The Causal Effect of Retirement on Health and Happiness*

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Abstract

We study the effect of retirement on health and happiness using a fuzzy regression discontinuity design based on eligibility age to old age state pension in the Netherlands. In the recent past, the state pension age has been gradually increased. We find that retirement of women has hardly any effect on their health or happiness. Retirement of men has positive effects on self-perceived health and well-being indicators of both themselves and their partner.

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

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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 would increase health and 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. Previous studies differ in terms of method of identification, cross-country or individual country data and dependent variable of interest. We provide a brief overview of previous studies starting with cross-country studies followed by individual country studies and concluding with some overview studies.

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 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.

Using Dutch data, Kerkhofs and Lindeboom (1997) is one of the first studies dealing with the relationship between retirement and health. Using 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 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 do, 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 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 with 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.

Kesavayuth et al. (2016) use instrumental variable approach based on retirement eligibility ages for UK basic state pension to study well-being effects of retirement. They find that overall there is not effect. However, the effect is heterogeneous and 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 the 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.

Nielsen (2017), using Danish data and an RDD exploiting a discontinuity in the age-retirement profile at age 60, finds no significant effect on mortality but does find a reduction in the use of healthcare services. Shai (2018) exploits an increase in the standard retirement age for Israeli men from 65 to 67 to find that employment at older ages has a negative health effect in particular for low-educated workers.

van der Heide et al. (2013) provide an overview of longitudinal studies on the health effects of retirement concluding that the effects on general health and physical health are unclear, while there seem to be beneficial effects on mental health. Nishimura et al. (2017) 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. 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.

In our paper, we study the effect of retirement on health and happiness in the Netherlands. Since in the Netherlands early retirement is diminishing 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. 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 the 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 effects.

The set-up of our paper is as follows. Section 2 describes the Dutch pension system and elucidated which features are exploited to identify the causal effect of retirement on outcome variables of interest. In Section 3 we present the econometric model, the identification assumptions, and the samples used in the econometric analysis. Section 4 displays and comments on the main estimation results. A set of validity and falsification tests are presented in Section 5. Finally, Section 6 concludes.

2 Institutional Set-up

The Dutch pension system consists of three pillars: state pension (called AOW), collective pensions, 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 pensions has a fixed age for benefit collection which depends on birth cohort only. Therefore, we focus on how the state pension through 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

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

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. In practice, hardly anyone keeps working after reaching the state pension age, if only because employers can terminate the employment contract with their workers as soon as they reach this 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 life expectancy of the Dutch population and will be accordingly calculated in the future.

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

3 Method

3.1 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 on unobservables: there might be individual characteristics unobserved by the analyst, like labour market attachment, labour market experiences, working conditions across the career, wealth, physical and mental conditions, grandparenthood and other family changes both affecting the decision on retirement and its timing, but also correlated to outcome variables like measures of health and well-being. A second reason is reversed causality. The health and well-being conditions of an individual and their evolution over time will affect the decision on retirement.

In this study, the identification of the effect of retirement on health and well-being is based on the discontinuity on the propensity to retire in the month that an individual attains the age for the entitlement to the state pension. In the Netherlands, as described in Section 2 and Table 1, individuals get indeed entitled to the state pension on the basis of their age and, depending on their year and month of birth, the eligibility ages varied across years. Since the jump in the probability of retiring at the moment of eligibility age is typically less than 1, the identification strategy is based on a fuzzy RDD. Eligibility ages for the state pension are popular instrumental variables in this kind of literature.[2]

The outcome variables of interest are measures of health and well-being, like for example self-reported health and life satisfaction. They 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 modelling the impact of retirement on such type of outcome variables, we take into account of their ordered response nature. We model the probability that each individual indicated each possible discrete value in the set of possible responses, conditional on the retirement status and other observables using ordered response models. These 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 stages. In our ordered response index model the fuzzy RDD approach consists in estimating by maximum likelihood (ML) an IV ordered response

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

model, with the discontinuity as instrument and flexible continuous functions of the forcing variable, months to pension state eligibility in this study, 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 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 therefore 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 5.

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 determines the values taken by these two indicators are the number of months from the moment in which, respectively, individual i or his/her partner becomes 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 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 the process determining the outcome variable and

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

the two endogenous retirement indicators by treating properly the ordinal nature of the choices:

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

where:

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

$$
\boldsymbol{\Sigma} = \begin{bmatrix} 1 & \sigma_{12} & \sigma_{13} \\ \cdot & 1 & \sigma_{23} \\ \cdot & \cdot & 1 \end{bmatrix} \tag{7}
$$

.

- $f(\cdot;\boldsymbol{\theta})$, $f^p(\cdot;\boldsymbol{\theta}^p)$, $k_1(\cdot;\boldsymbol{\theta}_1)$, $k_1^p(\cdot;\boldsymbol{\theta}_1^p)$, $k_2(\cdot;\boldsymbol{\theta}_2)$, 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 models, we will use either a polynomial of order one or a spline continuous function with two knots below and two knots above the cutoff.

3.2 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.[4]

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

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 cutoffs. We first define the triangular weight for individual i, as usual, as $we_i = 1 - \frac{|m_i|}{bw}$, where bw is the chosen bandwidth. Then, we define the triangular weight for individual i's partner as $we_i^p = 1 - \frac{|m_i^p|}{bw}$. Finally, the weight for individual i used in the estimation is given by $w_i = we_i we_i^p$, so as to 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 4.3 a robustness check with unweighted observations (rectangular kernel within the chosen bandwidth).

We will focus our discussion on the results coming from the bandwidth set to $bw = 42$ and satisfied simultaneously by both partners, with a local linear specification of the different functions of the forcing variables. We checked the sensitiveness of our results by trying different bandwidths, simultaneously satisfied by both partners. When we enlarge the bandwidth to 84 months, we allowed the functions of the forcing variables to be more flexible (spline continuous function with two knots below and two knots above the cutoff). Finally, as a further check we also tried different values of the bandwidth ($bw = 36, 48, 54$) and report the estimates in Subsection 4.3.

3.3 Data and Samples

The data used in this 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 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.[5] 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.[6]

In this study we use: i) the monthly information of the background variables, from which we infer the age in month and the retirement status[7] in each month of the year; ii) the core studies on

[5] 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.

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

[7] We define an individual as retired if (s)he reports to be a pensioner, because of either a voluntary early

health and personality, from which we retrieve measures of, respectively, health and well-being 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 core study on personality was conducted from 2008 until 2017, with the only exception of 2016, in May-June of each year.[8] Both core studies contain a variable with the exact information on the month of the interview. We can therefore link the measures of health and well-being 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 (9) waves with information on health (well-being), age in months and retirement status. In what follows, we describe more in detail the main features of the two samples used to study the impact of retirement on health and well-being.

The dataset on health

Between 5,072 and 6,698 individuals were interviewed each year for the core study on health between 2007 and 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. 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. We were left therefore with 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 of the same sex both answering the questionnaire on health (3,212 couples).

Finally, we dropped from the samples 35 couples 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

retirement or entering the old age state pension scheme.

