The Causal Effect of Retirement on Health and Happiness*

Matteo Picchio[a,b,c], Jan C. van Ours[c,d,e,f†]

[a] *Department of Economics and Social Sciences, Marche Polytechnic University, Italy*

[b] *Sherppa, Ghent University, Belgium*

[c] *IZA, Bonn, Germany*

[d] *Erasmus School of Economics, Erasmus University Rotterdam, The Netherlands*

[e] *Tinbergen Institute, Amsterdam/Rotterdam, The Netherlands*

[f] *Department of Economics, University of Melbourne, Australia*

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Abstract

We study the effects of retirement on health and happiness of partnered individuals and singles. We use a fuzzy regression discontinuity design based on the eligibility age to the old age state pension in the Netherlands. We find that the effects are heterogeneous by gender and marital status. Retirement of partnered men has positive effects on self-perceived health and happiness of both themselves and their partner. Single men retiring experience a drop in self-assessed health. Irrespective of whether they are partnered or single, retirement of women has hardly any effect on their health. Partnered women experience an increase in happiness if their partner retires but if they themselves retire their happiness drops. For single women, the drop in happiness at retirement is significantly negative. The health and happiness effects of retirement are also heterogeneous by educational attainment.

Keywords: Retirement; health; well-being; happiness; regression discontinuity design.
JEL classification codes: H55, J14, J26

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†Corresponding author: Erasmus School of Economics, Erasmus University Rotterdam, Burg. Oudlaan 50, 3062 PA Rotterdam, The Netherlands. Tel.: +31 10 408 1373.
E-mail addresses: `m.picchio@univpm.it` (M. Picchio); `vanours@ese.eur.nl` (J.C. van Ours).

1 Introduction

Like in many European countries, in the Netherlands the standard retirement age is going up because of concerns about the financial burden related to the increasing number of retired inactive people. Although the increase in retirement age seems necessary for reasons of sustainability of the pension system, it does raise questions about the consequences for workers who may have to stay in the labor market longer than they anticipated when they were young. In particular, if retirement improves health and increases well-being, i.e. happiness of workers, postponing retirement may not be welfare improving.

To establish the causal effect of retirement on health and happiness one has to take into account that the association between these variables may also be caused by joint unobserved characteristics and reverse causality. Association through joint time-invariant unobserved characteristics can be removed by introducing individual fixed effects. To deal with potential reverse causality two methods are generally used, instrumental variables and a regression discontinuity design (RDD). Eligibility ages for early retirement or retirement related social security benefits are popular instrumental variables. RDD analysis typically exploits the sudden increase in the retirement probability as soon as an individual attains the age for pension eligibility. Sometimes an increase in standard retiring age is exploited to establish causality.

The empirical evidence on the effects of retirement on health is mixed. Some studies find a positive effect, other studies conclude there is no effect or a negative effect. This may have to do with the nature of the retirement decision, i.e. whether retirement is voluntary or mandatory. Bassanini and Caroli (2015) for example conclude that voluntary retirement often has a positive effect on health whereas involuntary job loss has a negative effect on both health and happiness. As we discuss in more detail in the next section, the variation in the results from previous studies may also have to do with differences in terms of identification method, the nature of the data or the dependent variable of interest.

In our paper, we study the effect of retirement on health and happiness in the Netherlands. Since in the Netherlands early retirement programs are vanishing and employment rates among older workers are relatively high, there are many workers for whom the transition to retirement can be observed at the standard retirement age which recently has been slowly increasing. Our contribution to the literature is threefold. First, we add to the existing literature on retirement effects using an RDD but with a shifting retirement age which supports identification of causal effects. Second, we allow for spillover effects between partners, i.e. retirement of one partner may affect the health and happiness of the other partner. Retirement decisions of working couples are indeed often coordinated.[1] Third, we investigate heterogeneity in the retirement

[1]From an overview of the literature, Coile (2015) concludes that in about one-third of working couples partners

effects focusing on gender, marital status and educational attainment.

The set-up of our paper is as follows. In Section 2 we present an overview of previous studies. There is a wide variety in terms of data used, specific topic and identification strategy. There is no consensus about costs or benefits or retirement for health and happiness. Section 3 describes the Dutch pension system and elucidated which features are exploited to identify the causal effect of retirement on outcome variables of interest. In our identification, we focus on the age at which individuals are entitled to state pensions. This age has been 65 across the board for a long time but in recent years the age of entitlement to a state pension has been slowly increasing. In Section 4 we present the econometric model, the identification assumptions and the sample used in the econometric analysis. Section 5 displays and comments on the main estimation results focusing on self-reported health and happiness. Retirement of partnered and single women has hardly any effect on their health. Retirement of partnered men has positive effects on self-perceived health of both themselves and their partner. Single men retiring experience a drop in self-assessed health. In addition to general indicators on health and happiness, we also investigate retirement effects on indicators of physical health (fundamental and instrumental activities of daily living, comorbidity) and mental health (calmness, depression, anxiety) and on health behavior (smoking and drinking). In addition to differences according to gender and marital status we also find differences according to educational attainment. A set of validity and falsification tests are presented in Section 6, which suggest that our findings are robust. Section 7 is the concluding section in which we argue that retirement has effects on health and happiness but, since there is substantial heterogeneity across gender, marital status and educational attainment, it is a hard if not impracticable to draw strong policy conclusions.

2 Previous Studies

Studies on the effects of retirement on health and happiness differ in many ways, i.e. in terms of the method of identification, whether cross-country data or individual country data are used and in the nature of the dependent variable. In this section, we provide a brief overview of previous work starting with cross-country studies followed by individual country studies and concluding with some reviews of the literature.

Using cross-country data from the US, England and eleven European countries, Rohwedder and Willis (2010) find that early retirement has negative effects on cognitive skills of people in their early 60s. Using similar cross-country data, Horner (2014) concludes, from an instrumental variable analysis based on retirement age eligibility, that well-being improves through

retire within one year of each other.

retirement but this is a temporary effect. Fonseca et al. (2014) analyze data from various European countries and, using an instrumental variable approach based on pension eligibility ages, they conclude that there is weak evidence of retirement reducing depression. Belloni et al. (2016), using data from ten European countries and an instrumental variable approach, conclude that retirement has a positive effect on mental health of men while women are unaffected. The positive mental health effect is stronger for blue-collar men in areas that were strongly hit by the Great Recession. From an international comparative study on the effects of retiring on health and cognitive skills in ten European countries, Mazzonna and Peracchi (2017) conclude that these are negative and increasing with years after retiring. The effects are also heterogeneous in the sense that for physical demanding occupations retiring has a positive and immediate effect on both health and cognitive skills. Kolodziej and García-Gómez (2017) use cross-country data to investigate the heterogeneity of causal positive effects of retirement on mental health finding that these effects are larger for those in poor mental health. Müller and Shaikh (2018) use data from various European countries to investigate the causal health effects of the retirement of a partner. For this they use an RDD based on retirement eligibility ages, finding that health is negatively affected by the retirement of the partner and positively by own retirement. These effects are heterogeneous: male health is not affected by the retirement of his spouse, while female health is negatively affected by the retirement of her partner.

Kerkhofs and Lindeboom (1997) is one of the first studies dealing with the relationship between retirement and health. Using Dutch data and a fixed effect method the authors find that health improves after early retirement. De Grip et al. (2011) exploit a policy change in retirement rules in the Netherlands. In 2006 early retirement was made less attractive for civil servants born from January 1, 1950 onward. Who was born one day too late had to work 13 months longer to reach the same level of pension benefits. The authors show that this reduced attractiveness of early retirement and caused depression, which is partly related to the perceived unfairness of the policy change. Bloemen et al. (2017) use a temporary change in the rules for early retirement of older civil servants to identify the impact of retirement on mortality rates. Under specific conditions some of them were allowed to retire early. In the analysis the authors account for the possibility of selective retirement, i.e. less healthy workers retire earlier than healthy workers. When they do not account for this selection effect, they find a positive spurious relation between retirement and mortality rate. Once they account for selectivity, the relationship between retirement and mortality rate becomes negative, although not estimated with precision.

Bonsang et al. (2012) investigate the effects of retirement on cognitive functioning of older Americans using an instrumental variable approach based on the eligibility age for social security to account for endogeneity of the retirement decision. They find that retirement has a significant negative, though not instantaneous, effect on cognitive functioning as measured by a word learning and recall test. Gorry et al. (2015) also uses age-related retirement eligibility to establish a causal effect from retirement to health and life satisfaction for US workers. The impact of retirement on happiness turns out to be immediate, while health effects show up later on. Retirement does not seem to affect healthcare utilization. Fitzpatrick and Moore (2018) use an RDD based on eligibility to social security retirement insurance which during the period of analysis for most Americans occurred at age 62. In the first month of their eligibility about 30% of all Americans retire. At age 62 there is a discontinuous increase in male mortality which the authors attribute to retirement associated changes in unhealthy behaviors. On average, male mortality goes up by two percent. The increase is largest for unmarried males and males with low education. For females there is no significant increase in mortality after retirement. Insler (2014) finds instead a positive health effect of retirement in the US and attributes it to a behavioral change of retirees, who for example are more likely to quit smoking when they retire.

Kesavayuth et al. (2016) use an instrumental variable approach based on retirement eligibility ages for the UK basic state pension to study well-being effects of retirement. They find that on average there is no effect. However, the effect is heterogeneous and related to personality traits. For females the well-being effect of retiring is high if they score high in openness or low in conscientiousness. Fé and Hollingsworth (2016) investigate the retirement effects on health and healthcare utilization for UK males. Using an RDD for the short-run effects and a panel data model for the long-run effects, they find that retirement neither has short-run nor long-run health effects.

Bonsang and Klein (2012) study well-being effects of retirement in Germany distinguishing between voluntary and involuntary retirement. They find that voluntary retirement has no effect on life satisfaction, while involuntary retirement has a negative effect on life satisfaction. Eibich (2015) uses an RDD based on age related financial incentives in the German pension system to explain changes in measures of self-assessed health and health-care utilization. Because of financial incentives, there are discontinuities in the age-retirement profile at 60 and 65. The author finds positive effects on health, which he attributes to relief from work-related stress and strain, to an increase in sleep duration and to a more active lifestyle. Hernaes et al. (2013) use a retirement reform in Norway that made early retirement possible for some workers but not for others to study the effect of retirement age on mortality. Workers eligible for the program were gradually offered the possibility to retire earlier than the general retirement age at 67. Initially, in 1989 the early retirement age was 66 while in 1998 this was reduced to 62. From a difference-in-difference analysis the authors find that the reform induced some workers to indeed retire early but their mortality was not affected. Hallberg et al. (2015) analyze the effects of an early retirement offer to Swedish army personnel introduced in the period 1992-1994. Before this period the retirement age of military officers was 60; after this period early retirement age was 55. In the analysis cohort variation in the timing of the early retirement offer is exploited. Birth cohorts 1938-39 who were fully affected by the early retirement offer were compare to birth cohorts 1931-32 who were not affected. The effect of the early retirement offer on retirement was about 60 percentage points. The difference in survival up to age 70 between the two birth cohorts was 7.4 percentage-points for the military while for non-military the difference was 2.9 percentage-points. In addition to reducing mortality the authors also found that the early retirement offer also reduced inpatient care. Shai (2018) exploits an increase in the standard retirement age for Israeli men from 65 to 67 finding that employment at older ages has a negative health effect in particular for low-educated workers.

Van der Heide et al. (2013) is one of the overview of studies on the health effects of retirement. Focusing on longitudinal studies they conclude that the effects on general health and physical health are unclear, while there seem to be beneficial effects on mental health. Nishimura et al. (2018) investigate the differences in the retirement effects across various studies concluding that the choice of the estimation method is the key factor in explaining these differences. Redoing several earlier studies using a fixed effects instrumental variable analysis the authors conclude that results are more stable indicating positive health effects of retirement, though some cross-country heterogeneity remains.

Quite a few studies do not consider heterogeneity in the health and happiness effects of retirement. The studies that allow for heterogeneous effects do so for gender, type of occupation, marital status or education. Retirement of women often has smaller effects wile the effects for physically demanding occupations and lower educated workers has bigger effects. The only study that considers cross-partner effects of retirement find that retirement of a male has an effect on the health of the partner whereas the retirement of a female has no cross-partner effects. All in all, it is clear that the effects of retirement on health and happiness vary from study to study depending on the method of analysis and the country or countries involved in the studies.

3 Institutional Set-up

The Dutch pension system consists of three pillars: state pensions (called AOW), collective pensions, and individual pensions. The state pension is paid from a certain predefined age onward. Collective pensions are paid through pension funds to which employers pay monthly contributions on behalf of their employees. Collective pension funds are organized by industry, individual firms or professional organizations. Usually, contributions to collective pension funds are mandatory and more than 90 percent of the workers in the Netherlands contribute to a collective pension fund via their employer. Individual pension arrangements are often used by self-employed or workers who do not contribute to a collective pension fund.

Whereas there is a possibility for early or late retirement using benefits from the collective pension funds or individual pension funds, the state pension has a fixed age for benefit collection which depends on birth cohort only. Therefore, we focus on how the state pension induced retirement affects health and happiness of individuals. The state pension was introduced in 1957 and is intended for everyone who lived or worked in the Netherlands between ages 15 and 65. It provides benefits of up to 70 percent of the net minimum wage. The level of the state pension depends on the family situation (married or single) and on how many years an individual lived in the Netherlands. For example, in 2018 the monthly old-age benefits for a single person would be net €1,107, while a couple would receive a net benefit of €1,434 per month.

