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Thomas Barnay[1] **and Éric Defebvre**[2]

Abstract: Reforms of the French *pay-as-you-go* pension system relies on increases in the contribution period, gradually postponing legal retirement ages. Several works analyse the effect of these reforms on employment rate or the financial equilibrium of pension schemes. The effect of retirement on health status has not received the same attention. In order to assess the role of retirement on physical and mental health status, we use data coming from the French Health and Professional Path survey (Sip, "Santé et itinéraire professionnel") and address the methodological issues (endogeneity biases such as reverse causality and unobserved characteristics) by setting up an instrumental variables method relying on discontinuities induced by legal ages of retirement. Unaccounting for endogeneity biases, we do not find any significant effect of retirement on health status as a whole. When instrumenting by legal ages of retirement, we find consistent and large short-term effects on activity limitations, anxiety disorders and depressive episodes. We also find that these effects are heterogeneous according to gender, education levels and past exposures to detrimental working conditions during the entire career. Finally, mechanisms such as social activities, sport and health-related risky behaviours may be able to explain such a positive effect on health status.

JEL: I14, J26, C35, C36

Keywords: Retirement; Physical health; Mental health; Mechanisms; Identifying variables

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Introduction

Reforms of the French *pay-as-you-go* pension system relies on increases in the contribution period, gradually postponing legal retirement ages. Just like in the international literature, a set of French studies point out the effect of these reforms on employment rate or effective retirement age (Bozio, 2008). The effect of transitioning into retirement has not received the same attention in the French economic literature (besides Blake and Garrouste, 2012). Retirement in France mostly remains an absorbing state (combining work and a pension is very rare) and can thus be seen as an irreversible shock. The sharp transition into retirement can often affect perceived health status, but the nature of the causal relationship between retirement and health can also be bidirectional due to reverse causality.

Before retirement, health status already appears as one of the most important non-monetary drivers in the trade-off between work and leisure in older workers (Barnay, 2016; Lindeboom, 2006). Two opposite effects of retirement on health status may arise. Retirement can free individuals from a job strain situation. But retirement, considered as non-employment, may also be the cause of a feeling of social utility loss, leading to a decline in cognitive functions and a loss in self-esteem (Rohwedder and Willis, 2010). Finally, it appears difficult to isolate the health-related effects of retirement from those of the natural deterioration rate related to ageing, and many unobservable individual characteristics are also able to explain not only retirement behaviours, but also health status indicators (subjective life expectancy, risk aversion behaviours or labour supply disutility).

In this paper, we study the role of being retired on several physical and mental health status indicators. In order to take care of the inherent endogeneity biases, we set up an identifying variable approach relying on discontinuities in the probability to retire generated by legal incentives at certain ages as sources of exogeneity. Thanks to the Health and Professional Path survey (*Santé et Itinéraire Professionnel* – Sip) dataset, we are able to control for a set of covariates, including exposures to detrimental working conditions throughout the whole career. We also acknowledge the likely heterogeneity of the effect and the possible mechanisms explaining retirement effects on health status. To our knowledge, no study evaluates the effect of retirement on the physical and mental health conditions, after taking into account endogeneity biases as well as exposures to working conditions and the nature of the entire professional career.

The paper is organized as follows. Section 1 is dedicated to an empirical literature review on the relationships between retirement and health status. Section 2 and Section 3 then describes the database, Section 4 the empirical strategy. Section 5 then presents the results and Section 6 concludes.

1. Background and literature

The French economic literature is still relatively scarce in terms of studies on the relationships linking non-employment in general (and retirement in particular) and health status, compared to the number of international studies on this area of research (Barnay, 2016). In general, job loss is associated with a deterioration of well-being. Persistent unemployment and recurrent forms of non-employment have a deleterious effect on health, for example on overweight and alcohol consumption (Deb *et al.*, 2011). Unemployment and inactivity, happening early in the professional life, can promote the onset of depressive symptoms thereafter (Mossakowski, 2009). Furthermore, job loss increases mortality (Sullivan and Wachter, 2009). Finally, many studies agree on a negative effect of unemployment on health (Böckerman and Ilmakunnas, 2009; Browning and Heinesen, 2012; Eliason and Storrie, 2009b; Eliason and Storrie, 2009a; Kalwij and Vermeulen, 2008). When it comes to retirement, two competing hypotheses can be advanced to disentangle its effects on health status.

"Retirement blues"[3] and "Unhealthy Retirement"[4]

Retirement may generate a loss of social role (Kim and Moen, 2002), a reduction of social capital and therefore a deterioration in health, strengthened by the indirect mean of a loss in terms of living standards. Since the seminal paper by Adam *et al.* (2007), a specific literature is dedicated to cognitive abilities. The so-called *unengaged lifestyle hypothesis* thus refers to the assumption that work environment is more cognitively stimulating than leisure environment. This adverse effect complies with the theoretical framework proposed by Grossman (1972) to the extent that retirees reduce their investment in cognitive abilities. In this respect, Rohwedder and Willis (2010) show that early retirement has a significant adverse impact on the cognitive abilities. Other studies also reach similar conclusions (Behncke, 2012; Bonsang et al., 2012; Dave et al., 2008; Mazzonna and Peracchi, 2009). For instance, using English Longitudinal Study of Ageing (ELSA), Behncke (2012) finds that retirement increases the occurrence of chronic health conditions.

[3] *Title of Heller-Sahlgren (2017)*
[4] *Title of Mazzonna and Peracchi (2017)*

A set of recent studies confirms the detrimental effect of retirement on health. Using SHARE data, Celidoni *et al.* (2017) evaluate the causal impact of retirement on recall memory tests by using eligibility ages for early and legal retirement in several European countries as instruments. They stress out that retirement has a long-term negative effect on cognition for individuals who retire at the statutory eligibility age. Taking advantage of the panel dimension of SHARE by performing a two-stage least squares first difference, Mazzonna and Peracchi (2017) show that retirement is positive for both mental and physical health (depression and mobility limitation) and cognitive abilities (memory and fluency). By using SHARE and relying on a fixed-effect instrumental variable approach, Heller-Sahlgren (2017) investigate the short and long term effects of retirement on mental health (Euro-D scale) in ten European countries. They find a negative long-term effect.

A well-deserved retirement

Retirement can also free individuals from job strain situations and may improve their health condition in the short run. This virtuous circle will be sustainable provided that individuals have the capacity to invest in their health (income effect). Many international empirical studies show that retirement is beneficial to health status (Blake and Garrouste, 2012; Charles, 2002; Coe and Zamarro, 2011; Grip *et al.*, 2012; Insler, 2014; Neuman, 2008). Coe and Zamarro (2011) conclude that retirement decreases the likelihood of reporting poor perceived health (35%) after controlling for reverse causality. However, this effect cannot be found with both depression indicators. In the U.K., Bound and Waidmann (2007) found a positive but transitory health effect of retirement, only in men. Based on German data, Eibich (2015) finds that retirement improves general and mental health status by performing a Regression Discontinuity Design in order to explore financial incentives in the German pension scheme. Using three different datasets[5], Shai (2018) uses a pension reform happening in 2004 (delaying the retirement age by two years) as source of exogeneity in order to study the influence of retirement on health. He underlines that being in employment at older ages is related to poor general health or, in other words, that retirement is beneficial.

