939. The magnitudes of these interaction terms do not differ substantially acrossing columns (2)-(4). They are very close to that in the estimation of direct reform effects. So women are not responsive to changes in their husband' financial incentives, but strongly respond to their own changes in financial incentives that are caused by the pension reform.

Next, the coefficients of the interaction terms between the dummy variable for men having spouses born in birth cohorts 1937-1951 and dummies at ages 60 (or 63) are positive but insignificant in Table 8. Interestingly, the third interaction term between the dummy variable for men having spouses in the 1940-1951 cohorts and the dummy for spouse's age 60 is negative and highly statistically significant. The point estimate is 0.18 in the model without adding other covariates. Having wives at age 60 in the 1940-1951 cohorts (i.e. affected by the pension reform by increasing in the minimum age with full old-age benefits for women) decreases the

retirement probability for men by 18 percentage points, compared to that of men having spouses at the same age and born in earlier cohorts, who are not affected by the reform. This effect slightly reduces to about 16 percentage points as controlling the "direct" effect of the reform and other covariates in columns (2)-(4). Hence, women are not responsive to changes in their husbands' financial incentives, but men are responsive to changes in their wives' financial incentives. Once again, men respond to the direct effect of the pension reform via changes in own pension incentives on retirement decisions. The magnitudes of the interaction terms for men are close to that in estimating the direct effect of the reform in Table 5 and do not differ substantially across columns: the average probability of withdrawing pension at age 60 decreases by about 10 percentage points for birth cohorts born in 1937-1951, and that of retiring at age 63 decreases by 16 percentage points for the same birth cohorts, compared to those at the same ages in the earlier cohorts that are not exposed to the pension reform.

Table 9: Trend in predicted probabilities of retirement: indirect reform effect

	(1)	(2)	(3)	(4)
	Coef.	Coef.	Coef.	Coef.
	Std. err.	Std. err.	Std. err.	Std. err.
Men's sample				
Control: spousal cohort 1934-1939, Age 60	0.264	0.260	0.263	0.241
	(0.005)	(0.017)	(0.017)	(0.021)
Treatment: spousal cohort 1940-1951, Age 60	0.131	0.128	0.129	0.130
	(0.001)	(0.005)	(0.005)	(0.022)
Difference: Treatment - Control	-0.132***	-0.131***	-0.133***	-0.111***
	(0.005)	(0.017)	(0.018)	(0.022)
Own cohort dummies (17)		Yes	Yes	Yes
German			Yes	Yes
Years of education			Yes	Yes
log of household income				Yes
Industry dummies (9)				Yes
Residence dummies (15)				Yes

Note:*, **, *** indicate statistical significant at the 1%, 5% and 10% of difference between the probabilities of retirement at ages 60 and 63 under old and new regulations. Standard errors are clustered to account for intra-person correlation. Robust standard errors in parentheses. All regressions include an intercept.

The indirect effect of the WFG on women and men's retirement probability is quantified in Table 9. Since there is only a significant effect of indirect reform on men's retirement, I show only the difference in average predicted probability of retirement for men whose wives are aged 60 in the control group not exposed to

the pension reform, and those whose wives at the same age in the treatment group affected by the reform. The estimated difference indicates that having wives at age 60 in the 1940-1951 cohorts, who are affected by an increase in early retirement age for claiming pension for women, significantly reduces the predicted probability of claiming pension for men by 13.2 percentage points or 50%, compared to men whose wives at the same age but born in the earlier cohorts. It amounts to 26.4 percentage points for men whose wives at age 60 in the control group and drops to 13.1 percentage points for men whose wives at the same age but in the treated cohorts. The results do not differ substantially as adding additional control variables in columns (2)-(4) for controlling own financial incentives as well as characteristics.

In order to check the sensitivity of the indirect effect of reform to changes in spouse's financial incentives on women and men's retirement probability, I exclude the direct effect of the reform, instead of controlling the direct effect. To do this, I can avoid any potential biases due to a change of own financial incentives even though the subsample sizes would become small. I will focus on women and men born in earlier cohorts who are not exposed to the pension reform, i.e., women and men in the 1934-1936 cohorts. The retirement outcome of women and men would not be determined by own changes in financial incentives, rather by changes in financial incentives of their spouses. However, this means the necessary variation to identify spousal effects is significantly reduced, especially for women who are usually younger than their husbands. There remains only 512 year-person observations, (i.e. a reduction of 95% of observation in the main sample) with 123 couples in the women's estimation in which 60% of observations for husbands in 1934-1936 cohorts would not be affected by the reform. Thus, potential effect of a change to husbands' financial incentives is driven by women who married younger husbands. Similarly, the sample in this analysis for men drops to 1008 year-person observations (i.e. a reduction of 89% of observations in the main sample) with 228 couples in which about 27% of observations for wives born in years 1934-1936 would not be affected by the reform.

I re-estimate separately the effect of financial incentives on the retirement decisions for women and men. This alternative strategy would drop those who are directly affected by the pension reform. Tables 21 and 22 display the causal effect of the pension reform to a change in spouse's financial incentives on the retirement

probability of women and men in the absence of direct reform effects. For women, the estimated coefficients of spousal financial incentives are negative across columns (1)-(4), but still not significant. Hence, I do not find the indirect effect of the reform on women's retirement decision. This is consistent with the above results in which the direct effects of reform is controlled (see Table 7). For men, the estimated results in column (1) of Table 22 display negative and significant coefficients of the second and third interaction terms for men having spouses at age 63 in the 1937-1951 cohorts, as well as men having spouses at age 60 in the 1940-1951 cohorts. The average probability of retirement for men having wives aged 63 relative to other ages in the 1937-1951 cohorts decreases by 30.8 percentage points, and that for men having wives aged 60 relative to other ages in the 1940-1951 cohorts reduces by 33.8 percentage points, compared to their counterparts whose wives at the same ages in the control groups. The magnitudes of these significant coefficients in the absence of the direct reform effect are much higher than that in the previous estimation in which the direct effect of reform is controlled. The coefficients of these spousal financial incentives become insignificant as adding additional control variables in columns (2)-(4).

Furthermore, I also check the sensitivity of the above results if I do not restrict to individuals aged 65 as before in Tables 23 and 24. The sample sizes become slightly larger: increase by about 5% in women's sample and by 9% in men's sample. I find that the previous results are robust for adding older individuals aged above 65 for women and men, respectively. Table 23 displays the positive coefficients of the second interaction term between women in the 1937-1951 cohorts and the dummy at age 63, and the negative coefficients of the third interaction term between women in the 1940-1951 cohorts and the dummy at age 60. The results are almost the same as the results in the sample in which I exclude individuals aged above 65. Particularly, the retirement probability for women in the 1937-1951 cohorts at age 63 relative to other ages increases by about 10 percentage points, compared to that for women at the same age in the control group. By contrast, the retirement probability for women at age 60 in the 1940-1951 cohorts relative to other ages decreases by 24 percentage points, compared to that for women at the same age in the earlier cohorts. The magnitudes of the significant coefficients in column (1) are not much different from that in other columns which are added other control covariates.

For men, the estimated coefficients of own financial incentives in Table 24 are almost unchanged in comparison with that in the main sample. Particularly, the estimates of the first and the second interaction terms are still negative and significant. They indicate that the average probability of withdrawing pension at age 60 relative to other ages in the treatment cohorts for men decreases by about 10 percentage points in comparison with that of those at the same age and born before 1937. Also, the probability of withdrawing pension at age 63 relative to other ages for men in the 1937-1951 cohorts reduces by 18 percentage points in comparison to that for men at the same age and born in earlier cohorts.

In addition to focus on the direct reform effects in the new samples when adding individuals aged above 65 in the analysis, Tables 25 and 26 show the estimation results of the causal indirect effect of the reform on the retirement probability of women and men. I obtain similar results for both women and men as before that women are still not responsive to changes in their spouses' financial incentives, but men are responsive to their wives' financial incentives. Hence, these empirical results confirm again that the WFG has a direct effect on women and men's retirement behavior through changes in their own pension incentives, and an indirect effect on men's retirement behavior via changes in wife's pension financial incentives.

Then I study whether differences in East and West Germany might affect the response of the retirement decisions of women and men to changes in their partners' financial constraints. Table 27 shows significant effects of the financial constraints of wives on the retirement decisions of their husbands in East and West Germany but not vice versa. This result for the subgroups based on separate estimations in these two regions is consistent with the result for the whole population group. However, men in the East are more responsive to a change in their wives' financial constraints than men in the West whose wives are exposed to the reform.

4.3 Robustness Check

All results presented above are based on the definition of retirement, which indicates whether a person receives a positive statutory pension insurance. In order to check the robustness of the previous results, another definition of retirement is used. I try to use the definition of retirement which is based on a self-reported retirement status

by the respondents.[8] The self-reported retirement by respondents is commonly employed in the literature, particularly some previous studies of retirement based on SOEP, for example Drobnič (2002). I use self-reported retirement from the individual's employment history, i.e. the information on activity status over the life course, from the variable SPELLTYP in both PBIOSPE.dta and ARTKLEN.dta of SOEP data as a proven indicator of the retirement transition. The observations start at the age of 15 and end at the current age (up to age 65). Hence, the estimation results presented in this section are based on this definition. The second definition adds someone who receives formal pension but do not consider oneself as being retired (e.g., many of the self-employed). Also, some individuals are considered themselves as retirees before receiving offically pension benefits, which reduces the sample sizes because they would be excluded from it as they reported themselves as retirees (absorbing state). Given the new definition of retirement, the number of observations reduces substantially for women (a reduction of 15% observations) and for men (a reduction of 10% observations).

Table 10 reports the direct causal effect of the pension reform on the retirement probability for women in Panel A, and for men in Panel B. The table presents only the main results. The estimated coefficients of the first interaction term for women are still negative and insignificant. The estimated coefficients of the second interaction term remain positive and significant. The point estimate is about 11 percentage points. The coefficients of the third interaction term are negative and significant. Particularly, the probability of retirement at age 60 relative to other ages for women in the 1940-1951 cohorts reduces by nearly 25 percentage points compared to that for women at the same age in the earlier cohorts. The magnitues of these significant coefficients are slightly greater than the results using the definition of retirement based on the self-reported receipt of pension. The results do not differ as adding additional control covariates in columns (2)-(3). Although the estimated coefficients of both interaction terms for men remain negative, they are insignificant or not hightly significant across columns.

