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► **To cite this version:**

Steve Briand. Beyond the direct impact of retirement: coordination by couples in preventive and risky behaviors. 2020. hal-02467440

HAL Id: hal-02467440

<https://hal.science/hal-02467440>

Preprint submitted on 5 Feb 2020

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Beyond the direct impact of retirement: coordination by couples in preventive and risky behaviors.

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January 2020

Abstract

This paper investigates changes in health behaviors upon retirement among couples using European SHARE survey data. Contrary to previous analyses studying retirement effect in a purely individual framework, or only measuring spillover effects, the econometric strategy controls for coordination by couples in health behaviors, also dealing with the endogeneity of both spouses' retirements. Using variations in official retirement ages for identification, estimations of simultaneous equations models confirm an always positive and statistically significant correlation between spouses' behaviors. Results show no global impact of retirement on smoking and obesity and limited impact on physical activities. However, retirement strongly reduce binge drinking behaviors. Exploring sources of heterogeneity, additional results show that individuals with low job physical burden have healthier lifestyles while results for other individuals are more mixed. Furthermore, with regard to spillover effects, women are particularly sensitive to men's retirement when they are retired themselves, while the inverse occurs for men.

JEL codes: J26, I12, D19, C25.

Keywords: Retirement; health behaviors; couple's coordination

1. Introduction

With the increase in life expectancy, most of OECD economies have implemented pension reforms aiming to incite individuals to delay retirement. Although stylized facts show that individuals respond to these incentives (Blundell, French and Tetlow, 2016; Gruber and Wise, 2000), measuring global short-term and long-term effects of these policies is another relevant question. Delay individual retirements improve the financial sustainability of public Pay-As-You-Go pension funds in the long-term in a context where baby boomers generations get close to retirement. However, pension reforms also have to take into account potential adverse effects (or externalities) due to the increase of official legal retirement ages. For example, these policies

could run counter to the objectives of employment policies, by raising unemployment rates of active young people. Likewise, raising legal retirement ages does not guarantee that individuals continue working: it can also increase elderly unemployment, then, social security spending (Engels, Geyer and Haan, 2017; Staubli and Zweimüller, 2013).

Another central question is the effect of retirement on health. Delaying retirement could significantly increase medical expenses of social security systems if retirement has a general negative effect on health. Basically, on the one hand, retirement may reduce work-related stress or stop the health burden from straining work tasks. It should then have a positive effect on health and well-being, particularly for highly physically demanding occupations. On the other hand, workplace can be a channel for promoting healthy lifestyles and work can stimulate and preserve cognitive abilities and prevent social isolation. This research question gives rise to a substantial literature with conflicting and heterogeneous results across countries or social-economic groups (Nishimura, Oikawa and Motegi, 2017). In response to this empirical indeterminacy, several studies have concentrated on underlying mechanisms by analyzing the impact of retirement on health (preventive or risky) behaviors (e.g. Eibich, 2015; Celidoni and Rebba, 2017).

Theoretically, the impact of retirement on health behaviors seems ambiguous. Grossman's model of health capital (1972) suggests that the opportunity cost of health behaviors investments decreases with higher leisure time. Individuals are then expected to invest more time in healthy behaviors (e.g. physical activities). However, the marginal return of health behaviors investments decreases as income does almost not depend on health. Further, individuals experience a decrease in wage income, which leads to a pure negative income effect¹. Empirically, the challenge of most recent literature is to treat the likely endogeneity of retirement arising from different sources. First, health behaviors investments and retirement

¹ Risky behaviors can be seen as negative investments. The marginal benefit from consumption is supposed to decrease due to higher leisure time. Conversely, as income does not depend on health, the marginal cost of risky behaviors (in terms of health consequences) also decreases (Cawley and Ruhm, 2011).

decision can likely be affected by several common unobserved factors, resulting in omitted variable bias. For example, both behaviors can be impacted by unobserved time preferences (discounted factor), life projects (house move), social environment or psychological status (Cawley and Ruhm, 2011). Second, a potential bias can arise from reverse causality: strongly correlated with health, individuals with unhealthy lifestyles at baseline can be encouraged to retire earlier because of bad health. Using exogenous variations in legal retirement ages as sources of identification for measuring causal effect of retirement, the literature identifies heterogeneous effects depending on health behaviors or gender.

However, most of the previous analyses treat the health behavior in a purely individual setting, without considering spouses' behavior externalities or a potential simultaneity of both spouses' behaviors. Literature shows the existence of peer effects when an individual behavior is correlated with those of other individuals in a group (Manski, 1993, 2000)². Moreover, the economics of the family have shown that many decisions are taken in a collective way at the household level (Chiappori, 1992; Bourguignon et al. 1993). In particular, households share common (monetary and non-monetary) resources or preferences, which lead to interactions in retirement decisions (Hurd, 1990; Coile, 2004). Hence, not considering these interactions and likely coordination in spouses' behaviors may lead to misestimate the impact of retirement. To the best of our knowledge, Müller and Shaikh (2018) is the only analysis taking into account interactions among couple members. Nevertheless, they only measure the effect of spouse's retirement and consider spouse (health) behavior as exogenous³. This paper addresses this issue by taking into account potential coordination by couples, together with measuring causal impact of both spouses' retirements on five dimensions of health behaviors: flu vaccination, smoking,

² Manski (2000) differentiates between three different explanations for behaviors' correlation: endogenous interaction when the behavior of an individual directly affect the behavior of another individual, contextual interaction when the behavior of an individual varies depending on the characteristic of others (age or medical history), and correlated effects due to the share of common characteristics or environment. Note that correlated behaviors among couples can arise from all these three explanations. However, the disentangling of these effects is not an objective of this study.

³ In other words, an individual can be affected by the behavior of his spouse only indirectly by the impact of spouse's retirement.

obesity, alcohol consumption and the practice of regular physical activities. Using SHARE survey data and exogenous variations in official retirement ages, the estimation of simultaneous equations models accounts for this coordination by modeling simultaneously both spouses' behaviors and controlling for the endogeneity of each spouse's retirement status.

Results give highlights on the causal impact of retirement on health behaviors and externalities among couples. *First*, general findings provide no evidence of a retirement effect on obesity and smoking. Likewise, only men increase their practice of physical activities after their retirement. For alcohol consumption, although results show little evidence for the frequency of alcohol consumption, the net global effect of the couple's retirement significantly decreases binge drinking behaviors. Hence, the distinction between the consumption at the extensive margin (the frequency) and at the intensive margin (number of drinks per day) seems relevant. Concerning flu vaccination, results also show that the positive impact of retirement seems even stronger for prevention behaviors done with the need of a medical practitioner.

Second, in addition to spillover effects of spouses' retirement, econometric results provide strong evidence of a correlation between partners for all health behaviors, interpreted as a coordination process. Taking into account this coordination is then necessary to avoid a likely evaluation bias of retirement effect on both health status and health behaviors for couples.

Third, further estimations on separate samples based on the job physical burden or the retirement status of the partner highlight some sources of heterogenous effects. Explaining the relative absence of general effect on smoking and obesity, individuals with low job physical burden globally have a healthier lifestyle upon retirement while results are more mixed for individuals with high job physical burden. Furthermore, because couples share more leisure time when both partners are retired, spillover effect of a spouse's retirement can depend on the retirement status of the other partner. Controlling for the retirement status of one partner, additional results show that women are particularly sensitive to men's retirement when they are already retired while the inverse occurs for men.

The rest of the paper is structured as follows: the next section offers a brief literature review. A third section presents the data and several summary statistics. A fourth section is devoted to the description of the econometric strategy. The fifth section presents the economic results and some sources of heterogenous effects. The sixth section is devoted to additional robustness tests. The final section offers a conclusion.

2. Relevant Literature

This paper relates to several strands of the literature. First, it contributes to the general literature studying the retirement effect on health and risky behaviors. As previously said, this question gives rise to a substantial empirical literature on the retirement impact on various health indicators, cognitive abilities or mortality, but remain inconclusive (Nishimura, Oikawa and Motegi, 2017; Bonsang, Adam and Perelman, 2012; Coe and Zamarro, 2011; Behncke, 2012; Hernaes et al., 2013). For recent analyses, Mazzona and Peracchi (2017), using European SHARE survey data, find a negative global retirement effect on general subjective health and cognitive abilities, even if a short-term positive effect is present for individuals retiring from jobs with high physical burden. Celidoni *et al.* (2017), with the same survey data, find a positive effect for early retirement, but a negative effect for individuals who have delayed their retirement. However, analyses also show that results are heterogenous across countries. In France, Messe and Wolff (2019a) show that early retirement has no effect on subjective health. In the United States, Fitzpatrick and Moore (2018) find that retirement increases mortality. Shai (2018) identifies a negative impact of delaying retirement on men's health in Israel. Finally, Heller-Sahlgren (2017) finds that retirement impacts negatively health only in the long-term, pension reforms permitting the postponing of this effect.

Literature in the Economics of the family show that several economic decisions or behaviors are not made in a purely individual way (Chiappori, 1992). Notably, retirement seems to be the result of a coordination process by couples rather than an individual decision (Gustman

and Steinmeier, 2000; Legendre, Pedrant and Sabatier, 2018). Several papers study the effect of spouse's retirement on individual health and find mitigated results about the presence of spillover effects. Eibich (2015) shows that the retirement impact on an individual's health does not vary with the retirement status of his spouse. Conversely, for Japan, Bertoni and Brunello (2017) find that the early retirement of the husbands increases the likelihood of wives to develop stress, depression, or inability to sleep, even if the effect is quite limited. In Australia, Atalay and Zhu (2018) identify a positive effect of the wife's retirement on elderly husband's mental health. Likewise, Picchio and van Ours (2019) show that the effect of retirement is heterogenous depending on gender and marital status. For a man, both his wife and own retirements have a positive effect on his health. But for a woman, even if her husband's retirement is benefiting, her own retirement has a negative effect. Lastly, Messe and Wolff (2019b) find no retirement impact of an individual on his spouse's health.

Another trend of literature analyzes the retirement effect on health behaviors (e.g. physical activity or smoking) to give a better explanation by which mechanisms retirement affects health (Insler, 2014; Chung et al., 2009; Coe and Zamarro, 2015). Conclusions of recent papers are in favor of a positive retirement effect on physical activity (Zhu, 2016; Zhao, Konishi and Noguchi, 2017; Kämpfen and Maurer, 2016). However, results are less evident concerning smoking. Ayyagari (2016) finds little evidence of an increase in smoking probability after retirement while Celidoni and Rebba (2017) finds no effect. Godard (2016) and Feng, Li and Smith (2020) show that an increase in Body Mass Index (BMI) occurs for men, particularly when retiring from a strenuous job, but no effect for women. Lastly, Oshio and Kan (2017) and Eibich (2015) show no retirement impact on alcohol consumption. However, global retirement effect on health behaviors seems also sensitive to the job feature (physically demanding) or baseline behaviors before retirement (Kesavayuth, Rosenman and Zikos, 2018; Celidoni and Rebba, 2017).