[8]In 2014 and 2015, the surveys on personality were conducted in November-December, instead of May-June.

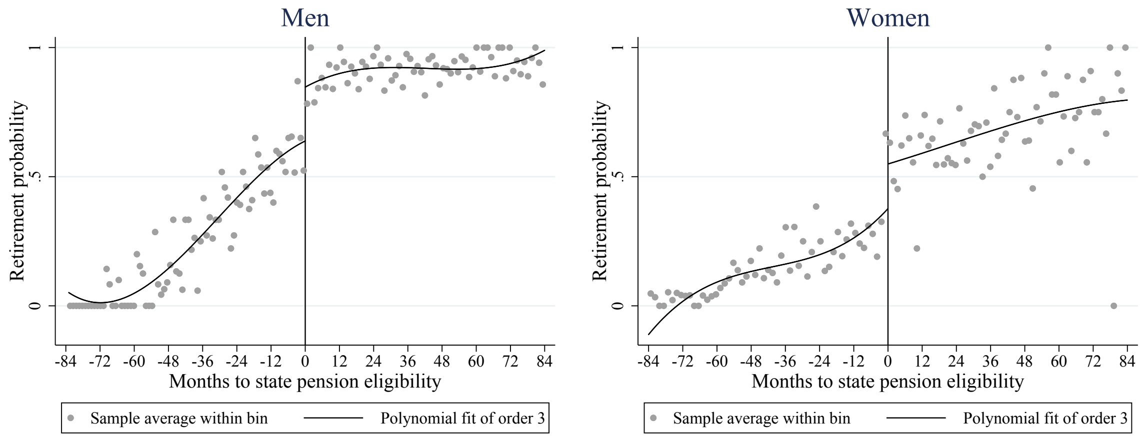
individual becomes eligible to the state pension, we cannot be sure, for those interviewed in the month in which they become eligible to the state pension, whether they are already eligible at the moment of the interview or they will be soon eligible to the state pension. Although this kind of error 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 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.

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 age for the state pension eligibility. 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 be a strong predictor of the retirement decision. Figure 1 displays the relation between the time to state pension eligibility and the retirement probability, obtained by regression functions with triangular kernel weights on a 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 by 20.9 percentage points (pp) for men and 17.3 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: wives' retirement probability increases by 5.8 pp at the cut-off, whereas husbands' retirement probability decreases by 2 pp.

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, happiness in the last month, limitations with fundamental activities of daily living (ADL) and with instrumental ADL, comorbidity, smoking, and alcohol drinking habits. Table A.1 reports the full list of outcome variables, the discrete values they can take, and the meaning of each discrete outcome. [9] Table A.2 displays summary statistics of these outcome variables and also the fraction on individuals that at the moment of the interview are already retired, including those that are at maximum 84 months far away from the state pension eligibility and if we restrict this

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

Figure 1: Graphical illustration of discontinuity in the retirement probability from the health dataset



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 within the bandwidth of 84 months: 3,177 observations. The discontinuity in the retirement probability amounts to 20.9 (17.3) percentage points for men (women), significantly different from zero with a p-value equal to 0.000 (0.007). The p-value is robust to within-individual correlation.

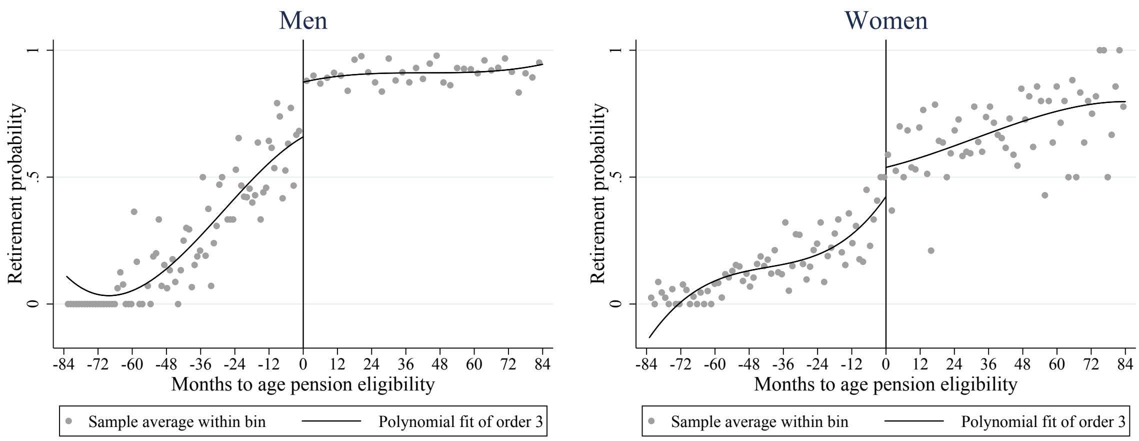
bandwidth to 18 months.

The dataset on personality

Between 5,169 and 6,808 individuals were interviewed each year for the core study on personality between 2008 and 2017, resulting in a total of 53,667 records. We followed the same rules for matching information and selecting the sample as for the dataset on health. The final sample contains 2,940 couples, at maximum 84 months away from the month of the state pension eligibility at the moment of the interview.

Figure 2 displays the relation between the time to state pension eligibility and the retirement probability for the observations in the personality dataset. It is built as Figure 1. For both men and women, we get a very similar profile of the relation between months to state pension eligibility and retirement probability to the relation coming out from the health dataset. For men, also the discontinuity at the cut-off is very similar, being of 21.5 pp. However, for women, the jump at the cutoff is much smaller (11.7 pp) and not significantly different from 0 (p-value=0.087). There are two main differences between the health dataset and the personality dataset that could explain this difference in the size and significance level of the discontinuity. First, the sample size of the personality dataset is somewhat smaller because it is made up of one less wave, generating a reduction in the estimation precision. Second, whereas the questionnaire on health was submitted in November-December of each year, data on personality were collected mainly in May-June of each year. It might be that in this period of the year women are less willing to retire as soon as they are entitled to state pension eligibility than what happens when state pension eligibility is attained at the end of year. Given that for women the discontinuity is small and weak, we will miss a strong exogenous instrument for the decision of women to retire. As such, in the econometric analysis, we will not be able to identify the impact of wives' retirement on their own and their husbands' well-being. We will stick to the identification of husbands' retirement on their own and their wives' well-being.

Figure 2: Graphical illustration of discontinuity in the retirement probability from the personality dataset



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 within the bandwidth of 84 months: 2,940 observations. The discontinuity in the retirement probability amounts to 21.5 (11.7) percentage points for men (women), with a p-value for its significance equal to 0.000 (0.087). The p-value is robust to within-individual correlation.

From the dataset on personality we extracted three outcome variables describing the well-being of an individual: life satisfaction, happiness and general feeling. Table A.3 provides more details about these three outcome variables, the discrete values they can take, and the meaning of each discrete outcome, whereas Table A.4 displays summary statistics, including the fraction on individuals that at the moment of the interview are already retired, both when focusing on those that are at maximum 84 months far away from the state pension eligibility and if we restrict this bandwidth to 18 months.