The indirect causal effect of the pension reform to changes in spouses' financial incentives on the retirement probability is shown in Panel A of Table 11 for women

[8]Ekerdt and DeViney (1990) define subjective and objectives indicators in which researchers may use to define retirement.

Table 10: Linear probability DiD estimation of direct reform effect - Alternative definition of retirement

	(1)		(2)		(3)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Panel A: Women's sample						
Cohort 1937-1951*Age 60	0.022	(0.075)	0.022	(0.075)	0.014	(0.075)
Cohort 1937-1951*Age 63	0.114**	(0.047)	0.112**	(0.047)	0.115**	(0.046)
Cohort 1940-1951*Age 60	-0.249***	(0.046)	-0.249***	(0.046)	-0.246***	(0.045)
German			0.027**	(0.013)	0.017	(0.014)
Years of education			-0.000	(0.001)	-0.001	(0.001)
log of household income					-0.004	(0.007)
Cohort dummies	Yes		Yes		Yes	
Age dummies	Yes		Yes		Yes	
Industry dummies					Yes	
Residence dummies					Yes	
R-squared	0.186		0.187		0.208	
Observations	8694		8694		8694	
Number of couples	1766		1766		1766	
Number of parameters	30		32		57	
Panel B: Men's sample						
Cohort 1937-1951*Age 60	-0.073	(0.046)	-0.073	(0.046)	-0.067	(0.043)
Cohort 1937-1951*Age 63	-0.109	(0.072)	-0.107	(0.071)	-0.115*	(0.069)
German			0.026***	(0.009)	0.045***	(0.009)
Years of education			-0.003***	(0.001)	0.000	(0.001)
log of household income					-0.013**	(0.006)
Cohort dummies	Yes		Yes		Yes	
Age dummies	Yes		Yes		Yes	
Industry dummies					Yes	
Residence dummies					Yes	
R-squared	0.140		0.146		0.198	
Observations	8246		8246		8246	
Number of couples	1703		1703		1703	
Number of parameters	29		31		56	

Note that linear probability models with dependent variable: retired. Standard errors are clustered to account for intra-person correlation. *significant at 10%; **significant at 5%; ***significant at 1%. All regressions include an intercept.

and in Panel B for men. Again, having husbands belonging to the cohorts exposed to the pension reform does not affect the retirement behavior of women as the reform was implemented. In other words, women do not respond to any changes in husbands' financial incentives. This result is consistent with the previous estimates which use the self-reported receipt of pensions as the retirement definition. Even though I do not find the direct effect of the reform on the retirement probability of men using the self-reported retirement definition, Panel B of Table 11 indicates a indirect causal effect of the pension reform on men's retirement decisions. Having wives born in years 1940-1951 and aged 60 reduces the retirement probability of men by about 17 percentage points compared to those whose wives at the same age in the earlier cohorts, who are not exposed to the reform. This is close to the results in the main sample using receipt of pension benefits for retirement definition. The reduction is slightly lower as I control the direct effect of the reform as well as other control variables in columns (2)-(4). In columns from (2) to (4) as the direct effect of the pension reform is controlled, the interaction term between the treatment group and the dummy at age 60 for women is significant and negative. The estimated point amounts to about 21 percentage points. But the interaction term between the treatment group and the dummy at age 63 for women becomes not significant any more. This result indicates that increasing gradually the minimum ages with full old-age benefits for women has an impact on not only their own retirement decisions, but also their spouse's retirement behavior. Put it differently, the WFG has both a direct effect on women's retirement behavior due to changes in own pension incentives, and an indirect effect through changes in spousal retirement incentives. This suggests that ignoring the impact of spillover effects of spouse would underestimate the impact of the WFG reform.

Table 11: Linear probability DiD estimation of indirect reform effect - Alternative definition of retirement

	(1)		(2)		(3)		(4)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Panel A: Women's sample								
Spouse cohort 1937-1951*Age 60	-0.046	(0.033)	-0.040	(0.029)	-0.039	(0.029)	-0.041	(0.029)
Spouse cohort 1937-1951*Age 63	-0.049	(0.042)	-0.023	(0.036)	-0.025	(0.036)	-0.197	(0.035)
Cohort 1937-1951*Age 60			0.037	(0.079)	0.037	(0.079)	0.032	(0.079)
Cohort 1937-1951*Age 63			0.072	(0.054)	0.069	(0.054)	0.073	(0.054)
Cohort 1940-1951*Age 60			-0.206***	(0.047)	-0.207***	(0.047)	-0.205***	(0.047)
German					0.025***	(0.008)	0.014	(0.009)
Years of education					0.001*	(0.001)	-0.000	(0.001)
log of household income							0.005	(0.005)
Spouse cohorts and age dummies	Yes		Yes		Yes		Yes	
Other own controls			Yes		Yes		Yes	
R-squared	0.036		0.178		0.179		0.196	
Observations	8694		8694		8694		8694	
Number of couples	1766		1766		1766		1766	
Number of parameters	51		81		83		108	
Panel B: Men's sample								
Spouse cohort 1937-1951*Age 60	0.110	(0.082)	0.102	(0.078)	0.103	(0.078)	0.109	(0.074)
Spouse cohort 1937-1951*Age 63	0.055	(0.089)	0.058	(0.086)	0.061	(0.086)	0.080	(0.083)
Spouse cohort 1940-1951*Age 60	-0.167***	(0.062)	-0.149***	(0.059)	-0.150***	(0.059)	-0.145***	(0.055)
Cohort 1937-1951*Age 60			-0.067	(0.046)	-0.068	(0.046)	-0.062	(0.044)
Cohort 1937-1951*Age 63			-0.071	(0.071)	-0.069	(0.071)	-0.082	(0.069)
German					0.025***	(0.009)	0.045***	(0.009)
Years of education					-0.003	(0.001)	0.000	(0.001)
log of household income							-0.012*	0.006
Spouse cohorts and age dummies	Yes		Yes		Yes		Yes	
Other own controls			Yes		Yes		Yes	
R-squared	0.059		0.154		0.156		0.206	
Observations	8246		8246		8246		8246	
Number of couples	1703		1703		1703		1703	
Number of parameters	52		81		83		108	

Note that linear probability models with dependent variable: retired. Standard errors are clustered to account for intra-person correlation. *significant at 10%; **significant at 5%; ***significant at 1%.All regressions include an intercept.

4.4 Placebo analysis

The crucial identification assumption of the difference-in-difference (DiD) procedure is that outcome variable would be evolved in the same way in the treated group and in the untreated group in the absence of the reform. In other words, DiD approach requires a parallel trend assumption or "common" trend. Theoretially, this assumption is not testable yet. So I assume that this condition holds. However, in order to achieve a view on the validity of this identification assumption, I perform a "Placebo" test which was proposed by Angrist and Krueger (1999). Specifically, I create "fake" treatment group for earlier cohorts who are not exposed to the reform. Then I test whether the probability of retirement at age 60 or 63 also changes significantly for the earlier birth cohorts unaffected by the reform. If the probability of retirement at age 60 or 63 significantly declines in these cohorts, I can not be certain that my estimates identify the reform effects. Furthermore, I test whether the probability of retirement at other ages instead at ages 60 and 63 for the treatment group significantly changes. If I do not find a significant effect, I may have identified age-specific effects rather than causal reform effects.

The results of "Placebo" tests are presented in Tables 12-13 and Table 28 for women, in Tables 14-15 and Table 29 for men in estimation of the direct reform effect; and in Table 16 and Table 30 for men in estimation of the indirect reform effect. Since I do not find any responsiveness of women via changes in their spouse's pension incentives, I would not implement a "Placebo" analysis in the indirect reform effect on women's retirement decision. All specifications from (1) to (3) in Table 4 and Table 5 in the regression of direct reform effect, and specifications from (1) to (4) in Table 7 and Table 8 in regression of indirect reform effect add "new" incentives effects which are shown in Panel B of the "Placebo" test tables.

The estimates of the direct reform effects on women's retirement behavior remain statistically significant (see in Panel A of Tables 12-13), which is similar to the results in the main sample. The estimates of the "fake" treatment group at age 60 or 63 are not statistically significant (see in Panel B of Tables 12-13). This indicates that there is no significant decrease in the probability of retirement for women at age 60 or 63 in "fake" treatment group. By contrast, the retirement probability of 60 year-old women reduces significantly in the "true" treatment group (i.e. in the post-reform). Notice that I do not see a significant effect of pension incentives for

63 year-old women in the 1937-1951 cohorts on own retirement decision in Table 13. Again, this result supports my above argument that we need to be careful to interpet the significant effect of changes in financial incentives for 63 year-old women in the treated cohorts in Table 4. In addition, I find a shift in retirement incentives from age 60 to other ages 62-65. The estimates are statistically significant in Table 28. The results show that the probability of retirement for women aged 62-65 increases in the post-reform. Moreover, the retirement probability decreases from age 62 to age 64, and then reaches the higher retirement probability at age 65. The significant increase of retirement at other ages 62-65 implies a consequence of the reform, that causes the 60 year old women to postpone retirement by from 2 to 5 years so that they would receive full pension benefits.

In Panel A of Tables 14 and 15, the coefficients of "true" incentive effects for men are still negative and significant, except that the interaction in the first row of Table 14 is not significant. The coefficients of "new" incentives effects are not significant, or positive and significant in the last row of Table 14. This indicates that the retirement probability for the 60 year old men increases in a year before the reform and reduces in the post-reform years. This means that the positive and statistically significant trend is reversed by the reform. Also, there is no significant change in the retirement probability for the 63 year old men in the "fake" treatment group. I test whether the retirement probability for men in the 1937-1951 cohorts at other ages rather than at age 60 changes significantly (see Table 29). The retirement probability for the 61 year old men in the treated group decreases. But the retirement probability for men at ages 64 and 65 in this group increases significantly. This suggests that the significant increases of retirement for men aged 64 and 65 may be as a result of an increase in the minimum age of full pension for the long-term insured from age 63 to age 65. This causes the 63 year old men to postpone retirement by from 1 to 2 years to receive full pension benefits when retired.