Finally, this paper contributes to the literature on the determinants of preventive behaviors (vaccination, screening) or risky behaviors (smoking, alcohol consumption, absence of physical activity) showing externalities or coordination by couples. Cao, Noyes and Homish (2019) show with HRS survey data that the individual's probability to receive the flu vaccine depends on his spouse's behavior: it increases if the latter is vaccinated, the impact varying with income and generation. Kotwal *et al.* (2016) find a correlation between the decision to preventively make a colonoscopy of the two spouses. Finally, concerning risky behaviors, Müller and Shaikh (2018) highlight an increase in alcohol consumption and a decrease in physical activity following spouse's retirement. However, individuals tend to increase both physical activity frequency and alcohol consumption after their own retirement.

3. Data and summary statistics

3.1. SHARE survey data and the analysis sample

This study uses data from the Survey of Health, Ageing and Retirement in Europe (SHARE) (Börsch-Supan, 2019a,b,c,d,e,f). It is a multi-disciplinary cross-country survey on individuals who are 50 or over, notably containing information on socio-economic and retirement status, household conditions, or preventive and risky behaviors. Unlike most survey data, both spouses were questioned for a significant part of the initial sample, and then offers the possibility to study interactions among couples. Moreover, contrary to papers analyzing the retirement effect in a single-country setting (see section 2.), using European data gives a multi-country analysis with results less sensitive to institutional features. This analysis uses six waves, respectively conducted in 2004/2005 (Wave 1), 2006/2007 (Wave 2), 2011/2012 (Wave 4), 2013 (Wave 5), 2015 (Wave 6) and 2017 (Wave 7)⁴.

Beyond traditional socio-economic characteristics (age, gender, education and occupation), the survey also provides information on households (e.g. number of children) and

⁴ Wave 3 SHARELIFE, which took place in 2008/2009, constitutes an exception since it focuses on people's life histories and is therefore not included in this analysis.

allows the simultaneous modeling of both spouses' behaviors. The first and second waves' originality is an additional survey module (drop-off) which asks individuals about preventive behaviors (flu vaccination, check-ups for blood pressure or cholesterol) done in the last twelve months. Furthermore, data also contain information on risky behaviors, like smoking, alcohol consumption, and the frequency of physical activities. This allows a comparison between different types of preventive and risky behaviors, which can be done with or without the medical practitioner.

In order to treat and control the endogeneity of both men and women retirements, it is necessary to precisely form the analysis sample. Like Müller and Shaikh (2018), individuals are considered as retired if they report themselves as 'retired,' opposed to being employed, unemployed, permanently sick (or disabled) and homemaker. The identification strategy is based on a regression discontinuity design (RDD) adapted to the non-linear case (see hereafter). Because the analysis estimates both men and women retirement effects on both spouses' behaviors, only both partners within a window of ± 4.5 years around the official retirement age are considered. The choice of the window is a major concern since it has to be sufficiently large to consider enough observations and have enough precision, together with considering individuals close enough to the eligibility threshold to get unbiased estimations (Lee and Lemieux, 2010). Some papers have derived data driven criteria, but they are not adapted or optimal with categorical outcome variables (Calonico, Cattaneo and Titiunik, 2014; Imbens and Kalyanaraman, 2012) or several treatments (Xu, 2017; Picchio and van Ours, 2019). As it is commonly the case in the literature, sensitivity tests using different windows will be performed in robustness checks (section 6). Lastly, in order to avoid results driven by extreme or atypical values, individuals with household income above 300,000 or a number of chronic diseases above four are not considered in the analysis⁵. Table 1 presents the principal characteristics of

⁵ This selection removed 105 couples (1.05% of the initial sample).

the final sample, an unbalanced panel of 9968 couples (19,936 individuals). The analysis considers 10 countries, all present in the first wave (Austria, Germany, Sweden, Netherlands, Spain, Italy, France, Denmark, Switzerland and Belgium).

Table 1. Summary statistics.

	Men		Women		All		Min	Max	N individuals	N couples
	Mean	S.D.	Mean	S.D.	Mean	S.D.				
Retired	0.81	0.39	0.52	0.50	0.67	0.47	0	1	19936	9968
<i>Education</i>										
Low	0.21	0.41	0.23	0.42	0.22	0.41	0	1	19936	9968
Medium	0.53	0.50	0.55	0.50	0.54	0.50	0	1	19936	9968
High	0.26	0.44	0.22	0.41	0.24	0.43	0	1	19936	9968
Age	65.6	2.5	63.7	2.8	64.7	2.8	55.5	71.5	19936	9968
Household income					8487	17859	0	299683	19906	9953
Nb of chronic diseases	1.0	1.04	0.8	0.95	0.9	1.00	0	4	19906	9953
Number of children					2.2	1.19	0	11	19936	9968
Grandchild					0.77	0.42	0	1	19672	9836
<i>Countries</i>										
Austria					0.09	0.28	0	1	19936	9968
Germany					0.10	0.31	0	1	19936	9968
Sweden					0.10	0.31	0	1	19936	9968
Netherlands					0.08	0.27	0	1	19936	9968
Spain					0.09	0.29	0	1	19936	9968
Italy					0.15	0.36	0	1	19936	9968
France					0.10	0.30	0	1	19936	9968
Denmark					0.10	0.29	0	1	19936	9968
Switzerland					0.06	0.23	0	1	19936	9968
Belgium					0.13	0.34	0	1	19936	9968
<i>Waves</i>										
Wave 1					0.14	0.35	0	1	19936	9968
Wave 2					0.13	0.34	0	1	19936	9968
Wave 4					0.19	0.39	0	1	19936	9968
Wave 5					0.26	0.44	0	1	19936	9968
Wave 6					0.20	0.40	0	1	19936	9968
Wave 7					0.08	0.26	0	1	19936	9968

Summary statistics for a window of +/- 4.5 years around ORA cutoff. Some characteristics are common for both spouses (e.g. number of children) and are then only displayed for the overall sample.

Table 2. Statistics about preventive and risky behaviors, by gender.

Preventive or risky behaviors	Men		Women		All		Min	Max	N individuals	N couples	Statistical test
	Mean	S.D.	Mean	S.D.	Mean	S.D.					
Flu vaccination	0.43	0.49	0.35	0.48	0.39	0.49	0	1	2162	1081	P = 267.91***
Smoking	0.19	0.39	0.14	0.35	0.16	0.37	0	1	14648	7324	P = 524.53***
<i>Vigorous physical activity</i>											
More than once a week	0.42	0.49	0.35	0.48	0.38	0.49	0	1	19736	9868	P = 828.02***
<i>Moderate physical activity</i>											
More than once a week	0.77	0.42	0.75	0.43	0.76	0.43	0	1	19740	9870	P = 748.52***
Obese (BMI > 30)	0.20	0.40	0.19	0.39	0.20	0.40	0	1	15236	7618	P = 191.75**
<i>Frequency of alcohol consumption</i>											
Not at all in last 3 months	0.14	0.35	0.30	0.46	0.22	0.41	0	1	14390	7195	P = 3834.91*** S = 0.40***
Less than once a month	0.04	0.21	0.09	0.28	0.07	0.25	0	1	14390	7195	
Once or twice a month	0.08	0.28	0.12	0.33	0.10	0.31	0	1	14390	7195	
Once or twice a week	0.21	0.41	0.20	0.40	0.20	0.40	0	1	14390	7195	
Three or four days a week	0.11	0.31	0.09	0.29	0.10	0.30	0	1	14390	7195	
Five or six days a week	0.06	0.21	0.03	0.16	0.04	0.19	0	1	14390	7195	
Almost every day	0.36	0.48	0.17	0.38	0.27	0.44	0	1	14390	7195	
Drinks per day	2.06	2.29	1.29	1.62	1.68	2.02	0	30	11388	5694	S = 0.39***

Interpretation: Among men, around 19% smoke and 14% have not consumed alcohol in the last three months. For statistical tests, P corresponds to the Pearson chi-squared test of independence and S corresponds to the rho of Spearman. ** p<0.05; *** p<0.01.

3.2. Outcomes Variables and Descriptive Evidences

The analysis considers seven preventive and risky behaviors which have an important role in individuals' health. In order to consider and differentiate behaviors with or without the need for a medical practitioner, the first outcome is flu vaccination. It is a representative of preventive behaviors since it is gender-neutral and constitutes an annual decision (Cao, Noyes and Homish, 2019). Although influenza virus can have a moderate health effect for most patients, likely complications can have severe health consequences for very young children and elderly people. Several other preventive behaviors are reported in the drop-off module. However, they are almost automatically highly recommended by general medical practitioners and, hence, cannot be considered as purely individual decisions.

Other health behaviors are smoking, physical activity, obesity and alcohol consumption. Smoking is measured by a dummy variable indicating if individuals report themselves as smokers. As pointed out by Eibich (2015), the survey also asks for the quantity of tobacco consumed, but this information may suffer from measurement errors and does not always distinguish between the type of consumption (cigarettes, cigars or pipes). Smoking is then studied only for the extensive margin.

Two types of physical activities are considered. The first is related to vigorous effort which refers to activities such as sports, heavy housework or jobs involving physical labor. The second is related to moderate effort which refers to activities such as gardening, cleaning the car or doing a walk. Such behaviors are measured with two dummies variables indicating if individuals respectively practice each activity more than once a week.

Obesity is measured via self-reported Body Mass Index (height and weight). An individual is considered as obese if his BMI is equal or higher than 30 kg/m². As pointed out by Godard (2016), BMI does not distinguish between fat from lean mass but is highly associated with more precise measures of adiposity.

Last, alcohol consumption is measured in two dimensions. The first is related to the frequency of alcohol intake, varying from ‘Not at all in the last three months’ to ‘Almost every day’ (7 modalities). The second corresponds to how many drinks the individual consumes in a day when he has occasion to drink. Note that for this latest measure, extreme values (more than 30 drinks) are removed from the analysis sample, due to the highly probable measurement error⁶.

Taken together, these behaviors are associated with various health conditions, chronic diseases and significant health costs (Sturm, 2002; OECD, 2018, 2017a). They are associated with higher prevalence of cancer, respiratory diseases (Torres et al. 2013) and cardiovascular diseases and diabetes (OECD, 2015), which represent main avoidable mortality causes (OECD, 2019)⁷. Likewise, smoking, obesity, alcohol consumption and lack of physical activity are respectively the first, third, sixth and eighth causes of healthy life years lost (in terms of disability-adjusted life-years DALY) across Level 3 risk factors in Western Europe in 2015⁸.

Summary statistics displayed in Table 2 give an overview of preventive and risky behaviors, separated by gender. To test if behaviors are correlated by couples, each variable comes with a non-parametric test (Pearson chi-squared or Spearman rho), depending on the type of variable. The case of a significant test, which rejects the null hypothesis, gives a first evidence of coordination by couples since both partners behaviors are correlated. Regarding differences by gender, women have healthier lifestyles (except for physical activity and vaccination). Particularly, men have a systematic higher tendency to smoke and consume alcohol (both frequency and quantity). However, the difference does not seem significant for

⁶ This selection removed 67 couples from the sample (1.16% of the original sample).