The start of the state pension depends on age only. For many decades this has been age 65, although the exact date of the pension age changed recently. Up to 1 January 2012, the pension benefits were received from the first day of the month in which someone reached the pension age. From 1 January 2012 onward, the benefit is received from the actual pension age. Up to 1 January 2015, couples in which one person reached the old-age pension age while the other person was younger could get a means-tested benefit until the partner would reach the old-age pension age. Individuals are not obliged to retire at the state pension age but many workers do because in many situations through collective agreements workers lose their job whether they like it or not on the day they reach the state pension age. Therefore, in practice, hardly anyone keeps working after reaching the state pension age.

Whereas collective pensions and individual pensions are funded by contributions from employees through their employers, state pensions are funded through a pay-as-you-go system financed by payroll taxes and government funds. Because of the aging of the Dutch population the contributions to the state pensions have increased and will keep on increasing in the years to come. To improve the sustainability of the pay-as-you-go system, the government decided some years ago to gradually increase the state pension age. Table 1 provides an overview of the changes in the eligibility age for the state pension. It shows that, for all individuals born before January 1, 1948, the state pension age is 65. For those born in 1948, the state pension age is 65 years and 1 month. For individuals born in 1955, up to October 1, the pension age will be 67 years and 3 months. The state pension age of later birth cohorts will depend on future life expectancy of the Dutch population and will be calculated accordingly.

Table 1: Entitlement age to the Dutch state pension

		State pension age		
Born from (included)	up to (excluded)	Year	Month	Retirement in
–	1 January 1948	65	0	
1 January 1948	1 December 1948	65	1	2013
1 December 1948	1 November 1949	65	2	2014
1 November 1949	1 October 1950	65	3	2015
1 October 1950	1 July 1951	65	6	2016
1 July 1951	1 April 1952	65	9	2017
1 April 1952	1 January 1953	66	0	2018
1 January 1953	1 September 1953	66	4	2019
1 September 1953	1 May 1954	66	8	2020
1 May 1954	1 January 1955	67	0	2021
1 January 1955	1 October 1955	67	3	2022

Whereas the state pension age is the same for different birth cohorts there are substantial differences in life expectancy between individuals related to gender and educational attainment. Table 2 presents an overview of life expectancy at birth and at age 65 according to various dimensions. To illustrate the effect of educational attainment a distinction is made between low educated with at most primary education and high educated with higher vocational education or a university degree. The first line gives the overall life expectancy where there is a difference between males and females of about 2 to 3.6 years. At birth, life expectancy between low educated and high educated differs about 5 to 6 years. At age 65, this difference is about 3.5 to 4 years. Life expectancy in good health has an astonishing educational gradient. Whereas male low educated have a life expectancy in good health of 53.0 years, this is 71.8 years for high educated men, a difference of almost 19 years. At age 65 the difference is most smaller but still 6.5 years. The difference in life expectancy in good health between males and females is not so big and not always to the advantage of the females. This gender-specific difference also holds for life expectancy without physical limits, without chronic diseases and in good health. For all these indicators there is a substantial educational gradient both as measured at birth and at age 65. Whereas life expectancy in good mental health at age 65 is 15.4 years for low educated males it is 20.2 years for high educated males.

Clearly, the difference between low and high educated in life expectancy in particular life expectancy in good health is substantial at birth but also still substantial at age 65. Therefore, it seems likely that the happiness effects at retirement may differ strongly between high and low educated. One can also imagine that the mental health effects of retiring are different for low educated who have in expectation less than 9 years left to life while for high educated this about 15 years.

Table 2: Life expectancy in the Netherlands by gender and education

	At birth				At age 65			
	Men		Women		Men		Women	
Education	Low	High	Low	High	Low	High	Low	High
Life expectancy (LE)	76.6	83.0	80.2	85.5	17.1	21.3	19.8	23.3
LE in good health	53.0	71.8	52.7	70.7	8.5	15.0	8.9	15.3
LE without physical limits	63.4	76.9	60.2	76.0	11.4	16.8	10.2	16.7
LE without chronic diseases	41.0	51.8	37.1	44.9	2.8	5.8	3.6	3.9
LE in good mental health	67.4	77.5	66.0	76.0	15.4	20.2	16.4	21.5

Notes: Life expectancy (LE) is the number of years someone of a certain age is expected to live under the assumption that future mortality risks remain equal. LE in good health is the number of years a person of a particular age is expected to live in good health, assuming the current risks of mortality and ill health do not change. Good health is the absence of chronic diseases and physical limitations or as perceived good health or good mental health. LE in good health is calculated by means of the Sullivan method. Firstly, mortality risk and life expectancy are calculated for each age category. Subsequently, the life expectancy for is each age category is divided into healthy and unhealthy years based on the percentage of unhealthy people in each age category, e.g. the percentage of people with at least one physical limitation. The physical disability indicator is based on seven questions on hearing, reading, recognizing, carrying objects, bending down and walking. A respondent has no physical disabilities if he/she has no difficulties on all seven activities. Chronic diseases are heart conditions, asthma, chronic bronchitis, cancer, stroke, diabetes, chronic arthritis, hypertension, migraine et cetera. Good mental health is based on the Mental Health Inventory (MHI-5) which includes questions on being nervous, feeling down, feeling calm and peaceful, being downhearted and blue, and being happy. Low educated = At most Primary School; High educated = At least Higher vocational education. *Source:* Statistics Netherlands.

4 Method

4.1 Regression Discontinuity Design

The retirement status cannot easily be assumed to be an exogenous variable when studying its impact on outcomes like health and well-being. A first reason is self-selection into retirement. There might be individual characteristics unobserved by the analyst both affecting the retirement and outcomes like health and well-being. Potential unobservables causing this selectivity are labor market attachment, labor market experiences, working conditions across the career, wealth, physical and mental conditions, grandparenthood and family circumstances. A second reason is reverse causality. Health and well-being conditions of an individual and their evolution over time may affect the decision to retire.

In our study, the identification of the effect of retirement on health and well-being is based on the discontinuity in the propensity to retire in the month that an individual attains the age for the entitlement to the state pension. As indicated before, in the Netherlands individuals are entitled to the state pension when they reach a certain age. This eligibility age varied across years depending on the year and month of birth of the individuals involved. Since the jump in the probability of retiring when individuals reach the eligibility age is typically less than 1, our identification strategy to establish the causal effect of retirement is based on a fuzzy RDD. Eligibility ages for the state pension are popular instrumental variables in this kind of literature.[2]

Measures of health and well-being, like for example self-reported health and happiness are usually collected by asking individuals to indicate a discrete value reflecting their situation, within a limited range of positive and ordered integers, where each integer has its own explained meaning. In modeling the impact of retirement on such type of outcome variables, we take into account of their ordered response nature: we use ordered response models for the probability that an individual indicated a discrete value in the set of possible responses, conditional on the retirement status and other observables. The probabilities are nonlinear functions of a set of parameters, but they depend on a linear index of the observables. We adapt the usual fuzzy RDD to this nonlinear framework. In a linear model, the fuzzy RDD boils down to a 2SLS estimate, with the discontinuity being the instrument and flexible continuous functions of the forcing variable specified both in the first and second stage. In our ordered response index model, the fuzzy RDD approach consists in estimating by maximum likelihood (ML) an IV ordered response model, with the discontinuity as instrument and flexible continuous functions of the forcing variable. The forcing variable is months to pension state eligibility, specified in the indexes determining both the retirement probability and the probability of each discrete outcome.

Both in the linear case and in the nonlinear counterpart, assumptions are needed for the RDD to credibly identify the retirement effect near the discontinuity. Hahn et al. (2001) formally studied the identification issues of the RDD. They show that the key assumption of a valid RDD is that all the other factors determining the realization of the outcome variable must be evolving smoothly with respect to the forcing variable (Lee and Lemieux, 2010). If further variables would jump at the threshold values, we would not be able to disentangle the effect of retirement from the one induced by the other jumping variables. When this continuity assumption is satisfied, in the absence of the treatment, the persons close to the cutoff point are similar (Hahn et al., 2001) and the average outcome of those right below the cutoff is a valid counterfactual for those right above the cutoff (Lee and Lemieux, 2010). Identification is there-

[2] See, among others Fé and Hollingsworth (2016) and Müller and Shaikh (2018) for recent work using this identification strategy.

fore attained only for individuals who are close to the cutoff point of the forcing variable (Hahn et al., 2001; Van der Klaauw, 2002). A further assumption is that individuals should not be able to precisely control the forcing variable. It would fail if the individual can anticipate what would happen if (s)he is below or above the threshold and can modify the realization of the forcing variable. In our framework, it is plausible to assume that individuals cannot manipulate their age. Both identifying assumptions will be tested in Section 6.

Denote by dis_i an indicator variable equal to one if the age of individual i is above the pension state eligibility age. In our study, we allow for spillover effects between partners, i.e. retirement of one partner may affect the outcome variable of the other partner. Hence, we also define as dis_i^p the indicator variable equal to one if the age of individual i's partner is above the pension state eligibility age. The forcing variables which fully determine the values taken by these two indicators are the number of months from the moment in which, respectively, individual i and his/her partner become eligible to the state pension. We indicate these two forcing variables with m_i and m_i^p.[3] The treatment indicator, equal to 1 if individual i has already retired and 0 otherwise, is denoted by D_i. The dummy variable for the retirement status of the partner of individual i is D_i^p. We denote by y_i the ordered response variable taking on the values $\{1, 2, \ldots, J\}$, and by y_i^* its latent counterpart, such that $y_i^* \in \mathbb{R}$. Finally, we collect into $\mathbf{x}_i$ the set of covariates which we will use to control for heterogeneity across individuals and across their partners.

The following equation system describes, for individuals living in a couple, the process determining the outcome variable and the two endogenous retirement indicators by treating properly the ordinal nature of the choices:

$$
\begin{aligned}
y_i^* &= \mathbf{x}_i'\boldsymbol{\beta} + \delta D_i + \delta^p D_i^p + f(m_i;\boldsymbol{\theta}) + f^p(m_i^p;\boldsymbol{\theta}^p) + v_i, && (1)\\
D_i^* &= \mathbf{x}_i'\boldsymbol{\beta}_1 + \gamma_1 dis_i + \gamma_1^p dis_i^p + k_1(m_i;\boldsymbol{\theta}_1) + k_1^p(m_i^p;\boldsymbol{\theta}_1^p) + u_{1i}, && (2)\\
D_i^{p*} &= \mathbf{x}_i'\boldsymbol{\beta}_2 + \gamma_2 dis_i + \gamma_2^p dis_i^p + k_2(m_i;\boldsymbol{\theta}_2) + k_2^p(m_i^p;\boldsymbol{\theta}_2^p) + u_{2i}, && (3)\\
y_i &= j \cdot \mathbb{1}[\alpha_{j-1} < y_i^* \leq \alpha_j], \text{ for } j \in \{1,\ldots,J\}, \alpha_0 = -\infty \text{ and } \alpha_J = +\infty, && (4)\\
D_i &= \mathbb{1}[D_i^* \geq 0], && (5)\\
D_i^p &= \mathbb{1}[D_i^{p*} \geq 0], && (6)
\end{aligned}
$$

where:

- $\mathbf{x}_i$ is a vector of covariates (dummies for education of both partners, year dummies, and indicators for the urban character of the place of residence).

[3]They take value 0 when individual i (or his/her partner) is interviewed in the month in which (s)he becomes eligible to the state pension.

- $\mathbb{1}(\cdot)$ is the indicator function, which returns 1 if the argument is true and 0 otherwise.
- $\alpha_1 < \alpha_2 < \cdots < \alpha_{J-1}$ are threshold parameters to be estimated.
- $(v_i, u_{1i}, u_{2i}) \sim N(\mathbf{0}, \mathbf{\Sigma})$ are random error terms with

$$\mathbf{\Sigma} = \begin{bmatrix} 1 & \sigma_{12} & \sigma_{13} \\ \cdot & 1 & \sigma_{23} \\ \cdot & \cdot & 1 \end{bmatrix} \quad (7)$$

.

- $f(\cdot;\boldsymbol{\theta})$, $f^p(\cdot;\boldsymbol{\theta}^p)$, $k_1(\cdot;\boldsymbol{\theta}_1)$, $k_1^p(\cdot;\boldsymbol{\theta}_1^p)$, $k_2(\cdot;\boldsymbol{\theta}_2)$, and $k_2^p(\cdot;\boldsymbol{\theta}_2^p)$ are continuous functions at the cutoff with different profiles below and above the cutoff. In the benchmark model, we will use a polynomial of order one, with different slope below and above the cutoff. In a sensitivity analysis, we will use a spline continuous function with two knots below and two knots above the cutoff.[4]

When we study the impact of retirement for singles, the model in Equations (1)-(6) simplifies to:

$$\begin{aligned} y_i^* &= \mathbf{x}_i'\boldsymbol{\beta} + \delta D_i + f(m_i;\boldsymbol{\theta}) + v_i, \\ D_i^* &= \mathbf{x}_i'\boldsymbol{\beta}_1 + \gamma dis_i + k(m_i;\boldsymbol{\theta}_1) + u_i, \\ y_i &= j \cdot \mathbb{1}[\alpha_{j-1} < y_i^* \leq \alpha_j], \text{ for } j \in \{1,\ldots,J\}, \alpha_0 = -\infty \text{ and } \alpha_J = +\infty, \\ D_i &= \mathbb{1}[D_i^* \geq 0], \end{aligned}$$

where (v_i, u_i) is assumed to have a zero mean bivariate normal distribution.