The indirect reform effect to changes in spousal pension incentives on the retirement behavior of men is similar to that in Table 8. Specifically, the average probability of retirement for men whose spouses are aged 60 in the treatment group reduces by about 18 percentage points, compared to that for men whose spouses are at the same age but are not exposed to the reform (see Panel A of Tables 16 and 30). I do not find a significant effect of indirect reform on the retirement probabil-

ity for men whose spouses are in "fake" treatment group and aged 60 in Panel B of Table 16. Also, I test whether having spouses in the treatment group at other ages instead at age 60 or 63 significantly affects men's retirement. The results show there are almost no significant effects. There is a positive and significant effect of financial incentives for spouses in the third row of Panel B (from columns (2)-(4)) of Table 30. Note that own financial incentives of men (i.e. the direct reform effect)) are controlled in columns (2)-(4). This result indicates that the probability of retirement for men significantly reduces when their wives in the treated cohorts are aged 60 and increases when their wives are aged 62 to some extent. This suggests a change in spouse's financial incentives caused by the reform affects men's retirement behavior. In sum, "Placebo" analysis for both the direct and indirect reform effects are relatively robust across columns as adding other control covariates. The placebo check supports the evidence in favor of causal reform effects.

Table 12: Placebo analysis: estimated results with counterfactual incentive effects of 60 year old women aged 60 in the pre-reform period

	(1)		(2)		(3)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Panel A						
Cohort 1937-1951*Age 60	0.026	(0.120)	0.027	(0.070)	0.020	(0.119)
Cohort 1937-1951*Age 63	0.087***	(0.022)	0.085***	(0.022)	0.079***	(0.022)
Cohort 1940-1951*Age 60	-0.234***	(0.042)	-0.234***	(0.042)	-0.230***	(0.042)
Panel B						
Cohort 1934 at age 60 (ref.)	-	-	-	-	-	-
Cohort 1935 at age 60	0.150	(0.152)	0.150	(0.152)	0.154	(0.150)
Cohort 1936 at age 60	0.097	(0.142)	0.096	(0.142)	0.094	(0.141)
R-squared	0.198		0.199		0.218	

*significant at 10%; **significant at 5%; ***significant at 1%. All estimations are based on specifications from (1) to (3) in Table 4. See notes below Table 4.

Table 13: Placebo analysis: estimated results with counterfactual incentive effects of 63 year old women in the pre-reform period

	(1)		(2)		(3)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Panel A						
Cohort 1937-1951*Age 60	-0.066	(0.070)	-0.066	(0.070)	-0.072	(0.069)
Cohort 1937-1951*Age 63	0.068	(0.044)	0.069	(0.045)	0.063	(0.043)
Cohort 1940-1951*Age 60	-0.234***	(0.042)	-0.234***	(0.042)	-0.230***	(0.042)
Panel B						
Cohort 1934 at age 63 (ref.)	-	-	-	-	-	-
Cohort 1935 at age 63	-0.052	(0.049)	-0.049	(0.051)	-0.056	(0.048)
Cohort 1936 at age 63	0.002	(0.046)	0.005	(0.046)	0.013	(0.044)
R-squared	0.198		0.199		0.218	

*significant at 10%; **significant at 5%; ***significant at 1%. All estimations are based on specifications from (1) to (3) in Table 4. See notes below Table 4.

Table 14: Placebo analysis: estimated results with counterfactual incentive effects of 60 year old men in the pre-reform period

	(1)		(2)		(3)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Panel A						
Cohort 1937-1951*Age 60	0.041	(0.063)	0.042	(0.063)	0.050	(0.061)
Cohort 1937-1951*Age 63	-0.178***	(0.070)	-0.175***	(0.069)	-0.205***	(0.066)
Panel B						
Cohort 1934 at age 60 (ref.)	-	-	-	-	-	-
Cohort 1935 at age 60	0.138	(0.091)	0.139	(0.090)	0.146	(0.088)
Cohort 1936 at age 60	0.254***	(0.092)	0.254	(0.092)	0.240	(0.089)
R-squared	0.188		0.192		0.259	

*significant at 10%; **significant at 5%; ***significant at 1%. All estimations are based on specifications from (1) to (3) in Table 5. See notes below Table 5.

Table 15: Placebo analysis: estimated results with counterfactual incentive effects of 63 year old men in the pre-reform period

	(1)		(2)		(3)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Panel A						
Cohort 1937-1951*Age 60	-0.103**	(0.041)	-0.102**	(0.041)	-0.091**	(0.040)
Cohort 1937-1951*Age 63	-0.222*	(0.120)	-0.218*	(0.119)	-0.236**	(0.110)
Panel B						
Cohort 1934 at age 63 (ref.)	-	-	-	-	-	-
Cohort 1935 at age 63	-0.165	(0.166)	-0.166	(0.165)	-0.145	(0.155)
Cohort 1936 at age 63	0.022	(0.022)	0.026	(0.160)	0.042	(0.150)
R-squared	0.187		0.191		0.258	

*significant at 10%; **significant at 5%; ***significant at 1%. All estimations are based on specifications from (1) to (3) in Table 5. See notes below Table 5.

Table 16: Placebo analysis: estimated results for men with counterfactual incentive effects of spouses aged 60 in the pre-reform period

	(1)		(2)		(3)		(4)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Panel A								
Spouse cohort 1937-1951*Age 60	0.082	(0.122)	0.139	(0.108)	0.142	(0.108)	0.121	(0.106)
Spouse cohort 1937-1951*Age 63	0.046	(0.086)	0.055	(0.083)	0.057	(0.082)	0.066	(0.080)
Spouse cohort 1940-1951*Age 60	-0.181***	(0.054)	-0.161***	(0.050)	-0.161***	(0.050)	-0.150***	(0.047)
Panel B								
Spouse cohort 1934 at age 60 (ref.)	-	-	-	-	-	-	-	-
Spouse cohort 1935 at age 60	-0.123	(0.128)	-0.082	(0.116)	-0.082	(0.116)	-0.092	(0.115)
Spouse cohort 1936 at age 60	0.082	(0.141)	0.183	(0.183)	0.184	(0.124)	0.166	(0.124)
R-squared	0.006		0.195		0.199		0.265	

*significant at 10%; **significant at 5%; ***significant at 1%. All estimations are based on specifications from (1) to (4) in Table 8. See notes below Table 8. I do not include the dummies for the spouse's birth cohorts from 1937-1939 because of the interaction for spouses born in 1939 is omitted because of collinearity, and the dummies for each of the cohorts from 1935 to 1938 at age 60 are also not significant.

5 Concluding Remarks

Some research have documented the effect of financial incentives on individuals' retirement decisions, that relies on the cross-sectional comparisons of individuals with different benefit claims. This approach neglects the possibility of individual unobserved heterogeneity. Fewer papers study the effect of financial incentives on individual's retirement behavior taking advantage of the natural experiment of exogenous institutional reforms. Relatively little is known about how individual's retirement is influenced by both own financial incentives and their spouses' incentives which are caused by a institutional reform. If the retirement decisions of couples are strongly connected, ignoring the impact of spillover effects of spouse would underestimate the effect of the reform. Therefore, it is very important for the policy makers to understand the effect of the pension reforms to changes in financial incentives on married couples' retirement behavior.

This paper provides an opportunity to examine how a pension reform affects the retirement decisions of both beneficiaries and their spouses. This study exploits the "Growth and Employment Promotion Act" than cross-individual variations in benefit entitlement as the "natural experiment" to identify the effects of individual financial incentives and their spouse's incentives on own retirement behavior in married couples. The WFG aims to raise a step-by-step in minimum ages of early retirement with full pension benefits from ages 60 (for women and the unemployed)

and 63 (for the long-term insured) to the standard retirement age 65. An early retirement at ages of 60 or 63 is still eligible but at the cost of benefit adjustments: a reduction is of 0.3% very month (18% at maximum) that retirement entry takes place prior to the adjusted minimum retirement ages of eligibility for the full pension benefits. Since the reform affects specific birth cohorts, I can identify causal effects.

In this paper, I compare the changes in retirement behavior between individuals in later cohorts, who are affected by the WFG, and their counterparts at the same ages in earlier cohorts, who are not exposed to the reform. I study retirement behavior for women and men separately: the difference in the average retirement probability of married women and men born after 1936 at age 60 or 63 relative to other ages, and that of their counterparts at the same ages in earlier cohorts. For women, there is an additional study. I compare the difference of the retirement probability at age 60 between women born in 1940 or later and those women at the same age but born before 1940.

The study shows that women are as similar responsive to their own pension financial incentives as men. The average probability of retirement at age 60 relative to other ages decreases about 23 percentage points or about 54% for women born in 1940 and later, compared to that of their counterparts in earlier cohorts. This result indicates the causal reform effect on refirement decision of the 60 year old women: increasing gradually the minimum age of full benefits from the age 60 to 65 reduces substantially the propensity of retirement at age 60 for women born in 1940 and later who are exposed to the WFG. The interaction variable of the dummy for individuals born after 1936 and the dummy at age 60 is also negative. This is statistically significant for men, but insignificant for women. This indicates that the average probability of retirement at age 60 relative to other ages reduces about 10 percentage points or 34% for men born after 1936, compared to men at the same age and born in or before 1936. This study also shows a causal direct effect of the WFG on the probability of retirement at age 63 for men. Once increasing the minimum age with full pension benefits for the long-term insured, the average probability of retirement at age 63 relative to other ages decreases around 18 percentage points or about 42% for men born after 1936, compared to those born in earlier cohorts. By contrast, the probability of retirement at age 63 relative to other ages increases approximately 8 percentage points for women born after 1936, compared to those in earlier cohorts.

However, this positive and significant effect of financial incentives for the 63 year old women in the treated cohorts becomes insignificant in "Placebo" analysis. The previous studies document that the occurrence of spikes in retirement hazard rates is at age 63 for men but not for women. This implies that more men than women can meet the criteria to claim pensions for their long-time contribution to the pension system. This is also a favorite way for men to enter the retirement period. The increase in the retirement probability of 63 year-old women is caused by the early retirement age which shifts from age 60 to age 65. The direct effects of the WFG to changes in women and men's financial incentives on own retirement probabilities are almost unchanged after controlling their characteristics and especially their spouses' incentives.