⁷ More information can be found in Warburton and Bredin (2017) for physical activity, Duncan et al. (2019) for smoking and GBD 2016 Alcohol Collaborators (2018) for alcohol consumption.

⁸ See GBD 2015 Risk Factors Collaborators (2016).

obesity. Statistical tests also reveal a systematic significant correlation between spouses' behaviors. This gives a first proof of coordination by couples in preventive and risky behaviors.

4. The Econometric Strategy

As previously said, this paper assesses the causal effect of both partners retirements on each spouse behavior, taking into account coordination by couples. In this aim, it is necessary to treat the likely endogeneity of each spouse retirement. As a reminder, in this context, there are several reasons to consider retirements as endogenous. First, the analysis may suffer from omitted variable bias because several unobserved factors are correlated with both retirement decisions and health behaviors (e.g. tastes and risk preferences). Second, a potential bias can arise from reverse causality since health is strongly correlated with risky behaviors and can be a main determinant of the decision to retire.

4.1. A Fuzzy RD Design

The identification strategy is based on a Regression Discontinuity Design, using the discontinuity in the propensity to retire at legal retirement ages. In this framework, the retirement status (treatment variable) is determined by a running variable (age) in such a way that, if the latter crosses a defined cutoff, the individual status switches to 'retired.' Because legal retirement ages constitute strong incentives to retire (Blundell, French and Tetlow, 2016; Hanel and Riphahn, 2012; Mastrobuoni, 2009; Behaghel and Blau, 2012; Gruber and Wise, 2000), the probability to be retired is supposed to jump significantly when individuals' age crosses these cutoffs. SHARE survey data contain information on both birth and interview dates that allow the measuring of age (in months) and then precisely identify the discontinuity at the cutoff.

This study uses variations across countries and overtime in official retirement age (ORA, or sometimes Normal Retirement Age), which is the age at which individuals are eligible to the minimum guaranteed pension or full benefits without condition on contribution history.

As retirement is not mandatory at this age, the discontinuity in retirement probability does not jump from 0 to 100%. Moreover, many specific policies allow retirement before the ORA (e.g. early retirement due to long careers or jobs with high physical burden). The econometric strategy based on discontinuity at this legal retirement age then corresponds to a fuzzy design. Table 3. presents the ORAs for all countries, based on the Social Security Programs Throughout the World Survey and OECD Pensions at a Glance (2017b).

The literature principally uses similar econometric strategies, based on FEIV (Fixed-Effects Instrumental Variable) or RDD in two steps estimations, using discontinuities in retirement probabilities at legal ages as instruments. Although this type of estimation allows a higher range of statistical tests, it is not optimal when dependent variables are categorical. Then, the usual fuzzy RD design is adapted to the nonlinear case, taking into account the qualitative nature of both dependent and endogenous variables. It consists in the estimation of simultaneous equations models, by Maximum Simulated Likelihood (MSL), associated with an IV approach with flexible continuous function of the running variable.

The objective is hence to estimate, for each behavior, a *simultaneous* equation model as follows:

$$\begin{cases} Prob(behavior_i^m = 1) = X_i^m \beta_1 + \gamma_1 retirement_i^m + \lambda_1 retirement_i^w + V_i \theta_1 + f(\widetilde{age}_i^m) + \varepsilon_{i1} \\ Prob(behavior_i^w = 1) = X_i^w \beta_2 + \gamma_2 retirement_i^m + \lambda_2 retirement_i^w + V_i \theta_2 + f(\widetilde{age}_i^w) + \varepsilon_{i2} \\ Prob(retirement_i^m = 1) = X_i^m \beta_3 + f(\widetilde{age}_i^m) + Z_i^m \delta_1 + \varepsilon_{i3} \\ Prob(retirement_i^w = 1) = X_i^w \beta_4 + f(\widetilde{age}_i^w) + Z_i^w \delta_2 + \varepsilon_{i4} \end{cases}$$

where m , w and i denote, respectively, men, women and couples. X_i^j are individual attributes, V_i household characteristics and Z_i^j the instruments. However, note that for the frequency of alcohol consumption and the number of drinks per day, dependent variables are considered as continuous and the associated equations become linear. Error terms are supposed to be drawn from a multivariate normal distribution with:

Table 3. Reference Official Retirement Age by country and gender.

Country	Wave 1		Wave 2		Wave 4		Wave 5		Wave 6		Wave 7	
	Man	Woman	Man	Woman	Man	Woman	Man	Woman	Man	Woman	Man	Woman
Austria	65	60	65	60	65	60	65	60	65	60	65	60
Germany ^a	65	65	65	65	65	65	65	65	65+4m	65+4m	65+6m	65+6m
Sweden	65	65	65	65	65	65	65	65	65	65	65	65
Netherlands	65	65	65	65	65	65	65	65	-	-	-	-
Spain	65	65	65	65	65	65	65+1m	65+1m	65+3m	65+3m	65+5m	65+5m
Italy	65	60	65	60	65	60	66+2m	62+2m	66+5m	62+4m	66+7m	65+7m
France	65	65	65	65	65	65	66+2m	66+2m	66+7m	66+7m	67	67
Denmark ^b	65	65	65	65	65	65	65	65	65	65	65	65
Switzerland	65	63	65	64	65	64	65	64	65	64	65	64
Belgium	65	63	65	64	65	65	65	65	65	65	65	65
	Man						Woman					
	Below the ORA			Above the ORA			Below the ORA			Above the ORA		
% of retirement	64.69			93.80			36.60			73.18		

Interpretation: the ORA for men in Austria is always 65 years. For wave 7, in Germany, the ORA is 65 years and 6 months.

a. For wave 4, the ORA for interviews in 2011 is 65 and 65 + 1 month for interviews in 2012.

b. For wave 1 and wave 2, the ORA is 67 for generations before 1940.

$$\begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \end{pmatrix} | x_i^j, V_i, z_i^j \sim N \left(\begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho_{12} & \rho_{13} & \rho_{14} \\ \rho_{12} & 1 & \rho_{23} & \rho_{24} \\ \rho_{13} & \rho_{23} & 1 & \rho_{34} \\ \rho_{14} & \rho_{24} & \rho_{34} & 1 \end{pmatrix} \right).$$

From the econometric point of view, this specification allows testing and controlling potential endogeneity of both men and women retirements, by ignoring their endogenous nature, notably from omitting variables or simultaneity (Greene, 2011). The correlation of the two error terms of both partners retirement status equations, ρ_{34} , captures likely coordination in partners retirement decisions. Likewise, a likely coordination by couples in health behaviors is captured by ρ_{12} , the correlation of the two error terms of both partners behaviors equations.

Both retirement status are instrumented using dummy variables indicating whether spouses' age has crossed the ORA, defined as follows:

$$Z_i^m = 1[\widehat{age}_i^m > 0] \text{ and } Z_i^w = 1[\widehat{age}_i^w > 0]$$

with \widehat{age}_i^m and \widehat{age}_i^w respectively men and women ages centered at ORA. As official retirement age is fixed exogenously by governments, it impacts behaviors in all likelihood only indirectly by the impact of retirement. Moreover, contrary to Early Retirement Age (ERA) which can vary depending on work/contribution history or occupation (Heller-Sahlgren, 2017)⁹, ORA is the same for all individuals within a country. Descriptive statistics in Table 3 confirm that instruments are significantly correlated with retirement status. The proportion of retirees is significantly higher for individuals above the threshold. For men, 64.69% are retired before reaching the ORA, but the proportion increases to 93.80% for individuals above the cutoff. The gap is even more important for women: the proportion is about 36.60% before the ORA and

⁹ This raises two potential issues. First, as the ERA depends on occupation, it is almost impossible to know which ERA must be attributed to which individuals. Second, depending on their preferences or their health status, individuals can self-select into jobs where the likelihood to be eligible for early retirement is more important. Despite these potential limitations, the literature argues that using discontinuities at ERA is preferable due to lower variation in ORAs across countries and overtime. However, Table 3 shows that taking into account the last three waves of SHARE survey significantly solve this problem encountered by analyses only considering earliest waves of the survey.

increases to 73.18%. Because results in the literature seem sensitive to the functional form of age (Gelman and Imbens, 2019), smooth function is adopted by allowing a linear trend with different slopes on each side of the cutoff (Angrist and Pischke, 2009; Lee and Lemieux, 2010).

In order to precisely estimate coordination by couples, several control variables are included to control for observed heterogeneity. Individuals' characteristics are the level of education and the number of chronic diseases. Based on the ISCED (UNESCO, 1997), three dummies indicate respectively low (none and primary), medium (lower secondary and secondary) and high (tertiary, university degree) levels of education. Households' characteristics are the number of children, the existence of grandchildren and income (expressed in purchasing power parity terms). Because several papers find heterogeneous retirement effects with respect to occupational strain (Celidoni and Rebba, 2017; Mazzonna and Peracchi, 2017), the job physical burden (or past jobs for retired) is also considered using the survey question '*Would you say your job is physically demanding?*' where individuals had to report if they agree with four alternatives: strongly agree, agree, disagree, strongly disagree. However, the information is particularly missing for retired individuals. This measure may also suffer from reporting heterogeneity or justification bias. Answers are predicted exogenously using the same methodology of Mazzonna and Peracchi (2017) and dichotomized to have, for each spouse, a final dummy indicator of physically demanding jobs (see Appendix 1). Another strategy will be tested in robustness checks. Finally, several dummies control for countries and waves fixed effects.

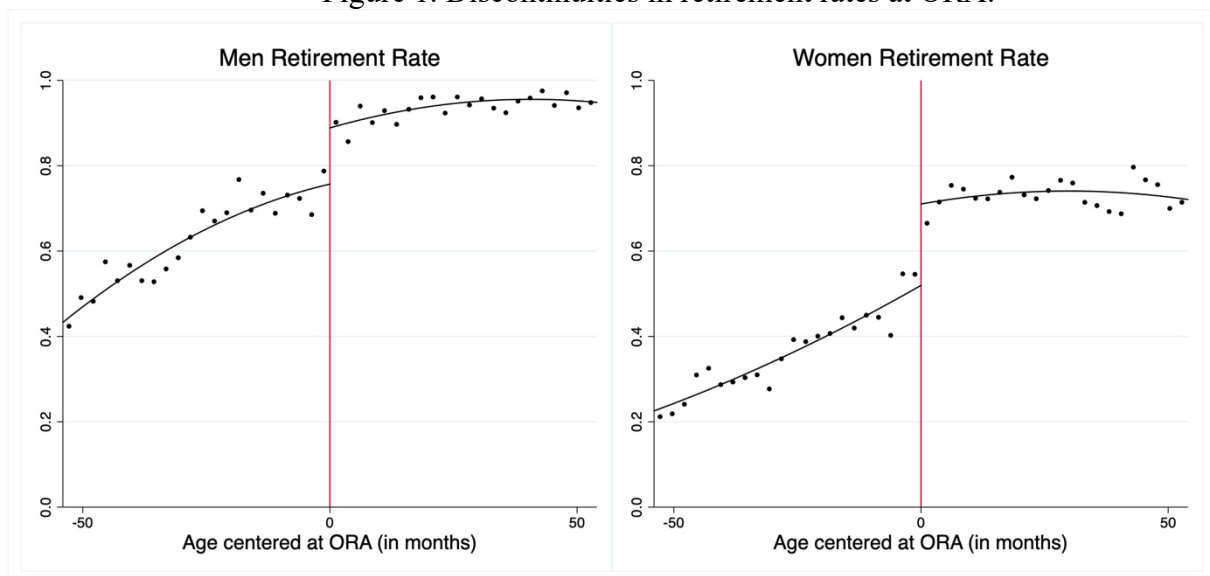
4.2. Discontinuity in the Retirement Rate and Validity Checks

Although the econometric strategy is adapted to nonlinear framework, a RD design is based on several assumptions, which need to be verified (Lee and Lemieux, 2010). First, it is assumed that health behaviors evolve smoothly with respect to the running variable. In other words, conditionally on an appropriate functional form for age, discontinuities in health behaviors

distributions can only be attributed to the effect of retirement. As pointing out by Eibich (2015), aging is a gradual process and there is no reason to question this assumption. Second, the running variable cannot be manipulated by individuals. Since the running variable is age, it seems justified considering that this condition holds by definition¹⁰.