4 Estimation Results

4.1 Baseline Parameter Estimates

Tables 2 and 3 display the estimated effect of retirement on self-perceived health and on life-satisfaction and are taken here as the main measures of health and well-being, respectively. Since life-satisfaction comes from the dataset on personality, in which the discontinuity in the probability of retirement at the cutoff was not a strong instrument for wife's retirement, we could not instrument it and we excluded it from the set of regressors. From Table 2, 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. From the estimation of the average partial effect, we realize that the positive impact of retirement on health is quite sizeable: husband's retirement increases by 22 (17.1) pp the probability that his own (wife's) health is very good or excellent. Table 3 depicts a similar portray when we look at the impact on life satisfaction, measured on a scale from 0 to 10.[10] Husband's retirement has a positive and significant impact of the level of life satisfaction of both partners: it increases by almost 24 (21) pp the probability that a man (woman) replies with at least a 9.

4.2 Additional Parameter Estimates

Table 4 summarizes the estimated effects of retirement on further measures of health and well-being. In Appendix B, the reader can find further estimation details. Retirement of women have hardly any effect on their own and their partner's measures of health and well-being. We only detect: i) a positive but barely significant effect on husband's happiness; ii) a negative, large, and significant impact on the probability of experiencing instrumental ADL limitations (-31 pp). The retirement of men: i) strongly affects both partners' happiness and general feeling; ii) reduces by 30 (20) pp wife's probability of experiencing instrumental (fundamental) ADL limitations; iii) singificantly increases by 30 pp the probability of being diagnosed no personal diseases in the next 12 months.

4.3 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.

[10]Before estimating the ordered probit model, we had to group the replies between 0 and 5, because of the too small frequencies in each of these values.

Table 2: Retirement effects on self-perceived health

	Local linear regression			Local spline continuous regression		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Husband's self-perceived health						
Estimated coefficients of ordered probit model						
Husband's retirement	0.819	**	0.346	0.783	***	0.207
Wife's retirement	-0.191		0.444	-0.334		0.311
Average marginal effects of husband's retirement on the probability that health is						
Poor or moderate	-0.217	**	0.092	-0.211	***	0.056
Good	-0.003		0.022	-0.001		0.015
Very good or excellent	0.220	**	0.099	0.212	***	0.058
Average marginal effects of wife's retirement on the probability that health is						
Poor or moderate	0.051		0.119	0.090		0.085
Good	0.001		0.005	0.001		0.006
Very good or excellent	-0.051		0.119	-0.090		0.085
Log-likelihood	-2,255.94			-5,651.17		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 19.32$			$\chi^2(2) = 30.63$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 16.10$			$\chi^2(2) = 18.73$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,221 (438)			3,102 (753)		
Kernel weights	Triangular (product of triangular weights of both partners)					
b) Wife's self-perceived health						
Estimated coefficients of ordered probit model						
Husband's retirement	0.661	**	0.283	0.477	*	0.256
Wife's retirement	0.029		0.400	-0.135		0.345
Average marginal effects of husband's retirement on the probability that health is						
Poor or moderate	-0.196	**	0.085	-0.138	*	0.075
Good	0.025		0.019	0.018		0.013
Very good or excellent	0.171	**	0.079	0.120	*	0.066
Average marginal effects of wife's retirement on the probability that health is						
Poor or moderate	-0.009		0.119	0.027		0.103
Good	0.001		0.015	-0.004		0.014
Very good or excellent	0.008		0.104	-0.023		0.089
Log-likelihood	-2,288.80			-5,678.06		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 26.75$			$\chi^2(2) = 32.81$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 15.58$			$\chi^2(2) = 19.08$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,221 (438)			3,102 (753)		
Kernel weights	Triangular (product of triangular weights of both partners)					

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

Table 3: Effect of husband's retirement on life satisfaction (from the dataset on personality)

	Local linear regression			Local spline continuous regression		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Husband's life satisfaction						
Estimated coefficients of ordered probit model						
Husband's retirement	0.766	***	0.204	0.759	***	0.202
Average marginal effects of husband's retirement on the probability of life satisfaction equal to						
[0-5]	-0.069	***	0.026	-0.070	***	0.024
6	-0.040	***	0.012	-0.050	***	0.014
7	-0.133	***	0.030	-0.130	***	0.029
8	0.005		0.015	0.016		0.012
9	0.140	***	0.034	0.140	***	0.033
10	0.098	***	0.032	0.094	***	0.031
Log-likelihood	-2,161.22			-5,295.24		
Power of excluded instruments for husband's retirement	$\chi^2(1) = 32.35$			$\chi^2(1) = 31.23$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,175 (431)			2,874 (741)		
Kernel weights	Triangular weights					
b) Wife's life satisfaction						
Estimated coefficients of ordered probit model						
Husband's retirement	0.629	**	0.309	0.533	**	0.240
Average marginal effects of husband's retirement on the probability of life satisfaction equal to						
[0-5]	-0.055		0.035	-0.047	*	0.025
6	-0.036	**	0.018	-0.038	**	0.017
7	-0.111	**	0.047	-0.096	**	0.039
8	-0.004		0.013	0.008		0.009
9	0.109	**	0.046	0.095	**	0.039
10	0.097	*	0.055	0.078	**	0.039
Log-likelihood	-2,220.03			-5,449.68		
Power of excluded instruments for husband's retirement	$\chi^2(1) = 30.56$			$\chi^2(1) = 31.36$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,175 (431)			2,874 (741)		
Kernel weights	Triangular weights					

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

Table 4: Summary of main parameter estimates for local linear regression, bandwidth equal to 42 and triangular kernel

	Effect on husband		Effect on wives	
	Husband retires	Wife retires	Husband retires	Wife retires
Self-reported health	0.819 **	-0.191	0.661 **	0.029
Last month happiness	0.800 **	0.819 *	1.064 ***	-0.444
Fundamental ADL	-0.664	-0.264	-0.643 *	-0.218
Instrumental ADL	-0.432	-0.427	-0.895 ***	-0.942 **
Last year comorbidity	-0.829 **	–	-0.271	–
Smoking	0.237	0.216	-0.340	0.059
Last year alcohol	-1.059 **	–	-0.949 ***	–
Happiness	0.634 **	–	0.627 **	–
Life satisfaction	0.766 ***	–	0.629 **	–
General feeling	0.791 **	–	0.849 ***	–

Table 5 reports the estimation results of the coefficients of the retirement indicators is we stick to the local linear regression, but we do not weight the observations on the basis of the joint individual's and partner's 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 4.

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

	Effect on husband		Effect on wives	
	Husband retires	Wife retires	Husband retires	Wife retires
Self-reported health	0.704 **	-0.326	0.511 *	-0.194
Last month happiness	0.542 **	0.588	1.016 ***	-0.110
Fundamental ADL	-0.831	0.158	-0.544 *	-0.481
Instrumental ADL	-0.539	-0.541	-0.586	-0.563
Last year comorbidity	-0.856 **	–	-0.246	–
Smoking	-0.474	0.220	0.000	-0.331
Last year alcohol	-1.052 **	–	-0.557	–
Happiness	0.716 ***	–	0.551 **	–
Life satisfaction	0.787 ***	–	0.453 **	–
General feeling	0.877 ***	–	0.600 **	–

Table 6 displays instead the results if we keep weighting the observations, we stick to the local polynomial regression, but we change the bandwidth and fix it to 36, 48 and 54 months. 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 and drinking alcohol. This the same kind of change in these estimated effects that we could note from Table 5, 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 that are closer to the cutoffs.