Using a structural model, Börsch-Supan et al. (2004) simulate a reduction in the retirement propensity of German women at age 60 by between 50% and 70% when the normal retirement age is raised from 60 to 65 at a benefit discount of 6% per year of early retirement. This effect is comparable in magnitude with that of this paper which employs the difference-in-difference type procedure: the propensity to retire at age 60 reduces by 54% for women and by 34% for men, and that at age 63 by 42% for men, i.e. total direct effect of the reform on men is about 76% as increasing the early retirement minimum ages of full benefits to the standard retirement age 65. Hanel (2010) uses the same reform studies here and finds that the reform causes an expected postponement of benefit claims by about 14 months and a delay of employment exit by about 10 months on average. However, these authors do not examine an indirect effect of the reform via changes in spousal pension incentives.

This paper fills in this gap by studying indirect effects of the WFG to changes in spouse's pension financial incentives on married women and men's retirement behavior. Results indicate that women are not responsive to changes in their husbands' financial incentives, but men are responsive to their wives' incentives. Having a wife at age 60 and born in later cohorts (i.e. after 1939), who are affected by the WFG reduces the average probability of retirement for men by 18 percentage points or approximately 50% in comparison to that of men having wives at the same age but born in earlier cohorts (i.e. before 1940). The magnitude of wife's financial incentives on men's retirement probability reduces to 16 percentage points once I control the direct effect of the WFG as well as additional covariates. This con-

cludes that men are responsive to their spouses' financial incentives as strong as their own incentives. This suggests that ignoring the impact of spillover effects of spouse would underestimate the impact of the WFG. This findings is in line with the results in previous studies (e.g. Coile (2004) and Zweimüller et al. (1996)). Coile (2004) suggests that this may be due to a asymmetric complementarity of leisure between husbands and wives. Also importantly, the study indicates that the financial incentives of the reform reduce significantly stronger the retirement probability of women and men at age 60 in East Germany than in West Germany. Moreover, the reform has a significant impact on women in the East and men in the West to retire at age 63. The reaction of men in the East is much stronger to their wives' financial constraints than that of men in the West whose wives are exposed to the reform.

This paper conducts a variety of sensitivity checks to assess the robustness of the results. I still apply the difference-in-difference procedure. The results are relative robust over different definitions of retirement. Instead of using a collection of the statutory pension benefit as a signal of retirement, this study employs another definition of retirement: self-reported retirement status by respondents. There is a direct effect of the WFG through changes in women's pension financial incentives on their retirement decision. The average probability of retirement at age 60 relative to other ages decreases approximately 25 percentage points for women born in 1940-1951, compared to their counterparts at the same age but born in earlier cohorts. This result is almost the same one based on the self-reported receipt of pensions. I do not find the direct causal effect of the WFG on men's retirement decisions, using the self-report retirement status. However, I still find the indirect effect of the reform via changes in their wives' financial incentives on men's retirement. The average probability of retirement for men having wives at age 60 in the treatment group reduces by 18 percentage points, compared to their counterparts whose wives at the same age and born in earlier cohorts, who are not exposed to the reform.

Furthermore, I perform a "Placebo" test: whether the probability of retirement at age 60 or 63 also changes significantly for the earlier cohorts so-called "fake" treatment group, who are unaffected by the reform in reality. The empirical results show that there is no significant increase in the probability of retirement for women aged 60 or 63 in "fake" treatment group. There is also no significant change in

the retirement probability for the 63 year old men in "fake" treated cohorts. The retirement probability for the 60 year old men increases significantly in the year before reform and reduces significantly in the post-reform years. This means the positive and significantly trend is reversed by the reform. In addition, I test whether the probability of retirement at other ages instead at ages 60 and 63 for the "true" treated cohorts changes significantly. The retirement probability for women aged 62-65 increases significantly in the post reform. This illustrates a consequence of the pension reform that causes 60 year-old women to postpone retirement by from 2 to 5 years to receive full pension benefits. There is also a significant increase of retirement probability for men aged 64-65. This may be a result of an increase in minimum age of full pension for the long-term insured (usually men are eligible to apply for) from age 63 to age 65. This causes the 63 year-old men to delay retirement by from 1 to 2 years to get full pension when retired.

To check the sensitivity of the spillover effects of spouses' financial incentive on individual's retirement decision, I isolate the effects of "direct" reform to changes in women and men's financial incentives on own retirement decision. I focus on women and men who were born in earlier cohorts (i.e. birth cohorts 1934-1936 because they are not exposed to the WFG). This leads to estimations on smaller sub-samples. This way can avoid any potential biases due to changes of own financial incentives, and therefore the retirement outcome would be determined by changes in spouses' financial incentives. Men's responsiveness to changes in their wives' financial incentives is not highly significant (only at 10%), and statistically insignificant in models with adding additional covariates. Again, women do not respond to any changes in their husbands' pension financial incentives.

The results in this study underline the success of the growth and employment promotion Act of pension reform in German. The reduction of pension benefits by raising the minimum early retirement ages of full benefits would prolong contribution periods to the pension system and might help to reduce the future contribution rates. Postponement of withdrawing pension benefits via changes in financial incentives is a promising way to reduce the fiscal stress on society as population aging. However, we could not always find a solution for reducing the financial burden of the pension system through the effects of the pension reduction on early retirement. This might lead to a poverty of the older people when they have to exit from labor force due

to some reasons such as bad health. Also, this reform may provide short- and medium-run relief, especially if future economic conditions are less favorable than expected. In addition, the response to retirement would be stronger for people in the birth cohorts who are close to the beginning years of the reform. This is because they have no more time to smooth their consumption as the retirement benefits are reduced, compared to those belonging to later cohorts who could adjust their consumption overtime. Therefore, it is necessary and important to have a reform towards a fully funded pension system. Employers and employees are encouraged to invest in private pension plans through subsidies and tax breaks.

The drawback of the study is that I do not construct social security wealth as well as pension wealth accruals which are components of forward-looking incentives to retire. In order to build up these variables I need to know detailed information about the past and future earnings, interest rates and preferences. However, this implies that measurement error may be an issue of estimation. Estimates based on these models may suffer from endogeneity bias (Krueger and Meyer (2002))

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6 Appendix

Estimating equation for women in Table 4.

$$\begin{aligned} Y \quad &= \alpha_0 + \alpha_{11}1(\text{C=1937-51})^*(A=60) + \alpha_{12}1(\text{C=1937-51})^*(A=63) + \alpha_{13}1(\text{C=1940-51})^*(A=60) \\ &\quad + \alpha_{2c}\textstyle\sum_{c=1934(c\neq 1936)}^{1951} 1(C=c) + \alpha_{3a}\sum_{a=55(a\neq 59)}^{65} 1(A=a) + \alpha_4 X + \epsilon \end{aligned} \tag{4}$$

where Y is equal to 1 when the individual is retired and zero otherwise. The indicator function $1(C=c)$ is equal to 1 if the individual is born in year c and 0 otherwise. The indicator function $1(A=a)$ is equal to 1 if the individual is a years old and 0 otherwise.

Since the specification includes all age dummies except of the age at 59, and omits the 1936 cohort dummy, the constant term $\hat{\alpha_0}$ measures the probability of retirement at age 59 for the 1936 cohort. $\hat{\alpha_0}$ is expressed by $\hat{\alpha_0} = \text{E}(Y|C=1936, A=59, X)$. $\hat{\alpha_{2c}} = \text{E}(Y|C=c(c\neq 1936), A=59, X) - \text{E}(Y|C=1936, A=59, X)$ which