4.2 Estimation

Given the distributional assumption on the idiosyncratic error terms, Equations (1)-(6) fully characterize the individual density. The individual contribution to the log-likelihood function, and therefore the sample log-likelihood, depend on a finite number of parameters and the model can be estimated by ML. Equations (1)-(6) define an instrumental variables ordered probit model, with two discrete endogenous variables. Its estimation by ML is the nonlinear counterpart of the 2SLS estimation of a linear specification of both the equation for y_i and of the reduced form equations for the endogenous retirement dummies.[5]

[4]Following the advice in Gelman and Imbens (2018), we keep low the order of the polynomials and use local estimation.

[5]We could enumerate the discrete response choices of the outcome variables, assign them a cardinal meaning, specify linear probability models for the retirement indicators and estimate the resulting linear model by 2SLS.

The model is estimated by ML using the *cmp* program for Stata (Roodman, 2011), separately for men and women. We weighted observations so as to give more importance to individuals closer to the cutoff. For singles, we use the usual triangular weights computed as $w_i = 1 - \frac{|m_i|}{bw}$, where bw is the chosen bandwidth for local estimation. For partnered individuals, we first define the triangular weight as usual at individual level. Then, we define the triangular weight for individual i's partner as $w_i^p = 1 - \frac{|m_i^p|}{bw}$. Finally, the weight for partnered individual i is given by the product of his/her own triangular weight and the one of his/her partner. By doing so, we give more importance to couples in which both partners are close to the cutoff. Since the weighting strategy could be considered as a source of arbitrariness, we provide in Subsection 5.3 a robustness check with unweighted observations (rectangular kernel within the chosen bandwidth).

For partnered individuals, we will focus our discussion on the results coming from the bandwidth set to $bw = 42$ months and satisfied simultaneously by both partners, with a local linear specification of the different functions of the forcing variables. In Subsection 5.3, we check the sensitiveness of our results by trying different bandwidths ($bw = 36, 54, 84$), simultaneously satisfied by both partners. When we enlarge the bandwidth to 84 months, we allow the functions of the forcing variables to be more flexible (spline continuous function with two knots below and two knots above the cutoff).[6] For singles, we use similar definition of the benchmark specification and run the same robustness checks, with the only difference that singles are included into the estimation sample only on the basis of their own distance from the cutoff. Hence, we do not base the bandwidth choices on data driven optimal criteria, but we rather try different bandwidths and check the sensitivity of the findings to different choices. With continuous outcomes, data driven criteria for an optimal choice of the bandwidth were recently proposed by Imbens and Kalyanaraman (2012) and Calonico et al. (2014). However, their criteria become suboptimal or cannot be applied with categorical dependent variables (Xu, 2017). Through the general approach of local likelihood, Xu (2017) derived an optimal criterion for discrete outcomes. However, it focuses on single treatment effect only, whereas in our framework we seek to identify the effect of multiple treatments with multiple discontinuities.

4.3 Data

The data used in our paper are from a Dutch panel, the Longitudinal Internet Studies for the Social Sciences (LISS) panel. The LISS panel is collected and administered by CentERdata of

However, the results would be affected by the arbitrary assignment of a cardinal value to each ordered choice.

[6]In this case we also delete the first and last percentile of the distribution of the age difference between the partners.

Tilburg University. A representative sample of households is drawn from a population register by Statistics Netherlands and asked to join the panel by Internet interviewing. Households are provided with a computer and/or an Internet connection if they do not have one.[7] Some background information on general characteristics, like demography, family composition, education, labor market position, retirement status, and earnings, is measured on a monthly basis, from November 2007 until February 2018 (at the time of writing). Ten core studies are instead carried out once a year, in different moments of each year. They survey individuals on a wide set of topics, like health, religion and ethnicity, social integration and leisure, work and schooling, personality, politics and economic situation.[8]

In our study we use: i) the monthly information of the background variables, from which we infer the age in month and the retirement status[9] in each month of the year; ii) the core study on health, from which we retrieve measures of, respectively, health and happiness at the month of data collection. The core study on health surveyed individuals in November-December of each year from 2007 until 2017, with the only exception of 2014. The study contains a variable with the exact information on the month of the interview. We can therefore link the measures of health and happiness collected in a given month with the corresponding information on age (in months) and retirement status available with a monthly frequency from the background variables. This results in 10 waves with information on health, happiness, age in months and retirement status. Details of our sample selection are provided in Appendix A.

Figure 1 shows the distribution of the age difference between husbands and wives in the sample used for our baseline estimates. The age difference is predominantly positively illustrating that males are on average older than their female partners. On average in almost 77% of the couples the male is older than the females. For 30% of the couples the male is at least two years older.

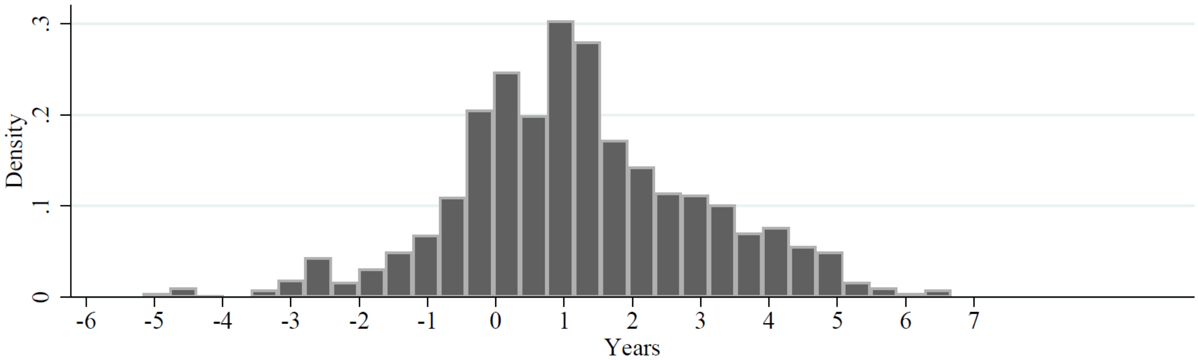
Our strategy for identifying the effect of retirement on different outcome variables hinges on the discontinuity in the retirement probability at the moment in which an individual reaches the state pension eligibility age. This discontinuity is supposed to be exogenous with respect to the outcome measures, which should not jump in the absence of the discontinuity. Hence, individuals locally above and below the eligibility age should be randomized. However, in order to be a valid instrument, the discontinuity must also be a strong predictor of the retirement decision. Figure 2 displays the relation between the time to state pension eligibility and the retirement probability, obtained by regression functions with triangular kernel weights on a

[7] See Knoef and de Vos (2009) for an evaluation of the representativeness of the LISS panel and Scherpenzeel (2011, 2010) and Scherpenzeel and Das (2010) for methodological notes on the design of the LISS panel.

[8] See https://www.dataarchive.lissdata.nl/study_units/view/1 for the full list of studies of the LISS panel.

[9] We define an individual as retired if (s)he reports to be a pensioner, because of either a voluntary early retirement or entering the old age state pension scheme.

Figure 1: Distribution of the age difference between partners are within the bandwidth of 42 months



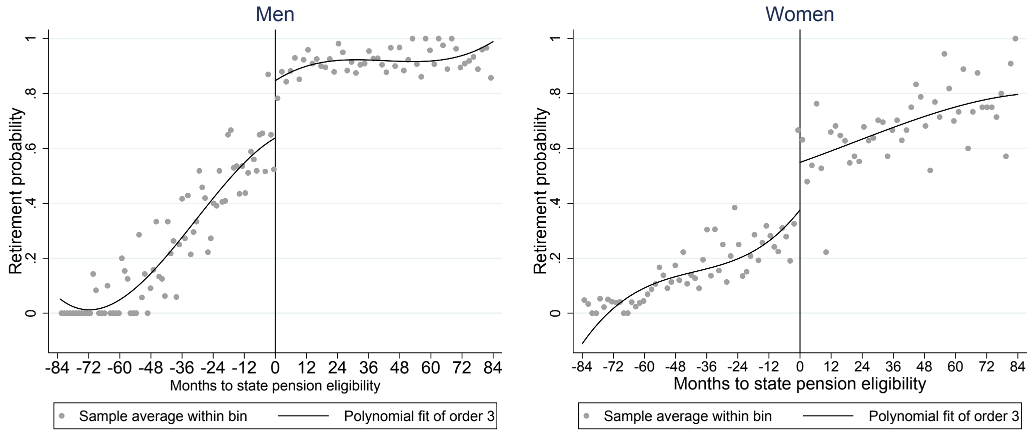
Note: The sample is limited to 1,221 couples with both partners within the bandwidth of 42 months.

3rd-order polynomial function, fitted separately above and below the cutoff. It shows that, for both men and women, at the moment of the state pension eligibility, the retirement probability significantly jumps. For those in a couple, the jump is 20.9 percentage points (pp) for men and 17.3 pp for women. For singles, it is 18 pp for men and 35.1 pp for women. Differently from Müller and Shaikh (2018), who detected strong explanatory power of the discontinuity at the cutoff on partner's retirement, we find that the impact of the discontinuity on partner's retirement probability is small and not significantly different from 0: the retirement probability of a wife increases by 5.8 pp at the eligibility age of her husband, whereas husbands' retirement probability decreases by 2 pp at the eligibility age of his wife. It is also noteworthy to mention that the discontinuity doubles when moving from women in a couple to single women, whereas it does not depend of the marital status for men. This is very likely due to the difference in terms of labor market participation between single women and those living in a couple.

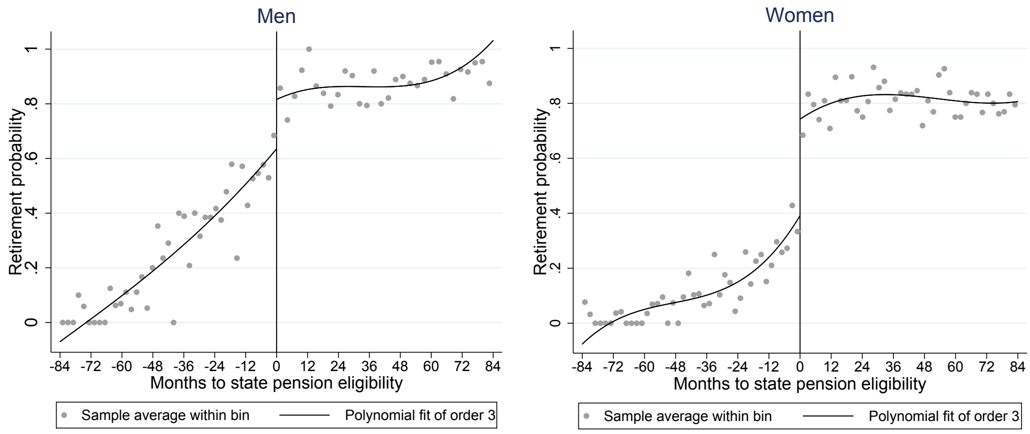
In Figure 2, we show the relationship between state pension eligibility age and the extensive margin of labor supply, i.e. whether individuals are retired or not. Then, there are clear discrete jumps in the probability to be retired for every group. These jumps have a different meaning for men and women in terms of hours of work. Figure 3 shows the relationship between pension eligibility age and the intensive margin of labor supply, i.e. hours of work conditional on working. We notice three important characteristics. First, there are no clear discontinuities in the relationship at the state pension eligibility age. This suggests that the adjustment of labor supply is mainly at the extensive margin. Some individuals stop working if they reach the pension eligibility age; other individuals keep on working and if they do they do not adjust their hours of work. Second, the variation in hours of work is much higher to the right of the pension eligibility age than to the left. This is caused by the limited number of observations of individuals working after reaching the pension eligibility age. Third, before the pension

Figure 2: Graphical illustration of discontinuity in the retirement probability

(a) Couples



(b) Singles



Notes: The solid lines are obtained by regression functions based on a 3rd-order polynomial regression (with triangular kernel) of the retirement indicator on the running variable (time until age pension eligibility), fitted separately above and below the cutoff. The dots represent local sample means of disjoint bins of the running variable reported in the mid point of the bin. The number of bins and their lengths are chosen optimally using the mimicking variance integrated mean-squared error criterion. The sample is limited to couples and singles within the bandwidth of 84 months: 3,177 couples and 3,844 singles. The discontinuity in the retirement probability amounts to: a) for couples, 20.9 (17.3) percentage points for men (women), significantly different from zero with a p-value equal to 0.000 (0.007); b) for singles, 18.0 (35.1) percentage points for men (women), significantly different from zero with a p-value equal to 0.045 (0.000). The p-values are robust to within-individual correlation.

eligibility age, there is a big difference in the average number of working hours between men, partnered women and single women. On average, men work about 35 hours per week, which roughly corresponds to a full-time job. For partnered women the working week on average has a little over 20 hours per week showing that these are predominantly part-time jobs. For single women the average weekly working hours is close to 30 suggesting that some single women work part-time while others work full-time.

When interpreting gender differences in the effect of retirement on health and happiness, these differences in pre-retirement working hours have to be taken into account. Retirement for men means a reduction of weekly working hours from 40 to zero, for partnered women it is a reduction from 20 to zero and for single women from 30 to zero. Retirement is terms of magnitude of effects on personal life is less substantial for partnered women than it is for single women or for men.

From the dataset on health we extracted a set of outcome variables depicting the short-term impact of retirement on health under different perspectives: self-perceived health, limitations with fundamental activities of daily living (ADL) and with instrumental ADL, comorbidity, smoking, alcohol drinking habits in the last week, happiness, calmness, anxiety, depression in the last month. Appendix A reports the full list of outcome variables, the discrete values they can take, and the meaning of each discrete outcome.[10] This appendix also displays summary statistics of these outcome variables and the fraction of individuals that at the moment of the interview have already retired.