5 Validity and Falsification Tests

As suggested by McCrary (2008), a jump in the density of the running variable at the threshold would be a direct evidence of the failure of the local randomization assumption. Figure 3 displays the local polynomial density estimate of the running variable described in Cattaneo et al. (2017). They graphically show that there is no evidence of discontinuity in the population density at the cutoff, for both genders and both the health and the personality datasets.

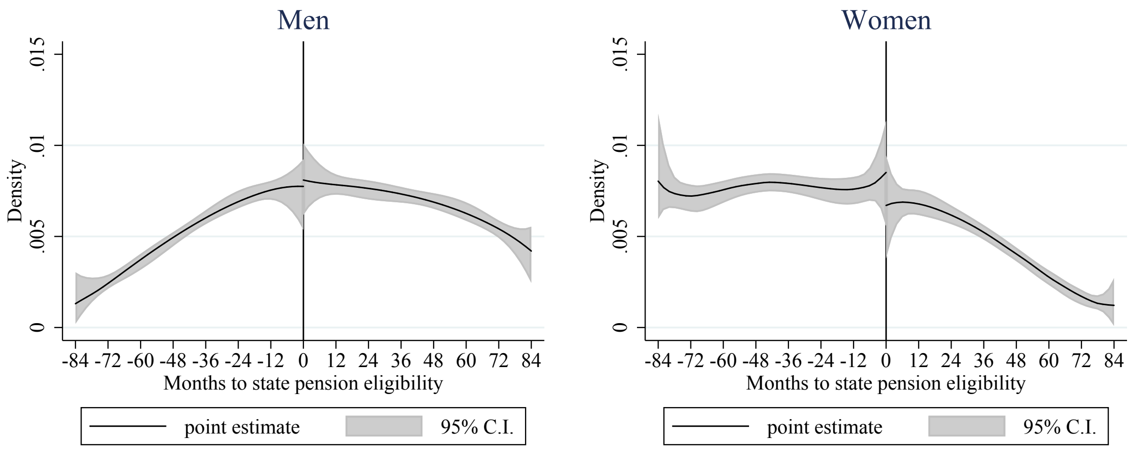
If the retirement probability is locally randomized near the cutoff, then the treatment should not have an effect on the pre-treatment covariates, i.e. the treated units should be similar to con-

Table 6: Summary of main parameter estimates for local linear regression, bandwidth equal to 36, 48 or 54 and triangular kernel

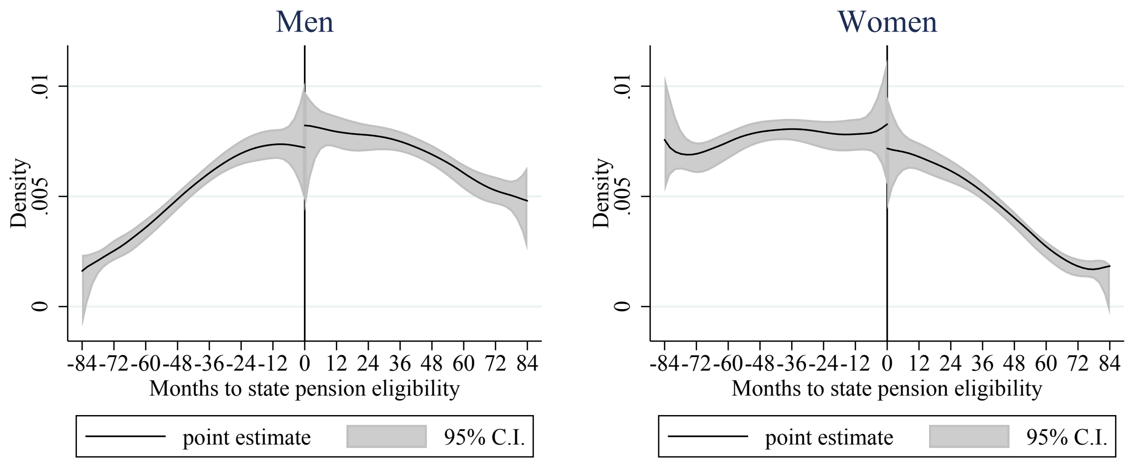
	Effect on husband		Effect on wives	
	Husband retires	Wife retires	Husband retires	Wife retires
a. Bandwidth equal to 36				
Self-reported health	0.887 *	-0.077	0.741 **	0.156
Last month happiness	1.061 ***	0.852 **	1.097 ***	-0.447
Fundamental ADL	-0.782	-0.464	-0.692 *	-0.245
Instrumental ADL	-0.302	-0.435	-0.987 ***	-1.032***
Last year comorbidity	-0.876 **	–	-0.104	–
Smoking	0.481	0.376	-0.421	0.065
Last year alcohol	-0.971 **	–	-1.073 ***	–
Happiness	0.841 ***	–	0.713 **	–
Life satisfaction	0.955 ***	–	0.852 ***	–
General feeling	0.784 *	–	0.971 ***	–
b. Bandwidth equal to 48				
Self-reported health	0.793 **	-0.250	0.638 **	0.011
Last month happiness	0.602 *	0.820 **	1.015 ***	-0.292
Fundamental ADL	-0.674	-0.116	-0.614 *	-0.142
Instrumental ADL	-0.402	-0.419	-0.792 ***	-0.758
Last year comorbidity	-0.755 **	–	-0.064	–
Smoking	0.001	0.239	-0.286	-0.036
Last year alcohol	-0.664	–	-0.619	–
Happiness	0.689 ***	–	0.711 ***	–
Life satisfaction	0.779 ***	–	0.640 **	–
General feeling	0.772 ***	–	0.796 ***	–
c. Bandwidth equal to 54				
Self-reported health	0.773 ***	-0.257	0.594 **	-0.051
Last month happiness	0.499 *	0.829 **	0.968 ***	-0.241
Fundamental ADL	-0.660	-0.068	-0.574 *	-0.211
Instrumental ADL	-0.328	-0.457	-0.738 **	-0.597
Last year comorbidity	-0.792 **	–	0.114	–
Smoking	-0.190	0.263	-0.222	-0.164
Last year alcohol	-0.824	–	-0.756**	–
Happiness	0.694 ***	–	0.747 ***	–
Life satisfaction	0.744 ***	–	0.603 **	–
General feeling	0.842 ***	–	0.744 ***	–

Figure 3: Graphical density test of the running variable

a. Health dataset



b. Personality dataset



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) from health dataset; p-value equal to 0.822 (0.478) for men (women) from personality dataset.

