Really healthier when retiring earlier? Evidence from France[#]

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March 2017

Abstract

We investigate the causal effect of early retirement on health of retirees in later life. Our identification strategy relies on eligibility rules to a new long-career based early retirement scheme introduced in France in 2004, that strongly increased the proportion of older workers who left their last job before 60. We show that early retirement is positively correlated with deterioration in health in later life. However, this effect disappears when we control for the endogeneity of the retirement decision.

JEL Classification: I14; J14; J26

Keywords: early retirement; self-assessed health; endogeneity; France

[#] This research has benefited from the support of CEPREMAP, Paris. We thank Bruno Decreuse, Rafael Lalive, Mathieu Lefebvre and seminar participants at the 2017 TEPP Winter School for their comments and suggestions. Any remaining errors are ours.

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1. Introduction

In almost all OECD countries, the retirement age has decreased significantly during the 70s and 80s. With the ageing of their population, most countries have decided over the last decade to postpone their legal retirement age (Hofäcker et al., 2016)[1]. In pay-as-you-go pension systems, postponing retirement should have positive effects for public accounts with a decrease in the total amount of pensions payable to retirees. However, this may also imply additional costs if lengthening the working period has adverse effects on older workers' health in later life.

From an empirical perspective, it hence matters to assess the consequences of the retirement timing on health status. Obviously, the association between early retirement and health is subject to endogeneity concern, either in the form of omitted variable bias or reverse causality (Bonsang et al., 2012, Coe et al., 2012, Insler, 2014, Eibich, 2015). For instance, people who entered the labor market during youth will be more likely to retire early because they will have contributed the requested number of years. If those persons have experienced strenuous working conditions during their career, then they are more likely to be in poor health during their remaining years of retirement. In such setting, being unhealthy would be the motivation (rather than the cause) of early retirement. Conversely, managers and executives in good health and having accumulated enough assets may be tempted to benefit from early retirement since they will not really be affected by the reduction in income due to lower pension once being retired.

In this paper, we study the consequences of early retirement on the health status of retirees in France. In this country, pensions are financed on a pay-as-you-go basis. The average age at which older workers withdraw from the labor market is substantially below the normal age for receiving a full pension (about 1.5 year)[2]. Early retirement is hence frequently observed but its impact on health outcomes has been under-investigated so far. To estimate a causal effect, our identification strategy relies on the introduction of a specific early retirement scheme whose focus was on long careers. Starting from 2004, individuals were allowed to retire before the minimum pension claiming age (60 years in France) subject to specific eligibility conditions that include among others birth cohort and starting age of activity. We use eligibility to the program as instrumental variable to control for the endogeneity of the early retirement decision in health equations.

Our empirical analysis relies on a unique data set conducted in France in 2012 on a sample of respondents aged between 50 and 69 and interviewed about their passage from employment to retirement. This survey provides information on three health indicators (self-reported health, chronic

[1] See http://www.oecd.org/els/emp/Summary_1970%20values.xls for an overview of time-series data concerning the average effective age of retirement in OECD countries.

[2] According to OECD (2015), the average effective age of retirement for the 2009-2014 period was 59.4 years for men and 59.8 years for women. The difference with the normal retirement age is 1.8 years for men and 1.4 years for women, respectively.

health problem, limitation in daily life), retirement timing for those having retired and working conditions. We focus on respondents born between 1943 and 1950 since the cohorts born from 1945 were the first eligible to the new early retirement scheme introduced in 2004. We further restrict our attention to the case of male retirees having worked in the private sector. We end up with a sample comprising around 1,350 retirees for whom we investigate the health consequences of early retirement.

Our paper contributes to the recent literature on the health-retirement relationship. Noting that the effect of retirement on health status cannot be signed on a priori grounds, a few studies have attempted to assess the causal impact of retirement with different estimation strategies. Considering cross-national household data, some authors have used variation in retirement ages between countries to instrument the retirement decision (Rohwedder and Willis, 2010, Coe and Zamarro, 2011, Mazzonna and Peracchi, 2012). Conversely, other authors have focused on a single country using temporal changes in pension eligibility as instruments (Bonsang et al., 2012, Eibich, 2015). Here, we focus more closely on the health consequences of early retirement and account for the role of working conditions. The early retirement scheme that we consider is a quasi-natural experiment which allows to properly instrument the early retirement decision.