5 Estimation Results

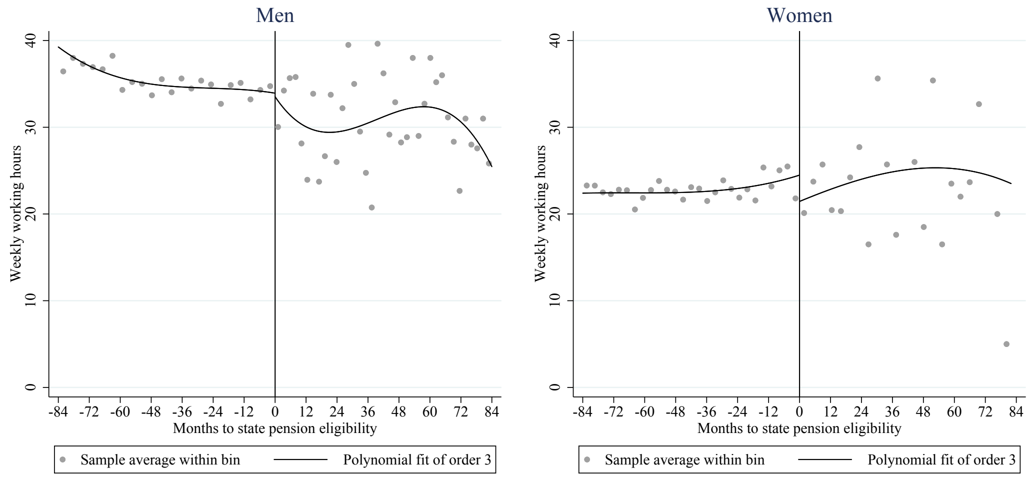
5.1 Baseline Parameter Estimates

Table 3 displays the estimated effect of retirement on self-perceived health for couples (top panel) and for singles (bottom panel), respectively. From panel a) of Table 3, we can see that whilst husband's retirement has a positive effect both on his own health and on wife's health, wife's retirement is able to impact neither on the health of the partner nor on her own health. The average partial effect indicates that the positive impact of retirement on health is quite sizable: when a man retires the probability that his own health is very good or excellent increases with 22 pp while the probability that the health of his wife is very good or excellent increases with 17 pp. If a women retires the effect on the self-perceived health of her male

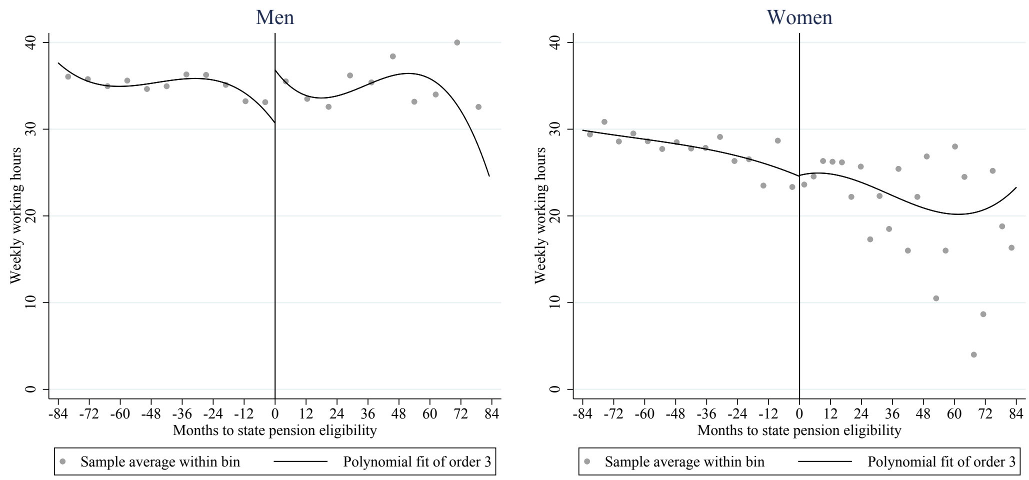
[10]Since the information on comorbidity refers to the previous 12 months, and not to the month of data collection, we merged this outcome variable with the information on retirement 12 months earlier. We lose therefore one wave of the health survey and the sample size shrinks accordingly when we estimate the impact of retirement on comorbidity.

Figure 3: Graphical illustration of discontinuity in weekly working hours (conditional on working)

(a) Couples



(b) Singles



Notes: The solid lines are obtained by regression functions based on a 3rd-order polynomial regression (with triangular kernel) of the weekly working hours on the running variable (time until age pension eligibility), fitted separately above and below the cutoff. The dots represent local sample means of disjoint bins of the running variable reported in the mid point of the bin. The number of bins and their lengths are chosen optimally using the mimicking variance integrated mean-squared error criterion. The sample is limited to couples and singles within the bandwidth of 84 months that are still at work: 1,200 (1,094) partnered men (women), 569 male singles and 858 female singles.

partner is negative with an effect on very good or excellent health of about 5 pp which is not significantly different from zero. The effect of a partnered women retiring on her own health is negligible.

Table 3: Retirement effects on self-perceived health for couples and singles

	Men			Women		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Couples						
Estimated coefficients of ordered probit model						
Husband's retirement	0.819	**	0.346	0.661	**	0.283
Wife's retirement	-0.191		0.444	0.029		0.400
Average marginal effects of husband's retirement on the probability that health is						
Poor or moderate	-0.217	**	0.092	-0.196	**	0.085
Good	-0.003		0.022	0.025		0.019
Very good or excellent	0.220	**	0.099	0.171	**	0.079
Average marginal effects of wife's retirement on the probability that health is						
Poor or moderate	0.051		0.119	-0.009		0.119
Good	0.001		0.005	0.001		0.015
Very good or excellent	-0.051		0.119	0.008		0.104
Log-likelihood	-2,255.94			-2,288.80		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 19.32$			$\chi^2(2) = 26.75$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 16.10$			$\chi^2(2) = 15.58$		
Bandwidth satisfied by both husband and wife (months)	42			42		
Number of observations (individuals)	1,221 (438)			1,221 (438)		
Kernel weights	Triangular (product of triangular weights of both partners)					
b) Singles						
Estimated coefficients of ordered probit model						
Retirement	-1.178	***	0.346	-0.193		0.393
Average marginal effects of retirement on the probability that health is						
Poor or moderate	0.364	***	0.082	0.060		0.124
Good	-0.044		0.028	-0.014		0.028
Very good or excellent	-0.320	***	0.078	-0.046		0.096
Log-likelihood	-1,157.23			-1,632.01		
Power of excluded instrument for retirement	$\chi^2(1) = 14.89$			$\chi^2(1) = 32.81$		
Bandwidth (months)	42			42		
Number of observations	802 (254)			1,162 (392)		
Kernel weights	Triangular weights					

Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are robust to within-individual correlation.

Panel b) of Table 3 depicts the relationship between retirement and self-perceived health for singles. For single men, the effects are opposite to those of partnered men. For single men, retiring has a substantial negative effect on their perceived health. The average partial effect is very large. On average, the probability that a single man is in very good or excellent health drops with 32 pp at retirement. For single women retirement also has a negative effect on self-perceived health but this is not significantly different from zero.

Table 4 shows the retirement effects on happiness in the last month. From panel a) it is clear that the retirement of men has a significant positive effect on their happiness and the happiness of their partners. These effects are quite substantial. The average marginal effects of the retirement of men increases the probability than they are continuously happy with almost

18 percentage-points. This effect of their partners being continuously happy is of the same magnitude. If women retire their own happiness is negatively though not significantly affected while the effect on their husbands is significantly positive (at a 10% level). The magnitude of the cross-partner effect for men is the same as their own happiness of retiring. If their wife retires, the probability of men being continuously happy increases with about 18 percentage-points. We can only speculate as to why retiring has a negative effect on the happiness of women. Perhaps this is due to the low employment rates among older women. This could imply that this is a selective group of women who like to work and prefer to do so rather than retire. Panel b) of Table 4 shows the happiness effects of retiring for single men and women. From this it appears that at retirement single men experience a small and insignificant effect on their happiness. For single women the retirement effect on their happiness is significantly negative. Their probability to be continuously happy drops with about 8 percentage-points at retirement.

Table 5 summarizes the estimated effects of retirement on further measures of health and happiness (Appendix B provides further estimation details similar to those in Table 3). The retirement of a man has quite a few significant effects on him and his partner. Fundamental and instrumental ADL of his wife go down significantly whereas the parameter estimates for his own fundamental and instrumental ADL are negative and substantial but not significantly different from zero. The effect of his wife are substantial. The probability of experiencing instrumental (fundamental) ADL is reduced with 30 (20) pp for the wife whose husband retires. If a man retires this has no effect on his smoking or the smoking of his wife. However, retirement of a man induces him to drink more alcohol whereas also his wife increases her alcohol consumption. If a man retires his comorbidity is reduced whereas there is no effect on the comorbidity of his wife. The retirement of a man affects various happiness and mental health indicators of both himself and his wife. Calmness is positively affected while depression is negative affected although for wives this is not significantly different from zero. Effects of a man retiring on anxiety of him and his female partner are also negative but not significantly different from zero. Retirement of a woman has hardly any effect on health and well-being of herself or her husband. Of all estimates effects only two are significantly different from zero. If a women retires her instrumental ADL goes down significantly with about 30 pp. Retiring of a partnered women has a negative and significant effect on her calmness and a negative and significant effect on depression of her male partner.

The last two columns of Table 5 provide parameter estimates for singles. For some of the dependent variables the effects of retirement are quite different. Whereas a partnered man reports an increase in health at retirement, single men report a clear drop in health at retirement.

Table 4: Retirement effects on happiness for couples and singles

	Men			Women		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Couples						
Estimated coefficients of ordered probit model						
Husband's retirement	0.800	**	0.403	1.064	***	0.333
Wife's retirement	0.819	*	0.426	-0.444		1.201
Average marginal effects of husband's retirement on the probability of happiness in the last month						
Never or seldom	-0.104		0.076	-0.126	*	0.075
Sometimes	-0.094	**	0.039	-0.138	***	0.031
Often	-0.069	**	0.031	-0.110	***	0.034
Mostly	0.090	**	0.037	0.192	***	0.045
Continuously	0.178	*	0.104	0.183	**	0.089
Average marginal effects of wife's retirement on the probability of happiness in the last month						
Never or seldom	-0.106		0.087	0.053		0.159
Sometimes	-0.097	***	0.035	0.058		0.151
Often	-0.071	***	0.020	0.046		0.109
Mostly	0.092	***	0.032	-0.080		0.198
Continuously	0.182		0.112	-0.076		0.221
Log-likelihood	-2,712.89			-2,692.07		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 15.96$			$\chi^2(2) = 26.09$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 14.15$			$\chi^2(2) = 11.95$		
Bandwidth satisfied by both husband and wife (months)	42			42		
Number of observations (individuals)	1,221 (438)			1,221 (438)		
Kernel weights	Triangular (product of triangular weights of both partners)					
b) Singles						
Estimated coefficients of ordered probit model						
Retirement	0.048		0.368	-0.483	**	0.202
Average marginal effects of retirement on the probability of happiness in the last month						
Never or seldom	-0.009		0.066	0.076	**	0.035
Sometimes	-0.008		0.062	0.086	***	0.033
Often	-0.001		0.010	0.025	**	0.011
Mostly	0.012		0.092	-0.105	***	0.038
Continuously	0.006		0.045	-0.082	**	0.039
Log-likelihood	-1,555.75			-2,232.55		
Power of excluded instrument for retirement	$\chi^2(1) = 16.12$			$\chi^2(1) = 41.04$		
Bandwidth (months)	42			42		
Number of observations	802 (254)			1,162 (392)		
Kernel weights	Triangular weights					

Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are robust to within-individual correlation.

With retirement the probability that a single man is in very good or excellent health drops by 32 pp.[11] Also for single women self-reported health drops at retirement although here the effect is not significantly different from zero. For single men retiring, smoking is reduced, while light physical activities increase at the expense of moderate physical activities. As with happiness, other mental health indicated are not affected either. For single women, strenuous physical activities go down at retirement while drinking alcohol increases.

[11]The average partial effects on self-reported health for singles are displayed in panel b) of Table 3. The average partial effects on the other outcome variables are instead reported in Appendix B.

Table 5: Summary of main parameter estimates for local linear regression by gender, bandwidth equal to 42 and triangular kernel

	Couples				Singles	
	Man retires		Woman retires			
	Own effect	Wife	Own effect	Husband	Man	Woman
General indicators						
a. Self-reported health	0.819 **	0.661 **	0.029	-0.191	-1.178 ***	-0.193
b. Happiness	0.800 **	1.064 ***	-0.444	0.819 *	0.048	-0.483 **
Physical health						
c. Fundamental ADL	-0.664	-0.643 *	-0.218	-0.264	0.238	-0.243
d. Instrumental ADL	-0.432	-0.895 ***	-0.942 **	-0.427	-0.204	-0.245
e. Comorbidity	-0.829 **	-0.271	–	–	0.914	-0.206
Mental health						
f. Calmness	0.874 **	0.800 **	-0.744 *	0.480	-0.436	-0.049
g. Depression	-0.920 **	-0.380	0.113	-0.547 *	-0.102	0.148
h. Anxiety	-0.631	-0.110	-0.222	-0.433	-0.552	-0.472
Health behavior						
j. Smoking	0.237	-0.340	0.059	0.216	-1.412 *	0.125
k. Drinking alcohol	1.159 ***	0.858 **	0.011	0.092	0.693	0.508 *

Notes: The full estimation results for row a. (b.) are presented in Table 3 (4). The full estimation results for the other rows are presented in Appendix B. * Significant at 10%; ** significant at 5%; *** significant at 1%. Inference is robust to heteroskedasticity and within-individual correlation. The number of observations (individuals) is 1,221 (438) for partnered individuals, 802 (254) for male singles and 1,162 (392) for female singles. When the dependent variable is comorbidity we lose one time period and the number of observations (individuals) is 1,052 (394) for partnered individuals, 680 (214) for male singles and 995 (327) for female singles.