trol 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. After the estimation of the SUR model, we performed joint and individual tests of the significance of the discontinuities. The left-hand side of Table 7 reports these individual and joint test statistics for the dataset on health. There are three covariates with a significant jump at the discontinuity (presence of children at the male cutoff, with a p-value equal to 0.049, and primary/intermediate secondary indicator and the 2012 time dummy at the female cutoff, with a p-value equal to 0.030 and 0.047, respectively). However, the joint tests do not reject the null hypotheses that the discontinuities at the male and female cutoffs are significantly different from zero. Since we are testing on many covariates, the joint test suggests that the two significant discontinuities are so by random chance (Lee and Lemieux, 2010). The right-hand side of Table 7 focuses instead on the dataset about personality. Since only the impact of the husband's retirement on personality is studied, due to the lack of explanatory power of the discontinuity at the cutoff for wives in explaining their retirement, the right-hand side of Table 7 reports joint and individual tests of the significance only of the discontinuity at the age of pension eligibility of husbands. In this case, there are only two time dummies displaying a jump at the cutoff significantly different from 0 at the 5% level. However, once again, the joint test does not reject the null hypothesis.[11]

6 Conclusions

Preliminary conclusions:

1. Retirement of women has hardly any effect.
2. Retirement of men has effects on self-perceived health and well-being indicators of both men and women.
3. For ADL there are spillover effects to women while there is no direct effect on men themselves.

In our research agenda, we plan to give an answer to the following questions:

1. Does it matter if a distinction is made between high and low educated?
2. What is the impact of retirement on mental health indicators?
3. What about hours of work shortly before retirement?

[11] If we test the joint significance of the discontinuities for the time dummies only, we cannot reject the null hypothesis with a p-value equal to 0.200.

Table 7: Falsification test: treatment effect (retirement of the husband and of the wife) on predetermined variables estimated by SUR

	Health dataset				Personality dataset	
	Significance test of discontinuity at				Significance test of discontinuity at male cutoff	
	male cutoff		female cutoff			
	t-stat[(a)]	p-value	t-stat[(a)]	p-value	t-stat[(a)]	p-value
Husband's education						
Primary/Intermediate secondary	1.34	0.180	0.23	0.821	0.02	0.985
Higher secondary/Tertiary	-0.20	0.843	0.02	0.984	-0.10	0.923
Vocational	-1.11	0.267	-0.23	0.815	0.17	0.863
Wife's education						
Primary/Intermediate secondary	-0.82	0.412	-2.17	0.030	-0.27	0.786
Higher secondary/Tertiary	0.19	0.846	1.76	0.078	-0.00	0.998
Vocational	0.76	0.446	1.42	0.155	1.09	0.275
Year of the survey						
2007	-1.10	0.272	-0.93	0.354	–	–
2008	-0.78	0.434	0.90	0.366	0.41	0.683
2009	1.06	0.287	1.01	0.313	-0.88	0.387
2010	-0.98	0.328	-1.79	0.073	1.10	0.273
2011	-0.21	0.832	-0.20	0.845	-1.78	0.076
2012	1.28	0.201	1.99	0.047	2.58	0.010
2013	-1.23	0.217	-0.30	0.766	-2.32	0.020
2014	–	–	–	–	0.37	0.709
2015	1.33	0.184	-0.58	0.560	-0.03	0.976
2016	0.24	0.813	-0.61	0.543	–	–
2017	0.50	0.616	0.39	0.698	0.24	0.809
Degree of urbanization of place of residence						
Very or extremely urban	0.15	0.881	0.92	0.358	0.59	0.554
Moderately urban	0.42	0.673	0.23	0.818	0.02	0.984
Slightly or not urban	0.03	0.973	-1.03	0.303	-0.50	0.618
Presence of children in the household	1.97	0.049	-0.35	0.729	-1.85	0.065
Joint significance test of discontinuities[(a)]	$\chi^2(17) = 14.94$		$\chi^2(17) = 23.61$		$\chi^2(16) = 17.61$	
	p-value $= 0.600$		p-value $= 0.130$		p-value $= 0.347$	

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

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Appendix

A Details on our dataset

Table A.1: Outcome indicators for health

Measure	Question	Ordered values
Self-perceived health	How would you describe your health, generally speaking?	1. poor or moderate 2. good 3. very good or excellent
Happiness in the last month	How did you feel over the past month? I felt happy. . .	1. never or seldom 2. sometimes 3. often 4. mostly 5. continuously
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
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
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, or other serious memory problem	0. no disease 1. one disease 2. two diseases 3. three or more diseases
Smoking cigarettes	Do you smoke now?	0. no 1. yes
Drinking alcohol	How often did you have a drink containing alcohol over the last 12 months?	1. almost every day 2. five or six days per week 3. three or four days per week 4. once or twice a week 5. once or twice a month or less

Table A.2: Descriptive statistics of the retirement indicator and the outcome variables from the health dataset[a]

	|Months from state pension|≤84		|Months from state pension|≤18			
	Mean	Std. Dev.	Mean	Std. Dev.	Min.	Max.
Husband's retirement	0.662	0.473	0.735	0.442	0	1
Wife's retirement	0.335	0.472	0.435	0.496	0	1
Husband's self-perceived health if retired	2.011	0.609	2.061	0.584	1	3
Husband's self-perceived health if not retired	1.965	0.647	1.953	0.640	1	3
Wife's self-perceived health if retired	2.008	0.619	2.042	0.621	1	3
Wife's self-perceived health if not retired	1.938	0.609	1.919	0.613	1	3
Husband's last month happiness if retired	3.611	0.951	3.669	0.914	1	5
Husband's last month happiness if not retired	3.382	1.046	3.427	1.029	1	5
Wife's last month happiness if retired	3.459	0.938	3.478	0.911	1	5
Wife's last month happiness if not retired	3.434	0.981	3.427	0.988	1	5
Husband's fundamental ADL if retired	1.721	0.717	1.663	0.688	1	3
Husband's fundamental ADL if not retired	1.887	0.748	1.957	0.760	1	3
Wife's fundamental ADL if retired	1.963	0.749	1.875	0.745	1	3
Wife's fundamental ADL if not retired	1.944	0.751	2.000	0.761	1	3
Husband's instrumental ADL if retired	1.478	0.662	1.395	0.619	1	3
Husband's instrumental ADL if not retired	1.623	0.753	1.733	0.788	1	3
Wife's instrumental ADL if retired	1.677	0.692	1.569	0.660	1	3
Wife's instrumental ADL if not retired	1.696	0.734	1.756	0.744	1	3
Husband's comorbidity if retired	0.994	1.090	0.889	1.064	0	3
Husband's comorbidity if not retired	0.866	1.022	0.913	1.077	0	3
Wife's comorbidity if retired	0.920	1.096	0.919	1.128	0	3
Wife's comorbidity if not retired	0.977	1.072	0.972	1.050	0	3
Husband's smoking if retired	0.117	0.321	0.109	0.312	0	1
Husband's smoking if not retired	0.169	0.375	0.172	0.379	0	1
Wife's smoking if retired	0.108	0.311	0.108	0.311	0	1
Wife's smoking if not retired	0.170	0.375	0.202	0.402	0	1
Husband's drinking if retired	2.907	1.623	2.824	1.623	1	5
Husband's drinking if not retired	2.968	1.554	2.862	1.558	1	5
Wife's drinking if retired	3.050	1.641	3.085	1.632	1	5
Wife's drinking if not retired	3.607	1.527	3.521	1.549	1	5

[a] Table A.1 clarifies the discrete nature of the outcome variables and the meaning attached to the numeric values.