Our empirical analysis provides new results for the case of France. To date, very little work has been conducted on the health-retirement relationship in this country, Blake and Garrouste (2012) being an exception. Many studies have analyzed the data provided by the Survey of Health, Ageing and Retirement in Europe for which France is one of the contributing members (see Coe and Zamarro, 2011, Mazzonna and Peracchi, 2012, 2017, Heller-Sahlgren, 2016). However, country heterogeneity is a serious concern so that Motegi et al. (2016) have recently casted doubt on the relevance of pooled results from such cross-country comparisons. With our data, we find a positive association between early retirement and health problems among retirees. However, this early retirement effect is no longer significant once we control for endogeneity.

The remainder of our paper is organized as follows. In the next Section, we briefly summarize the existing literature. Section 3 provides a description of the French retirement system with a focus on the long career early retirement scheme. We present the data and our identification strategy in Section 4. We discuss our results in Section 5 where we show differences in the effect of early retirement depending on whether endogeneity of the retirement decision is taken into account or not. Finally, section 6 concludes.

2. The effect of retirement on health: A review

Over the last ten years, a growing number of studies have attempted to investigate the health effects of retirement. Starting from the model of Grossman (1972), Dave et al. (2008) note

that the effect of retirement on health is ambiguous from a theoretical perspective. On the one hand, people invest in health across the lifecycle in order to improve their own productivity and avoid the adverse effect of illness on earnings but this investment motive is no longer present after retirement (negative effect). On the other hand, health enters as consumption good in the utility function so that retirees still have incentives to invest in health (positive effect). The net effect will depend on the marginal benefits and marginal costs of investing in health and is in particular related to the marginal value of time (Dave et al., 2006). As emphasized in Behncke (2012), the health effect of retirement is expected to be heterogeneous depending on individual preferences.

Identification of the causal effect of retirement on health is thus an empirical issue. With respect to the literature on the effect of job loss during activity which is found to have negative consequences on health (Strully, 2009, Browning and Heinesen, 2012, Schaller and Stevens, 2015), a difficulty is that the retirement decision is unlikely to be exogenous. The two main following sources of endogeneity have to be taken into account (Dave et al., 2008, Eibich, 2015)[3]. First, both the retirement decision and the health outcomes are likely to be influenced by the same set of (not necessarily unobserved) individual characteristics. Fixed effect models are most often estimated to avoid the underlying omitted variable bias. Second, there may be a problem of reverse causality (Dwyer and Mitchell, 1999, McGarry, 2004). In particular, even if the retirement decision is expected to be strongly related to rules of the current state pension system, individuals may choose to postpone their retirement decision because they are in good health.

Different estimation strategies have been proposed to assess the causal effect of retirement. The most frequent approach is to rely on institutional variation in retirement incentives. Using data from several countries, Rohwedder and Willis (2010), Coe and Zamarro (2011) and Mazzonna and Peracchi (2012) use cross-country variation in retirement ages and consider the early and full statutory retirement ages in each country[4]. The resulting bias is no longer present in studies exploiting panel variation and social security eligibility within one country. Bonsang et al. (2012) and Eibich (2015) consider the key retirement ages as instruments for the retirement decision, i.e. the earliest age at which social security benefits can be claimed and the normal retirement age. The causal effect can be assessed either in a standard Instrumental Variable (IV) framework or in a Regression Discontinuity (RD) design. The difference between both settings is that the age trend introduced in the health equation can differ on both sides of the thresholds with the RD strategy.

[3] Bingley and Martinello (2013) show that those variations in pension eligibility are invalid instruments without controlling for level of schooling. Another source of endogeneity is related to measurement errors. A potential drawback is the so-called justification bias such that retirees tend to report more often a poor health as a justification of their retirement status (Bazzoli, 1985, McGarry, 2004).