Heterogeneous effects

This ambiguous effect of retirement might therefore find an explanation in its timing, inducing heterogeneous effects. Thus, as Mazzonna and Peracchi (2017), we can assume that

[5] *The Israeli Health Surveys, the Israeli Household Expenditure Surveys, and the SHARE survey.*

these two competing hypotheses are not antagonistic. The positive effect of retirement on health is often related to early retirement or past employment in physically demanding occupations (individuals employed in low-skill jobs are overrepresented in early retirees). Unlike for workers retiring late, people who retire as soon as possible benefit from positive effects on their cognitive abilities (Celidoni *et al.*, 2017). As a consequence, the negative effect of retirement may not be instantaneous (Bonsang *et al.*, 2012; Mazzonna and Peracchi, 2012; Heller-Sahlgren, 2017), inducing that the adverse effect may appear in the long run.

2. Data

The *Santé et Itinéraire Professionnel* survey (Sip) used in this study provides access to particularly detailed individual descriptions. Besides the usual socioeconomic variables (age, sex, activity sector, professional category, educational level, marital status), specific items are provided about physical and mental health. The survey was designed jointly by the French Ministries in charge of Healthcare and Labour and includes two waves (2006 and 2010), conducted on the same sample of people aged 20-74 years living in private households in metropolitan France. Two questionnaires are available: the first one is administered by an interviewer and accurately informs the individual and job characteristics and the current health status of the respondents. It also contains a biographical lifegrid to reconstruct individual careers and life events: childhood, education, health, career changes, working conditions and significant life events. The second one is a self-administered questionnaire targeting risky health behaviours (weight, cigarette and alcohol consumption). It notably informs the current or past tobacco and alcohol consumption (frequency, duration, *etc.*). A total of 13,648 people were interviewed in 2006, and 11,016 of them again in 2010. We make use of the biographic dimension of the 2006 survey by reconstructing workers' careers yearly. We are therefore able to know, for each individual, his/her employment status and working conditions every year from their childhood to the date of the survey (2006). As far as work strains are concerned, the survey provides information about ten indicators of exposure: night work, repetitive work, physical load and exposure to toxic materials, full skill usage, work under pressure, tensions with the public, reward, conciliation between work and family life and relationships with colleagues. The intensity of exposure to these work strains is also known.

In our sample, we only retain interviewees present in both the 2006 and 2010 waves, *i.e.* 11,016 individuals. In order to avoid too heterogeneous samples, we select individuals aged

50-69 in 2010 for whom we benefit from all the information needed in terms of pension and health status characteristics. Thus, we work on a sample of 4,610 individuals, 2,071 of whom being retired.

3. Descriptive statistics

In our sample, retirees systematically self-report a worse general health condition and a better mental health status than non-retirees (Table 1). Obviously these raw statistics do not account for other characteristics, notably the 8-year difference in age between the two populations. Yet, 38% of the retired population declare poor levels of self-assessed health against 36% in the non-retired population, 50% a chronic disease (against 40%) and 26% being limited in daily activities *(vs*. 24%). Yet, the retired population suffers from less anxiety disorders (5%) and depressive episodes (6%) than the control group *(resp*. 8% and 9%). Exposure to harsh physical and psychosocial working conditions is much higher among retirees than among non-retirees as it is likely that the last years of professional life are marked by greater exposures. Finally, retirees are more prone to having social activities such as associations, unions, religious or artistic activities (48% *vs.* 38%), have more physical activities (45% *vs.* 40%), are less often smokers (16% *vs.* 27%, most likely at least partly indicating a selection effect, the most heavy smokers having a shorter life expectancy) but are more often overweight (60% *vs.* 52%) than the rest of the population.