Table A.3: Outcome indicators for well-being

Measure	Question	Ordered values
Happiness	On the whole, how happy would you say you are?[a]	0. totally unhappy ⋮ 10. totally happy
Life satisfaction	How satisfied are you with the life you lead at the moment?[a]	0. not at all satisfied ⋮ 10. completely satisfied
General feeling	In general, how do you feel?[b]	1. very bad ⋮ 7. very good

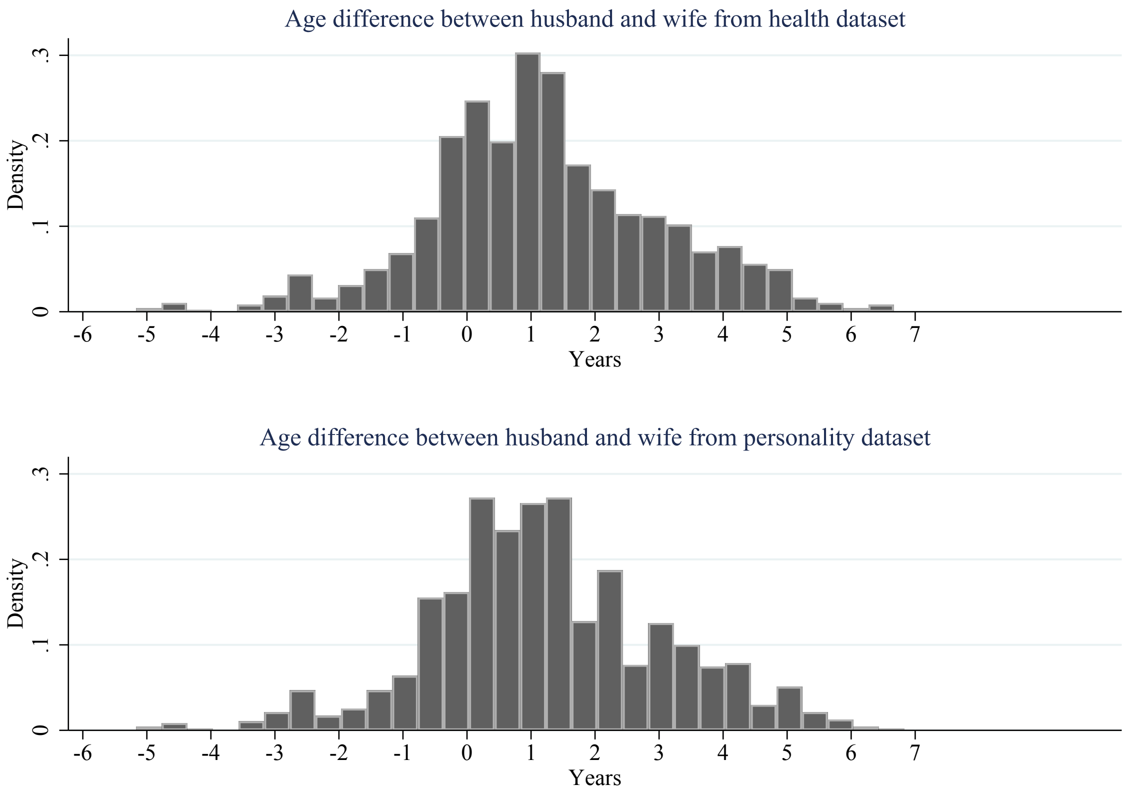
[a] We grouped the values from 0 to 5, due to the small number of observations in those categories.
[b] We grouped the values from 1 to 3, due to the small number of observations in those categories.

Table A.4: Descriptive statistics of the retirement indicator and the outcome variables from the personality dataset[(a)]

	|Months from state pension| ≤ 84		|Months from state pension| ≤ 18			
	Mean	Std. Dev.	Mean	Std. Dev.	Min.	Max.
Husband's retirement	0.663	0.473	0.741	0.438	0	1
Wife's retirement	0.337	0.473	0.421	0.494	0	1
Husband's happiness if retired	7.927	1.099	7.970	1.088	0	10
Husband's happiness if not retired	7.621	1.313	7.688	1.310	0	10
Wife's happiness if husband retired	7.893	1.135	7.901	1.230	0	10
Wife's happiness if husband not retired	7.716	1.294	7.725	1.335	0	10
Husband's life satisfaction if retired	7.948	1.133	7.987	1.090	0	10
Husband's life satisfaction if not retired	7.550	1.421	7.639	1.448	0	10
Wife's life satisfaction if husband retired	7.934	1.170	7.927	1.264	0	10
Wife's life satisfaction if husband not retired	7.699	1.381	7.716	1.436	0	10
Husband's general feeling if retired	5.981	0.796	6.030	0.767	1	7
Husband's general feeling if not retired	5.730	0.953	5.741	0.920	1	7
Wife's general feeling if husband retired	5.891	0.808	5.881	0.839	1	7
Wife's general feeling if husband not retired	5.839	0.888	5.811	0.909	1	7

[(a)] Table A.3 clarifies the discrete nature of the outcome variables and the meaning attached to the numeric values.

Figure A.1: Distribution of the age difference between husbands and wives in the health and personality datasets when both partners are within the bandwidth of 42 months



B Additional Parameter Estimates

Table B.5: Retirement effects on happiness in the last month

	Local linear regression			Local spline continuous regression		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Husband's happiness in the last month						
Estimated coefficients of ordered probit model						
Husband's retirement	0.800	**	0.403	0.489	**	0.227
Wife's retirement	0.819	*	0.426	0.869	***	0.324
Average marginal effects of husband's retirement on the probability of happiness in the last month						
Never or seldom	-0.104		0.076	-0.057	*	0.031
Sometimes	-0.094	**	0.039	-0.064	**	0.030
Often	-0.069	**	0.031	-0.047	**	0.023
Mostly	0.090	**	0.037	0.062	**	0.030
Continuously	0.178	*	0.104	0.106	**	0.051
Average marginal effects of wife's retirement on the probability of happiness in the last month						
Never or seldom	-0.106		0.087	-0.102	*	0.059
Sometimes	-0.097	***	0.035	-0.114	***	0.032
Often	-0.071	***	0.020	-0.084	***	0.016
Mostly	0.092	***	0.032	0.111	***	0.026
Continuously	0.182		0.112	0.189	**	0.081
Log-likelihood	-2,712.89			-6,808.11		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 15.96$			$\chi^2(2) = 27.06$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 14.15$			$\chi^2(2) = 18.10$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,221 (438)			3,102 (753)		
Kernel weights	Triangular (product of triangular weights of both partners)					
b) Wife's happiness in the last month						
Estimated coefficients of ordered probit model						
Husband's retirement	1.064	***	0.333	0.925	***	0.254
Wife's retirement	-0.444		1.201	-0.189		0.833
Average marginal effects of husband's retirement on the probability of happiness in the last month						
Never or seldom	-0.126	*	0.075	-0.097	***	0.038
Sometimes	-0.138	***	0.031	-0.135	***	0.032
Often	-0.110	***	0.034	-0.104	***	0.020
Mostly	0.192	***	0.045	0.187	***	0.037
Continuously	0.183	**	0.089	0.150	***	0.051
Average marginal effects of wife's retirement on the probability of happiness in the last month						
Never or seldom	0.053		0.159	0.020		0.089
Sometimes	0.058		0.151	0.028		0.122
Often	0.046		0.109	0.021		0.093
Mostly	-0.080		0.198	-0.038		0.168
Continuously	-0.076		0.221	-0.031		0.135
Log-likelihood	-2,692.07			-6,779.81		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 26.09$			$\chi^2(2) = 33.77$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 11.95$			$\chi^2(2) = 18.38$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,221 (438)			3,102 (753)		
Kernel weights	Triangular (product of triangular weights of both partners)					