[4] In that case, the estimator of the retirement effect is severely biased and the magnitude of the endogeneity bias depends on the correlation between schooling and the retirement instruments.

In terms of results, empirical evidence is mixed so far. Using cross-country data from the US and Europe, Rohwedder and Willis (2010) report a large negative impact of early retirement on the cognitive ability of people in their early 60s. Using the European SHARE data, Mazzonna and Peracchi (2012) find an increase in the rate of decline of cognitive abilities after retirement. However, it is important to differentiate between short-term and long-term effects of retirement as only long-terms effects are significantly negative (Heller-Sahlgren, 2016). Using US data from the Health and Retirement Study (HRS), Bonsang et al. (2012) conclude in favor of a substantial negative effect (around 10%) of retirement on cognitive functioning obtained from episodic memory scores[5]. With the same data, Dave et al. (2008) show that the negative effect of retirement concerns the number of mobility difficulties, the number of difficulties in daily activities, the number of illness conditions and depression symptoms. Also, retirement causes an increase in the probability of being obese among men (Godard, 2016). In England and using non-parametric techniques, Behncke (2012) find that retirement raises the risk of being diagnosed with a chronic condition, the probability of having problems in physical activities as well as the probability of self-reporting poor health.

However, a few other studies have reached the exactly opposite conclusion concerning the retirement-health relationship. Using three different US datasets, Charles (2004) shows that the negative correlation between retirement and well-being is no longer valid once accounting for exogenous variation in retirement probability. The endogeneity-corrected effect of retirement corresponds instead to an improvement in subjective well-being. Using the HRS data, Coe et al. (2012) report a negative association between retirement duration and cognitive function, but there is no causal effect for white-collar workers and a positive one for blue-collar workers after proper instrumentation. With the same data and using predicted probability of working past ages 62 and 65 as instruments, Insler (2014) find that retirement has a beneficial effect on a global health index incorporating both objective and subjective health characteristics. Again, the IV estimates switch sign compared to the OLS estimates. With the European SHARE data, Coe and Zamarro (2011) conclude that retirement leads to a 35 percent decrease in the probability of being in fair or poor health. In Germany, Eibich (2015) finds that retirement improves both subjective health and mental health by around 0.25 standard deviations.

The case of France has received little attention to date. France is of course one of the countries contributing to the SHARE project from which the causal health-retirement relationship has been empirically investigated in Europe (Coe and Zamarro, 2011, Mazzonna and Peracchi, 2012, 2017, Heller-Sahlgren, 2016). However, recent work from Motegi et al. (2016a) shows that country heterogeneity has a large influence on the estimated results, so cross-country estimation is not

[5] In Ireland, the negative effect of retirement on mental health is significant for involuntary or forced retirement, but not for voluntary retirement (Mosca and Barrett, 2016).

appropriate when estimating the health effect of retirement. To the best of our knowledge, only Blake and Garrouste (2012) have specifically focused on the case of France based on the Health Barometer surveys collected in 1999 and 2005. Dealing with causality using the 1993 reform of the French pension system which concerned only private worker employees, they find that retirement leads to an improvement of physical health, especially among men and low-educated individuals.

Very few studies have explored the channels through which retirement may have an influence (either positive or negative) on health outcomes. Focusing on smoking and exercise habits, Insler (2014) observes contrasting post-retirement evolution with a decline in smoking incidence and an increase in exercise levels. For both outcomes, the correlation obtained from fixed effect models is significant especially for long-term retirement. Eibich (2015) provides a detailed analysis of changes in daily life after retirement in Germany. The retirement decision leads to a decrease in smoking probability, an increase in sleep time and an increase in time spent on leisure activities. In both studies, those changes in post-retirement behavior are mechanisms explaining the positive health effects. At the same time, both Eibich (2015) and Mazzonna and Peracchi (2017) report substantial heterogeneity across occupations[6]. They demonstrate that relief from work-related stress and physical strain is important to explain the positive effect of retirement on health.