5.2 Heterogeneity of the Retirement Effects by Educational Attainment

As indicated in Table 2, various life expectancy indicators differ a lot between low educated and high educated individuals. To study whether these differences have an effect on the consequences of retirement, we investigate heterogeneity by educational attainment.[12] Since we split the sample according to education and gender, we enlarge the bandwidth to 54 months to increase the number of observations in each cell determined by those covariates and limit small sample biases due to the low power of instruments (Bound et al., 1995).

The health and happiness effects of partnered men retiring are not very different by educational attainment. Although the significance level of the estimated parameters is different, the sign of the parameters is often the same. Self-reported health goes up significantly for men who retire among high educated individuals whereas for low educated individuals the effect is not significant. Whereas there are significant spill-over effects of partnered men retiring for low educated there is no such effect for high educated men. If a partnered low educated man retires, there are significant positive effects on happiness of both the man and his partner while such effects are absent for high educated men. If a partnered woman retires the cross-partner

[12] In Table 2, we report differences in life expectancy between individuals with maximum primary school and individuals with minimum higher vocational education ignoring individuals with educational attainment between these two extremes. In this sensitivity analysis, we split up the sample in two groups. Here lower educated individuals are defined as those with primary school or intermediate secondary education (VMBO). All the others are considered to be highly educated.

happiness effects are very much related to the educational attainment of the woman. For the partners of low-educated women happiness goes down significantly while for the partners of high-educated women happiness goes up.

Table 6: Summary of main parameter estimates for local linear regression by gender and education, bandwidth equal to 54 and triangular kernel

	Couples					
	Man retires		Woman retires		Singles	
	Own effect	Wife	Own effect	Husband	Man	Woman
I. Low educated individuals						
General indicators						
a. Self-reported health	**1.024**	1.036 ***	-0.352	0.389	**1.478** ***	-0.084
b. Happiness	1.112 ***	1.025 **	-0.198	-0.998 ***	**0.929**	-0.854 **
Physical health						
c. Fundamental ADL	-0.533	**-1.359**	-0.182	0.161	**-1.564** ***	-0.283
d. Instrumental ADL	-0.628	-0.619	1.038 **	-0.250	**0.179**	0.019
e. Comorbidity	-0.783 *	0.187	–	–	**1.202** **	-1.088 *
Mental health						
f. Calmness	**0.924**	0.934 **	-0.602 **	0.597	**-0.121**	-0.004
g. Depression	-0.916 **	-0.723	-0.721	-0.034	**-0.221**	0.448
h. Anxiety	-0.677 *	-0.697	0.923	-0.317	-1.383 ***	-0.360
Health behavior						
j. Smoking	0.110	-0.164	**0.603**	0.103	**-0.830**	0.523
k. Drinking alcohol	1.122 ***	0.593	0.005	0.357	**1.613**	0.649 **
Observations (individuals)	1,149 (353)	697 (221)	697 (221)	1,149 (353)	443 (120)	713 (230)
II. Highly educated individuals						
General indicators						
a. Self-reported health	0.752 ***	0.022	**0.119**	**-0.088**	-1.140 **	-0.509
b. Happiness	0.242	0.667	**-0.549**	0.948 ***	**0.370**	-0.182
Physical health						
c. Fundamental ADL	-0.862 **	-0.516 **	**-1.492** ***	**-1.188** ***	0.963 **	-0.167
d. Instrumental ADL	-0.300	-0.567	-0.919 **	**-1.232** **	**0.681**	-0.330
e. Comorbidity	-1.066 **	0.187	–	–	0.208	0.296
Mental health						
f. Calmness	0.632	0.264	**-0.717**	0.459	-0.239	-0.080
g. Depression	-0.951 *	-0.305	0.164	**-0.545**	**-0.188**	-0.212
h. Anxiety	0.015	0.080	-1.094 *	**1.229** **	**-0.043**	-0.584 *
Health behavior						
j. Smoking	**-1.131**	0.272	-0.471	**-0.217**	-0.817	-0.246
k. Drinking alcohol	-0.468	-0.469	0.682	**1.193** ***	0.216	0.372
Observations (individuals)	649 (203)	1,100 (337)	1,100 (337)	649 (203)	575 (172)	770 (229)

Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%. Inference is robust to heteroskedasticity and within-individual correlation. Lower educated individuals are those with primary school or intermediate secondary education (VMBO). We report in bold estimated parameters from models in which the explanatory power of the instrument is weak (Wald statistic of significance of the instrument in explaining the retirement indicator below 10); when this is the case, the identification is based solely on parametric restrictions and results should be interpreted with caution. The full estimation results are available from the authors upon request.

The health and happiness effects of singles retiring is at least partly related to their educational attainment. For low educated men self-reported health goes up at retirement while it goes down for high educated single men. In line with this fundamental ADL go down for low educated single men while they go up for high educated men. For single women, there is not a lot of difference in the retirement effects on health and happiness which are largely absent.

One of the exceptions is that happiness for low educated single women goes down significantly at retirement while the effect for high educated single women is much smaller and not significantly different from zero. Comorbidity of low educated single women goes down at retirement while it goes up slightly for high educated single women.

5.3 Robustness Checks

In order to check the robustness of our results to different choices of the bandwidth and of the kernels, we present here the estimation results under different choices.

Table 7 report the parameter estimates for the retirement effects on health and happiness if we stick to the local linear regression, but we do not weight the observations on the basis of distance from the cutoff. With the exception of the effects of retirement on wives' instrumental ADL and drinking alcohol, which are no longer significant, all the other findings are in line with those reported in Table 5.

Table 7: Summary of main parameter estimates for local linear regression by gender, bandwidth equal to 42 and rectangular kernel (unweighted observations)

	Couples				Singles	
	Man retires		Woman retires			
	Own effect	Wife	Own effect	Husband	Man	Woman
General indicators						
a. Self-reported health	0.704 **	0.511 *	-0.194	-0.326	-1.138 ***	-0.404
b. Happiness	0.542 **	1.016 ***	-0.110	0.588	0.222	-0.511 ***
Physical health						
c. Fundamental ADL	-0.831	-0.544 *	-0.481	0.158	0.477	-0.208
d. Instrumental ADL	-0.539	-0.586	-0.563	-0.541	0.493	-0.192
e. Comorbidity	-0.856 **	-0.246	–	–	1.193 ***	-0.286
Mental health						
f. Calmness	0.489	0.777 *	-0.236	0.454	-0.349	-0.145
g. Depression	-1.008 ***	-0.300	0.412	-0.171	0.014	0.182
h. Anxiety	-0.638	-0.071	-0.336	-0.372	-0.342	-0.336
Health behavior						
j. Smoking	-0.474	0.000	-0.331	0.220	-1.312	0.126
k. Drinking alcohol	1.139 ***	0.543	-0.115	0.183	0.674	0.260

Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%. Inference is robust to heteroskedasticity and within-individual correlation. The number of observations (individuals) is 1,221 (438) for partnered individuals, 802 (254) for male singles and 1,162 (392) for female singles. When the dependent variable is comorbidity we lose one time period and the number of observations (individuals) is 1,052 (394) for partnered individuals, 680 (214) for male singles and 995 (327) for female singles. The full estimation results are available from the authors upon request.

Table 8 display instead the results if we keep weighting the observations and stick to the local polynomial regression, but change the bandwidth and fix it to 36, 54 and 84 months. When we enlarge the bandwidth to 84 months, we allowed the functions of the forcing variables to be more flexible, by using spline continuous functions with two knots below and two knots above the cutoff. Also in these cases the results are very close to the benchmark specification. When we increase the bandwidth by keeping fixed the kernel and the order of the local polynomial regression, we are more likely to get biased estimates. We can see that the larger the bandwidth, the closer to zero the effects of the retirement on wives' instrumental ADL. This the same kind of change in these estimated effects that we could note from Table 7, as the rectangular kernel gives the same weight to all the units within the bandwidth, whereas our kernel based on the triangular weights of both partners puts more weight on couples closer to the cutoffs.

6 Validity and Falsification Tests

As suggested by McCrary (2008), a jump in the density of the running variable at the threshold would be direct evidence of the failure of the local randomization assumption. Figure 4 displays the local polynomial density estimate of the running variable described in Cattaneo et al. (2017). The graphs show that there is no evidence of discontinuity in the population density at the cutoff, for both genders and whether living in a couple or not.

If the retirement probability is locally randomized near the cutoff, then the treatment should not have an effect on the pre-treatment covariates, i.e. the treated units should be similar to control units in terms of observed characteristics. We follow Lee and Lemieux (2010) and test if the discontinuity influences our predetermined variables, by estimating a seemingly unrelated regression (SUR) with one equation for each of the predetermined variables, same weighting strategy and same bandwidth (42 months) as in the baseline estimates. After the estimation of the SUR model, we performed joint and individual tests of the significance of the discontinuities. They are reported in Table 9. The left-hand (right-hand) sides of these tables report test statistics for the dataset on health (personality). The single tests do not show systematic jumps at the cutoff: only 3 discontinuities are significantly different from 0 out of 92. All the joint tests do not reject the null hypothesis. Since we are testing the presence of discontinuities for many covariates, the joint tests suggest that the three significant discontinuities are so by random chance (Lee and Lemieux, 2010).

7 Conclusions

Due to aging populations, in many countries retirement is postponed through limiting of early retirement programs and increases in standard retirement ages. To the extent that the increase in retirement age is voluntary there is no need to worry about welfare implications. However, if individuals lack financial resources to retire if their preferred age is before the standard retirement age, then an increase in retirement age is involuntary and welfare implications might

Table 8: Summary of main parameter estimates with triangular kernel for different choices of the bandwidth and of the local regression functions

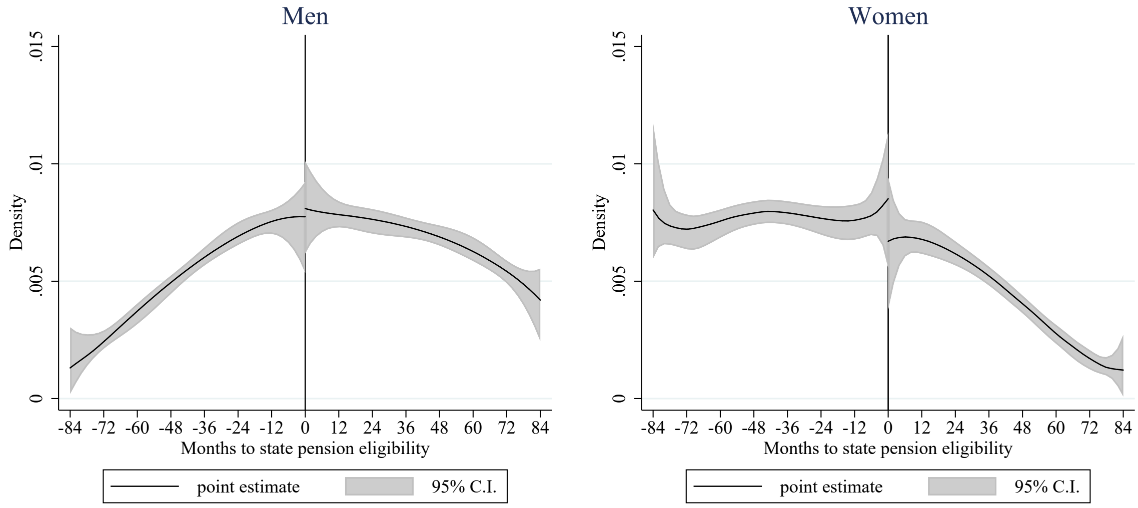
	Couples				Singles	
	Man retires		Woman retires			
	Own effect	Wife	Own effect	Husband	Man	Woman
I. Bandwidth equal to 36, local linear regression						
General indicators						
a. Self-reported health	0.887 *	0.741 **	0.156	-0.077	-1.225 ***	-0.121
b. Happiness	1.061 ***	1.097 ***	-0.447	0.852 **	0.032	-0.506 **
Physical health						
c. Fundamental ADL	-0.782	-0.692 *	-0.245	-0.464	0.075	-0.236
d. Instrumental ADL	-0.302	-0.987 ***	-1.032 ***	-0.435	-0.823	-0.270
e. Comorbidity	-0.876 **	-0.104	–	–	0.932	-0.091
Mentcal health						
f. Calmness	0.945 **	0.830 **	-0.776 *	0.538	-0.452	-0.054
g. Depression	-0.904 **	-0.482	0.280	-0.707 **	-0.125	0.189
h. Anxiety	-0.582	-0.175	-0.354	-0.499	-0.611	-0.491
Health behavior						
j. Smoking	0.481	-0.421	0.065	0.376	-1.527 **	0.109
k. Drinking alcohol	1.183 ***	0.915 **	0.041	0.105	0.808	0.585 *
Observations (individuals)	966 (388)				689 (223)	977 (344)
II. Bandwidth equal to 54, local linear regression						
General indicators						
a. Self-reported health	0.773 ***	0.594 **	-0.051	-0.257	-1.095 ***	-0.186
b. Happiness	0.499 *	0.968 ***	-0.241	0.829 **	0.146	-0.447 **
Physical health						
c. Fundamental ADL	-0.660	-0.574 *	-0.211	-0.068	0.342	-0.227
d. Instrumental ADL	-0.328	-0.738 **	-0.597	-0.457	0.231	-0.187
e. Comorbidity	-0.792 **	0.114	–	–	0.962	-0.233
Mentcal health						
f. Calmness	0.730 **	0.730 **	-0.401	0.482	-0.373	-0.040
g. Depression	-0.853 **	-0.350	0.200	-0.180	-0.087	0.145
h. Anxiety	-0.615	-0.103	-0.174	-0.331	-0.570	-0.422 *
Health behavior						
j. Smoking	-0.190	-0.222	-0.164	0.263	-1.174	0.109
k. Drinking alcohol	1.079 ***	0.708 **	-0.036	0.092	0.622	0.406 *
Observations (individuals)	1,800 (555)				1,018 (288)	1,486 (452)
III. Bandwidth equal to 84, local spline continuous regression[(a)]						
General indicators						
a. Self-reported health	0.783 ***	0.477 *	-0.135	-0.334	-0.953 **	-0.323
b. Happiness	0.489 **	0.925 ***	-0.189	0.869 ***	0.079	-0.549 ***
Physical health						
c. Fundamental ADL	-0.801	-0.645 **	-0.308	0.320	0.212	-0.059
d. Instrumental ADL	-0.521	-0.718	-0.996	-0.212	-1.129	-0.088
e. Comorbidity	-0.732 ***	0.147	–	–	0.527	-0.232
Mentcal health						
f. Calmness	0.586 *	0.740 ***	-0.333	0.156	-0.298	-0.075
g. Depression	-0.840 ***	-0.247	0.514	0.253	-0.325	0.270
h. Anxiety	-0.617	-0.185	0.168	-0.077	-0.661	-0.391
Health behavior						
j. Smoking	-0.283	-0.199	-0.299	-0.002	-1.434 *	0.166
k. Drinking alcohol	0.908 ***	0.773 ***	-0.118	0.008	0.693	0.415
Observations (individuals)	3,102 (753)				1,534 (407)	2,284 (624)

Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%. Inference is robust to heteroskedasticity and within-individual correlation. The full estimation results are available from the authors upon request.

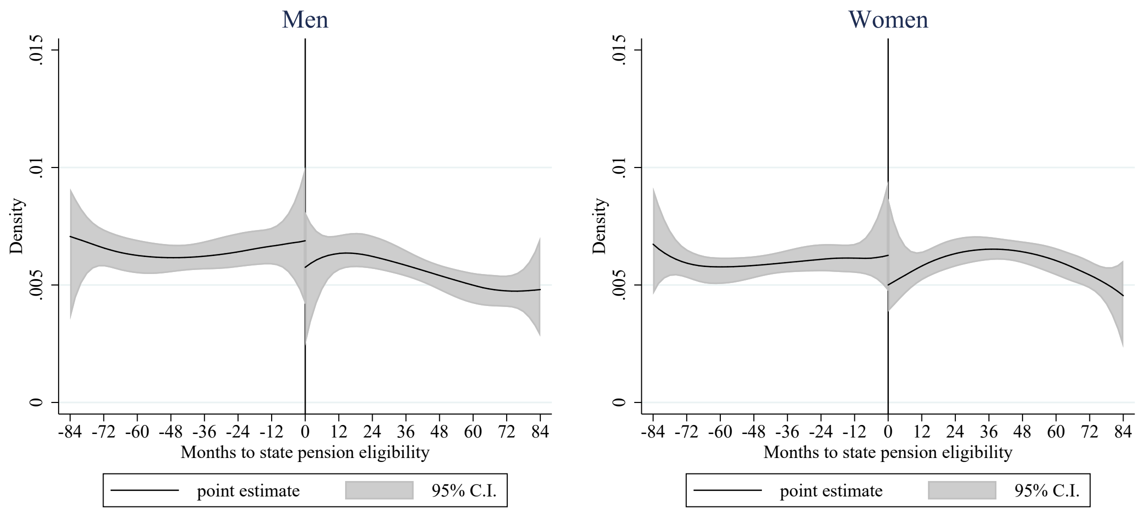
[(a)] The spline continuous functions have two knots below and two knots above the cutoff. The knots are at 28 and 56 months below and above the cutoff.

Figure 4: Graphical density test of the running variable

(a) Couples



(b) Singles



Notes: The solid line is the the local polynomial density estimate of the running variable described in Cattaneo et al. (2017). The local polynomial is of order 3. The robust bias-corrected test proposed in Cattaneo et al. (2017) cannot reject the null hypothesis of the absence of discontinuity: p-value equal to 0.557 (0.377) for men (women) for couples; p-value equal to 0.384 (0.648) for men (women) for singles.

Table 9: Falsification test: discontinuity of the predetermined variables at the cutoff for couples (SUR estimation, bandwidth equal to 42 and triangular kernel weights)

	Couples				Singles	
Significance test of discontinuity at:[(a)]	male cutoff		female cutoff		cutoff	
	t-stat	p-value	t-stat	p-value	t-stat	p-value
Husband's education						
Primary/Intermediate secondary	1.41	0.159	0.28	0.783	0.71	0.481
Higher secondary/Tertiary	0.18	0.859	0.02	0.982	-0.84	0.403
Vocational	-1.48	0.139	-0.28	0.776	-0.09	0.929
Wife's education						
Primary/Intermediate secondary	-0.85	0.397	-1.92	0.055		
Higher secondary/Tertiary	0.46	0.648	1.28	0.199		
Vocational	0.64	0.525	1.45	0.147		
Year of the survey						
2007	-0.86	0.392	-0.75	0.453	0.61	0.542
2008	-1.13	0.257	0.72	0.471	0.26	0.793
2009	0.88	0.381	0.28	0.782	-1.08	0.279
2010	-0.55	0.580	-1.16	0.248	-0.66	0.511
2011	0.05	0.963	-0.31	0.760	2.44	0.015
2012	0.74	0.457	1.59	0.113	-1.32	0.187
2013	-0.48	0.628	-0.21	0.835	-0.20	0.839
2014	–	–	–	–	–	–
2015	1.28	0.202	-0.79	0.432	-0.98	0.328
2016	-0.51	0.609	-0.20	0.842	1.42	0.157
2017	0.79	0.432	0.62	0.535	-0.43	0.666
Degree of urbanization of place of residence						
Very or extremely urban	-0.07	0.947	0.92	0.356	0.11	0.916
Moderately urban	0.32	0.752	-1.11	0.266	0.43	0.665
Slightly or not urban	0.15	0.878	0.16	0.874	-0.71	0.480
Presence of children in the household	1.85	0.064	-0.79	0.430	1.76	0.079
Joint significance test of discontinuities[(a)]	$\chi^2(17) = 13.63$		$\chi^2(17) = 20.33$		$\chi^2(16) = 17.33$	
	p-value $= 0.693$		p-value $= 0.258$		p-value $= 0.299$	
Observations (individuals)	1,221 (438)				1,964 (646)	

[(a)] The test statistics are robust to heteroskedasticity and within-individual correlation.

need to be taken into account. The welfare implications of postponing retirement will depend among others on health and well-being consequences.

In previous studies, the empirical evidence on the effects of retirement on health is mixed. Some studies find a positive effect, other studies conclude there is no effect or a negative effect. We use Dutch data to study how retirement affected health and happiness. To establish causal effects of retirement on health and happiness we use an RDD which exploits the age of eligibility to the state pension. Since this eligibility age is determined only by year and month of birth, it has an exogenous effect on the retirement decisions.

For both men and women, there is a clear discontinuity in the probability to retire at the eligibility age for the state pension. Therefore, we can identify the effects of the retirement of men on their own health and happiness and the health and happiness of their wives and similarly, we can establish the effect of a women's retirement on her own health and happiness and those of her husband.

Our main findings are the following. The retirement of a man has quite a few significant health effects on him and his partner. Self-assessed health improves for both the retiree and his partner. Furthermore, fundamental and instrumental ADL of his wife go down significantly and substantially. If a man retires this has no effect on his smoking or the smoking of his wife but both the retiree and his wife drink more alcohol. Finally, if a man retires his comorbidity is reduced. The retirement of a man also has various positive effects on mental health, i.e. happiness and calmness are improved for both the retiree and his partner and depression decreases only for the retiree. Contrary to the health and happiness effects of a man retiring, retirement of a woman has hardly any effect on health and well-being of herself or her husband. All in all, it seems that increasing the eligibility age of the state pension has negative effects on the health and happiness of male workers and their wives. For females workers increasing the eligibility age of the state pension is less of an issue.

Our findings on single men and women sometimes differ substantially from those on partnered men and women. For example for single women, the drop in happiness at retirement is significantly negative. Single men retiring experience a drop in self-assessed health. As to heterogeneity, we focus on the effects of educational attainment. In the Netherlands, life expectancy along various dimensions including life expectancy in good health and good mental health differs a lot depending on educational attainment. High educated individuals live much longer and in better health than low educated workers. This raises the question how educational attainment relates to health and happiness effects at retirement. We find that these effects are related. We find that the drop in health among single men is due to the experience among high educated men. Self-perceived health of low educated men goes up at retirement. The increase in happiness if partnered women retire among their partners is driven by high educated women. Low educated single women experience a drop in happiness at retirement. Happiness of partnered low educated men and their partner increases when they retire while there is no such effect for high educated partnered men. Sometimes cross-partnered effects are related to educational attainment. When low educated women retire it reduces the happiness of their partners while retirement of high educated women increases the happiness of their partners.

Because of the heterogeneity in the retirement effects according to marital status and educational attainment it is difficult to draw clear policy conclusions. Whereas for partnered men retirement has positive health and happiness effects, for single men the health effects are only positive for low educated men. Whereas for high educated partnered women retiring has a positive effect on the happiness of the partner this is opposite for low educated women. Also low educated single women face a drop in happiness at retirement. A possible reason for the differences by educational attainment is that the financial consequences of retirement are more severe for low educated and thus low income groups. There are substantial differences in life expectancy at age 65 according to educational attainment. A further increase in retirement eligibility age will cause low educated workers to postpone their increase in health and happiness to later. For low educated workers, retiring earlier is often not an option because of financial reasons. Low educated workers are more restricted in the sense that they have to wait until they reach the state pension retirement age before they can actually retire. For high educated workers, retiring earlier is an easier option from a financial point of view. Taking into account the differences in life expectancy and the health and happiness effects of retiring, we conclude that those who benefit from retirement the most are the least likely to get it early.

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Appendix

A. Details on Our Data

A.1. Sample Selection

Between 5,072 and 6,698 individuals were interviewed each year for the core study on health from 2007 until 2017, resulting in a total of 58,103 records. We matched each record on the basis of the information on the year and month of interview to the corresponding information about the retirement status and age in months coming from the background variables.[13] We were able to match 57,445 records, belonging to 12,832 different individuals. Given the aim of this paper, we restricted the sample to individuals close to the moment of the state pension eligibility. After defining according to the rules outlined in Table 1 a variable which measures the distance in months from the month in which an individual becomes eligible to the state pension, we kept all the observations who were within 84 months away from the month of the state pension eligibility at the moment of the interview. The sample size shrank therefore to 15,024 observations. Since the aim is to unveil, not only the effect of retirement on his/her-own health and well-being, but also to identify the impact on partner's outcome variables, we restrict the sample to couples both answering the questionnaire on health (3,212 couples) and to singles (3,863 observations).

Finally, we dropped from the samples 35 couples (and 19 singles) for which at least one partner is interviewed in the month in which the eligibility to the state pension is attained. This refinement is due to a kind of heaping problem (Barreca et al., 2016) or rounding error (Dong, 2015). From 1 January 2012, the state pension eligibility is indeed received from the day in which one satisfies the age requirement. Since we do not have the day of birth, but only the month in which an individual becomes eligible to the state pension, we cannot be sure, for those interviewed in the month in which they become eligible to the state pension, whether they are already eligible at the moment of the interview or they will be soon eligible to the state pension. Although this kind of error is likely to be randomly distributed across those observations interviewed in the month of state pension eligibility, it is present only above the cutoff (Lee and Card, 2008). Given the small number of such observations, omitting them from the sample is the easiest way of facing the problem and getting unbiased estimates of the treatment effect for all the others (Barreca et al., 2016). The remaining sample has 3,177 records of couples and 3,844 singles. Along the paper, we used different subsamples, depending on the chosen bandwidth. For example, when the chosen bandwidth is 42 (for couples satisfied

[13] Since not all the respondents to the health survey responded in the same month also to the monthly background variables, we could not match 658 observations.

by both partners), the sample is made up of 1,221 couples and 1,964 singles (802 men and 1,162 women). When the chosen bandwidth is 84 months, the observations with strictly positive triangular kernel weight are 3,102 for couples and 3,818 for singles (1,534 men and 2,284 women).