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

Table B.6: Retirement effects on fundamental ADL

	Local linear regression			Local spline continuous regression		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Husband's fundamental ADL						
Estimated coefficients of ordered probit model						
Husband's retirement	-0.664		0.713	-0.801		0.593
Wife's retirement	-0.264		0.497	0.320		0.367
Average marginal effects of husband's retirement on the probability of having						
No difficulties	0.234		0.239	0.288		0.201
At least one minor difficulty	-0.072		0.065	-0.089		0.056
At least one major difficulty	-0.163		0.176	-0.199		0.147
Average marginal effects of wife's retirement on the probability of having						
No difficulties	0.093		0.172	-0.115		0.133
At least one minor difficulty	-0.028		0.050	0.036		0.041
At least one major difficulty	-0.065		0.123	0.079		0.092
Log-likelihood	-2,369.96			-5,945.45		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 17.92$			$\chi^2(2) = 25.20$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 16.90$			$\chi^2(2) = 15.97$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,221 (438)			3,102 (753)		
Kernel weights	Triangular (product of triangular weights of both partners)					
b) Wife's fundamental ADL						
Estimated coefficients of ordered probit model						
Husband's retirement	-0.643	*	0.348	-0.645	**	0.280
Wife's retirement	-0.218		0.617	-0.308		0.522
Average marginal effects of husband's retirement on the probability of having						
No difficulties	0.215	*	0.114	0.217	**	0.093
At least one minor difficulty	-0.014		0.016	-0.015		0.012
At least one major difficulty	-0.202	*	0.107	-0.203	**	0.087
Average marginal effects of wife's retirement on the probability of having						
No difficulties	0.073		0.205	0.104		0.174
At least one minor difficulty	-0.005		0.014	-0.007		0.012
At least one major difficulty	-0.068		0.192	-0.097		0.163
Log-likelihood	-2,446.13			-6,120.69		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 23.881$			$\chi^2(2) = 27.50$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 15.38$			$\chi^2(2) = 18.86$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,221 (438)			3,102 (753)		
Kernel weights	Triangular (product of triangular weights of both partners)					

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

Table B.7: Retirement effects on instrumental ADL

	Local linear regression			Local spline continuous regression		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Husband's instrumental ADL						
Estimated coefficients of ordered probit model						
Husband's retirement	-0.432		0.687	-0.521		0.395
Wife's retirement	-0.427		0.932	-0.212		0.861
Average marginal effects of husband's retirement on the probability of having						
No difficulties	0.156		0.235	0.194		0.141
At least one minor difficulty	-0.075		0.103	-0.096		0.065
At least one major difficulty	-0.081		0.134	-0.098		0.077
Average marginal effects of wife's retirement on the probability of having						
No difficulties	0.154		0.322	0.079		0.318
At least one minor difficulty	-0.074		0.138	-0.039		0.154
At least one major difficulty	-0.080		0.184	-0.040		0.163
Log-likelihood	-2,240.37			-5,718.08		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 21.79$			$\chi^2(2) = 28.05$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 14.79$			$\chi^2(2) = 22.84$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,221 (438)			3,102 (753)		
Kernel weights	Triangular (product of triangular weights of both partners)					
b) Wife's instrumental ADL						
Estimated coefficients of ordered probit model						
Husband's retirement	-0.895	***	0.294	-0.718		0.234
Wife's retirement	-0.942	**	0.388	-0.996		0.337
Average marginal effects of husband's retirement on the probability of having						
No difficulties	0.299	***	0.091	0.247	***	0.078
At least one minor difficulty	-0.078	**	0.034	-0.067	**	0.028
At least one major difficulty	-0.221	***	0.075	-0.180	***	0.060
Average marginal effects of wife's retirement on the probability of having						
No difficulties	0.314	***	0.111	0.342	***	0.098
At least one minor difficulty	-0.082	***	0.018	-0.093	***	0.015
At least one major difficulty	-0.232	**	0.107	-0.249	***	0.095
Log-likelihood	-2,351.06			-5,999.71		
Power of excluded instruments for husband's retirement	$\chi^2(2) = 19.11$			$\chi^2(2) = 24.82$		
Power of excluded instruments for wife's retirement	$\chi^2(2) = 16.35$			$\chi^2(2) = 17.63$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,221 (438)			3,102 (753)		
Kernel weights	Triangular (product of triangular weights of both partners)					

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

Table B.8: Retirement effects on comorbidity in the last year

	Local linear regression			Local spline continuous regression		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Husband's comorbidity						
Estimated coefficients of ordered probit model						
Husband's retirement	-0.829	**	0.372	-0.732	***	0.246
Average marginal effects of husband's retirement on the probability of being diagnosed in the last year						
No disease	0.303	**	0.125	0.275	***	0.087
One disease	-0.037	**	0.016	-0.045	***	0.014
Two diseases	-0.086	***	0.029	-0.088	***	0.025
Three or more diseases	-0.181	*	0.088	-0.143	***	0.054
Log-likelihood	-1,763.26			-4,352.72		
Power of excluded instruments for husband's retirement	$\chi^2(1) = 20.90$			$\chi^2(1) = 28.97$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,052 (394)			2,636 (657)		
Kernel weights	Triangular weights					
b) Wife's comorbidity						
Estimated coefficients of ordered probit model						
Husband's retirement	-0.271		0.536	0.147		0.457
Average marginal effects of husband's retirement on the probability of being diagnosed in the last year						
No disease	0.105		0.207	-0.058		0.179
One disease	-0.016		0.031	0.011		0.034
Two diseases	-0.029		0.055	0.019		0.059
Three or more diseases	-0.060		0.122	0.028		0.086
Log-likelihood	-1,787.96			-4,340.65		
Power of excluded instruments for husband's retirement	$\chi^2(1) = 29.24$			$\chi^2(1) = 30.13$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,052 (394)			2,636 (657)		
Kernel weights	Triangular weights					