Understanding why the estimated effect of retirement on health is sometimes negative, sometimes positive remains challenging. In their comprehensive analysis, Motegi et al. (2016b) point out the role of the analysis method and to a lower extent the role of control variables. A central issue, further discussed in Hagen (2016), concerns the empirical strategy to account for endogenous selection into retirement. The commonly used instruments relate to age-specific retirement incentives (like eligibility age thresholds) which are expected to influence health indirectly, i.e. only through age of retirement. A potential drawback of those instruments is that pension reform may have an impact on health before individuals take their decision to retire, for instance due to some expectation effects. Using data from the HRS, Falba et al. (2009) show that divergence between the subjective probability of working full-time at age 62 and actual labor participation at that time affects the risk of depression. Assessing the effect of a Dutch pension system reform, De Grip et al. (2012) find that depression rates increase by about 40% for the 1950 cohort affected by a reduction in pension rights compared to the 1949 cohort[7].

[6] In the European comparative analysis of Mazzonna and Peracchi (2017), the negative health-retirement relationship obtained from the whole sample becomes positive when the sample is restricted to individuals working in very demanding physically occupations.

[7] This sizable effect is estimated on a sample of workers approaching retirement, but having not yet retired. The deteriorating effect on mental health is significantly more important for "married workers who experience a large income loss and for married men whose partner has no pension income" (De Grip et al., 2012, p. 21).

3. The French pension system

The French pension system is characterized by many different pension schemes depending on employment status, with specific rules for self-employed, civil servants or workers in special public services. The majority of wage earners in the private sector, representing around 60% of the labor force, contribute to a general mandatory pay-as-you-go pension scheme called general regime ("*régime general*") and they receive pensions from the Caisse Nationale d'Assurance Vieillesse (CNAV). For these workers, there is a second pillar that consists of mandatory complementary schemes, ARRCO and AGIRC, respectively for non-executives and executives, both schemes being also financed in a pay-as-you-go manner.

The basic formula to compute pensions in the general regime is based on the three following parameters: the reference wage corresponding to the 25 best annual earnings, the number of years of contribution and the conversion rate[8]. The latter reaches its maximum, i.e. 50%, when workers draw their pensions at the full rate age (FRA hereafter). The FRA is a complex feature of the French pension system since it depends on both the retirement age and the number of years of contribution (Rabaté and Rochut, 2016). Before 2003, workers covered by the general regime were entitled to a pension once they reached the age of 60 that we will refer to as the Minimum Claiming Age (MCA). They received a pension at a full rate only if they had validated a sufficient number of quarters to the pension system that we will refer to as the full rate duration (D_{FR})[9].

To restore the financial balance of the pension scheme, the French government introduced some changes starting from 1993. The main reform consisted in increasing gradually the full rate duration from 150 to 160 quarters. This change was phased in with one additional quarter for each cohort, starting from the 1934 generation (for which the full rate duration was 151 quarters) to the 1943 generation (for which full rate duration was 160 quarters). Before 2003, each year of missing validated quarters led to a reduction of 10 percentage points in the replacement rate. However, for workers aged 65 that we will refer to as the Normal Retirement Age (NRA) and over, this penalty did not apply and the full pension rate was reached even though individuals had not validated the full rate duration.

[8] The definition of the reference wage for the general regime has changed over time. Before 1993, it was based on the average earnings of the best 10 years. Since then, it has been gradually raised with an increase of one year for each cohort from generation 1933 to generation 1948. For civil servants, the reference wage corresponds to the average earnings of the 6 best months.

[9] A distinction has to be made between two types of quarters, i.e. quarters of contribution and assimilated quarters. A quarter of contribution to the system is validated if the annual earnings equals at least 200 hours of minimum wage (1886 euros in 2013). The number of quarters of contribution cannot exceed 4 in one year. Under some conditions, some missing quarters of contribution may be purchased by individuals to compensate incomplete years or high exit age from the schooling system. An assimilated quarter is validated even though the individual was not employed in some cases (sickness leaves, unemployment schemes, maternity or disability).