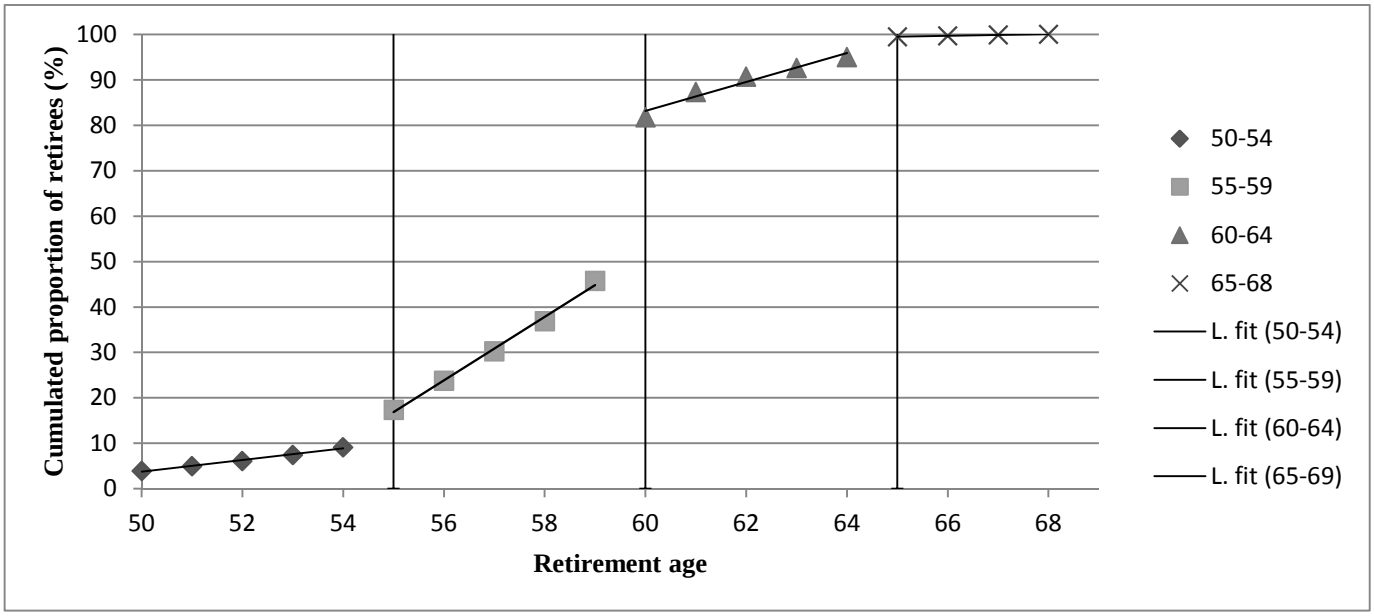
Table 1: General descriptive statistics

Variable	Mean	Std. error	Min.	Max.	N	Mean Retirees	Mean non-retirees	Diff.
Retirement								
Retired	.42	*.49*	0	1	2071	-	-	-
Retirement duration	4.90	*4.04*	0	34	2071	-	-	-
Aged 55 or more	.74	*.44*	0	1	3629	.98	.55	-.44***
Aged 60 or more	.45	*.50*	0	1	2235	.90	.13	-.77***
Aged 65 or more	.18	*.38*	0	1	876	.40	.01	-.39***
Health status								
Poor perceived health	.37	*.48*	0	1	1802	.38	.36	-.02*
Chronic diseases	.45	*.50*	0	1	2200	.50	.40	-.10***
Activity limitations	.25	*.43*	0	1	1219	.26	.24	-.02*
Anxiety disorder	.07	*.25*	0	1	321	.05	.08	.02***
Depressive episode	.08	*.27*	0	1	380	.06	.09	.03***
Demographics								
Men	.46	*.50*	0	1	2254	.51	.42	-.08***
Age	58.79	*.40*	50	69	4932	63.47	55.40	-8.06***
No education	.09	*.28*	0	1	421	.08	.09	.01
Primary/secondary	.56	*.50*	0	1	2782	.62	.52	-.09***
Equivalent to French BAC	.14	*.34*	0	1	679	.12	.15	.04***
Superior	.19	*.40*	0	1	957	.17	.21	.04***
One or more children	.91	*.29*	0	1	4466	.91	.90	-.01
Employment								
Public sector	.18	*.39*	0	1	898	.12	.23	.11***
Private sector	.36	*.48*	0	1	1772	.20	.47	.26***
Self-employed	.07	*.26*	0	1	348	.04	.10	.06***
Career in long-term jobs	.79	*.41*	0	1	3881	.84	.75	-.10***
Stable career	.59	*.49*	0	1	2887	.53	.62	.10***
Poor physical working cond.	.22	*.41*	0	1	1010	.29	.17	-.12***
Poor psychosocial working cond.	.16	*.37*	0	1	731	.20	.13	-.07***
Mechanisms								
Daily social activities	.42	*.49*	0	1	2088	.48	.38	-.10***
Sport	.42	*.49*	0	1	2063	.45	.40	-.05***
Tobacco consumption	.22	*.42*	0	1	1034	.16	.27	.11***
Risky alcohol consumption	.24	*.42*	0	1	1085	.25	.23	-.02
Overweight	.56	*.50*	0	1	2540	.60	.52	-.09***

Note: ****: significant at 1%, **: significant at 5%, *: significant at 10%.*
Reading: *Retirees are 38% to report poor perceived health and 36% of non-retirees are in good perceived health. This difference of −2 percentage points is significant at the 10% level.*
Field: *Santé et Itinéraire Professionnel survey, individuals aged 50-69 in 2010.*

As expected in the French context (see Appendix 1), three retirement ages seem to emerge as the most common in the sample: age 55, 65 but mostly age 60, which corresponds to the legal threshold for full-rate pension (Figure I). Thus, when the proportion of pensioners only represents about 45% of the sample's total at age 59, it amounts to more than 80% only a year later.

Figure I: Proportion of retirees in the sample according to age



Field: *Santé et Itinéraire Professionnel survey. Individuals aged 50-69 in 2010.*

4. Empirical strategy

Two major sources of endogeneity may be raised. The first is the existing two-way relationship between retirement and health status. In particular, being retired depends on individuals' initial health condition, leading to a health-related selection bias. The second is the unobserved factors influencing not only health status but also retirement. To the extent that individuals have different characteristics, notably in terms of subjective life expectancy, risk aversion preferences or disutility at work, then the estimates are at risk of being biased.

4.1. Identifying variables approach

To address these methodological difficulties, we set up an identifying variable method, the objective being to determine the causal effect of being retired on health status. The identification strategy relies on the use of legal norms following which individuals undergo a change (retirement) or not, norms therefore regarded as sources of exogeneity (Coe and Zamarro, 2011; Mazzonna and Peracchi, 2012; Mazzonna and Peracchi, 2017). The general idea of this method lies in the exploitation of discontinuities in the allocation of a *treatment* (retirement) related to laws granting incentives to retire at a certain age. To the extent that a full-rate legal retirement age in France exists (60 years-old for this study, before the implementation of the 2010 reform), we use this indicator as the identifying variable for the retirement process. However, it is noteworthy that age, and more importantly reaching a certain age, is not the only element predicting the retirement status.

4.1.1. Advantages

The two main advantages in our case of such a method are that it allows handling endogeneity biases coming from omitted variables as well as reverse causality. Using a minimum age as a source of exogeneneity, this identifying variable approach is close to a Regression Discontinuity Design (RDD) framework on panel data, the major difference between identifying variables and RDD being that the latter allows establishing different trends before and after reaching the threshold, which is not possible with a conventional instrumental variables method (Eibich, 2015). Nevertheless, identifying variables allow for a greater flexibility in estimations: it does not exclusively focus on very short-term effects nor heavily selected (*ie.* small) samples. Also, RDD methods rely on the hypothesis that the discontinuity observed in the outcome solely comes from a discontinuity in the treatment (and not in other observed or unobserved covariates). This hypothesis, often difficult to verify thoroughly, is not necessary in our framework.

4.1.2. Hypotheses

The use of identifying variable methods such as ours is based on two assumptions widely discussed in the literature. The first, called the relevance assumption induces that the identifying variable is correlated with the endogenous variable. In our case, the identifying variable being a legal age of retirement at full rate (*ie.* inducing heavy financial incentives to retire), it appears intrinsically relevant to explain the decision to retire (see Figure I). The second, called the validity assumption, assumes that the identifying variable is not correlated with the error term. In other words, reaching a certain age shall not induce discontinuities on health status. While it is obvious that age as a whole plays a significant role on health, it appears more doubtful that reaching a specific given age (for instance reaching age 60) induces a significant decline in health in comparison to health status beforehand (for example at age 59) (Eibich, 2015). To the extent that the legal age of retirement is decided at the level of the state and is not conditioned by health status requirements, this hypothesis, although not directly testable, does not appear as particularly worrying especially considering age is controlled for in the regressions.

4.2. Estimation

The classical issue faced in such studies is that individuals are either observed as retired (treated) or not (control), and not simultaneously in both states. Let Y_{i1} and Y_{i0} denote respectively the health outcomes for the treated ($T_i = 1$) and control ($T_i = 0$) groups. As such, Y_{i1} is not observed when $T_i = 0$ and *vice-versa* and evaluating the effect of retirement on

health ($Y_{i1} - Y_{i0}$) is not trivial. More specifically, because we rely on legal age thresholds to identify the relationship between health and retirement, we estimate the average treatment effect at this threshold (denoted $\overline{Age}$): $E(Y_{i1} - Y_{i0} | Age_i = \overline{Age})$, as described in Coe and Zamarro, (2011) and Hahn *et al.* (2001).