Figure 1. shows graphically the discontinuities in retirement probabilities at ORA both for men and women. Dots represent average rates of retirees for different values of the running variable and are overlaid with smooth functions obtained by 2nd-order polynomial regressions on each side of the cutoff. Significant discontinuities in the share of retirees are observed at the threshold, hence, at ORA. For men, the jump in the retirement rate at ORA is about 15 percentage points. For women, the corresponding jump is about 20 percentage points. This gives strong evidence that individuals below the cutoff have a significant lower probability to be retired compared with those above. It confirms that the ORA constitutes a strong incentive to retire once individuals reach this legal age.

Figure 1. Discontinuities in retirement rates at ORA.



¹⁰ A formal McCrary (2008) test has been done and no statistical evidence of manipulation has been found. Results are available upon request.

As previously said in section 4.1, several additional control variables are considered, notably similar to Eibich (2015) and Celidoni and Rebba (2017). Taking control variables into account allows a higher precision of the estimators. However, RDD hypotheses assume that individuals just below and above the cutoff are similar in such a way that those below the ORA constitute a valid control group for those just above. In other words, the treatment (retirement) is locally randomized. Hence, intuitively, there is no need of control variables to get unbiased estimation of the retirement effect and considering further covariates may suggest the violation of this assumption. This is not a concern if there is no discontinuity in the distribution of covariates at the threshold, hence, if variables are balanced around the cutoff (Calonico et al. 2019; Lee and Lemieux, 2010). In appendix 2, several graphical tests have been conducted and no violation of these two conditions has been found. Further investigation will be conducted in robustness checks. Overall, considering the absence of discontinuity in the distribution of control variables (particularly for predetermined characteristics) and other validity checks, these evidences suggest no violation of RDD assumptions and support the identification strategy.

5. Econometric Results

A first subsection discusses the validity of instruments. Then, principal results are presented, differentiating by the impact of ‘own’ retirement (direct effect) and the impact of spouse’s retirement (spillover effect) on health behaviors. Further, some sources of heterogeneity are considered in a final subsection, explaining mitigated results for some health behaviors.

5.1. The Instruments

Average marginal effects after estimation of simultaneous equations models are displayed in Table 4 for vaccination, physical activities and obesity, and in Table 5 for smoking and alcohol consumption. Confirming graphical evidence of discontinuities in retirement probabilities at

the ORA, instruments are always significant at 1%. Varying with models, crossing the ORA significantly increases the men's retirement probability: the effect varies between 9.2 and 17.9 percentage points. The corresponding increase in women's retirement probability ranges from 17.3 to 26.0 percentage points¹¹. Higher effect for women can be explained due to different career paths by gender. Women are less likely to be eligible for early retirement because of a shorter working history due to potential career interruptions (Engels, Geyer and Haan, 2017). The discontinuities at ORA clearly satisfy conditions for valid instruments since Wald F – statistics of excluded instruments ranges from 40.846 to 189.166. These results are in line with previous analyses showing significant impacts of financial incentives on individual retirements (Müller and Shaikh, 2018; Mastrobuoni, 2009).

5.2. Direct and Spillover Effects of Retirement

Direct effect of retirement strongly varies depending on health behaviors. In line with Müller and Shaikh (2018) and Celidoni and Rebba (2017), there is no direct effect, neither for man nor woman, on smoking behavior (extensive margin). Surprisingly and contrary to Godard (2016) and Feng, Li and Smith (2020), no direct effect is present for obesity as well. Moreover, regarding spillover effect (spouse retirement), there is also no effect for these two health behaviors. Overall, these findings suggest no effect of retirement on both smoking and obesity.

Concerning physical activities, results show a direct effect of man's retirement (Kesavayuth, Rosenman and Zikos, 2018). The probabilities to practice activities demanding vigorous or moderate effort both increase by around 10 percentage points. This effect seems particularly significant since, respectively, only about 49% of men practice (more than once a

¹¹ These effects are slightly lower than those observed in the literature for several reasons. First, most of the analyses only consider education (or no control variables) in the estimation of the reduced form effect. Second, the literature rarely differentiates between men and women. Then, estimations give a 'mean' effect for all individuals, which lead to overestimate the true impact for men. Third, this analysis only considers couples, who are less responsive to financial incentives (compared with singles), because they tend to retire together. Note that this effect is captured by the error terms correlation of the two retirement equations. Fourth, contrary to the estimation of simultaneous equations models which give different effects for each health behaviors, RDD in the literature correspond to a two-step estimation. The predicted retirement probability is estimated exogenously with a linear probability model estimated by OLS. Using this method, crossing the ORA increases the retirement probability by 13.84 p.p. for men and 21.76 p.p. for women.

week) an activity demanding vigorous effort among non-retirees, and respectively 76% for an activity demanding moderate effort. Conversely, unlike Zhu (2016) and Oshio and Kan (2017), there is no direct effect for women. Likewise, results show the absence of spillover effects among couples for these health behaviors.

As regards the alcohol take-up, results point to the absence of direct effect on the frequency of alcohol consumption, corresponding to the conclusions of Zhu (2016) and Oshio and Kan (2017). However, spouse retirement affects alcohol consumption frequency heterogeneously by gender. While men's retirement decreases consumption frequency of women, the effect is the opposite for women's retirement. Note that these latter effects are, though, only significant at 10%. In contrast, retirement seems to have strong effects on alcohol consumption at the intensive margin. Looking at the results for the number of drinks, direct effects show a strong decrease in alcohol units of about 2.27 for men and 1.53 for women. These impacts are particularly important regarding the consumption at the baseline. Indeed, among non-retirees, the average drinks per day is about 2.22 for men and 1.26 for women. In addition, although the spillover effect is positive for men (respectively negative for women), the net effect of the couple's retirement (direct + spillover effects) is negative for both spouses. Regardless of the frequency, since important variability in the number of drinks is observed in the sample (cf. Table 2), retirement seems to significantly reduce binge drinking behaviors.

Lastly, results for vaccination emphasize a strong distinction between precedent health behaviors and prevention behaviors done with the need of a medical practitioner. Indeed, direct effects reveal a sizable increase in the probability to receive the flu vaccine for men (about 33 percentage points). Likewise, spillover effects are positive for both men and women. The man's likelihood to be vaccinated increases of about 18 percentage points when the woman retires. The reciprocal effect for the woman is about 22 percentage points. Regarding baseline behaviors among non-retirees, about 30% of men and 27% of women are vaccinated before retirement. Then, it seems that couple's retirement has a strong impact for prevention behaviors

done with the need of a medical practitioner compared with other health behaviors. This result contrasts the findings of Nielsen (2019) which shows a decrease in General Practitioner (GP) visits and hospitalizations after early retirement, and then seems in favor of a substitutability relationship between preventive and curative care (Cabral and Cullen, 2017).

Overall, econometric results differ from those of previous analyses in the literature in several ways. Because the econometric strategy allows the analysis of both spouses' behaviors, it helps to explain heterogeneous results found in analyses which do not take into account marital status and only consider the effect of retirement in a purely individual setting (Inslar, 2014; Eibich, 2015). In the same way, results differ from analyses inspecting heterogeneity by gender without taking into account spillover behaviors. They usually find a positive effect on BMI for men (Feng, Li and Smith, 2020; Godard, 2016) and a positive effect on physical activity for both genders (Celidoni and Rebba, 2017; Kämpfen and Maurer, 2016; Oshio and Kan, 2017; Kesavayuth, Rosenman and Zikos, 2018). Note that results also differ from the closest study of Müller and Shaikh (2018), measuring spillover effects but not simultaneously modeling both spouses' behaviors. Notably, concerning this latter point, the econometric strategy seems particularly relevant regarding the correlation of the error terms. Regarding Table 4 and Table 5, for all behaviors, the correlation between error terms of both spouses' behavior equations reveals a strong and always significant coordination by couples for health behaviors. Although coordination is also measured by spillover effects, both behaviors are impacted by common elements of unobserved heterogeneity. Conditionally on household covariates (income, children, grandchildren), this coordination cannot be explained by liquidity constraints or the presence of other household members. Moreover, the extent of error terms correlation is globally constant across behaviors (regardless of obesity and vaccination), which confirm the idea that these unobserved common elements do not entirely depend on the health behavior.

5.3 Sources of Heterogeneity

The literature finds important heterogeneous effect of retirement on health or health behaviors depending on the job physical burden (Celidoni and Rebba, 2017; Mazzonna and Peracchi, 2017). In order to go beyond general mean effects, same econometric models are estimated on separate samples for both men and women, depending on the job physical burden status presented in section 4.1 and appendix 1. Concentrating the attention on the spouse for which the job physical burden is determined, Table 6 shows some signs of heterogeneous effects for both direct and spillover effects of retirement. Notably, for men, the direct effect of retirement on his probability to practice vigorous effort physical activity becomes negative for individuals with a high job physical burden. Likewise, for the same category, women's retirement spillover effect becomes nonsignificant on the probability to be obese. Lastly, the spillover effect of women's retirement on alcohol drinks per day is still significantly positive but the extent is almost divided by seven between low and high job physical burden individuals. For other effects, the differences in coefficients are not statistically significant as confidence intervals overlap between low and high job physical burden individuals. However, it allows envisaging one additional potential heterogeneous effect. For high job physical burden, the direct effect is nonsignificant for moderate effort physical activity.