In 2003, the Fillon government made changes in some rules of the pension system. First, it applied the 1993 changes to the public sector, leading to equality in the full rate duration for private sector employees and civil servants in 2008. Second, starting from 2009, it prolonged the increase in the full rate duration for both types of workers from 160 quarters for the 1948 cohort to 166 quarters for the 1955 one. It also reduced the penalty for early retirement from 10% to 5% and introduced a bonus for delayed retirement. Another side of the reform introduced social equity. Before 2003, workers having started to contribute to the system very early (at 16) had also to retire at the minimum claiming age (60 years). In the case of continuous careers, they contributed 44 years (176 quarters) to the system, 4 years more than a worker having started to work at 20 or over.

The 2003 reform reduced this inequality by introducing a "long-career early retirement" scheme (*retraite anticipée pour carrière longue*, RACL hereafter). Starting from January 1st 2004, the RACL scheme allowed individuals who started working very young to retire before the minimum claiming age (60 years)[10]. The eligibility to the RACL scheme was subject to a triple condition: i) having started working at 17 or before, the age of first contribution to the pension system conditioning the minimum claiming age (between 56 and 58 if the individual started working at 16 or before, at 59 if he/she started working at 17); ii) having validated 8 quarters more than the full rate duration, while the insurance duration had to be 16 quarters higher before the introduction of this measure (the validated quarters could be made up of short unemployment spells and other types of assimilated quarters); and iii) having a number of quarters of contribution higher than the full rate duration or not depending on age of the first contribution.

In 2009, the conditions for workers having started working at 17 or earlier to retire before 60 have been severely tightened in many respects (Denayrolles and Guilain, 2015) [11]. In particular, the increase in the number of required contribution quarters to retire before 60 increased starting from 2009 as planned by the 2003 reform. This raised automatically the insurance duration criteria. A last reform was voted in 2010 under the Sarkozy government, which yet came into force in 2011. It increased the minimum claiming age from 60 to 62 and the normal retirement age (at which there is no penalty, even though the number of validated quarters is lower than the full rate duration) from 65 to 67. This change was gradually phased in with 4 additional months for each cohort from the 1951 one. It also increased the minimum claiming age for workers eligible to the RACL scheme from 56 to 58, but with a delayed implementation (starting from the cohort 1955).

[10] See https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000000781627.

[11] Among the other changes, the number of quarters purchased by the workers to compensate incomplete years or high number of schooling years have been excluded since 2009 from the total number of validated quarters required to be entitled to the retirement before 60. Also, the possibilities of overstatement for contributed years have been reduced: age of the first contribution requires a formal evidence of work since 2009.

Due to data constraints (we use a survey completed in 2012) and the several changes in the RACL scheme after 2009, we will focus in our paper on the situation of cohorts who were eligible to the RACL scheme between 2004 and 2008. For cohorts born between 1942 and 1949, we describe in Table 1 the eligibility to the RACL scheme as well as changes in the various criteria. Implementation of the RACL scheme led to a high number of demands. According to official statistics, it is estimated that from 2004 to 2008, more than 550,000 individuals took their retirement using the RACL scheme: 114,790 in 2004, 101,462 in 2005, 107,903 in 2006, 114,382 in 2007 and 119,620 in 2008[12]. In 2009, the number of recipients collapsed to about 24,000 and was around 42,000-43,000 in both 2010 and 2011. All over the period, men were overrepresented among recipients, with proportions equal to 85.7% in 2004, 79.3% in 2006 and 76.5% in 2008.

Insert Table 1

4. Description of the data

4.1. The PRE survey

We assess the effect of retirement on health in France using the RACL scheme as a quasi-natural experience. Indeed, this scheme provided exogenous incentives to retire between 2004 and 2008, at least for some specific groups of workers since recipients had to begin their career early and fulfill the requested number of contributed quarters.