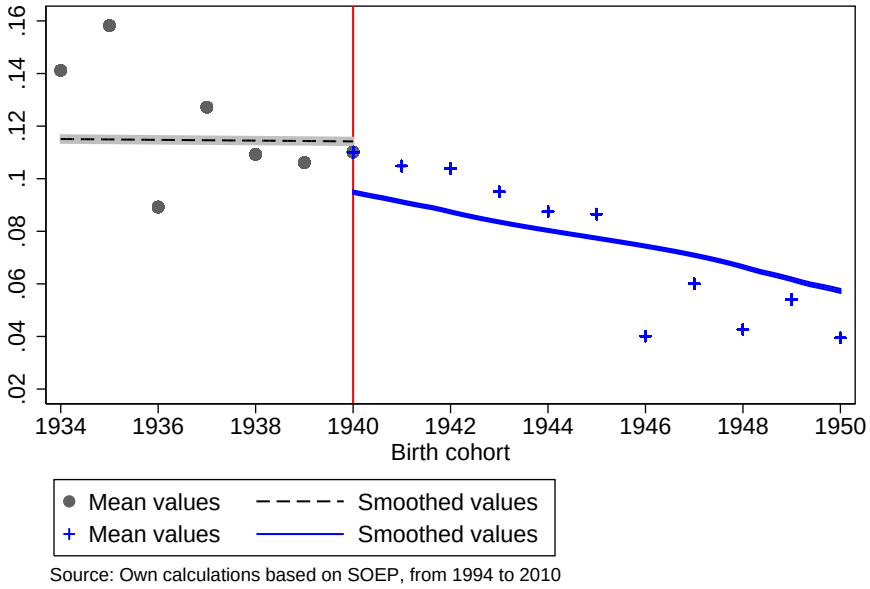

Figure 3: Women's retirement means by birth cohorts at age 60

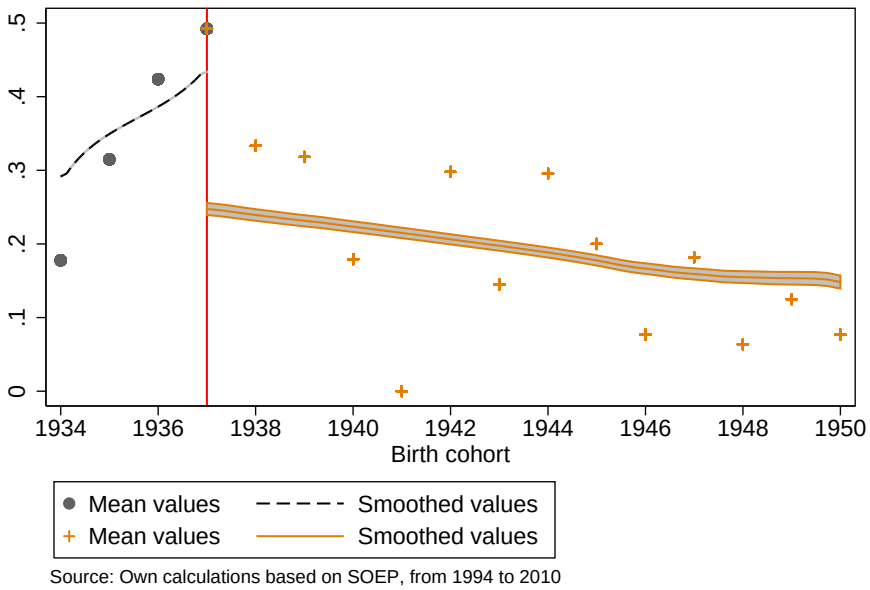

Figure 4: Men's retirement means by birth cohorts at age 60

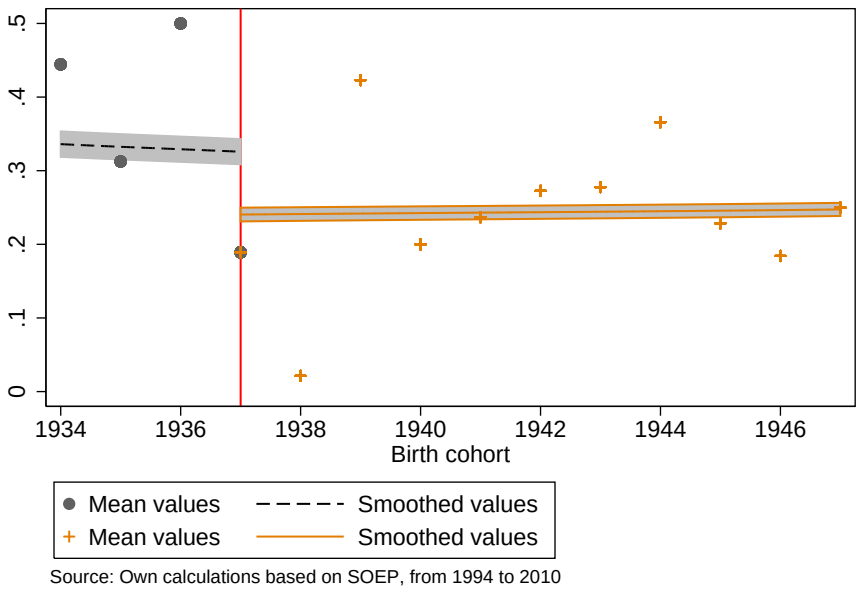

Figure 5: Men's retirement means by birth cohorts at age 63

measures the difference in retirement at age 59 between the c cohort and the 1936 cohort. For age (55-58) dummies, $\hat{\alpha_{3a}} = \mathrm{E}(Y|C = c, A = \{55-58\}, X) - \mathrm{E}(Y|C = c, A = 59, X)$, meaning the difference in retirement probability of individuals born in each cohort (from 1934 to 1951) between age $a = \{55-58\}$ and age 59. For age (60-65) dummies, $\hat{\alpha_{3a}} = \mathrm{E}(Y|C = \{1934-36\}, A = \{60-65\}, X) - \mathrm{E}(Y|C = \{1934-36\}, A = \{60-65\}, X)$ meaning the difference in retirement probability of individuals born in each cohort (from 1934-1936) between age $a = \{60-65\}$ and age 59.

The estimated coefficients of the interaction terms are given by

$$\hat{\alpha_{11}} = \mathrm{E}(Y|C = \{1937-39\}, A = 60, X) - \mathrm{E}(Y|C = \{1937-39\}, A = 59, X) - (\mathrm{E}(Y|C = \{1934-36\}, A = 60, X) - \mathrm{E}(Y|C = \{1934-36\}, A = 59, X)) \quad (5)$$

$\hat{\alpha_{11}}$ represents a change in probability of retirement at age 60 between the treatment cohorts ($C = \{1937-1939\}$) and the control cohorts ($C = \{1934-1936\}$) in comparison to a change in probability of retirement at age 59 between these treat-

ment and control groups. This coefficient captures the effect of the WFG on the retirement probability of individuals who claim pension benefits for the unemployed.

$$\hat{\alpha_{12}} = \mathrm{E}(Y|C = \{1937-51\}, A = 63, X) - \mathrm{E}(Y|C = \{1934-36\}, A = 63, X) - (\mathrm{E}(Y|C = \{1937-51\}, A = 59, X) - \mathrm{E}(Y|C = \{1934-36\}, A = 59, X)) \quad (6)$$

$\hat{\alpha_{12}}$ gives a change in probability of retirement at age 63 between the treatment cohorts ($C = \{1937-1951\}$) and the control cohort ($C = \{1934-1936\}$) in comparison to a change in probability of retirement at age 59 between these treatment and control groups. This coefficient captures the effect of the WFG on the retirement probability of individuals who claim pension benefits for the long-term insured.

$$\hat{\alpha_{13}} = \mathrm{E}(Y|C = \{1940-51\}, A = 60, X) - \mathrm{E}(Y|C = \{1937-39\}, A = 60, X) - (\mathrm{E}(Y|C = \{1940-51\}, A = 59, X) - \mathrm{E}(Y|C = \{1937-39\}, A = 59, X)) \quad (7)$$

$\hat{\alpha_{13}}$ shows a change in probability of retirement at age 60 between the treatment cohorts ($C = \{1940-1951\}$) and the control cohorts ($C = \{1937-1939\}$) in comparison to a change in probability of retirement at age 59 between these treatment and control groups. This coefficient captures the effect of the WFG on the retirement probability of individuals who claim pension benefits for women.

Similar to women, estimating equation for men in Table 5.

$$\begin{aligned} Y \quad &= \alpha_0 + \alpha_{11}1(\text{C=1937-51})^*(A = 60) + \alpha_{12}1(\text{C=1937-51})^*(A = 63) \\ &+\alpha_{2c}\textstyle\sum_{c=1934(c\neq 1936)}^{1951} 1(C = c) + \alpha_{3a}\sum_{a=55(a\neq 59)}^{65} 1(A = a) + \alpha_4 X + \epsilon \end{aligned} \quad (8)$$

where $\hat{\alpha_0}$, $\hat{\alpha_{2c}}$, and $\hat{\alpha_{12}}$ are expressed the same as for women. Age dummies are given by $\hat{\alpha_{3a}} = \mathrm{E}(Y|C = c, A = a(a \neq 59), X) - \mathrm{E}(Y|C = c, A = 59, X)$

$$\hat{\alpha_{11}} = \mathrm{E}(Y|C = \{1937-51\}, A = 60, X) - \mathrm{E}(Y|C = \{1937-51\}, A = 59, X) - (\mathrm{E}(Y|C = \{1934-36\}, A = 60, X) - \mathrm{E}(Y|C = \{1934-36\}, A = 59, X)) \quad (9)$$

Table 17: Summary statistics for women and men based on different definitions of retirement using person-year observations

	Definition I				Definition II			
	Women		Men		Women		Men	
Covariates	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Retired	0.076	0.265	0.101	0.302	0.087	0.282	0.099	0.299
German	0.915	0.278	0.881	0.322	0.905	0.291	0.871	0.334
Years of education	10.546	2.727	11.369	3.122	10.496	2.836	11.241	3.270
log of household income	10.274	0.539	10.358	0.521	10.265	0.535	10.365	0.514
Industry:								
Agriculture	0.007	0.085	0.021	0.146	0.005	0.077	0.021	0.144
Energy	0.000	0.017	0.014	0.119	0.000	0.019	0.015	0.122
Mining	0.000	0.021	0.002	0.050	-	-	0.001	0.040
Manufacturing industry	0.063	0.243	0.175	0.380	0.068	0.252	0.193	0.394
Construction	0.012	0.110	0.156	0.363	0.013	0.115	0.173	0.378
Trade	0.099	0.298	0.086	0.280	0.104	0.306	0.094	0.293
Transport	0.008	0.093	0.032	0.176	0.009	0.095	0.033	0.181
Banking and insurance	0.020	0.141	0.025	0.158	0.022	0.147	0.027	0.162
Services	0.195	0.396	0.192	0.394	0.204	0.403	0.188	0.391
Region:								
Schleswig-Holstein	0.054	0.227	0.049	0.216	0.054	0.227	0.051	0.221
Hamburg	0.009	0.097	0.013	0.116	0.010	0.099	0.014	0.120
Lower Saxony	0.101	0.302	0.098	0.297	0.097	0.296	0.098	0.297
Bremen	0.013	0.115	0.011	0.108	0.014	0.120	0.011	0.105
North-Rhine-Westfalia	0.252	0.434	0.228	0.419	0.253	0.435	0.221	0.415
Hessen	0.067	0.251	0.060	0.237	0.067	0.250	0.063	0.243
Rheinland-Pfalz	0.052	0.223	0.055	0.228	0.049	0.217	0.056	0.231
Baden-Wuerttemberg	0.133	0.340	0.131	0.338	0.147	0.354	0.144	0.351
Bavaria	0.129	0.336	0.129	0.335	0.125	0.331	0.128	0.335
Saarland	0.010	0.103	0.006	0.079	0.011	0.106	0.007	0.085
Berlin	0.023	0.151	0.028	0.165	0.023	0.150	0.028	0.165
Brandenburg	0.023	0.150	0.029	0.168	0.021	0.145	0.024	0.153
Mecklenburg-Vorpommern	0.017	0.131	0.025	0.156	0.016	0.127	0.025	0.159
Saxony	0.046	0.211	0.061	0.240	0.046	0.209	0.057	0.231
Saxony-Anhalt	0.034	0.183	0.043	0.205	0.033	0.181	0.039	0.194
Thuringia	0.026	0.159	0.027	0.163	0.026	0.160	0.028	0.165
Cohort 1934	0.012	0.110	0.035	0.185	0.009	0.097	0.033	0.180
Cohort 1935	0.024	0.115	0.047	0.212	0.023	0.151	0.045	0.207
Cohort 1936	0.028	0.167	0.067	0.251	0.026	0.159	0.062	0.241
Cohort 1937	0.055	0.229	0.089	0.285	0.056	0.230	0.081	0.273
Cohort 1938	0.072	0.259	0.095	0.293	0.076	0.266	0.093	0.290
Cohort 1939	0.085	0.279	0.082	0.275	0.089	0.285	0.082	0.275
Cohort 1940	0.075	0.264	0.094	0.292	0.073	0.261	0.095	0.293
Cohort 1941	0.078	0.269	0.078	0.269	0.082	0.274	0.080	0.272
Cohort 1942	0.069	0.254	0.071	0.258	0.066	0.249	0.072	0.260
Cohort 1943	0.070	0.255	0.060	0.237	0.070	0.256	0.066	0.248
Cohort 1944	0.069	0.254	0.054	0.226	0.059	0.237	0.055	0.229
Cohort 1945	0.054	0.226	0.047	0.213	0.053	0.224	0.047	0.212
Cohort 1946	0.044	0.205	0.045	0.207	0.045	0.208	0.047	0.212
Cohort 1947	0.060	0.246	0.030	0.171	0.068	0.252	0.029	0.170
Cohort 1948	0.048	0.215	0.041	0.198	0.048	0.214	0.042	0.201
Cohort 1949	0.045	0.207	0.028	0.166	0.046	0.211	0.032	0.178
Cohort 1950	0.068	0.252	0.020	0.142	0.069	0.253	0.022	0.148
Cohort 1951	0.030	0.172	0.008	0.089	0.033	0.179	0.008	0.093
Age 55	0.130	0.336	0.115	0.320	0.133	0.340	0.122	0.328
Age 56	0.131	0.337	0.128	0.334	0.134	0.341	0.132	0.339
Age 57	0.132	0.339	0.133	0.340	0.135	0.343	0.134	0.341
Age 58	0.128	0.335	0.134	0.341	0.130	0.336	0.131	0.337
Age 59	0.126	0.332	0.127	0.333	0.125	0.331	0.124	0.330
Age 60	0.117	0.322	0.116	0.320	0.115	0.319	0.109	0.312
Age 61	0.072	0.259	0.083	0.276	0.070	0.255	0.082	0.275
Age 62	0.055	0.229	0.065	0.246	0.053	0.225	0.064	0.245
Age 63	0.043	0.203	0.047	0.213	0.042	0.201	0.049	0.216
Age 64	0.034	0.181	0.028	0.165	0.032	0.178	0.028	0.165
Age 65	0.027	0.162	0.018	0.136	0.025	0.158	0.020	0.141
# of observations (unweighted)	10205		9170		8694		8146	
# of events (unweighted)	837		945		763		892	