We explain health status in 2010 (vector $y_{k,i}$, for health indicator k and individual i) by self-declared retirement status (R_i), controlling the model for a vector of other explanatory variables ($C_i^{'}$). Formally, our identification strategy is based on the fact that, even if achieving or exceeding a certain age $\overline{Age}$ does not fully determine the retirement status, it causes a discontinuity in the probability of being retired at that certain age. The dummy variable $\mathbf{1}_{(Age_i \geq \overline{Age})}$ takes value 1 when individual i is at least $\overline{Age}$ years-old. Consequently, we estimate simultaneously a system of two equations (1):

$$\begin{cases} y_{i,k}^* = \alpha + \beta R_i + \gamma C_i^{'} + \varepsilon_i \\ R_i^* = \alpha^{'} + \theta\, \mathbf{1}_{(Age_i \geq \overline{Age})} + \gamma^{'} C_i^{'} + \varepsilon_i^{'} \end{cases} \quad (1)$$

$$y_{i,k} = \begin{cases} 1 \; if \; y_{i,k}^* > 0 \\ 0 \; if \; y_{i,k}^* \leq 0 \end{cases} \qquad R_i = \begin{cases} 1 \; if \; R_i^* > 0 \\ 0 \; if \; R_i^* \leq 0 \end{cases}$$

Empirically, to estimate this simultaneous two-equation system, we set up a bivariate probit model, estimated by maximum likelihood. The use of such models is justified by the fact that both explained and explanatory variables are binary indicators (Lollivier, 2006). This method is equivalent to conventional two-stage methods in a linear case.

$$\begin{cases} y_{i,k}^* = \alpha + \beta R_i + \gamma C_i^{'} + \varepsilon_i \\ R_i^* = \alpha^{'} + \theta\, Ident_i^{'} + \gamma^{'} C_i^{'} + \varepsilon_i^{'} \end{cases} \quad (2)$$

$$y_{i,k} = \begin{cases} 1 \; if \; y_{i,k}^* > 0 \\ 0 \; if \; y_{i,k}^* \leq 0 \end{cases} \qquad R_i = \begin{cases} 1 \; if \; R_i^* > 0 \\ 0 \; if \; R_i^* \leq 0 \end{cases}$$

We simultaneously explain the probability of being retired and health status. We introduce the vector $Ident_i^{'}$ representing the identifying variables allowing the model's identification (2). These variables take the form of dummies, taking value 1 if individual i is at least $\overline{Age}$ years-old and 0 otherwise. Bivariate probit models also assume the correlation between residuals ε_i and $\varepsilon_i^{'}$, *ie.* $\rho = Corr(\varepsilon_i, \varepsilon_i^{'} | C_i^{'}) \neq 0$. In addition, residuals of this model are expected to follow a bi-normal distribution: $\begin{bmatrix} \varepsilon_i \\ \varepsilon_i^{'} \end{bmatrix} \rightarrow N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}\right]$.

4.3. Variables

We use three health indicators: self-assessed health status (very good and good *vs.* fair, bad and very bad), chronic illnesses (binary) and limitations in daily activities (binary). We also use two mental health indicators: Generalised Anxiety Disorders (GAD) or Major Depressive Episodes (MDE) (see Appendix 2).

Regarding our variable of interest, we use a question specifying the current occupation status at the time of the 2010 survey, and build a dummy variable equal to 1 if the individual has reported being retired or pre-retired at this date and 0 otherwise.

We control all our results by sex, age, age squared, educational level, having had at least one child and activity sector (public, private or self-employed, when applicable). Relying on the retrospective part of the data, we include indicators for having spent the majority of the career in long-term jobs of more than 5 years and finally an indicator for career fragmentation. We are also able to reconstruct, year by year, the professional path (including working conditions) of individuals since the end of their initial studies to the end of their career. Exposure to physical and psychosocial working conditions during the whole career (the fact of having been exposed 20 years to single strains or 10 years to multiple simultaneous strains of the same type) are thus accounted for. We assume that individuals having faced such strains at work should be even more relieved by retirement, hence inducing heterogeneity in the effect of retirement on health status. Finally, we control for the duration individuals spent into retirement in the health status equations.

The potential mechanisms explaining the role of retirement on health status will be assessed by daily social activities (associations, volunteering, unions, political, religious or artistic activities), physical activity and health-related risky behaviours (tobacco, alcohol and BMI).

5. Results

5.1. Main results

Naive univariate models indicate, whatever the health indicator considered, no effect of retirement on health status whatsoever (Table 2).

Table 2: Retirement and health status

Variable	Poor SAH		Chronic diseases		Activity limitations		GAD		MDE	
	Probit	**Biprobit**	**Probit**	**Biprobit**	**Probit**	**Biprobit**	**Probit**	**Biprobit**	**Probit**	**Biprobit**
Retired	.00	-.07	.03	-.02	.00	-.09**	-.02*	-.11***	-.02	-.10***
	.02	*.05*	*.02*	*.05*	*.02*	*.04*	*.01*	*.03*	*.01*	*.03*
Demographics										
Men	.00	.00	-.00	-.00	.02	.02	-.04***	-.04***	-.03***	-.03***
(*ref.: women*)	*.01*	*.01*	*.02*	*.02*	*.01*	*.01*	*.01*	*.01*	*.01*	*.01*
Age	.06**	.06**	.03	.02	.07***	.07***	.03	.03*	.03**	.04***
	.03	*.03*	*.03*	*.03*	*.03*	*.03*	*.02*	*.02*	*.02*	*.02*
Age²	-.01**	-.01*	-.00	-.00	-.01**	-.01**	-.01*	-.00	-.01**	-.01*
	.00	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.01*
Children	-.03	-.03	-.03	-.03	.01	.01	.03*	.03*	.03*	.03*
(*ref.: none*)	*.02*	*.02*	*.03*	*.03*	*.02*	*.02*	*.01*	*.02*	*.02*	*.02*
Education										
< French bac.	-.11***	-.11***	-.03	-.03	-.04*	-.04*	-.02	-.02	-.04***	-.04***
(*ref.: no dipl.*)	*.02*	*.02*	*.03*	*.03*	*.02*	*.02*	*.01*	*.01*	*.01*	*.01*
= French bac.	-.14***	-.14***	-.03	-.03	-.04	-.04	-.01	-.00	-.04**	-.03**
(*ref.: no dipl.*)	*.02*	*.03*	*.03*	*.03*	*.03*	*.03*	*.01*	*.02*	*.01*	*.02*
> French bac.	-.26***	-.26***	-.08***	-.08**	-.09***	-.09***	-.03**	-.04**	-.07***	-.07***
(*ref.: no dipl.*)	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*	*.01*	*.02*	*.02*	*.02*
Employment										
Public sector	-.02	-.02	-.01	-.01	-.05**	-.05**	.01	.01	.01	.01
(*ref.: private*)	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.01*	*.01*	*.01*	*.01*
Self-employed	-.07**	-.08***	-.04	-.05	-.05*	-.06**	-.02	-.04**	-.04*	-.05**
(*ref.: private*)	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*	*.02*	*.02*	*.02*	*.02*
Long-term jobs	-.12***	-.11***	-.08***	-.08***	-.10***	-.09***	-.02**	-.01	-.04***	-.03***
(*ref.: short term*)	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.01*	*.01*	*.01*	*.01*
Stable career	-.02	-.02	-.01	-.01	-.02*	-.02*	.00	.01	-.01*	-.01
(*ref.: unstable*)	*.01*	*.01*	*.02*	*.02*	*.01*	*.01*	*.01*	*.01*	*.01*	*.01*
Physical strains	.11***	.12***	.07***	.07***	.09***	.10***	.02***	.03***	.02*	.02**
	.02	*.02*	*.02*	*.02*	*.02*	*.02*	*.01*	*.01*	*.01*	*.01*
Psycho. strains	.07***	.07***	.06***	.06***	.04**	.04**	.03***	.04***	.04***	.04***
	.02	*.02*	*.02*	*.02*	*.02*	*.02*	*.01*	*.01*	*.01*	*.01*
Time in retirem.	.00	-.00	.00	.00	.00	.00	.00	.00	.00	.01
	.00	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.01*
Rho		.14		.10		.21**		.47***		.41***
		.09		*.08*		*.08*		*.10*		*.12*
Hausman test[6]	2.33		1.71		6.75***		10.13***		10.13***	
N	4,610									