Our empirical analysis is based on a unique survey completed in 2012 by the French National Institute of Economics and Statistics (INSEE) entitled 'Passage from Employment to Retirement' (*Passage de l'Emploi à la Retraite*, PRE)[13]. The PRE survey is a complementary module asked to the sample of individuals interviewed in the Employment survey (so that both surveys are matched by construction) and meeting the two following criteria: they should be aged 50-69 and should have been in the labor market after 50. Its main purpose was to document the circumstances through which people leave the labor market, the motivation to maintain a professional activity at old ages as well as intentions of retiring for those still in the labor market. It was also conducted to better characterize the transition periods separating the end of working life and retirement, with a focus on the use of early retirement schemes. Overall, the sample comprised 16,938 respondents.

We rely on three different sets of questions in the PRE survey related to health, retirement and working conditions, respectively. Our dependent variable concerns the respondent's health. We consider the following indicators: i) a self-reported assessment of health status obtained from the question "how do you currently assess your general health ?", possible answers being "very good",

[12] http://dares.travail-emploi.gouv.fr/IMG/xls/series_internet_caa_2003-2014_sexe_age_2015_23_11.xls.

[13] The PRE data files are available to researchers using the French portal Réseau Quetelet for data in the humanities and social sciences (http://www.reseau-quetelet.cnrs.fr/spip/).

"good", "good enough", "bad", very bad"; ii) an indicator of chronic illness obtained from the question "do you currently have a chronic illness or health problem ?", possible answers being "yes" or "no"; iii) an indicator of limitation in daily life from the question "have you been limited, for at least six months, because of a health problem in the activities that people usually do ?", possible answers being "yes" or "no"[14]. These self-reported outcomes have been widely used in health economics and self-assessed health has been shown to be highly correlated with mortality, disability as well as utilization of health services (Schnittker and Bacak, 2014).

The PRE survey provides a detailed description of the labor force participation history. This includes the age at which the respondent began to work, the number of working years and the retirement status. Those who have already retired at the date of the survey indicate both when they withdrew from the labor market and when they started to receive their pension. We construct an early retirement indicator which is equal to one when the respondent has left his last job before the legal age of 60. There are also several questions related to the conditions through which respondents retired, for instance with a full-rate pension, a discount (*décote*) or a premium (*surcote*), and on the use of a specific scheme in case of early retirement.

The PRE survey includes a question on the RACL scheme: "you can retire at age 60 or earlier if you start working young and have had a long career, it is the early departure for long career: did you retire as part of an early retirement for a long career ?", possible answers being "yes" or "no". We will use this self-reported information to identify recipients of the RACL scheme. However, for various reasons (for instance recall error or reluctance to reveal how they decided to retire), some recipients may deliberately choose not to indicate that they have benefited from the RACL scheme. Thus we will account for the criteria required for eligibility to the RACL scheme. Due to the lack of information on the number of contributed and validated quarters, we consider only two criteria to construct an indicator of eligibility : birth cohort and starting age of activity.

The PRE survey includes detailed information on working conditions experienced either with the current job (for those who have not yet retired) or with the last job. Here, retired workers provide retrospective information about the physical or psycho-social burden of their past activity. Respondents have to answer to the following assertions: "I had a night-shift work", "I worked with rotating hours", "I did repetitive work or chain work", "my job was physically demanding (heaving loads to carry, strenuous position)", "I was exposed to toxic, harmful or dangerous products", "I worked in a noisy environment", "I worked in high or low temperatures", "I lived tensions with an audience (customers, users, patients, students, travelers, suppliers, …)", possible answers to each item being either "yes" or "no". We construct a set of dummy variables associated to each working

[14] There is no information on mental health in the PRE survey.

condition. Finally, the survey contains the usual set of demographic and socio-economic characteristics like year of birth, marital status and education.