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

Table B.9: Retirement effects on smoking

	Local linear regression		Local spline continuous regression	
	Coeff.	Std. Err.	Coeff.	Std. Err.
a) Husband is smoking				
Estimated coefficients of probit model				
Husband's retirement	0.237	0.422	-0.283	0.656
Wife's retirement	0.216	0.638	-0.002	0.813
Average marginal effects of husband's retirement on the probability of				
Smoking	0.053	0.098	-0.058	0.132
Average marginal effects of wife's retirement on the probability of				
Smoking	0.048	0.147	-0.001	0.166
Log-likelihood	-1,615.38		-3,992.96	
Power of excluded instruments for husband's retirement	$\chi^2(2) = 29.82$		$\chi^2(2) = 26.68$	
Power of excluded instruments for wife's retirement	$\chi^2(2) = 13.14$		$\chi^2(2) = 19.51$	
Bandwidth satisfied by both husband and wife (months)	42		84	
Number of observations (individuals)	1,221 (438)		3,102 (753)	
Kernel weights	Triangular (product of triangular weights of both partners)			
b) Wife is smoking				
Estimated coefficients of probit model				
Husband's retirement	-0.340	0.592	-0.199	0.504
Wife's retirement	0.059	0.547	-0.299	0.501
Average marginal effects of husband's retirement on the probability of				
Smoking	-0.074	0.129	-0.044	0.112
Average marginal effects of wife's retirement on the probability of				
Smoking	0.013	0.120	-0.066	0.112
Log-likelihood	-1,645.01		-4,092.24	
Power of excluded instruments for husband's retirement	$\chi^2(2) = 26.01$		$\chi^2(2) = 29.64$	
Power of excluded instruments for wife's retirement	$\chi^2(2) = 15.74$		$\chi^2(2) = 18.30$	
Bandwidth satisfied by both husband and wife (months)	42		84	
Number of observations (individuals)	1,221 (438)		3,102 (753)	
Kernel weights	Triangular (product of triangular weights of both partners)			

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

Table B.10: Retirement effects on drinking alcohol over the last 12 months

	Local linear regression			Local spline continuous regression		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Husband's drinking alcohol in the last 12 months						
Estimated coefficients of ordered probit model						
Husband's retirement	-1.059	**	0.450	-0.882	*	0.505
Average marginal effects of husband's retirement on the probability of drinking alcohol over the last 12 months						
Almost every day	0.363	**	0.142	0.305	*	0.165
Five or six days per week	0.016	***	0.005	0.020	***	0.006
Three or four days per week	-0.003		0.008	-0.001		0.005
Once or twice a week	-0.064	***	0.015	-0.059	***	0.020
Once or twice a month or less	-0.312	**	0.128	-0.265	*	0.150
Log-likelihood	-2,063.70			-5,155.63		
Power of excluded instruments for husband's retirement	$\chi^2(1) = 13.33$			$\chi^2(1) = 15.23$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,052 (394)			2,636 (657)		
Kernel weights	Triangular weights					
b) Wife's drinking alcohol in the last 12 months						
Estimated coefficients of ordered probit model						
Husband's retirement	-0.949		0.339	-0.669		0.498
Average marginal effects of husband's retirement on the probability of drinking alcohol over the last 12 months						
Almost every day	0.287	***	0.106	0.200		0.149
Five or six days per week	0.030	***	0.007	0.028	*	0.016
Three or four days per week	0.027	***	0.007	0.023	*	0.012
Once or twice a week	-0.016		0.011	-0.011		0.010
Once or twice a month or less	-0.328	***	0.104	-0.239		0.169
Log-likelihood	-2,022.26			-5,032.27		
Power of excluded instruments for husband's retirement	$\chi^2(1) = 34.20$			$\chi^2(1) = 30.81$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,052 (394)			2,636 (657)		
Kernel weights	Triangular weights					

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

Table B.11: Effect of husband's retirement on happiness (from the dataset on personality)

	Local linear regression			Local spline continuous regression		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Husband's happiness						
Estimated coefficients of ordered probit model						
Husband's retirement	0.634	**	0.258	0.621	***	0.234
Average marginal effects of husband's retirement on the probability of happiness equal to						
[0-5]	-0.052	*	0.027	-0.050	**	0.023
6	-0.040	**	0.017	-0.041	**	0.016
7	-0.107	***	0.038	-0.112	***	0.038
8	0.011		0.014	0.017		0.011
9	0.115	***	0.043	0.116	***	0.040
10	0.072	**	0.035	0.070	**	0.031
Log-likelihood	-2,117.24			-5,158.00		
Power of excluded instruments for husband's retirement	$\chi^2(1) = 32.69$			$\chi^2(1) = 30.71$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,175 (431)			2,874 (741)		
Kernel weights	Triangular weights					
b) Wife's happiness						
Estimated coefficients of ordered probit model						
Husband's retirement	0.627	**	0.310	0.724	***	0.258
Average marginal effects of husband's retirement on the probability of happiness equal to						
[0-5]	-0.047		0.031	-0.063	**	0.030
6	-0.042	*	0.022	-0.052	***	0.019
7	-0.113	**	0.048	-0.129	***	0.038
8	0.005		0.013	0.017		0.012
9	0.118	**	0.051	0.140	***	0.043
10	0.079	*	0.047	0.087	**	0.039
Log-likelihood	-2,160.78			-5,273.25		
Power of excluded instruments for husband's retirement	$\chi^2(1) = 29.61$			$\chi^2(1) = 29.46$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,175 (431)			2,874 (741)		
Kernel weights	Triangular weights					

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

Table B.12: Effect of husband's retirement on general feeling (from the dataset on personality)

	Local linear regression			Local spline continuous regression		
	Coeff.		Std. Err.	Coeff.		Std. Err.
a) Husband's general feeling						
Estimated coefficients of ordered probit model						
Husband's retirement	0.791	**	0.328	0.900	***	0.226
Average marginal effects of husband's retirement on the probability of general feeling equal to						
[1-3]	-0.038		0.026	-0.047	**	0.019
4	-0.062	**	0.029	-0.069	***	0.020
5	-0.111	***	0.037	-0.128	***	0.026
6	-0.003		0.018	-0.006		0.015
7	0.214	**	0.091	0.250	***	0.064
Log-likelihood	-1,816.80			-4,405.35		
Power of excluded instruments for husband's retirement	$\chi^2(1) = 31.63$			$\chi^2(1) = 31.84$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,175 (431)			2,874 (741)		
Kernel weights	Triangular weights					
b) Wife's general feeling						
Estimated coefficients of ordered probit model						
Husband's retirement	0.849	***	0.287	0.651	***	0.249
Average marginal effects of husband's retirement on the probability of general feeling equal to						
[1-3]	-0.065	*	0.036	-0.036	*	0.019
4	-0.049	***	0.018	-0.043	**	0.017
5	-0.135	***	0.034	-0.111	***	0.038
6	0.019		0.018	0.019		0.012
7	0.230	***	0.084	0.171	**	0.068
Log-likelihood	-1,859.20			-4,427.17		
Power of excluded instruments for husband's retirement	$\chi^2(1) = 32.43$			$\chi^2(1) = 31.61$		
Bandwidth satisfied by both husband and wife (months)	42			84		
Number of observations (individuals)	1,175 (431)			2,874 (741)		
Kernel weights	Triangular weights					

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