A.2. Definition of Variables and Descriptives

Table A.1 clarifies the discrete nature of the outcome variables and the meaning attached to the numeric values. Table A.2 provides descriptive statistics of the retirement indicator and the outcome variables

Table A.1: Outcome indicators

Measure	Question	Ordered values
General indicators		
a. Self-perceived health	How would you describe your health, generally speaking?	1. poor or moderate 2. good 3. very good or excellent
b. Happiness in the last month	I felt happy…	1. never or seldom – 2. sometimes 3. often – 4. mostly – 5. continuously
Physical health		
c. Fundamental ADL limitations	Can you… walk 100 meters? get up from a chair in which you sat for some time? walk up a staircase without resting? crouch, kneel, crawl on all fours? reach or stretch your arms above shoulder height? move large objects such as a dining room chair? dress and undress, including shoes and socks? walk across the room? bathing or showering? eat, such as cutting your food into small bits? get in and out of bed? use the toilet, including sitting down and standing up?	1. yes, without difficulty 2. at least one minor difficulty 3. at least one major difficulty
d. Instrumental ADL limitations	Can you… read a map to find your way in an unfamiliar area? prepare a hot meal? shop? telephone? take medicines? perform housekeeping work or maintain the garden? take care of financial affairs, such as paying bills and keeping track of expenditure?	1. yes, without difficulty 2. at least one minor difficulty 3. at least one major difficulty
e. Comorbidity	Has a physician told you this last year that you suffer from one of the following? angina heart attack high blood pressure or hypertension high cholesterol a stroke or brain infarction or a disease affecting the blood vessels in the brain diabetes or a too high blood sugar level chronic lung disease asthma arthritis, including osteoarthritis, or rheumatism, bone decalcification or osteoporosis cancer a gastric ulcer or duodenal ulcer, peptic ulcer Parkinson's disease Alzheimer, dementia, organic brain syndrome, senility, other serious memory problem	0. no disease 1. one disease 2. two diseases 3. three or more diseases
Mental health		
f. Calmness in the last month	I felt calm and peaceful…	1. never or seldom – 2. sometimes 3. often – 4. mostly – 5. continuously
g. Depressed in the last month	How did you feel over the past month? I felt depressed and gloomy…	1. never – 2. seldom – 3. sometimes 4. often, mostly, or continuously
h. Anxiety in the last month	I felt very anxious…	1. never – 2. seldom 3. sometimes or more often
Health behavior		
j. Smoking cigarettes	Do you smoke now?	0. no – 1. yes
k. Drinking alcohol	On how many of the past seven days did you have a drink containing alcohol?	Integers from 0 to 7

Table A.2: Descriptive statistics of the outcome variables

	Couples			Singles		
	Means		p-value of t test on the equality of the means	Means		p-value of t test on the equality of the means
	Not retired	Retired		Not retired	Retired	
Men's self-perceived health	1.923	2.003	0.043	1.889	1.966	0.098
Women's self-perceived health	1.902	2.000	0.008	1.863	1.964	0.007
Men's last month happiness	3.338	3.623	0.000	2.899	3.105	0.012
Women's last month happiness	3.460	3.514	0.342	3.155	3.159	0.945
Men's fundamental ADL	1.938	1.724	0.000	1.926	1.870	0.283
Women's fundamental ADL	2.022	1.908	0.010	2.036	1.940	0.034
Men's instrumental ADL	1.683	1.474	0.000	1.706	1.575	0.018
Women's instrumental ADL	1.747	1.643	0.014	1.782	1.721	0.172
Men's comorbidity	0.866	0.994	0.091	1.017	0.923	0.276
Women's comorbidity	0.977	0.920	0.407	1.036	1.060	0.715
Men's calmness	3.566	3.632	0.314	3.250	3.459	0.007
Women's calmness	3.265	3.505	0.000	3.165	3.342	0.006
Men's depression	1.729	1.674	0.309	2.054	1.911	0.043
Women's depression	1.946	1.842	0.057	2.068	1.998	0.212
Men's anxiety	1.794	1.711	0.090	1.966	1.806	0.004
Women's anxiety	2.054	1.893	0.001	2.054	1.967	0.068
Men's smoking	0.194	0.110	0.000	0.386	0.236	0.000
Women's smoking	0.174	0.109	0.002	0.200	0.211	0.655
Men's drinking	3.529	3.612	0.642	2.841	3.289	0.024
Women's drinking	3.319	2.308	0.000	1.993	2.640	0.000

Notes: Observations are restricted to those used in the baseline estimates. The number of observations is 1,221 for partnered individuals, 802 for male singles and 1,162 for female singles. When the dependent variable is comorbidity we lose one time period and the number of observations is 1,052 for partnered individuals, 680 for male singles and 995 for female singles.

B. Full Set of Estimation Results

Table B.1: Retirement effects on fundamental ADL for couples

	Men		Women		
	Coeff.	Std. Err.	Coeff.		Std. Err.
a) Couples					
Estimated coefficients of ordered probit model					
Husband's retirement	-0.664	0.713	-0.643	*	0.348
Wife's retirement	-0.264	0.497	-0.218		0.617
Average marginal effects of husband's retirement on the probability of having					
No difficulties	0.234	0.239	0.215	*	0.114
At least one minor difficulty	-0.072	0.065	-0.014		0.016
At least one major difficulty	-0.163	0.176	-0.202	*	0.107
Average marginal effects of wife's retirement on the probability of having					
No difficulties	0.093	0.172	0.073		0.205
At least one minor difficulty	-0.028	0.050	-0.005		0.014
At least one major difficulty	-0.065	0.123	-0.068		0.192
Log-likelihood	-2,369.96		-2,446.13		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 17.92$		$\chi^2(2) = 23.88$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 16.90$		$\chi^2(2) = 15.38$		
Bandwidth satisfied by both husband and wife (months)	42		42		
Number of observations (individuals)	1,221 (438)		1,221 (438)		
Kernel weights	Triangular (product of triangular weights of both partners)				
b) Singles					
Estimated coefficients of ordered probit model					
Retirement	0.238	0.550	-0.243		0.251
Average marginal effects of retirement on the probability of having					
No difficulties	-0.082	0.188	0.082		0.084
At least one minor difficulty	0.012	0.028	-0.001		0.006
At least one major difficulty	0.069	0.161	-0.081		0.083
Log-likelihood	-1,237.36		-1,789.33		
Power of excluded instrument for retirement	$\chi^2(1) = 17.27$		$\chi^2(1) = 37.82$		
Bandwidth (months)	42		42		
Number of observations	802 (254)		1,162 (392)		
Kernel weights	Triangular weights				

Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are robust to within-individual correlation.

Table B.2: Retirement effects on instrumental ADL

	Men			Women		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Couples						
Estimated coefficients of ordered probit model						
Husband's retirement	-0.432		0.687	-0.895	***	0.294
Wife's retirement	-0.427		0.932	-0.942	**	0.388
Average marginal effects of husband's retirement on the probability of having						
No difficulties	0.156		0.235	0.299	***	0.091
At least one minor difficulty	-0.075		0.103	-0.078	**	0.034
At least one major difficulty	-0.081		0.134	-0.221	***	0.075
Average marginal effects of wife's retirement on the probability of having						
No difficulties	0.154		0.322	0.314	***	0.111
At least one minor difficulty	-0.074		0.138	-0.082	***	0.018
At least one major difficulty	-0.080		0.184	-0.232	**	0.107
Log-likelihood	-2,240.37			-2,351.06		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 21.79$			$\chi^2(2) = 19.11$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 14.79$			$\chi^2(2) = 16.35$		
Bandwidth satisfied by both husband and wife (months)	42			42		
Number of observations (individuals)	1,221 (438)			1,221 (438)		
Kernel weights	Triangular (product of triangular weights of both partners)					
b) Singles						
Estimated coefficients of ordered probit model						
Retirement	-0.204	1.779		-0.245		0.259
Average marginal effects of retirement on the probability of having						
No difficulties	0.079		0.682	0.095		0.100
At least one minor difficulty	-0.029		0.249	-0.030		0.031
At least one major difficulty	-0.050		0.433	-0.065		0.069
Log-likelihood	-1,191.36			-1,741.79		
Power of excluded instrument for retirement	$\chi^2(1) = 12.21$			$\chi^2(1) = 37.23$		
Bandwidth (months)	42			42		
Number of observations	802 (254)			1,162 (392)		
Kernel weights	Triangular weights					

Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are robust to within-individual correlation.

Table B.3: Retirement effects on comorbidity in the last 12 months

	Men			Women		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Couples						
Estimated coefficients of ordered probit model						
Husband's retirement	-0.829	**	0.372	-0.271		0.536
Average marginal effects of husband's retirement on the probability of being diagnosed in the last year						
No disease	0.303	**	0.125	0.105		0.207
One disease	-0.037	**	0.016	-0.016		0.031
Two diseases	-0.086	***	0.029	-0.029		0.055
Three or more diseases	-0.181	*	0.088	-0.060	***	0.122
Log-likelihood	-1,763.26			-1,787.96		
Power of excluded instruments for husband's retirement	$\chi^2(1) = 20.90$			$\chi^2(1) = 29.24$		
Bandwidth satisfied by both husband and wife (months)	42			42		
Number of observations (individuals)	1,052 (394)			1,052 (394)		
Kernel weights	Triangular weights					
b) Singles						
Estimated coefficients of ordered probit model						
Retirement	0.914		0.765	-0.206		0.450
Average marginal effects of retirement on the probability of being diagnosed in the last year						
No disease	-0.326		0.245	0.076		0.164
One disease	0.036		0.018	-0.008		0.017
Two diseases	0.082		0.038	-0.024		0.052
Three or more diseases	0.208		0.203	-0.044		0.097
Log-likelihood	-1,171.08			-1,746.55		
Power of excluded instrument for retirement	$\chi^2(1) = 8.19$			$\chi^2(1) = 27.58$		
Bandwidth (months)	42			42		
Number of observations	680 (214)			995 (327)		
Kernel weights	Triangular weights					

Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are robust to within-individual correlation.

Table B.4: Retirement effects on feeling calm and peaceful in the last month

	Men			Women		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Couples						
Estimated coefficients of ordered probit model						
Husband's retirement	0.874	***	0.282	0.800	**	0.359
Wife's retirement	0.480		0.626	-0.744	*	0.430
Average marginal effects of husband's retirement on the probability of feeling calm and peaceful in the last month						
Never or seldom	-0.123	**	0.056	-0.135	*	0.078
Sometimes	-0.061	***	0.017	-0.094	***	0.034
Often	-0.095	***	0.028	-0.061	***	0.023
Mostly	0.093	***	0.032	0.142	***	0.052
Continuously	0.185	**	0.072	0.148	*	0.083
Average marginal effects of wife's retirement on the probability of feeling calm and peaceful in the last month						
Never or seldom	-0.067		0.098	0.125		0.093
Sometimes	-0.033		0.040	0.087	**	0.038
Often	-0.052		0.056	0.057	***	0.019
Mostly	0.051		0.054	-0.132	***	0.048
Continuously	0.102		0.140	-0.137		0.101
Log-likelihood	-2,597.26			-2,770.07		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 18.14$			$\chi^2(2) = 25.90$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 16.53$			$\chi^2(2) = 17.40$		
Bandwidth satisfied by both husband and wife (months)	42			42		
Number of observations (individuals)	1,221 (438)			1,221 (438)		
Kernel weights	Triangular (product of triangular weights of both partners)					
b) Singles						
Estimated coefficients of ordered probit model						
Retirement	-0.436		0.297	-0.049		0.238
Average marginal effects of retirement on the probability of feeling calm and peaceful in the last month						
Never or seldom	0.065		0.049	0.008		0.037
Sometimes	0.059		0.037	0.008		0.037
Often	0.040		0.024	0.004		0.019
Mostly	-0.099		0.061	-0.012		0.058
Continuously	-0.064		0.048	-0.007		0.035
Log-likelihood	-1,464.58			-2,145.50		
Power of excluded instrument for retirement	$\chi^2(1) = 18.54$			$\chi^2(1) = 38.73$		
Bandwidth (months)	42			42		
Number of observations	802 (254)			1,162 (392)		
Kernel weights	Triangular weights					

Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are robust to within-individual correlation.

Table B.5: Retirement effects on feeling depressed and gloomy in the last month

	Men			Women	
	Coeff.		Std. Err.	Coeff.	Std. Err.
a) Couples					
Estimated coefficients of ordered probit model					
Husband's retirement	-0.920	**	0.387	-0.380	0.404
Wife's retirement	-0.548	*	0.312	0.113	1.522
Average marginal effects of husband's retirement on the probability of feeling depressed and gloomy in the last month					
Never	0.321	***	0.120	0.144	0.151
Seldom	-0.096	***	0.027	-0.025	0.026
Sometimes	-0.119	***	0.037	-0.063	0.065
Often/Mostly/Continuously	-0.106		0.068	-0.055	0.062
Average marginal effects of wife's retirement on the probability of feeling depressed and gloomy in the last month					
Never	0.191	*	0.102	-0.043	0.577
Seldom	-0.057	**	0.026	0.008	0.101
Sometimes	-0.071	**	0.036	0.019	0.254
Often/Mostly/Continuously	-0.063		0.047	0.016	0.222
Log-likelihood	-2,438.77			-2,644.62	
Power of excluded instruments for husband's retirement	$\chi^2(2) = 12.79$			$\chi^2(2) = 26.30$	
Power of excluded instruments for wife's retirement	$\chi^2(2) = 17.04$			$\chi^2(2) = 12.61$	
Bandwidth satisfied by both husband and wife (months)	42			42	
Number of observations (individuals)	1,221 (438)			1,221 (438)	
Kernel weights	Triangular (product of triangular weights of both partners)				
b) Singles					
Estimated coefficients of ordered probit model					
Retirement	-0.102		0.531	0.148	0.314
Average marginal effects of retirement on the probability of feeling depressed and gloomy in the last month					
Never	0.038		0.198	-0.053	0.114
Seldom	-0.006		0.032	0.004	0.008
Sometimes	-0.016		0.085	0.029	0.060
Often/Mostly/Continuously	-0.016		0.082	0.021	0.046
Log-likelihood	-1,391.19			-1,997.94	
Power of excluded instrument for retirement	$\chi^2(1) = 16.73$			$\chi^2(1) = 34.16$	
Bandwidth (months)	42			42	
Number of observations	802 (254)			1,162 (392)	
Kernel weights	Triangular weights				

Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are robust to within-individual correlation.