Source: Author's calculations based on weighted data from German Social Economic Panel data (1992-2010). Definition I of retirement is based on the self-reported receipt of pension benefits. Definition II of retirement is based on the self-reported retirement.

Table 18: Mean comparison of control and treatment group characteristics for women

	Women at age 60										Women at age 63					
	(1)		(2)		(3)		(2)-(1)		(3)-(2)		(4)		(5)		(5)-(4)	
Birth cohort	1934-1936		1937-1939		1940-1951		Difference		Difference		1934-1936		1937-1951		Difference	
	Mean	S.e.	Mean	S.e.	Mean	S.e.	Mean	S.e.	Mean	S.e.	Mean	S.e.	Mean	S.e.	Mean	S.e.
German	0.930	0.021	0.959	0.015	0.904	0.014	0.029	0.026	-0.055	0.020	0.897	0.047	0.902	0.020	0.005	0.051
Years of education	10.389	0.256	10.004	0.366	10.588	0.143	0.385	0.447	0.583	0.392	9.936	0.558	10.721	0.184	0.784	0.587
log of household income	10.145	0.066	10.200	0.049	10.280	0.021	0.055	0.082	0.079	0.053	10.116	0.133	10.180	0.036	0.063	0.137
Industry:																
Agriculture	-	-	0.007	0.006	0.004	0.002	0.007	0.006	-0.002	0.006	0.032	0.032	0.001	0.001	-0.031	0.032
Energy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mining	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manufacturing industry	0.026	0.018	0.039	0.015	0.061	0.010	0.012	0.024	0.022	0.019	-	-	0.046	0.015	0.046	0.015
Construction	0.036	0.035	-	-	0.015	0.004	-0.036	0.035	0.015	0.004	-	-	0.003	0.002	0.003	0.002
Trade	0.075	0.033	0.073	0.022	0.099	0.015	-0.001	0.040	0.025	0.026	-	-	0.044	0.012	0.044	0.012
Transport	-	-	0.006	0.006	0.007	0.002	0.006	0.006	0.001	0.006	-	-	-	-	-	-
Banking and insurance	0.031	0.031	0.017	0.017	0.017	0.005	-0.014	0.035	-0.000	0.018	-	-	0.008	0.005	0.008	0.005
Services	0.118	0.042	0.171	0.036	0.195	0.015	0.052	0.056	0.024	0.039	0.039	0.039	0.087	0.017	0.048	0.042
Region:																
Schleswig-Holstein	0.025	0.025	0.047	0.027	0.069	0.014	0.022	0.037	0.021	0.031	-	-	0.070	0.020	0.070	0.020
Hamburg	-	-	0.007	0.007	0.017	0.006	0.007	0.007	0.009	0.010	-	-	0.002	0.002	0.002	0.002
Lower Saxony	0.073	0.038	0.060	0.019	0.103	0.014	-0.013	0.043	0.043	0.024	0.340	0.154	0.121	0.020	-0.219	0.156
Bremen	-	-	0.002	0.002	0.018	0.007	0.002	0.002	0.015	0.007	0.044	0.043	0.012	0.009	-0.031	0.044
North-Rhine-Westfalia	0.214	0.054	0.268	0.053	0.231	0.017	0.053	0.076	-0.036	0.056	0.107	0.060	0.281	0.027	0.173	0.066
Hessen	0.095	0.038	0.095	0.027	0.050	0.008	0.000	0.046	-0.044	0.028	0.152	0.075	0.062	0.015	-0.089	0.076
Rheinland-Pfalz	0.088	0.038	0.080	0.026	0.031	0.006	-0.008	0.046	-0.048	0.026	0.096	0.067	0.045	0.010	-0.051	0.067
Baden-Wuerttemberg	0.155	0.054	0.163	0.048	0.138	0.016	0.008	0.072	-0.025	0.051	0.061	0.044	0.125	0.021	0.063	0.049
Bavaria	0.067	0.034	0.105	0.028	0.139	0.015	0.037	0.044	0.033	0.032	0.151	0.079	0.201	0.027	0.050	0.084
Saarland	-	-	-	-	0.011	0.004	-	-	0.011	0.004	-	-	0.025	0.008	0.025	0.008
Berlin	0.030	0.024	0.034	0.014	0.020	0.005	0.004	0.028	-0.013	0.015	0.014	0.014	0.007	0.005	0.006	0.015
Brandenburg	0.065	0.025	0.033	0.011	0.019	0.003	-0.032	0.027	-0.013	0.012	0.032	0.032	0.004	0.002	-0.027	0.032
Mecklenburg-Vorpommern	0.028	0.016	0.012	0.007	0.018	0.004	-0.015	0.018	0.006	0.008	-	-	0.003	0.001	0.003	0.001
Saxony	0.100	0.033	0.020	0.009	0.055	0.008	-0.079	0.034	0.035	0.012	-	-	0.022	0.006	0.022	0.006
Saxony-Anhalt	0.040	0.023	0.031	0.011	0.044	0.006	-0.008	0.025	0.013	0.013	-	-	0.007	0.003	0.007	0.003
Thuringia	0.014	0.014	0.035	0.011	0.029	0.005	0.020	0.018	-0.006	0.012	-	-	0.005	0.002	0.005	0.002

Source: Author's calculations based on weighted data from German Social Economic Panel data (1992-2010)

Table 19: Mean comparison of control and treatment group characteristics for men

	Men at age 60						Men at age 63					
	(1)		(2)		(2) - (1)		(3)		(4)		(4) - (3)	
Birth cohort	1934-1936		1937-1951		Difference		1934-1936		1937-1951		Difference	
	Mean	S.e.	Mean	S.e.	Mean	S.e.	Mean	S.e.	Mean	S.e.	Mean	S.e.
Retired	0.282	0.042	0.226	0.018	-0.055	0.046	0.534	0.086	0.233	0.026	-0.300	0.090
German	0.878	0.037	0.882	0.014	0.003	0.040	0.881	0.054	0.880	0.022	-0.001	0.059
Years of education	11.220	0.200	11.266	0.146	0.045	0.248	11.530	0.345	11.773	0.253	0.242	0.428
log of household income	10.183	0.060	10.329	0.022	0.146	0.064	10.422	0.085	10.407	0.033	-0.014	0.091
Industry:												
Agriculture	0.022	0.013	0.009	0.004	-0.012	0.013	0.029	0.021	0.030	0.014	0.001	0.025
Energy	0.019	0.012	0.010	0.005	-0.009	0.013	0.039	0.023	0.002	0.002	-0.036	0.023
Mining	-	-	0.001	0.001	0.001	0.001	-	-	0.001	0.001	0.001	0.001
Manufacturing industry	0.143	0.037	0.129	0.014	-0.013	0.039	0.222	0.071	0.114	0.018	-0.108	0.073
Construction	0.128	0.030	0.138	0.014	0.010	0.033	0.173	0.086	0.126	0.019	-0.046	0.088
Trade	0.074	0.027	0.072	0.011	-0.002	0.030	0.143	0.062	0.080	0.016	-0.063	0.064
Transport	0.007	0.005	0.024	0.005	0.017	0.007	0.013	0.013	0.018	0.007	0.005	0.015
Banking and insurance	0.007	0.007	0.030	0.008	0.022	0.011	0.016	0.016	0.017	0.008	0.001	0.018
Services	0.145	0.034	0.168	0.015	0.023	0.037	0.171	0.055	0.257	0.029	0.086	0.063
Region:												
Schleswig-Holstein	0.032	0.018	0.049	0.011	0.017	0.021	0.031	0.030	0.064	0.019	0.003	0.036
Hamburg	-	-	0.017	0.006	0.017	0.006	-	-	0.014	0.006	0.014	0.006
Lower Saxony	0.104	0.034	0.088	0.011	-0.016	0.036	0.155	0.063	0.080	0.015	-0.075	0.065
Bremen	0.006	0.006	0.014	0.004	0.007	0.008	-	-	0.009	0.006	0.009	0.006
North-Rhine-Westfalia	0.253	0.047	0.229	0.019	-0.023	0.050	0.337	0.092	0.216	0.025	-0.120	0.095
Hessen	0.056	0.020	0.053	0.009	-0.003	0.022	0.071	0.035	0.046	0.014	-0.025	0.038
Rheinland-Pfalz	0.084	0.026	0.052	0.010	-0.032	0.028	0.062	0.035	0.061	0.019	-0.000	0.040
Baden-Wuerttemberg	0.136	0.040	0.136	0.015	-0.000	0.043	0.134	0.058	0.144	0.024	0.009	0.063
Bavaria	0.066	0.020	0.135	0.015	0.069	0.025	0.030	0.022	0.149	0.022	0.118	0.031
Saarland	-	-	0.010	0.004	0.010	0.004	-	-	0.018	0.009	0.018	0.009
Berlin	0.020	0.012	0.031	0.006	0.011	0.014	0.038	0.024	0.027	0.009	-0.010	0.026
Brandenburg	0.046	0.014	0.026	0.004	-0.020	0.015	0.037	0.019	0.023	0.006	-0.013	0.020
Mecklenburg-Vorpommern	0.041	0.015	0.020	0.004	-0.020	0.016	0.059	0.029	0.020	0.006	-0.038	0.030
Saxony	0.091	0.023	0.058	0.007	-0.033	0.024	0.007	0.007	0.067	0.012	0.060	0.014
Saxony-Anhalt	0.040	0.015	0.048	0.007	0.005	0.017	0.034	0.026	0.030	0.008	-0.004	0.027
Thuringia	0.015	0.007	0.027	0.004	0.011	0.009	-	-	0.024	0.007	0.024	0.007