Reading: *Marginal effects. Standard errors in italics. ***: significant at 1%, **: significant at 5%, *: significant at 10%.*
Field: *Santé et Itinéraire Professionnel survey. Individuals aged 50-69 in 2010.*

[6] *The Hausman test has been calculated as follow:* $\frac{(\beta_{Biprobit}-\beta_{Probit})^2}{\sigma^2_{Biprobit}-\sigma^2_{Probit}}$*, followed by a Chi² test.*

Based on the bivariate methods, the results are radically changed. Retirement indeed has a fairly strong negative effect on activity limitations (-9 percentage points – pp), anxiety disorders ($-11pp$) and depressive episodes ($-10pp$). Retirement yet seems to have no particular effect on perceived health status and chronic diseases. The effects of other control variables seem quite stable and are therefore confirmed in comparison to univariate models. The bivariate probit's auxiliary models explaining the probability to be retired by being aged 60 or more are available in Appendix 2. As expected, the identifying variable appears to be strongly correlated with retirement (reaching age 60 induces a $16pp$ increase on the probability to be retired).

5.2. Heterogeneity

This mean impact of retirement on health status is heterogeneous, notably according to sex (the determinants of men's and women's health status and career outcomes differ and health condition suffers from declarative social heterogeneity – Barnay, 2016; Devaux *et al.*, 2008; Shmueli, 2003), education levels (because of the protective role of education in terms of career and health outcomes) and more importantly according to past exposures to detrimental working conditions (the beneficial effects of retirement on health status can be seen as a relief effect from strenuous jobs). We can therefore test these assumptions (Table 3)[7].

[7] *All the following models also make use of the fact of being aged 60 or older as identifying variable.*

Table 3: Heterogeneity analysis

Variable	Poor SAH		Chronic diseases		Activity limitations		GAD		MDE	
	Probit	**Biprobit**	**Probit**	**Biprobit**	**Probit**	**Biprobit**	**Probit**	**Biprobit**	**Probit**	**Biprobit**
Retired (male)	-.07*	-.09	.00	-.04	-.05*	-.12*	-.03	-.11***	-.03	-.13***
N = 2,140	*.03*	*.07*	*.04*	*.07*	*.03*	*.06*	*.02*	*.04*	*.02*	*.04*
Rho		.05		.09		.17		.60***		.61***
		.13		*.11*		*.12*		*.15*		*.17*
Retired (female)	.04	-.08	.04	-.03	-.04	-.06	-.02	-.09**	-.00	-.09**
N = 2,470	*.03*	*.07*	*.03*	*.07*	*.03*	*.06*	*.02*	*.04*	*.02*	*.04*
Rho		.22**		.13		.20*		.34**		.30*
		.12		*.11*		*.12*		*.14*		*.15*
Retired (low education)	-.00	-.07	.03	.02	-.02	-.13**	-.03	-.08***	-.02	-.08**
N = 3,045	*.03*	*.06*	*.03*	*.06*	*.03*	*.05*	*.01*	*.03*	*.02*	*.03*
Rho		.12		.03		.25**		.32**		.31**
		.10		*.09*		*.10*		*.14*		*.13*
Retired (high education)	-.00	-.04	.01	-.15*	.04	.03	-.01	-.13***	-.02	-.22***
N = 1,565	*.04*	*.09*	*.04*	*.09*	*.03*	*.08*	*.02*	*.05*	*.02*	*.05*
Rho		.10		.28*		.02		.57***		.77***
		.17		*.15*		*.17*		*.15*		*.14*
Retired (high phys. exp.)	-.07	-.08	-.10*	-.14*	-.10*	-.16*	-.08**	-.17**	-.04	-.11**
N = 1,010	*.05*	*.05*	*.06*	*.08*	*.05*	*.10*	*.03*	*.08*	*.03*	*.06*
Rho		-.20		.06		.13		.41*		.31*
		.16		*.17*		*.17*		*.25*		*.17*
Retired (low phys. exp.)	.02	-.08	.05	.02	.03	-.07	.00	-.10***	-.00	-.09**
N = 3,600	*.02*	*.06*	*.03*	*.06*	*.02*	*.05*	*.01*	*.04*	*.01*	*.04*
Rho		.26**		.08		.23**		.43***		.39**
		.10		*.09*		*.10*		*.12*		*.15*
Retired (high psych. exp.)	-.12**	-.22**	-.15***	-.35***	-.11**	-.19*	-.04	-.35***	-.02	-.23**
N = 731	*.05*	*.12*	*.05*	*.13*	*.05*	*.12*	*.03*	*.12*	*.04*	*.09*
Rho		.16		.38*		.16		.93***		.70**
		.21		*.21*		*.23*		*.20*		*.23*
Retired (low psych. exp.)	.03	-.08	.07***	.03	.03	-.10*	-.01	-.08***	-.01	-.09***
N = 3,879	*.02*	*.05*	*.02*	*.06*	*.02*	*.05*	*.01*	*.03*	*.01*	*.03*
Rho		.20**		.07		.26***		.39***		.36**
		.09		*.09*		*.09*		*.12*		*.14*