Table B.6: Retirement effects on feeling anxious in the last month

	Men		Women	
	Coeff.	Std. Err.	Coeff.	Std. Err.
a) Couples				
Estimated coefficients of ordered probit model				
Husband's retirement	-0.631	0.908	-0.111	0.510
Wife's retirement	-0.433	0.492	-0.222	1.449
Average marginal effects of husband's retirement on the probability of feeling anxious in the last month				
Never	0.233	0.120	0.038	0.174
Seldom	-0.070	0.027	-0.000	0.003
Sometimes or more often	-0.163	0.037	-0.038	0.172
Average marginal effects of wife's retirement on the probability of feeling anxious in the last month				
Never	0.160	0.218	0.076	0.493
Seldom	-0.048	0.054	-0.000	0.007
Sometimes or more often	-0.112	0.167	-0.076	0.487
Log-likelihood	-2,397.444		-2,468.58	
Power of excluded instruments for husband's retirement	$\chi^2(2) = 8.30$		$\chi^2(2) = 25.38$	
Power of excluded instruments for wife's retirement	$\chi^2(2) = 17.13$		$\chi^2(2) = 12.52$	
Bandwidth satisfied by both husband and wife (months)	42		42	
Number of observations (individuals)	1,221 (438)		1,221 (438)	
Kernel weights	Triangular (product of triangular weights of both partners)			
b) Singles				
Estimated coefficients of ordered probit model				
Retirement	-0.552	0.602	-0.472	0.300
Average marginal effects of retirement on the probability of feeling anxious in the last month				
Never	0.201	0.211	0.162	0.101
Seldom	-0.036	0.035	0.001	0.008
Sometimes or more often	-0.164	0.177	-0.163	0.102
Log-likelihood	-1,250.96		-1,791.26	
Power of excluded instrument for retirement	$\chi^2(1) = 16.29$		$\chi^2(1) = 38.88$	
Bandwidth (months)	42		42	
Number of observations	802 (254)		1,162 (392)	
Kernel weights	Triangular weights			

Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are robust to within-individual correlation.

Table B.7: Retirement effects on smoking

	Men			Women		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Couples						
Estimated coefficients of probit model						
Husband's retirement	0.237		0.422	-0.340		0.592
Wife's retirement	0.216		0.638	0.059		0.547
Average marginal effects of husband's retirement on the probability of						
Smoking	0.053		0.098	-0.074		0.129
Average marginal effects of wife's retirement on the probability of						
Smoking	0.048		0.147	0.013		0.120
Log-likelihood	-1,615.38			-3,992.96		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 29.82$			$\chi^2(2) = 26.01$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 13.14$			$\chi^2(2) = 15.74$		
Bandwidth satisfied by both husband and wife (months)	42			42		
Number of observations (individuals)	1,221 (438)			1,221 (438)		
Kernel weights	Triangular (product of triangular weights of both partners)					
b) Singles						
Estimated coefficients of probit model						
Retirement	-1.412	*	0.790	0.125		0.250
Average marginal effects of retirement on the probability of						
Smoking	-0.421	**	0.186	0.035		0.071
Log-likelihood	-874.43			-1,137.65		
Power of excluded instrument for retirement	$\chi^2(1) = 12.58$			$\chi^2(1) = 38.49$		
Bandwidth (months)	42			42		
Number of observations	802 (254)			1,162 (392)		
Kernel weights	Triangular weights					

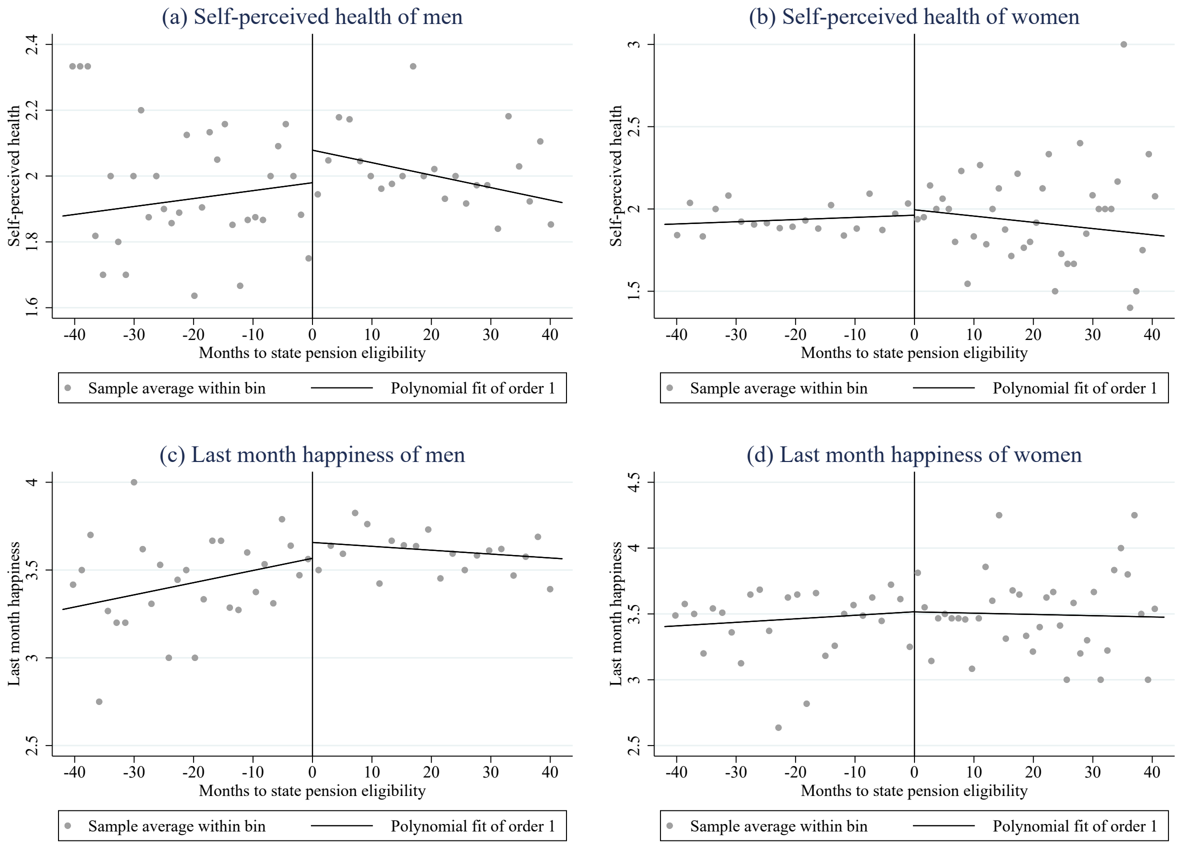
Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are robust to within-individual correlation.

Table B.8: Retirement effects on drinking alcohol in last 7 days

	Men			Women		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Couples						
Estimated coefficients of ordered probit model						
Husband's retirement	1.159	***	0.222	0.858	**	0.399
Wife's retirement	0.092		0.386	0.011		0.523
Average marginal effects of husband's retirement on the probability of drinking alcohol in the last week						
Never	-0.328	***	0.062	-0.296	**	0.126
1 day	-0.040	***	0.008	-0.014	**	0.006
2 days	-0.035	***	0.008	-0.002		0.005
3 days	-0.011	**	0.005	0.013	**	0.005
4 days	0.001		0.004	0.017	***	0.005
5 days	0.011	**	0.005	0.026	***	0.008
6 days	0.024	***	0.006	0.027	***	0.010
7 days	0.377	***	0.072	0.231	**	0.112
Average marginal effects of wife's retirement on the probability of drinking alcohol in the last week						
Never	-0.026		0.109	-0.004		0.180
1 day	-0.003		0.013	-0.000		0.009
2 days	-0.003		0.011	-0.000		0.001
3 days	-0.001		0.003	0.000		0.008
4 days	0.000		0.001	0.000		0.010
5 days	0.001		0.004	0.000		0.016
6 days	0.002		0.008	0.000		0.016
7 days	0.030		0.125	0.003		0.141
Log-likelihood	-3,477.18			-3,336.52		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 28.79$			$\chi^2(2) = 31.04$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 17.30$			$\chi^2(2) = 14.71$		
Bandwidth satisfied by both husband and wife (months)	42			42		
Number of observations (individuals)	1,221 (438)			1,221 (438)		
Kernel weights	Triangular (product of triangular weights of both partners)					
b) Singles						
Estimated coefficients of ordered probit model						
Retirement	0.693		0.670	0.508	*	0.288
Average marginal effects retirement on the probability of drinking alcohol in the last week						
Never	-0.219		0.203	-0.189	*	0.103
1 day	-0.025		0.018	-0.006		0.004
2 days	-0.013		0.011	0.008		0.005
3 days	0.004		0.004	0.015	*	0.008
4 days	0.011		0.007	0.019	*	0.010
5 days	0.021		0.015	0.020	*	0.011
6 days	0.028		0.021	0.021	*	0.012
7 days	0.193		0.190	0.112	*	0.065
Log-likelihood	-1,927.85			-2,612.07		
Power of excluded instrument for retirement	$\chi^2(1) = 13.40$			$\chi^2(1) = 38.97$		
Bandwidth (months)	42			42		
Number of observations	802 (254)			1,162 (392)		
Kernel weights	Triangular weights					

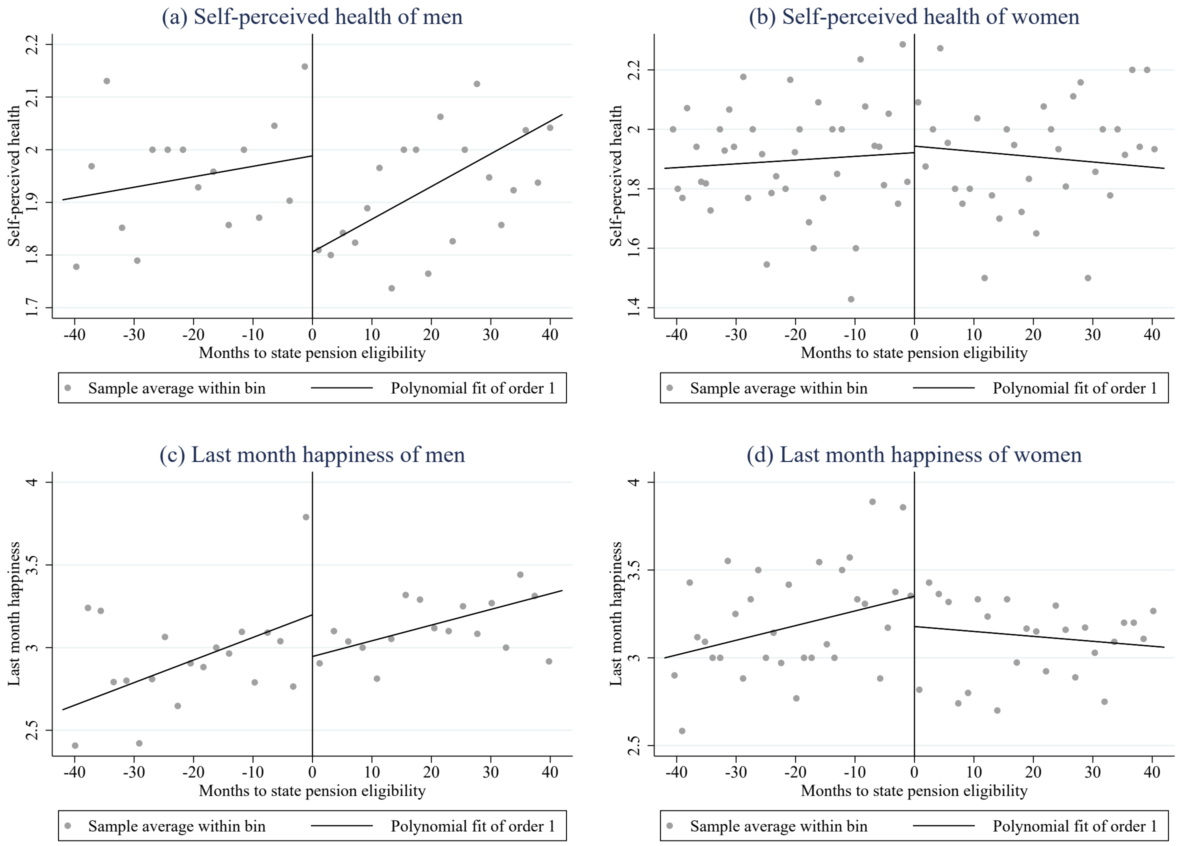
Notes: * Significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are robust to within-individual correlation.

Figure 5: Graphical illustration of discontinuity in self-perceived health and happiness for couples by gender



Notes: The solid lines are obtained by regression functions based on a 1st-order polynomial regression (with triangular kernel) of the self-perceived health or last month happiness variables on the running variable (time until age pension eligibility), fitted separately above and below the cutoff. The dots represent local sample means of disjoint bins of the running variable reported in the mid point of the bin. The number of bins and their lengths are chosen optimally using the mimicking variance integrated mean-squared error criterion. The sample is limited to the 1,221 couples within the 42-month bandwidth.

Figure 6: Graphical illustration of discontinuity in self-perceived health and happiness for singles by gender



Notes: The solid lines are obtained by regression functions based on a 1st-order polynomial regression (with triangular kernel) of the self-perceived health or last month happiness variables on the running variable (time until age pension eligibility), fitted separately above and below the cutoff. The dots represent local sample means of disjoint bins of the running variable reported in the mid point of the bin. The number of bins and their lengths are chosen optimally using the mimicking variance integrated mean-squared error criterion. The sample is limited to 802 single men and 1,162 single women within the 42-month bandwidth.