Table 4. Direct and spillover effect of retirement on flu vaccination, physical activities and obesity

	Vaccination		Vigorous effort activity		Moderate effort activity		Obesity	
	Man	Woman	Man	Woman	Man	Woman	Man	Woman
Man retirement	0.339 (0.126)***	0.219 (0.090)**	0.103 (0.056)*	0.007 (0.029)	0.101 (0.047)**	0.032 (0.028)	-0.022 (0.053)	-0.020 (0.029)
Woman retirement	0.180 (0.062)***	0.194 (0.143)	-0.032 (0.027)	-0.101 (0.063)	0.010 (0.023)	-0.017 (0.062)	0.036 (0.025)	0.000 (0.075)
1(Man age > ORA)	0.179 (0.046)***		0.126 (0.015)***		0.126 (0.015)***		0.130 (0.017)***	
1(Woman age > ORA)		0.260 (0.050)***		0.198 (0.018)***		0.198 (0.018)***		0.176 (0.021)***
ρ Health behaviors	0.745 (0.046)***		0.420 (0.017)***		0.404 (0.020)***		0.220 (0.028)***	
ρ Retirement behaviors	0.190 (0.081)***		0.380 (0.024)***		0.382 (0.024)***		0.390 (0.028)***	
Wald F instruments	40.846		189.166		188.081		128.662	
P-value	0.000		0.000		0.000		0.000	
N (couples)	924		7595		7597		5694	

Interpretation: Man's retirement increases the woman's probability to receive the flu vaccine of 21.9 p.p. For men, crossing the ORA increases their retirement probability of about 17.9 p.p when vaccination is considered.

* p<0.1; ** p<0.05; *** p<0.01; (.) standard errors.

Table 5. Direct and spillover effect of retirement on smoking and drinking behaviors.

	Smoke		Drinks per day		Alcohol frequency	
	Man	Woman	Man	Woman	Man	Woman
Man retirement	0.002 (0.058)	-0.039 (0.025)	-2.267 (0.160)***	-0.760 (0.120)***	0.101 (0.311)	-0.319 (0.182)*
Woman retirement	-0.009 (0.026)	-0.023 (0.042)	0.571 (0.139)***	-1.534 (0.091)***	0.232 (0.139)*	0.155 (0.288)
1(Man age > ORA)	0.122 (0.017)***		0.092 (0.018)***		0.124 (0.017)***	
1(Woman age > ORA)		0.237 (0.020)***		0.173 (0.021)***		0.240 (0.021)***
ρ Health behaviors	0.471 (0.025)***		0.355 (0.017)***		0.412 (0.011)***	
ρ Retirement behaviors	0.367 (0.027)***		0.356 (0.028)***		0.369 (0.028)***	
Wald F instruments	176.603		91.986		180.916	
P-value	0.000		0.000		0.000	
N (couples)	5988		4641		5914	

Interpretation: Man's retirement decreases the woman's alcohol consumption of about 0.76 alcohol units.

* p<0.1; ** p<0.05; *** p<0.01; (.) standard errors.

Table 6. Heterogenous effects by physically demanding job status

Physically demanding job	Man		Woman	
	Low	High	Low	High
Vigorous effort activity				
Man retirement	0.251 (0.070)***	-0.158 (0.078)**	0.050 (0.042)	-0.051 (0.042)
Woman retirement	-0.035 (0.038)	-0.040 (0.038)	-0.065 (0.089)	-0.105 (0.088)
Moderate effort activity				
Man retirement	0.147 (0.061)**	0.048 (0.072)	0.109 (0.035)***	-0.067 (0.040)*
Woman retirement	0.003 (0.031)	0.014 (0.034)	0.082 (0.077)	-0.098 (0.075)
Obesity				
Man retirement	0.009 (0.074)	-0.037 (0.074)	-0.045 (0.038)	-0.004 (0.041)
Woman retirement	0.075 (0.032)**	-0.011 (0.038)	0.080 (0.093)	-0.147 (0.102)
Smoke				
Man retirement	0.014 (0.083)	-0.049 (0.081)	-0.028 (0.033)	-0.043 (0.040)
Woman retirement	-0.026 (0.035)	0.019 (0.038)	-0.015 (0.067)	-0.003 (0.060)
Drinks per day				
Man retirement	-2.728 (0.151)***	-2.644 (0.213)***	-0.709 (0.159)***	-0.865 (0.143)***
Woman retirement	1.930 (0.159)***	0.284 (0.163)*	-1.599 (0.156)***	-1.312 (0.127)***
Alcohol frequency				
Man retirement	0.948 (0.652)	-0.071 (0.396)	-0.168 (0.225)	-0.305 (0.263)
Woman retirement	0.103 (0.191)	0.160 (0.205)	-0.325 (0.380)	0.392 (0.402)

Interpretation: For men with low job physical burden, their retirement increases their probability to practice vigorous effort activity of about 25.1 p.p. For same individuals, women's retirement increases their probability to be obese of about 7.5 p.p

* p<0.1; ** p<0.05; *** p<0.01; (.) standard errors.

Conversely, results for women are relatively more stable. Previously nonsignificant, the spillover effect of men's retirement on moderate effort physical activity becomes significant with opposite signs between the two categories of job physical burden. Now it decreases the probability for high physical burden jobs of almost 7 percentage points. All over effects are similar between the two groups. However, for both spouses, spillover effects on alcohol consumption frequency become non-significant, although previously significant at only 10%. In the same way, there is still no effect of retirement on smoking behavior. Overall, heterogeneous results by job physical burden explain the absence or limited retirement effect in the general sample (alcohol consumption frequency, smoking, obesity). Global effect of the couple's retirement seems to encourage healthier lifestyles for low job physical burden, while results are more contrasted for high job physical burden.

Another important issue is the order of retirements within the couple and likely heterogeneous spillover effect depending on the retirement status of the spouse. For example, the absence of spillover effects for both vigorous and moderate effort physical activities could be explained by the fact that individuals are not retired themselves. As pointed out by Müller and Shaikh (2018), non-retirees may lack time or energy to react from their spouses' retirement. Couples can share more leisure time once both partners are retired, and spillover effects could be amplified for retired individuals. Moreover, the effect of women's retirement could also capture the effect when the two partners in the couple are both retired, since women generally retire later than men and are also younger than men. In the sample, the average age difference between partners is about 2.6 years and men are older than women in around 80% of couples. To test whether spillover effects are heterogeneous depending on the spouse retirement status and retirements order, additional econometric models are separately estimated for non-retirees and retirees without measuring direct effects. Concentrating the attention on the spouse for

which the retirement status is determined, Table 7 shows some signs of heterogeneous effects¹². Women retirement spillover effects are positive on smoking and drinking behaviors at the intensive margin when men are non-retired. Conversely, these effects are non-significant when men are retired. In the same way, men's retirement spillover effect on practicing activity demanding vigorous effort becomes positive when women are retired. Despite the non-significant differences in coefficients because of confidence intervals overlapping, other results also suggest that women are particularly sensitive to men's retirement when they are already retired. In contrast, men only respond to women's retirement when they are non-retired.

6. Robustness Checks

Tables A1-A5 in appendix 3 offer additional estimations to verify the robustness with respect to the choice of the window around ORA cutoff, the functional form of age, the control of the job physical burden, the definition of retirement and the stability without additional control variables. First, econometric results may suffer from a potential bias if they are driven by individuals far away from the retirement eligibility threshold (Angrist and Pischke, 2009). As previously explained, optimal criteria for the window choice derived from the literature are non-adapted in the nonlinear framework. However, one of the ways to verify that results are not systematically biased is to estimate same econometric models by varying the window choice. Table A1 presents additional estimations considering window sizes of ± 5 years, ± 5.5 years and ± 6 years. Overall, despite the presence of slight differences in significativity, results are qualitatively similar and conclusions remain mostly unchanged.

¹² One can also be interested whether the direct effect of an individual's retirement depends on the retirement status of his spouse. Not displayed in Table 7, results have shown only one significant difference for men. Man's retirement increases his probability of smoking when the woman is non-retired. At the inverse, man's retirement has still no effect on his probability of smoking when the woman is retired.

Table 7. heterogeneous effects depending on retirement status.

Subsample	Non-retired men	Retired men	Non-retired women	Retired women
Health behavior	Man	Man	Woman	Woman
Vigorous effort activity				
Man retirement	-	-	-0.061 (0.040)	0.142 (0.050)***
Woman retirement	-0.053 (0.067)	-0.026 (0.033)	-	-
Moderate effort activity				
Man retirement	-	-	0.036 (0.037)	-0.013 (0.054)
Woman retirement	0.016 (0.055)	0.022 (0.027)	-	-
Obesity				
Man retirement	-	-	-0.036 (0.039)	-0.020 (0.053)
Woman retirement	0.098 (0.051)*	0.012 (0.030)	-	-
Smoke				
Man retirement	-	-	-0.049 (0.037)	-0.070 (0.041)*
Woman retirement	0.144 (0.056)**	-0.045 (0.030)	-	-
Drinks per day				
Man retirement	-	-	-0.849 (0.155)***	-0.871 (0.203)***
Woman retirement	2.350 (0.385)***	0.090 (0.186)	-	-
Alcohol frequency				
Man retirement	-	-	-0.165 (0.225)	-0.531 (0.379)
Woman retirement	0.576 (0.357)	0.172 (0.159)	-	-

Interpretation: Among non-retired men, woman's retirement increases man's probability of smoking of about 14.4 p.p. Among retired women, man's retirement increases woman's probability to practice vigorous effort activity of about 14.2 p.p.

* p<0.1; ** p<0.05; *** p<0.01; (.) standard errors.

Secondly, econometric results could also be biased if the functional form of age is misspecified (Lee and Lemieux, 2010). Even if the window is relatively small and the assumption of different linear trends seems plausible, the pure causal effect of retirement may not be identified if the functional form cannot correctly control the effect of age. Table A2 presents results adopting the same econometric strategy but allowing the relation between age and health behaviors to be nonlinear (quadratic terms) with two different trends on each side of the cutoff. Results are globally the same with this more flexible functional form and reject the misspecification hypothesis of age effect.

As explained in section 4.1, the job physical burden is controlled by a measure derived from the methodology of Mazzonna and Peracchi (2017), with the following statement ‘*Would you say your job is physically demanding?*’. Because the information is particularly missing for retired individuals, the dummy variable controlling for job physical burden is exogenously predicted by OLS as shown in Appendix 1. To test the robustness of the method, another specification uses the same strategy as Celidoni and Rebba (2017), differentiating between white or blue collars, and between high and low-skilled, leading to four different categories of individuals. Table A3 shows that results are globally stable using this alternative strategy. One can only note one exception (on 28 effects): the direct effect of women’s retirement becomes positive for vaccination.

Results can also be sensitive to the definition of retirement chosen. Although the definition retained for the analysis, based on self-reporting status, has good validity and is often used in the literature (Müller and Shaikh, 2018), women can misreport their status by indicating they are homemakers instead of retired once they leave the job market. The presence of a potential bias is tested by additional estimations on the subsample of only employed, unemployed or retired individuals. Table A4 shows that results remain mostly unchanged¹³.

¹³ One can note three exceptions (on 28 effects). First, for men, the direct effect of retirement on the probability to practice activity demanding vigorous effort becomes non-significant. Likewise, for men, the effect of women’s retirement on their probability to be obese becomes significant with a positive effect. Finally, the spillover effect of women’s retirement on alcohol consumption frequency also becomes non-significant for men.