Source: Author's calculations based on weighted data from German Social Economic Panel data (1992-2010)

Table 20: Linear probability DiD estimation of direct reform effect in East and West Germany

	West				East			
	(1)		(2)		(3)		(4)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Panel A: Women's sample								
Cohort 1937-1951*Age 60	-0.051	(0.078)	-0.054	(0.078)	-0.082	(0.122)	-0.098	(0.121)
Cohort 1937-1951*Age 63	0.024	(0.022)	0.025	(0.022)	0.549***	(0.082)	0.430***	(0.087)
Cohort 1940-1951*Age 60	-0.184***	(0.046)	-0.183***	(0.046)	-0.292***	(0.082)	-0.279***	(0.081)
Cohort dummies	Yes		Yes		Yes		Yes	
Age dummies	Yes		Yes		Yes		Yes	
German			Yes				Yes	
Years of education			Yes				Yes	
Log of household income			Yes				Yes	
Industry dummies			Yes				Yes	
R-squared	0.200		0.202		0.333		0.333	
Observations	7800		7800		2405		2405	
Number of couples	1502		1502		467		467	
Number of parameters	30		42		30		42	
Panel B: Men's sample								
Cohort 1937-1951*Age 60	-0.094**	(0.048)	-0.078***	(0.029)	-0.115	(0.078)	-0.115***	(0.045)
Cohort 1937-1951*Age 63	-0.238***	(0.080)	-0.243***	(0.044)	-0.037	(0.139)	0.116	(0.081)
Cohort dummies	Yes		Yes		Yes		Yes	
Age dummies	Yes		Yes		Yes		Yes	
German			Yes				Yes	
Years of education			Yes				Yes	
Log of household income			Yes				Yes	
Industry dummies			Yes				Yes	
R-squared	0.180		0.253		0.220		0.285	
Observations	6505		6505		2665		2665	
Number of couples	1298		1298		466		466	
Number of parameters	29		41		29		41	

*** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.10$. Standard errors are clustered to account for intra-person correlation. All regressions include an intercept.

Table 21: Linear probability DiD estimation of indirect reform effect on women's retirement, in absence of direct reform effect

	(1)	(2)	(3)	(4)
	Coef.	Coef.	Coef.	Coef.
	Robust S.e.	Robust S.e.	Robust S.e.	Robust S.e.
Spouse cohort 1937-1951*Age 60	-0.086	0.098	0.107	0.105
	(0.135)	*(0.133)*	*(0.133)*	*(0.130)*
Spouse cohort 1937-1951*Age 63	-0.065	-0.097	-0.089	-0.124
	(0.157)	*(0.165)*	*(0.165)*	*(0.163)*
Spouse cohort dummies (13)	Yes	Yes	Yes	Yes
Spouse's age dummies (21)	Yes	Yes	Yes	Yes
Age 60		0.381***	0.379***	0.359***
		(0.064)	*(0.063)*	*(0.063)*
Age 63		-0.128***	-0.122***	-0.117***
		(0.039)	*(0.038)*	*(0.041)*
German			0.081**	0.031
			(0.036)	*(0.045)*
Years of education			-0.003	-0.007
			(0.007)	*(0.007)*
log of household income				0.013
				(0.032)
Own cohort dummies (2)		Yes	Yes	Yes
Industry dummies (9)				Yes
Residence dummies (15)				Yes
R-squared	0.058	0.235	0.243	0.304
Observations	512	512	512	512
Number of couples	123	123	123	123
Number of parameters estimated	33	37	39	59

In this sample, the spouses of wives were born 1934-1946, aged 46-68. Note that linear probability models with dependent variable: retired. Standard errors are clustered to account for intra-person correlation. Note that *significant at 10%; **significant at 5%; ***significant at 1%.All regressions include an intercept.

Table 22: Linear probability DiD estimation of indirect reform effect on men's retirement, in absence of direct reform effect

	(1)	(2)	(3)	(4)
	Coef.	Coef.	Coef.	Coef.
	Robust S.e.	Robust S.e.	Robust S.e.	Robust S.e.
Spouse cohort 1937-1951*Age 60	0.075	0.103	0.105	0.093
	(0.126)	*(0.127)*	*(0.127)*	*(0.120)*
Spouse cohort 1937-1951*Age 63	-0.308**	-0.181	-0.173	-0.098
	(0.141)	*(0.134)*	*(0.137)*	*(0.128)*
Spouse cohort 1940-1951*Age 60	-0.338*	-0.231	-0.245	-0.174
	(0.185)	*(0.185)*	*(0.187)*	*(0.220)*
Spouse cohort dummies (18)	Yes	Yes	Yes	Yes
Spouse's age dummies (23)	Yes	Yes	Yes	Yes
Age 60		0.174***	0.173***	0.135***
		(0.040)	*(0.040)*	*(0.040)*
Age 63		0.143*	0.142*	0.166**
		(0.078)	*(0.078)*	*(0.074)*
German			0.045	0.070**
			(0.031)	*(0.030)*
Years of education			-0.010***	-0.004
			(0.004)	*(0.004)*
log of household income				-0.027
				(0.023)
Own cohort dummies (2)		Yes	Yes	Yes
Industry dummies (9)				Yes
Residence dummies (15)				Yes
R-squared	0.136	0.170	0.176	0.264
Observations	1008	1008	1008	1008
Number of couples	228	228	228	228
Number of parameters estimated	43	47	49	71

Note that spouses of husbands born 1934-1951, aged 42-65. Note that linear probability models with dependent variable: retired. Standard errors are clustered to account for intra-person correlation. Note that *significant at 10%; **significant at 5%; ***significant at 1%. All regressions include an intercept.

Table 23: Linear probability DiD estimation of direct reform effect on retirement of women aged 55 and above

	(1)	(2)	(3)
	Coef.	Coef.	Coef.
	Robust S.e.	Robust S.e.	Robust S.e.
Cohort 1937-1951*Age 60	-0.036	-0.036	-0.040
	(0.070)	(0.069)	(0.069)
Cohort 1937-1951*Age 63	0.107***	0.106***	0.101***
	(0.020)	(0.020)	(0.020)
Cohort 1940-1951*Age 60	-0.238***	-0.238***	-0.233***
	(0.042)	(0.042)	(0.042)
German		0.034***	0.023***
		(0.007)	(0.008)
Years of education		-0.001*	-0.003***
		(0.000)	(0.001)
log of HH post-Gov. Inc.			0.005
			(0.004)
Cohort dummies	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes
Industry dummies			Yes
Residence dummies			Yes
R-squared	0.193	0.194	0.212
Observations	10663	10663	10663
Number of couples	1997	1997	1997
Number of parameters	41	43	68

The standard errors are clustered to account for intra-person correlation. Note that *significant at 10%; **significant at 5%; ***significant at 1%. Standard errors are clustered to account for intra-person correlation. Robust standard errors in parentheses. All regressions include an intercept.

Table 24: Linear probability DiD estimation of direct reform effect on retirement of men aged 55 and above

	(1)	(2)	(3)
	Coef.	Coef.	Coef.
	Robust S.e.	Robust S.e.	Robust S.e.
Cohort 1937-1951*Age 60	-0.110***	-0.101**	-0.090**
	(0.041)	(0.041)	(0.040)
Cohort 1937-1951*Age 63	-0.180***	-0.178***	-0.207***
	(0.005)	(0.070)	(0.066)
Cohort 1939-1951*Age 65			
German		0.028***	0.044***
		(0.009)	(0.009)
Years of education		-0.006***	-0.002**
		(0.000)	(0.000)
log of HH post-Gov. Inc.			-0.021***
			(0.006)
Cohort dummies	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes
Industry dummies			Yes
Residence dummies			Yes
R-squared	0.196	0.200	0.265
Observations	9249	9249	9249
Number of couples	1768	1768	1768
Number of parameters	40	42	67

The standard errors are clustered to account for intra-person correlation. Note that *significant at 10%; **significant at 5%; ***significant at 1%. Standard errors are clustered to account for intra-person correlation. Robust standard errors in parentheses. All regressions include an intercept.