Note: *Controlled, when applicable, for sex, age, age-squared, presence of children, education, activity sector (public, private), career stability, physical and psychosocial working conditions and time spent in retirement.*
Reading: *Marginal effects. Standard errors in italics. ***: significant at 1%, **: significant at 5%, *: significant at 10%.*
Field: *Santé et Itinéraire Professionnel survey. Individuals aged 50-69 in 2010.*

In the male population, retirement reduces the probability to declare activity limitations, generalized anxiety disorders and major depressive episodes (with respectively $-12pp$, $-11pp$ and $-13pp$). Among women, retirement only seems favourable for GAD and MDE. In the less educated population, retirement seems beneficial in terms of daily activity limitations, GAD and MDE. In the more educated sample, the role of retirement is sizeable on chronic diseases and even more important for mental health. Individuals having faced a physically strenuous career clearly experience the most positive effects of retiring on their health condition, as each indicator but self-assessed health status is impacted. When it comes to individuals with lower levels of physical exposures, only mental health is improved. The most psychosocially exposed individuals also experience massive improvements in all aspects of their health status. In the less exposed individuals, only GAD and MDE are affected. The massive impacts in the psychosocial subgroup specifically on self-assessed health and mental health indicators can be explained by the relief from a very stressful work-life. The impact on chronic diseases most likely depicts the role of retirement on long-term mental health deterioration.

5.3. Mechanisms

We investigate several possible reasons (mechanisms) as of why retirement appears to have such a positive impact on retirees' health.

Table 4: Mechanisms

Variable	Social activities		Sport		Tobacco		Alcohol		Overweight	
	Probit	**Biprobit**	**Probit**	**Biprobit**	**Probit**	**Biprobit**	**Probit**	**Biprobit**	**Probit**	**Biprobit**
Retired	.09***	.10**	.06**	.10*	-.05**	-.11***	.04*	.08**	.03	.12**
	.02	*.04*	*.02*	*.05*	*.02*	*.04*	*.02*	*.04*	*.02*	*.05*
Demographics										
Men	-.01	-.01	.00	.01	.08***	.09***	.26***	.26***	.19***	.19***
(*ref.: women*)	*.02*	*.02*	*.02*	*.02*	*.01*	*.01*	*.01*	*.01*	*.01*	*.01*
Age	-.00	-.01	-.04	-.04	.01	.00	.05**	.05**	.05*	.06*
	.03	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*
Age²	.00	.00	.00	.00	-.00	-.00	-.01**	-.01**	-.00	-.01*
	.00	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*
Children	-.00	-.00	.01	.01	-.01	-.01	.00	.00	.01	.01
(*ref.: none*)	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.03*	*.03*
Education										
< French bac.	.11***	.11***	.11***	.12***	-.03	-.03	.04	.04	-.01	-.01
(*ref.: no dipl.*)	*.03*	*.03*	*.03*	*.03*	*.02*	*.02*	*.02*	*.02*	*.03*	*.03*
= French bac.	.21***	.21***	.20***	.20***	-.02	-.02	.04	.03	-.07**	-.07**
(*ref.: no dipl.*)	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*
> French bac.	.34***	.34***	.31***	.31***	-.06**	-.06**	.04	.03	-.15***	-.15***
(*ref.: no dipl.*)	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*
Employment										
Public sector	.05**	.05**	.03	.02	.00	.00	-.01	-.01	-.04*	-.04*
(*ref.: private*)	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*
Self-employed	.02	.01	-.08***	-.09***	-.01	-.01	.02	.03	-.02	-.01
(*ref.: private*)	*.03*	*.03*	*.03*	*.03*	*.03*	*.03*	*.02*	*.02*	*.03*	*.03*
Long-term jobs	-.01	-.00	.06***	.07***	-.05***	-.05**	-.03*	-.04**	-.02	-.03
(*ref.: short term*)	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*
Stable career	.01	.01	.02*	.03*	-.02	-.01	.01	.01	.01	.01
(*ref.: unstable*)	*.01*	*.03*	*.01*	*.02*	*.01*	*.01*	*.01*	*.01*	*.02*	*.02*
Physical strains	-.05***	-.05***	-.04**	-.04**	.03**	.04**	-.00	-.00	.07***	.07***
	.02	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*
Psycho. strains	.04**	.04**	.01	.01	.02	.02	.00	.00	-.02	-.02
	.02	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*	*.02*
Time in retirem.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	.00	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*	*.00*
Rho		.05		.10		.07		-.09		-.13
		.08		*.08*		*.10*		*.09*		*.08*
Hausman test	.00		.43		1.33		1.33		2.33	
N	4,610									

Note: *Controlled for sex, age, age-squared, presence of children, education, activity sector (public, private), career stability, physical and psychosocial working conditions and time spent in retirement.*
Reading: *Marginal effects. Standard errors in italics. ***: significant at 1%, **: significant at 5%, *: significant at 10%.*
Field: *Santé et Itinéraire Professionnel survey. Individuals aged 50-69 in 2010.*

Retirement has a positive role on the probability of having daily social activities as well as on the probability to have physical activities, which is in line with the literature (Eibich, 2015) (Table 4). Even though it is not possible to say for sure this causally explains why retirees have a better health condition, daily social activities and sport are bound to be correlated with better health status and well-being (Ho, 2016; Ku *et al.*, 2016; Sarma *et al.*, 2015). Retiring is also found to decrease the probability of smoking which is also in line with a general health status improvement and makes sense, because of the relief retirement generates from the stress of the work-life. Yet, most likely because of the increase in spare time and despite the fact that retirees do sport more often, they are also more numerous to have a risky alcohol consumption and to be overweight. These results are congruent with the literature too, which notably shows that quitting smoking involves higher BMI levels (Courtemanche *et al.*, 2016), just like the fact of retiring (Godard, 2016).

5.4. Robustness checks

First, we test other retirement thresholds, as three different thresholds are potentially relevant in the French case: years 55, 60 and 65 (see Figure I and Appendix 1). We estimate models including these three thresholds in the retirement estimations. The main results are unchanged, and the auxiliary models show a strong effect for the 60 and 65 thresholds, this potentially rendering them useful as identifying variables (Appendix 4). We then put our results to the test of linear probability models (LPM), estimated by the generalized method of moments (GMM) with heteroscedasticity-robust standard errors, in order to take advantage of the possibility of using our two relevant identifying variables (60 and 65 years-old thresholds) by initiating different tests. This type of modelling also allows for several tests, as well as for a better handling of unobserved heterogeneity (Angrist and Pischke, 2009). It also allows relaxing the hypothesis of the residuals following a bi-normal distribution (which is the case of bivariate probits). The results (available upon request) are resilient to LPM modelling. It is the same for the results of auxiliary retirement models, which are also stable. Sargan-Hansen tests show that the instruments are correctly excluded and Kleibergen-Paap test statistics are consistently well above the arbitrary critical value of 10. Finally, we test whether the results hold up when not controlling for several endogenous covariates related to the professional career and without including civil servants (because this population is rather particular, notably in terms of retirement frameworks). The results (available upon request) appear as robust to this new specification, indicating that the effect of retirement was not driven by endogenous relationships with such variables or the particularity of part of the sample.