Finally, despite graphical evidences of the absence of discontinuities in the distributions of covariates (see section 4.2), the robustness is tested by only considering the level of education in addition to age effect. Table A5 shows that, again, results are both qualitatively and quantitatively similar. One exception is for women: the direct effect of retirement for practicing physical activity demanding vigorous effort and the spillover effect of man's retirement on alcohol consumption frequency become non-significant. Overall, all additional results reinforce the robustness of the findings in section 5.2 and confirm the validity of the econometric strategy.

7. Conclusion

This study uses six waves of the Survey of Health, Ageing and Retirement in Europe (SHARE) to investigate the effect of retirement on five dimensions of health behaviors among couples: flu vaccination, smoking, obesity, alcohol consumption and the practice of regular physical activities. Unlike previous analyses in the literature, estimations of simultaneous equations models allow the measure of short-term causal impacts of both individual retirement and spouse's retirement on both partners' behaviors, taking into account the qualitative nature of dependent variables. Moreover, it exploits variations in official retirement ages (ORA) across countries and overtime to deal with the endogeneity of both spouses' retirements.

Results show that the impact of retirement strongly varies depending on health behaviors. General findings provide no evidence of retirement effect (direct or indirect) for obesity and smoking, and little evidence of spillover effect which increases the alcohol intake frequency. Conversely, strong negative direct and spillover effects are found on alcohol units consumed, which result in a general reduction of binge drinking behaviors. Moreover, analyzing retirement effect on flu vaccination shows a stronger positive increase in preventive behaviors done with the need of a medical practitioner compared with other health behaviors. The analysis also goes beyond general effects by investigating sources of heterogeneity. Retirement seems to particularly cause healthier lifestyles among individuals with low (past)

job physical burden while conclusions are more mixed for other individuals. Furthermore, because the timing of retirement is different by gender, spillover effect of an individual's retirement depends on the order of retirements among couples, hence, on the retirement status of the partner. Results show that men are not particularly sensitive to women's retirement when they are retired themselves, while the inverse occurs for women.

These findings contrast precedent mixed conclusions of the literature and bring important highlights on the link between retirement and health behaviors. For example, unlike papers finding a general increase in alcohol intake without distinguishing extensive and intensive margins (Eibich, 2015; Kesavayuth, Rosenman and Zikos, 2018), results are in favor of a slight increase in frequency, but a strong decrease in alcohol units consumed. Similarly, most of previous analyses have investigated changes in health behaviors in a purely individual framework, without considering spillover effects of the spouse's retirement or coordination by couples (Kesavayuth, Rosenman and Zikos, 2018; Celidoni and Rebba, 2017). However, literature on peer effects have shown that individual behaviors are correlated with those of others (Manski, 1993, 2000). Likewise, the economics of the family questions the traditional individual view by considering most of the decisions taken at a collective level in the household, resulting in coordinated behaviors, as retirement (Hurd, 1990; Legendre, Pedrant and Sabatier, 2018). In this regard, findings provide strong evidence of externalities among partners, and an always significant positive correlation between both spouses' behaviors, interpreted as a result of a coordination process. Hence, not considerate these interactions among couples may lead to misestimate the pure causal impact of retirement in policy evaluations.

Nevertheless, this analysis has some limitations and also suggests possible extensions. As most of analyses in the literature, this study only considers the short-term impact of retirement. However, measuring both short-term and long-term effects requires sufficient panel data, not readily compatible with the observation of couples for the time being, with available survey data. Similarly, literature brings evidence of heterogenous dynamic effects depending

on baseline behaviors, hence, if individuals initially have some preventive of risky behaviors (Kesavayuth, Rosenman and Zikos, 2018; Cao, Noyes and Homish, 2019). Another possible extension would be to shed light on the nature of interactions between partners and retirement spillover effects. Indeed, despite evidences, this study cannot bring conclusions about the cause of such effects, which may arise from selection (e.g. spouses choosing each other based on similar preferences or expectations), correlated effects (e.g. shared environment), or true endogenous interactions (Christakis and Fowler, 2007; Cohen-Cole and Fletcher, 2008).

Finally, this analysis has several implications for public policies. Since retirement has significant effect on health behaviors, policymakers should take into account these beneficial and adverse effects, together with distinguishing global and heterogeneous effects between singles and couples in policy evaluations. For example, policies aiming to postpone individual retirements may delay the health benefit from reduction in alcohol intake (regardless of the frequency of consumption) or from the increase in physical activities practicing for men, if these effects are permanent. Lastly, this analysis offers some insights which can improve prevention strategies of international organizations and national governments. Notably, near retirement health promoting campaigns should particularly target individuals with high job physical burden as well as men before they are retiring.

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Appendices

Appendix 1. The measure of job physical burden.

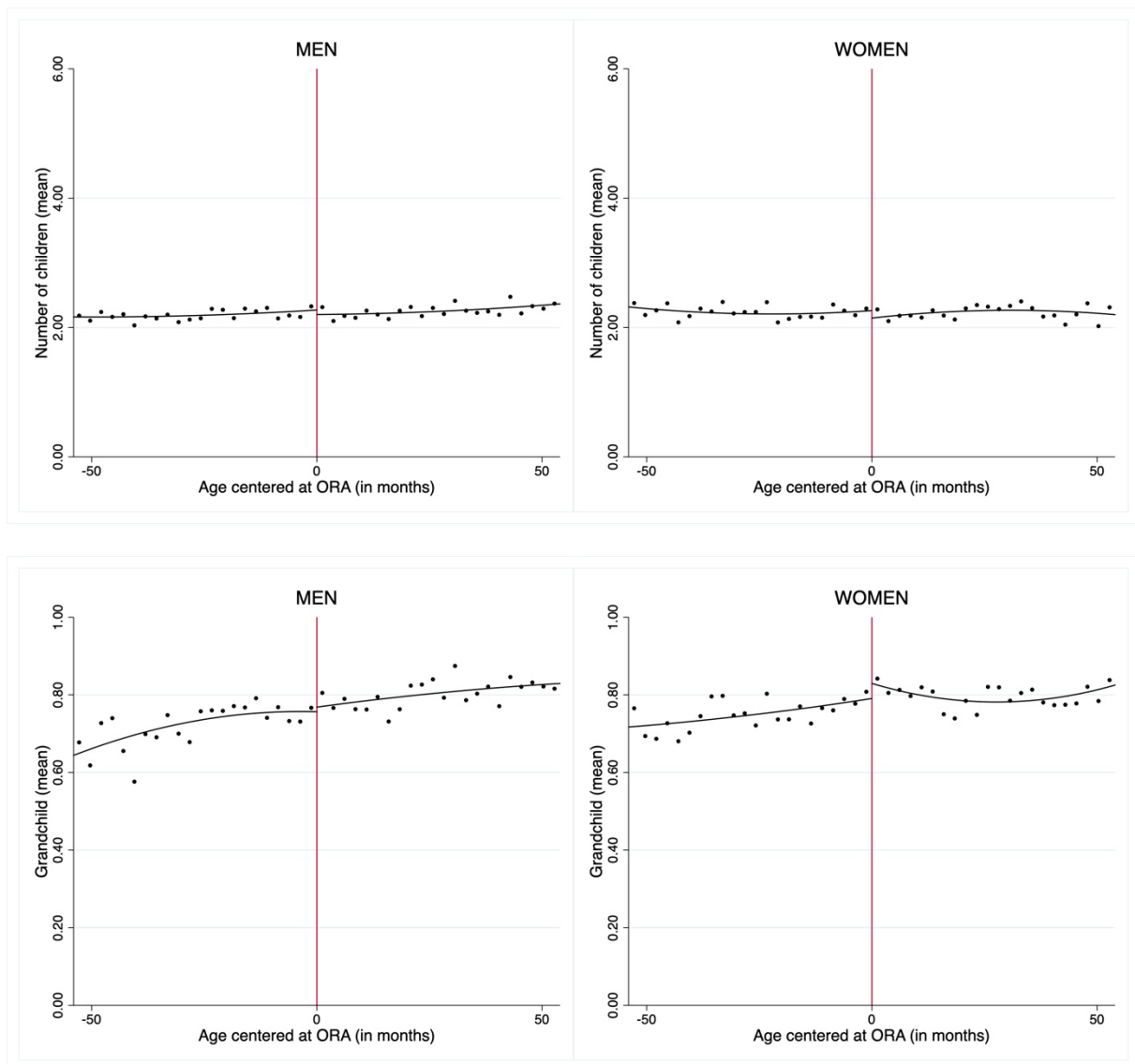
Job physical burden is measured based on a self-reported evaluation, with the following sentence ‘Would you say your job is physically demanding?’. However, answers are particularly missing for retired people. Following the same idea of Mazzonna and Peracchi (2017), the job physical burden (from 1 to 4) is predicted exogenously by estimating the following model on individuals currently employed:

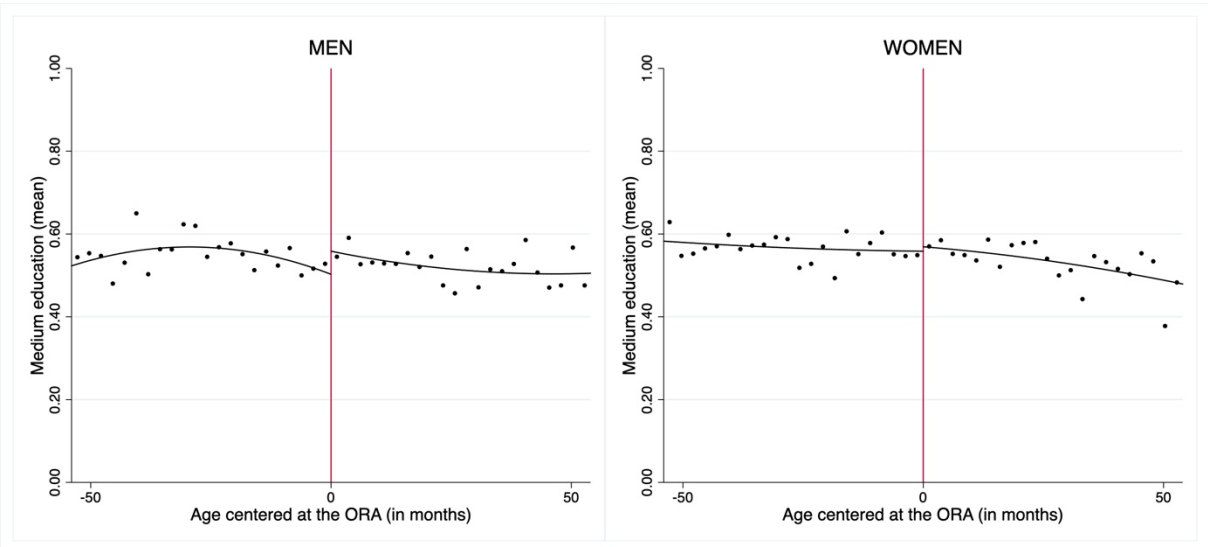
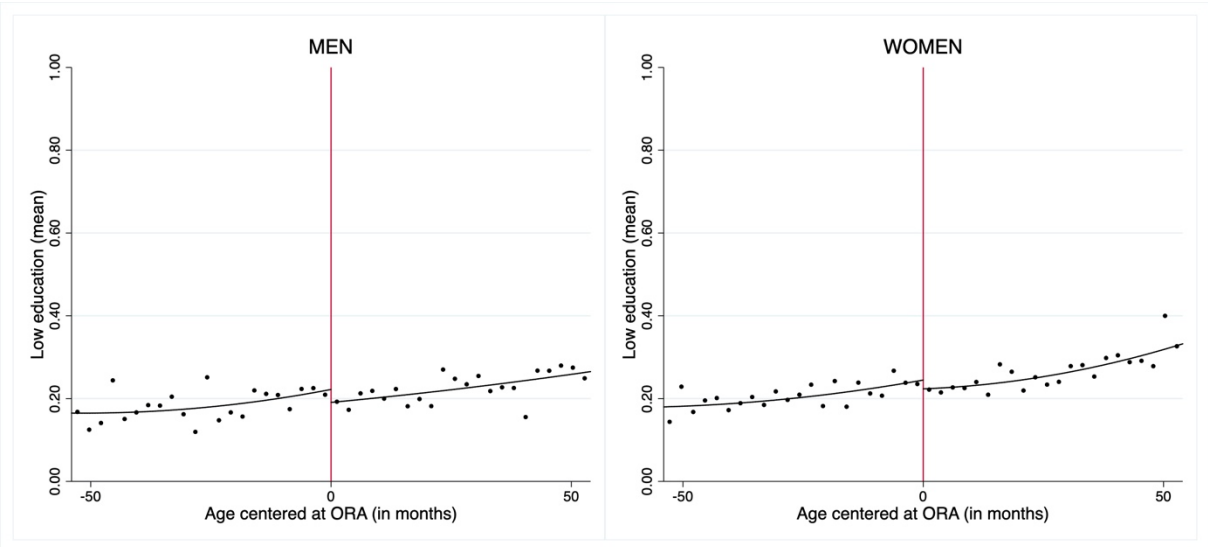
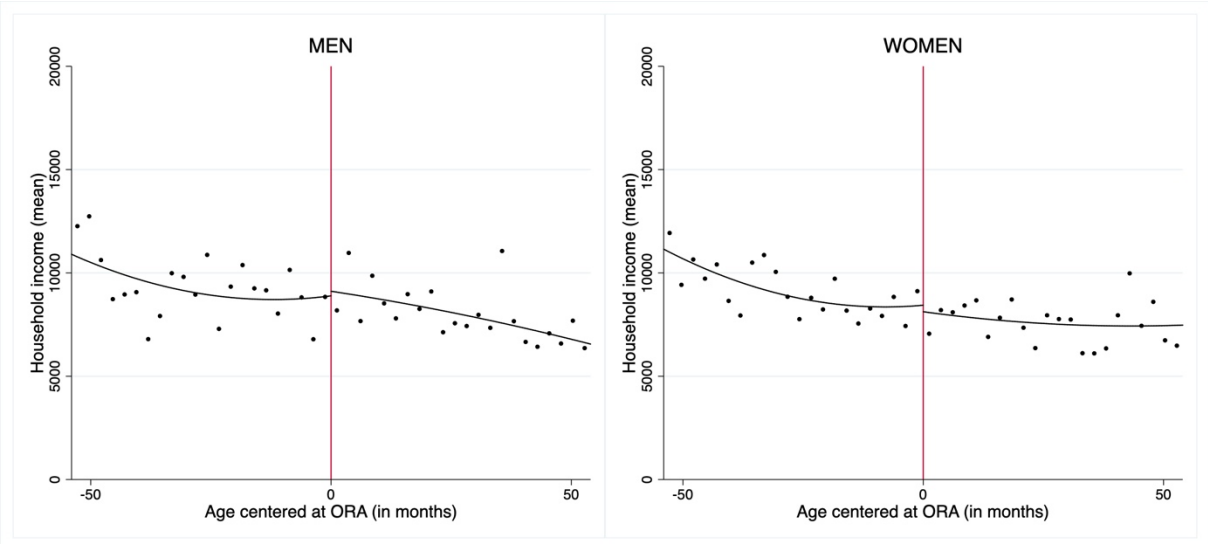
$$Index_i = \beta_0 + \beta_j Occupation_{ij} + \delta_m ISCED_{im} + \alpha_k Country_{ik} + u_i$$

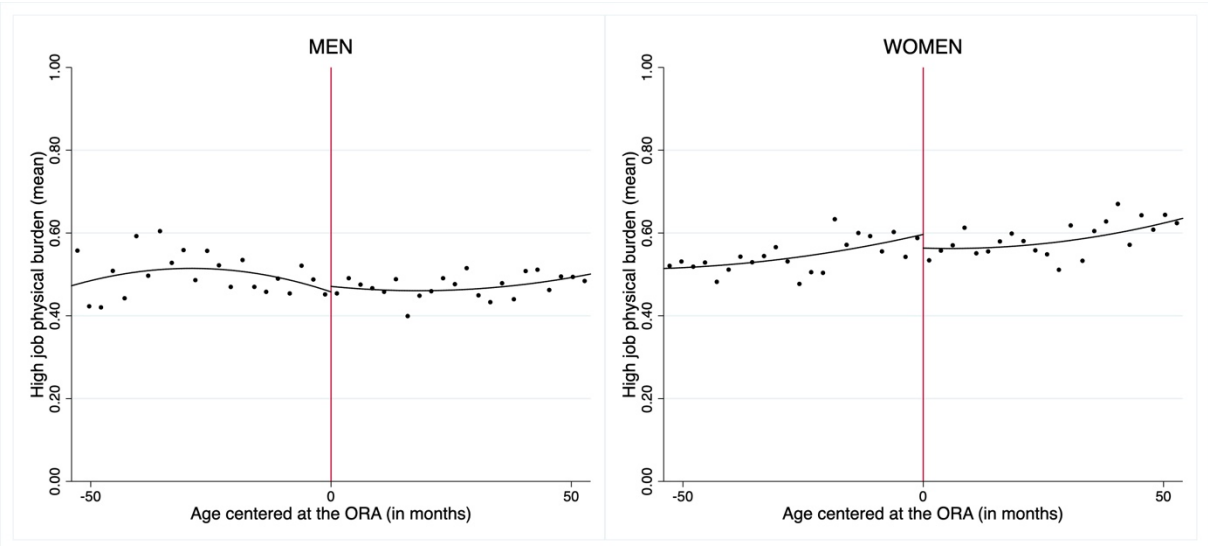
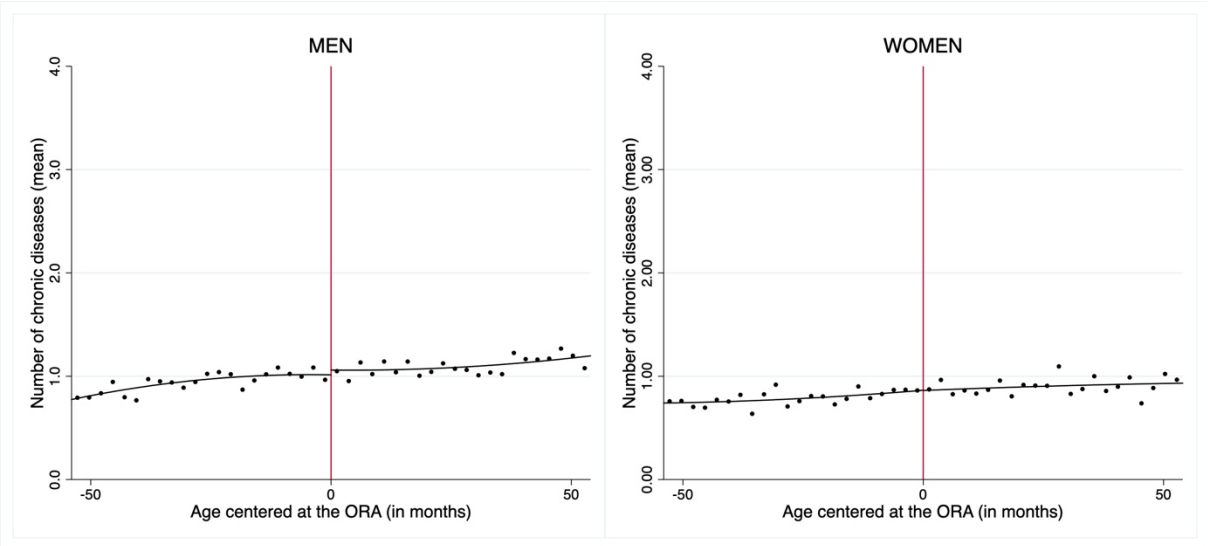
where Occupation is measured with three dummies capturing differences between four groups of workers: high-skilled white collar, low-skilled white collar, high-skilled blue collar and low-skilled blue collar. The distinction between the four groups is based on the first digit of the ISCO-88 classification (Celidoni and Rebba, 2017). High-skilled white collars are legislators, senior officials, managers, professionals, technicians or associate professionals. Low-skilled white collars are clerks, service workers, shop and market sales workers and armed forces. High-skilled blue collars are skilled agricultural or fishery workers, craft and related trade workers, plant and machine operators or assemblers. Low-skilled blue collars concern all other elementary occupations. ISCED controlled for detail level of education and is measured with seven dummies variables corresponding to different levels of this classification. Finally, a set

of dummies captured different reporting styles by countries. Note that the model is estimating twice on separated samples of men and women, allowing for the effects to differ by gender. Several other specifications have been tested with interaction terms or different groups of education, but predictability power was not significantly improved. In a final step, after predictions, the index is dichotomized with a single dummy indicator of high physically demanding jobs.

Appendix 2. RD validity checks and discontinuities in covariates distributions







Appendix 3. Robustness checks.

Table A1. Varying the choice of the window around retirement cutoff.