Table 25: Linear probability DiD estimation of indirect reform effect on retirement of women aged 55 and above

	(1)	(2)	(3)	(4)
	Coef.	Coef.	Coef.	Coef.
	Robust S.e.	Robust S.e.	Robust S.e.	Robust S.e.
Spouse cohort 1937-1951*Age 60	-0.033	-0.025	-0.026	-0.025
	(0.030)	(0.027)	(0.027)	(0.027)
Spouse cohort 1937-1951*Age 63	-0.049	-0.028	-0.027	-0.025
	(0.038)	(0.032)	(0.032)	(0.032)
Own cohort 1937-1951*Age60		-0.034	-0.035	-0.038
		(0.070)	(0.070)	(0.069)
Own cohort 1937-1951*Age63		0.111***	0.109***	0.104***
		(0.022)	(0.022)	(0.022)
Own cohort 1940-1951*Age 60		-0.235***	-0.234***	-0.231***
		(0.042)	(0.042)	(0.042)
German			0.033***	0.022***
			(0.007)	(0.008)
Years of education			-0.001*	-0.003***
			(0.000)	(0.001)
log of HH post-Gov. Inc.				0.005
				(0.004)
Own cohort and age dummies		Yes	Yes	Yes
Spousal cohort and age dummies	Yes	Yes	Yes	Yes
Other own controls				Yes
R-squared	0.033	0.196	0.197	0.215
Observations	10663	10663	10663	10663
Number of couples	1997	1997	1997	1997
Number of parameters	51	92	94	119

The standard errors are clustered to account for intra-person correlation. Note that *significant at 10%; **significant at 5%; ***significant at 1%.All regressions include an intercept. Column (1) consists of only two interaction terms, birth cohort and age dummies for spouses. Column (2) add additionally the third interaction term between spouses born in 1937-1951 and the age dummy for 65 years old. Column (3) includes all variables in column (2), and the interaction terms, birth cohort and age dummies for wives, plus other own controls such as dummy for German nationality, industry dummies, residence dummy of wives, and log of household post-government income. Standard errors are clustered to account for intra-person correlation. Robust standard errors in parentheses.

Table 26: Linear probability DiD estimation of indirect reform effect on retirement of men aged 55 and above

	(1)	(2)	(3)	(4)
	Coef.	Coef.	Coef.	Coef.
	Robust S.e.	Robust S.e.	Robust S.e.	Robust S.e.
Spouse cohort 1937-1951*Age 60	0.083	0.084	0.086	0.078
	(0.073)	(0.068)	(0.068)	(0.065)
Spouse cohort 1937-1951*Age 63	0.044	0.048	0.050	0.061
	(0.085)	(0.082)	(0.081)	(0.080)
Spouse cohort 1940-1951*Age 60	-0.182***	-0.162***	-0.162***	-0.151***
	(0.054)	(0.050)	(0.050)	(0.047)
Own cohort 1937-1951*Age60		-0.097**	-0.097**	-0.086**
		(0.041)	(0.041)	(0.040)
Own cohort 1937-1951*Age63		-0.155**	-0.153**	-0.187***
		(0.071)	(0.070)	(0.067)
German			0.029***	0.047***
			(0.009)	(0.009)
Years of education			-0.006***	-0.001**
			(0.000)	(0.001)
log of HH post-Gov. Inc.				-0.021***
				(0.006)
Own cohort and age dummies		Yes	Yes	Yes
Spousal cohort and age dummies	Yes	Yes	Yes	Yes
Other own controls				Yes
R-squared	0.065	0.204	0.215	0.272
Observations	9249	9249	9249	9249
Number of couples	1768	1768	1768	1768
Number of parameters	52	93	95	120

The standard errors are clustered to account for intra-person correlation. Note that *significant at 10%; **significant at 5%; ***significant at 1%.All regressions include an intercept. Column (1) consists of only two interaction terms, birth cohort and age dummies for spouses. Column (2) add additionally the third interaction term between spouses born in 1937-1951 and the age dummy for 65 years old. Column (3) includes all variables in column (2), and the interaction terms, birth cohort and age dummies for husbands, plus other own controls such as dummy for German nationality, industry dummies, residence dummy of husbands, and log of household post-government income. Standard errors are clustered to account for intra-person correlation. Robust standard errors in parentheses.

Table 27: Linear probability DiD estimation of indirect reform effect in East and West Germany

	West				East			
	(1)		(2)		(3)		(4)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Panel A: Women's sample								
Spouse cohort 1937-1951*Age 60	-0.062*	(0.035)	-0.053	(0.078)	0.025	(0.059)	0.022	(0.047)
Spouse cohort 1937-1951*Age 63	-0.056	(0.040)	-0.031	(0.022)	-0.024	(0.095)	-0.038	(0.065)
Spouse's cohort dummies	Yes		Yes		Yes		Yes	
Spouse's age dummies	Yes		Yes		Yes		Yes	
3 interaction dummies for women			Yes				Yes	
Age dummies			Yes				Yes	
Cohort dummies			Yes				Yes	
German			Yes				Yes	
Years of education			Yes				Yes	
Log of household income			Yes				Yes	
Industry dummies			Yes				Yes	
R-squared	0.038		0.207		0.058		0.372	
Observations	7800		7800		2405		2405	
Number of couples	1502		1502		467		467	
Number of parameters	49		91		48		89	
Panel B: Men's sample								
Spouse cohort 1937-1951*Age 60	0.026	(0.088)	0.025	(0.078)	0.238*	(0.131)	0.207*	(0.116)
Spouse cohort 1937-1951*Age 63	-0.037	(0.117)	0.029	(0.114)	0.229*	(0.124)	0.164	(0.108)
Spouse cohort 1940-1951*Age 60	-0.167***	(0.060)	-0.118**	(0.052)	-0.212*	(0.113)	-0.236***	(0.100)
Spouse's cohort dummies	Yes		Yes		Yes		Yes	
Spouse's age dummies	Yes		Yes		Yes		Yes	
3 interaction dummies for women			Yes				Yes	
Age dummies			Yes				Yes	
Cohort dummies			Yes				Yes	
German			Yes				Yes	
Years of education			Yes				Yes	
Log of household income			Yes				Yes	
Industry dummies			Yes				Yes	
R-squared	0.061		0.262		0.092		0.304	
Observations	6505		6505		2665		2665	
Number of couples	1298		1298		466		466	
Number of parameters	48		89		50		90	

*** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.10$. Standard errors are clustered to account for intra-person correlation. All regressions include an intercept.

Table 28: Placebo analysis: estimated results for women at different ages in post-reform period

	(1)		(2)		(3)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Panel A						
Cohort 1937-1951*Age 60	-0.070	(0.071)	-0.069	(0.071)	-0.075	(0.070)
Cohort 1937-1951*Age 63	0.019	(0.027)	0.016	(0.027)	0.017	(0.027)
Cohort 1940-1951*Age 60	-0.206***	(0.043)	-0.205***	(0.043)	-0.204***	(0.042)
Panel B						
Cohort 1940-1951*Age <60 (ref.)	-	-	-	-	-	-
Cohort 1940-1951*Age 61	-0.016	(0.036)	-0.016	(0.036)	-0.025	(0.036)
Cohort 1940-1951*Age 62	0.165***	(0.019)	0.166***	(0.019)	0.149***	(0.019)
Cohort 1940-1951*Age 63	0.113**	(0.029)	0.116***	(0.030)	0.103***	(0.029)
Cohort 1940-1951*Age 64	0.046*	(0.026)	0.049**	(0.026)	0.037	(0.026)
Cohort 1940-1951*Age 65	0.147***	(0.057)	0.150***	(0.057)	0.138**	(0.057)
R-squared	0.203		0.205		0.223	

*significant at 10%; **significant at 5%; ***significant at 1%. All estimations are based on specifications from (1) to (3) in Table 4. See notes below Table 4.

Table 29: Placebo analysis: estimated results for men at different ages in post-reform period

	(1)		(2)		(3)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Panel A						
Cohort 1937-1951*Age 60	-0.106***	(0.040)	-0.105***	(0.040)	-0.100***	(0.039)
Cohort 1937-1951*Age 63	-0.184***	(0.071)	-0.181***	(0.070)	-0.217***	(0.067)
Panel B						
Cohort 1937-1951*Age < 60 (ref.)	-	-	-	-	-	-
Cohort 1937-1951*Age 61	-0.146***	(0.049)	-0.148***	(0.049)	-0.149***	(0.045)
Cohort 1937-1951*Age 62	-0.041	(0.047)	-0.039	(0.047)	-0.061	(0.044)
Cohort 1937-1951*Age 64	0.265***	(0.046)	0.268***	(0.046)	0.200***	(0.047)
Cohort 1937-1951*Age 65	0.336***	(0.105)	0.336***	(0.105)	0.300***	(0.105)
R-squared	0.194		0.198		0.263	

*significant at 10%; **significant at 5%; ***significant at 1%. All estimations are based on specifications from (1) to (3) in Table 5. See notes below Table 5.

Table 30: Placebo analysis: estimated results for men with spouses exposed to the reform at different ages

	(1)		(2)		(3)		(4)	
	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.	Coef.	Robust S.e.
Panel A								
Spouse cohort 1937-1951*Age 60	0.089	(0.073)	0.087	(0.068)	0.089	(0.068)	0.078	(0.065)
Spouse cohort 1937-1951*Age 63	-0.008	(0.097)	0.024	(0.093)	0.024	(0.092)	0.041	(0.089)
Spouse cohort 1940-1951*Age 60	-0.175***	(0.054)	-0.149***	(0.050)	-0.149***	(0.050)	-0.143***	(0.047)
Panel B								
Spouse cohort 1940-1951 at < 60 (ref.)	-	-	-	-	-	-	-	-
Spouse cohort 1940-1951 at age 61	-0.011	(0.043)	-0.006	(0.039)	-0.005	(0.039)	-0.030	(0.036)
Spouse cohort 1940-1951 at age 62	0.072	(0.048)	0.091**	(0.044)	0.093**	(0.044)	0.080**	(0.042)
Spouse cohort 1940-1951 at age 63	0.081	(0.067)	0.059	(0.061)	0.061	(0.061)	0.044	(0.058)
Spouse cohort 1940-1951 at age 64	-0.069	(0.077)	-0.006	(0.071)	-0.005	(0.071)	-0.005	(0.066)
Spouse cohort 1940-1951 at age 65	0.059	(0.097)	0.049	(0.083)	0.053	(0.083)	0.034	(0.079)
R-squared	0.064		0.195		0.199		0.265	

*significant at 10%; **significant at 5%; ***significant at 1%. All estimations are based on specifications from (1) to (4) in Table 8. See notes below Table 8.