6. Discussion

Our findings underline a positive short-term effect of retirement on mental health. In the French case, they tend to reject the "Retirement blues" assumption in favour of the "Well deserved retirement" assumption, after controlling for endogeneity biases and retirement duration. Three main specificities of our dataset may be discussed in order to explain these results.

The first specificity is embodied by the fact that France has a relatively advantageous position in terms of retirement schemes compared to similar countries, while it is not as much the case in terms of exposures to detrimental working conditions. The retirement age is comparatively lower (age 62 while the standard is age 65 in most other countries today). This position is convergent with better results in terms of life expectancy at age 65. French workers also tend to leave the labour market early (at age 60, the first year of full-rate pension for the studied generations in this paper – see Figure I). Yet, they appear to face poor physical and environmental working conditions in comparison to the European average, according to the data of the European Working Conditions Survey (EWCS). The EU28 average physical environment index reaches approximately 84 out of 100 (relatively stable throughout the 2005-2015 period) indicating rather low exposures to a variety of physical and environmental strains. In France, this score only amounts to 79 out of 100 (decreasing during the same time span), indicating significantly higher levels of exposure and ranking the country in the 23rd position (out of 28 countries) (Eurofound, 2017). Based on SHARE data, Celidoni *et al.* (2017) and Mazzonna and Peracchi (2017) show that, for people retiring as soon as possible or working in more physically demanding occupations, retirement has a positive effect on cognitive abilities. French retirees thus happen to be overrepresented in both of these groups, explaining the mental retirement effect.

The second specificity is that French retirees tend to be richer than their European counterparts, and thus are more able to invest in their health status after retirement. The net replacement rate is 68%, which places France among the most generous countries with Italy and Sweden. In contrast, the Anglo-Saxon countries relying on funded schemes have lower replacement rates, and the share of individual savings in retirement is much higher than in countries where pension systems are of the pay-as-you-go scheme. As a consequence, the poverty rate among the elderly is the lowest among most countries (3.8% in France, compared

to 12.6% on average for the OECD). Thus, thanks to the French welfare state, retirees' health status and well-being seem therefore more protected.

The last specificity is that the time spent in retirement in our sample is rather low. As stressed out by Mazzonna and Peracchi (2017), years spent into retirement play an important role: the more time spent in retirement, the worse the effect on health status. Because the average number of years spent in retirement in our study is of only 5 years, this could explain that our retirees have been relieved from their strenuous work lives, but did not spend enough time as retired to experience a potentially detrimental effect, on cognitive abilities notably.

Several limitations can be noted. As we do not rely on panel data *per se*, we do not have the possibility to account systematically for individual unobserved heterogeneity. Even though this should not matter because of our instrumental variables framework, panel data would have enabled RDD methods allowing the implementation of differentiated trends left and right of the thresholds, at the cost of temporal distance and sample sizes. Another main limit lies in the fact that we cannot determine precisely if the mean effect of retirement on health status differs according to the distance with the retirement shock. We do not know, because of our data, if this effect is majorly led by short-, mid- or long-run consequences, neither can we determine if the impact on health status happens right after retirement or in a lagged fashion. There are also several missing variables, such as the professional status before retirement and standards of living as well as elements related to retirement reforms. It is also to be noted that comparisons between stratified samples are difficult because the results hold on different samples. These stratifications are also potentially endogeneous and thus should be taken with caution.

7. Conclusion

This study measures the causal effect of retirement on health status by mobilizing an econometric strategy allowing taking into account the endogenous nature of the retirement-health relationship and retrospective panel data on individual careers. We find that retirement has an average positive effect on activity limitations, GAD and MDE after controlling for reverse causality and unobserved heterogeneity. No significant effect can be found on self-assessed health and chronic diseases. It is also the case in the male population when in women, retirement benefits appear only on GAD and MDE and no effect is to be measured on physical health status. These results are particularly strong in the less educated and in the most exposed individuals to physical and psychosocial working conditions during their career.

We also find that this positive effect on health status might be explained by a greater ability for retirees to have more social and physical daily activities and smaller tobacco consumption. Yet, retirees are also found to be significantly more at risk for alcohol consumption and overweight. To our knowledge, this is the first study to give insights on the average effect of retirement on the whole population in France. It also deals with the mechanisms which could explain health effects as well as describing heterogeneous impacts according to sex, education levels and past exposures to two types of working conditions during the entire career, while addressing the endogeneity biases inherent to this type of study.

Delaying retirement ages may therefore induce health-related risks, retirement appearing as one important tool to relieve workers from their potentially poor working conditions. In that sense, postponing legal retirement ages may not be successful in balancing pension systems, simply because of the consequences in terms of health status at old ages of these reforms, and also because exposed workers may not be able to reach these higher thresholds at work. Extensions of the contribution period or the reversibility of the status of retiree (increasingly desired in Europe in recent years – Barnay, 2016) should be accompanied by preventive measures for work strains, or at least by differentiated retirement schemes depending on the nature and intensity of the entire work life of pensioners. Finally, retirement generally seems to promote more healthy behaviours due to the increase of available free time but also suggests an increase in alcohol consumption and overweight. Thus, information campaigns and specific incentives towards retirees could be introduced.

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Appendix 1: the French *pay-as-you-go* system

Before 2003, most individuals benefitted from the main retirement scheme at age 60. In the case they worked enough time (in terms of quarters at work), they received their full-rate pension. This also means that workers retiring before age 60 suffered from reduced rates for their pension calculations. In 2003, a reform of the pension system was initiated by the Fillon government and indicated that, starting from year 2009, workers would have to validate more quarters in order to still benefit from a full-rate pension. In 2010, a new reform took place, increasing the main retirement age from 60 to 62 starting from year 2011. In our case, age 60 appears as an interesting cut-off point (especially considering our sample is rather old and thus was not really impacted by these reforms). Retiring before age 60 exposes the sample to substantial financial disincentives (for each year which was not validated, a 10% decrease in the replacement rate was operated). This is therefore likely that individuals will not retire earlier if they do not benefit from other retirement schemes.