	±4.5 years		±5 years		±5.5 years		±6 years	
	Man	Woman	Man	Woman	Man	Woman	Man	Woman
Vaccination								
Man retirement	0.339 (0.126)***	0.219 (0.090)**	0.353 (0.109)***	0.203 (0.077)***	0.334 (0.092)***	0.186 (0.066)***	0.265 (0.103)**	0.177 (0.060)***
Woman retirement	0.180 (0.062)***	0.194 (0.143)	0.140 (0.061)**	0.207 (0.105)**	0.102 (0.058)*	0.126 (0.113)	0.099 (0.056)*	0.126 (0.113)
Vigorous effort activity								
Man retirement	0.103 (0.056)*	0.007 (0.029)	0.084 (0.052)	0.008 (0.027)	0.085 (0.048)*	0.009 (0.024)	0.083 (0.046)*	-0.001 (0.022)
Woman retirement	-0.032 (0.027)	-0.101 (0.063)	-0.018 (0.025)	-0.104 (0.060)*	-0.021 (0.023)	-0.036 (0.059)	-0.025 (0.021)	-0.011 (0.057)
Moderate effort activity								
Man retirement	0.101 (0.047)**	0.032 (0.028)	0.108 (0.043)**	0.036 (0.026)	0.116 (0.039)***	0.031 (0.022)	0.122 (0.037)***	0.022 (0.020)
Woman retirement	0.010 (0.023)	-0.017 (0.062)	0.006 (0.021)	-0.034 (0.058)	0.019 (0.019)	0.010 (0.054)	0.009 (0.018)	0.010 (0.050)
Obesity								
Man retirement	-0.022 (0.053)	-0.020 (0.029)	-0.024 (0.048)	0.003 (0.026)	-0.006 (0.047)	-0.009 (0.022)	0.012 (0.044)	-0.002 (0.020)
Woman retirement	0.036 (0.025)	0.000 (0.075)	0.024 (0.023)	0.000 (0.072)	0.021 (0.021)	-0.023 (0.062)	0.031 (0.019)	0.018 (0.057)
Smoke								
Man retirement	0.002 (0.058)	-0.039 (0.025)	0.018 (0.050)	-0.037 (0.023)	0.038 (0.045)	-0.028 (0.020)	0.030 (0.043)	-0.027 (0.018)
Woman retirement	-0.009 (0.026)	-0.023 (0.042)	-0.007 (0.024)	-0.027 (0.042)	-0.008 (0.021)	-0.036 (0.040)	-0.019 (0.020)	-0.023 (0.041)
Drinks per day								
Man retirement	-2.267 (0.160)***	-0.760 (0.120)***	-2.239 (0.147)***	-0.601 (0.122)***	-0.344 (0.278)	-0.255 (0.125)**	-0.891 (0.358)**	-0.473 (0.099)***
Woman retirement	0.571 (0.139)***	-1.534 (0.091)***	0.550 (0.130)***	-1.553 (0.085)***	0.109 (0.172)	0.143 (0.203)	0.682 (0.161)***	-1.015 (0.111)***
Alcohol frequency								
Man retirement	0.101 (0.311)	-0.319 (0.182)*	0.209 (0.295)	-0.262 (0.161)	0.511 (0.282)*	-0.253 (0.139)*	0.423 (0.261)	-0.252 (0.125)**
Woman retirement	0.232 (0.139)*	0.155 (0.288)	0.146 (0.127)	0.126 (0.267)	0.181 (0.115)	0.146 (0.255)	0.171 (0.104)	0.110 (0.240)

Interpretation: for a window of ±5 years, woman's retirement increases man's probability to receive the flu vaccine of about 14 p.p.

* p<0.1; ** p<0.05; *** p<0.01; (.) standard errors.

Table A2. Linear vs. Nonlinear functional form of age

	Linear		Nonlinear	
	Man	Woman	Man	Woman
Vaccination				
Man retirement	0.339 (0.126)***	0.219 (0.090)**	0.284 (0.174)	0.248 (0.099)**
Woman retirement	0.180 (0.062)***	0.194 (0.143)	0.195 (0.062)***	-0.039 (0.152)
Vigorous effort activity				
Man retirement	0.103 (0.056)*	0.007 (0.029)	0.120 (0.058)**	0.009 (0.029)
Woman retirement	-0.032 (0.027)	-0.101 (0.063)	-0.032 (0.027)	-0.107 (0.076)
Moderate effort activity				
Man retirement	0.101 (0.047)**	0.032 (0.028)	0.099 (0.048)**	0.032 (0.028)
Woman retirement	0.010 (0.023)	-0.017 (0.062)	0.007 (0.023)	0.070 (0.070)
Obesity				
Man retirement	-0.022 (0.053)	-0.020 (0.029)	-0.020 (0.055)	-0.017 (0.028)
Woman retirement	0.036 (0.025)	0.000 (0.075)	0.039 (0.024)	-0.127 (0.072)*
Smoke				
Man retirement	0.002 (0.058)	-0.039 (0.025)	-0.017 (0.057)	-0.039 (0.025)
Woman retirement	-0.009 (0.026)	-0.023 (0.042)	-0.008 (0.026)	0.020 (0.052)
Drinks per day				
Man retirement	-2.267 (0.160)***	-0.760 (0.120)***	-2.290 (0.158)***	-0.748 (0.118)***
Woman retirement	0.571 (0.139)***	-1.534 (0.091)***	0.556 (0.137)***	-1.572 (0.090)***
Alcohol frequency				
Man retirement	0.101 (0.311)	-0.319 (0.182)*	0.070 (0.315)	-0.342 (0.183)*
Woman retirement	0.232 (0.139)*	0.155 (0.288)	0.240 (0.140)*	0.366 (0.369)

Interpretation: Allowing the relation between age and health behaviors to be non-linear on both sides of the cutoff, man's retirement increases his probability to practice vigorous effort activity of about 12 p.p.

* p<0.1; ** p<0.05; *** p<0.01; (.) standard errors.

Table A3. Alternative strategy for the control of the job physical burden

	Subjective index		ISCO 4 groups	
	Man	Woman	Man	Woman
Vaccination				
Man retirement	0.339 (0.126)***	0.219 (0.090)**	0.435 (0.076)***	0.166 (0.085)*
Woman retirement	0.180 (0.062)***	0.194 (0.143)	0.192 (0.062)***	0.266 (0.132)**
Vigorous effort activity				
Man retirement	0.103 (0.056)*	0.007 (0.029)	0.107 (0.056)*	0.007 (0.031)
Woman retirement	-0.032 (0.027)	-0.101 (0.063)	-0.025 (0.030)	-0.110 (0.062)*
Moderate effort activity				
Man retirement	0.101 (0.047)**	0.032 (0.028)	0.125 (0.047)***	0.037 (0.031)
Woman retirement	0.010 (0.023)	-0.017 (0.062)	0.011 (0.024)	-0.001 (0.065)
Obesity				
Man retirement	-0.022 (0.053)	-0.020 (0.029)	-0.035 (0.054)	-0.010 (0.031)
Woman retirement	0.036 (0.025)	0.000 (0.075)	0.035 (0.027)	-0.016 (0.075)
Smoke				
Man retirement	0.002 (0.058)	-0.039 (0.025)	-0.026 (0.058)	-0.023 (0.026)
Woman retirement	-0.009 (0.026)	-0.023 (0.042)	-0.001 (0.026)	-0.029 (0.045)
Drinks per day				
Man retirement	-2.267 (0.160)***	-0.760 (0.120)***	-2.149 (0.180)***	-0.795 (0.126)***
Woman retirement	0.571 (0.139)***	-1.534 (0.091)***	0.674 (0.154)***	-1.407 (0.102)***
Alcohol frequency				
Man retirement	0.101 (0.311)	-0.319 (0.182)*	-0.053 (0.273)	-0.449 (0.193)**
Woman retirement	0.232 (0.139)*	0.155 (0.288)	0.315 (0.144)**	0.200 (0.293)

Interpretation: controlling job physical burden with dummies indicating four groups (high-skilled white collar, high-skilled blue collar, low-skilled white collar and low-skilled blue collar), man's retirement increases his probability to practice vigorous effort activity of about 10.7 p.p.

* p<0.1; ** p<0.05; *** p<0.01; (.) standard errors.

Table A4. Alternative definition of retirement

	Reference definition		Alternative definition	
	Man	Woman	Man	Woman
Vigorous effort activity				
Man retirement	0.103 (0.056)*	0.007 (0.029)	0.120 (0.061)*	0.050 (0.034)
Woman retirement	-0.032 (0.027)	-0.101 (0.063)	-0.044 (0.030)	-0.039 (0.060)
Moderate effort activity				
Man retirement	0.101 (0.047)**	0.032 (0.028)	0.069 (0.053)	0.025 (0.033)
Woman retirement	0.010 (0.023)	-0.017 (0.062)	-0.015 (0.024)	0.062 (0.055)
Obesity				
Man retirement	-0.022 (0.053)	-0.020 (0.029)	-0.059 (0.057)	-0.023 (0.033)
Woman retirement	0.036 (0.025)	0.000 (0.075)	0.053 (0.026)**	0.065 (0.062)
Smoke				
Man retirement	0.002 (0.058)	-0.039 (0.025)	-0.023 (0.062)	-0.036 (0.030)
Woman retirement	-0.009 (0.026)	-0.023 (0.042)	0.028 (0.027)	0.061 (0.046)
Drinks per day				
Man retirement	-2.267 (0.160)***	-0.760 (0.120)***	-2.407 (0.156)***	-0.827 (0.150)***
Woman retirement	0.571 (0.139)***	-1.534 (0.091)***	0.349 (0.138)**	-1.519 (0.118)***
Alcohol frequency				
Man retirement	0.101 (0.311)	-0.319 (0.182)*	-0.172 (0.370)	-0.583 (0.253)**
Woman retirement	0.232 (0.139)*	0.155 (0.288)	0.164 (0.170)	0.054 (1.105)

Interpretation: using alternative definition of retirement (only considering employed, unemployed or retired self-reported status), man's retirement increases his probability to practice vigorous effort of about 12 p.p. Note that, because of limited number of observations, this robustness check has not been done for flu vaccination.

* p<0.1; ** p<0.05; *** p<0.01; (.) standard errors.

Table A5. Stability without additional control variables

	With additional covariates (reference)		Without additional covariates (alternative)	
	Man	Woman	Man	Woman
Vaccination				
Man retirement	0.339 (0.126)***	0.219 (0.090)**	0.294 (0.105)***	0.302 (0.070)***
Woman retirement	0.180 (0.062)***	0.194 (0.143)	0.148 (0.069)**	0.180 (0.119)
Vigorous effort activity				
Man retirement	0.103 (0.056)*	0.007 (0.029)	0.089 (0.051)*	0.002 (0.026)
Woman retirement	-0.032 (0.027)	-0.101 (0.063)	-0.008 (0.026)	-0.136 (0.055)**
Moderate effort activity				
Man retirement	0.101 (0.047)**	0.032 (0.028)	0.079 (0.044)*	0.040 (0.026)
Woman retirement	0.010 (0.023)	-0.017 (0.062)	0.013 (0.022)	0.010 (0.056)
Obesity				
Man retirement	-0.022 (0.053)	-0.020 (0.029)	0.056 (0.050)	-0.020 (0.027)
Woman retirement	0.036 (0.025)	0.000 (0.075)	0.022 (0.024)	0.004 (0.074)
Smoke				
Man retirement	0.002 (0.058)	-0.039 (0.025)	0.036 (0.050)	-0.033 (0.023)
Woman retirement	-0.009 (0.026)	-0.023 (0.042)	0.007 (0.025)	0.002 (0.042)
Drinks per day				
Man retirement	-2.267 (0.160)***	-0.760 (0.120)***	-2.417 (0.137)***	-0.543 (0.089)***
Woman retirement	0.571 (0.139)***	-1.534 (0.091)***	0.853 (0.145)***	-1.143 (0.101)***
Alcohol frequency				
Man retirement	0.101 (0.311)	-0.319 (0.182)*	0.138 (0.278)	-0.226 (0.158)
Woman retirement	0.232 (0.139)*	0.155 (0.288)	0.296 (0.139)**	0.251 (0.264)

Interpretation: with alternative specification, only considering the level of education as covariate, woman's retirement decreases her probability to practice vigorous effort of about 13.6 p.p.

* p<0.1; ** p<0.05; *** p<0.01; (.) standard errors.