Numerous pre-retirement schemes also existed. The opening age for pre-retirement schemes is age 55. During the 90's, economic pre-retirement frameworks were implemented in France, with the objective to ease the entry on the labour market for younger workers. Notably, the job search exemption (*Dispense de recherche d'emploi*) for older workers when unemployed as well as the assistance for finding a first job (*Aide à la recherche d'un premier emploi* – ARPE) for younger workers all went in this particular direction. Yet, because of the specific objectives of the OECD to reach higher employment rates (notably in older workers), these pre-retirement schemes mostly stopped (job search exemption for instance, implemented in 2006, was abrogated in 2008). Today, other pre-retirement frameworks are in place. They are mostly based on workers having faced specific detrimental working conditions during their lives and objective work drudgery in general. The special allocation of the national employment fund (*Allocation spéciale du fonds national de l'emploi* – ASFNE) handles older workers being fired for economic reasons by granting them money until they reach the full-rate retirement age. The cessation of salaried workers' activity framework (*Cessation d'activité des travailleurs salariés* – CATS) for workers aged 55 or more having troubles with new technologies or having been exposed to work drudgery also gives opportunities for early retirement. Finally, more specific frameworks (focusing on specific working conditions) like the early retirement allowance for asbestos workers (*Allocation de cessation anticipée d'activité des travailleurs de l'amiante* – ACAATA) handles this type of situations. All in all and even if these very diverse early-retirement frameworks do not operate the same way, it

should make sense to test the possibility of age 55 inducing a first threshold in the probability to retire.

For individuals who have started working late or have known breaks in their careers, an unconditional legal retirement age exists. These individuals may indeed retire after age 65. In this case whatever their number of validated quarters, they are not going to be impacted by penalties in their replacement rates. These incentives at age 65 might dissuade these workers to retire before age 65 when their number of quarters is not high enough and on the contrary prompt them to retire once being 65. Therefore, this may grant us with a nice threshold to study.

Appendix 2: Major Depressive Episodes (MDE) and Generalized Anxiety Disorder (GAD)

The MDE are identified in two stages. First, two questions making use of filters are asked:

- Over the past two weeks, have you felt particularly sad, depressed, mostly during the day, and this almost every day? *Yes/No*
- Over the past two weeks, have you almost all the time the feeling of having no interest in anything, to have lost interest or pleasure in things that you usually like? *Yes/No*

Then, if one of the two filter questions receives a positive response, a third question is then asked, in order to know the specific symptoms: Over the past two weeks, when you felt depressed and/or uninterested for most things, have you experienced any of the following situations? *Check as soon as the answer is "yes", several possible positive responses.*

- Your appetite has changed significantly, or you have gained or lost weight without having the intention to (variation in the month of +/- 5%)
- You had trouble sleeping nearly every night (sleep, night or early awakenings, sleep too much)
- You were talking or you moved more slowly than usual, or on the contrary you feel agitated, and you have trouble staying in place, nearly every day
- You felt almost tired all the time, without energy, almost every day
- You feel worthless or guilty, almost every day
- You had a hard time concentrating or making decisions, almost every day
- You have had several dark thoughts (such as thinking it would be better be dead), or you thought about hurting yourself

Using the responses, two algorithms are then implemented in accordance with the criteria of the Diagnostic and Statistical Manual (DSM-IV). An individual suffers from MDE if:

- A positive response to two filter questions and four symptoms are listed
- Two positive answers to two filter questions and three symptoms are listed

GAD are identified using a similar filter questions system.

Three questions are asked:

- Over the past six months, have you felt like you were too much concerned about this and that, have you felt overly concerned, worried, anxious about life's everyday problems, at work/at school, at home or about your relatives? *Yes/No*

In case of positive answer:

- Do you have such concerns almost every day? *Yes/No*

In case of positive answer:

- Is it difficult to control these concerns or do they prevent you to focus on what you have to do? *Yes/No*

If the interviewee responds positively to the three filter questions, another question is asked in order to know the specific symptoms: "Over the last six months, when you felt particularly concerned, worried, anxious, you often happened:

- To feel restless, tense, the edgy nerves?
- To have tense muscles?
- To feel tired, weak or exhausted easily?
- To have trouble concentrating or vacuum passages?
- To be particularly irritable?
- To have sleep problems (difficulty falling asleep, waking in the middle of the night, waking early or sleeping too much)?

For a person to suffer from generalized anxiety disorder, he/she must respond positively to the three filter questions, then three out of six symptoms described later. This protocol is consistent with that used by the DSM-IV.

Appendix 3: Main auxiliary models

Table 5: Auxiliary models of the probability of being retired

	Probit	Biprobit
Aged 60 or more	.16***	.16***
	.01	*.01*
Demographics		
Men	.03***	.03***
(*ref.: women*)	*.01*	*.01*
Age	.02	.02
	.03	*.03*
Age²	.00	.00
	.00	*.00*
Children	.01	.01
(*ref.: none*)	*.02*	*.02*
Education		
< French bac.	.03**	.03**
(*ref.: no dipl.*)	*.02*	*.01*
= French bac.	.02	.02
(*ref.: no dipl.*)	*.02*	*.02*
> French bac.	-.01	-.01
(*ref.: no dipl.*)	*.02*	*.02*
Employment		
Public sector	.01	.01
(*ref.: private*)	*.01*	*.01*
Self-employed	-.15***	-.15***
(*ref.: private*)	*.02*	*.02*
Long-term jobs	.11***	.12***
(*ref.: short term*)	*.01*	*.01*
Stable career	.03***	.03***
(*ref.: unstable*)	*.01*	*.01*
Physical strains	.04***	.03***
	.01	*.01*
Psycho. strains	.01	.01
	.01	*.01*
N	4,610	

Reading: *Coefficients. Standard errors in italics. ***: significant at 1%, **: significant at 5%, *: significant at 10%.*
Field: *Santé et Itinéraire Professionnel survey. Individuals aged 50-69 in 2010.*

Appendix 4: Robustness checks

Table 6: Tests with three instruments (age 55, 60 and 65)

Variable	Poor SAH	Chronic diseases	Activity limitations	GAD	MDE
	Biprobit	**Biprobit**	**Biprobit**	**Biprobit**	**Biprobit**
Retired	-.08	-.02	-.10**	-.11***	-.11***
	.05	*.05*	*.04*	*.03*	*.03*
N	4,610				

Note: *Controlled for sex, age, age-squared, presence of children, education, activity sector (public, private), career stability, physical and psychosocial working conditions and time spent in retirement.*
Reading: *Marginal effects. Standard errors in italics. ***: significant at 1%, **: significant at 5%, *: significant at 10%.*
Field: *Santé et Itinéraire Professionnel survey. Individuals aged 50-69 in 2010.*

Table 7: Auxiliary models of the probability of being retired (age 55, 60 and 65)

	Probit	Biprobit
Aged 55 or more	-.00	-.00
	.03	*.03*
Aged 60 or more	.18***	.18***
	.02	*.02*
Aged 65 or more	.09***	.09***
	.03	*.03*
N	4,610	

Note: *Controlled for sex, age, age-squared, presence of children, education, activity sector (public, private), career stability, physical and psychosocial working conditions.*
Reading: *Marginal effects. Standard errors in italics. ***: significant at 1%, **: significant at 5%, *: significant at 10%.*
Field: *Santé et Itinéraire Professionnel survey. Individuals aged 50-69 in 2010.*

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