We apply the following selections to the original sample. First, we only consider male respondents (8,281 observations deleted), whose current or last job was not in the public sector (3,107 observations deleted), and being currently retired (3,256 observations deleted). While the last criterion is obvious since we focus on the effect of early retirement, the first two criteria are due to substantial differences in the working history between men and women and in retirement conditions between workers from the private and public sectors. Second, we only keep individuals born between 1943 and 1950 since people born after 1951 have been subject to substantial changes in the RACL scheme[15]. Third, we exclude a small number of respondents (N=16) reporting having worked for the first time after 26 years as well as incoherent answers between early retirement and use of RACL scheme[16]. Overall, our final sample comprises 1,359 respondents.

We provide a description of the sample in Table 2. The average age of respondents is 64.3 years, 82% of them are in couple and they have 2.1 children. Most respondents (about 80%) have completed less than high school, 18.8% are executives, 25.3% are intermediates, 49.7% are blue-collar workers and 43.7% have experienced at least one unemployment spell. Many retirees have experienced bad working conditions during their last job. The highest proportions are found for physically demanding work (51.5%), high pace of work (48.8%), exposition to loud noise (44%) or exposition to low/high temperatures (43.5%). Concerning our outcomes, 41.7% of respondents report a bad health, 46% have chronic health problems and 25.5% face some health limitations in their daily life.

Insert Table 2

In our sample, more than one respondent over two (57.0%) have retired before the legal retirement age. Table 2 shows substantial differences in the characteristics of people who chose to retire before the legal age and those who did not. Early retirees are slightly younger (-0.8 year), less educated and more often blue-collar workers (+14.6 percentage points). Also, respondents did not report similar working conditions. Early retirees have experienced worse working conditions, in particular for physically demanding work (+12.6 points), exposition to low/high temperatures (+10.5 points), exposition to loud noise (+8.7 points), exposition to toxic products (+8.1 points) and shift work (+7.7points). Finally, people who will retire early are likely to be in worst health compared to those who will retire at the legal retirement age: +10.4 points for self-reported bad health, +11.0 points for chronic health problems and +8.6 points for health limitation.

[15] We exclude the 1942 birth cohort as the number of individuals born in 1942 (N=81) is much lower compared to that of other cohorts. This choice has no effect on our results.

[16] In particular, 21 respondents claim having benefited from the RACL scheme (which means that they retire before the legal age of retirement) but do not report that they retire before 60.

4.2. Identification strategy

As emphasized in previous studies (Rohwedder and Willis, 2010, Coe and Zamarro, 2011, Bonsang et al., 2012, Mazzonna and Peracchi, 2012, 2017, Insler, 2014, Eibich, 2015, Motegi et al., 2016a, Hagen, 2016), endogeneity is a central concern when investigating the causal effect of retirement on health. In our context, the endogenous selection in early retirement is likely to lead to a positive correlation between bad health and early retirement because of a reverse causality issue. With the data at hand, we turn to an instrumental variable strategy to account for the endogeneity of the early retirement decision[17]. More precisely, we use the introduction of the RACL scheme which has led to an increase in early retirement rates as a quasi-natural experiment and consider eligibility to the RACL scheme as an instrument. In what follows, we investigate the relevance of our identification strategy.

In Figure 1, we present the proportion of early retirees by birth cohort calculated from the PRE survey. For those born in 1943 and 1944, the proportion of early retirees is around 42-43%. Then, it increases to 48.2% for the 1945 cohort, 57.6% for the 1946 cohort, 59.8% for the 1948 cohort and 69.1% for the 1950 cohort. On average, the proportion of early retirees increases by 17.5 percentage points when comparing the situation of the cohorts born in 1943 and 1944 and that of cohorts born from 1945 (from 42.9% to 60.4%). Furthermore, the difference is highly significant according to a mean-comparison test ($p<0.000$). We argue that this increase in the number of early retirees results from the introduction of the RACL scheme.

Insert Figure 1

As shown in Table 1, people born either in 1943 or 1944 were not eligible to the RACL scheme. Only cohorts born from 1945 had the opportunity to leave before 60 because of the RACL scheme. For those born in 1945 and after, the proportion of respondents reporting that they have used the RACL scheme is equal to 21.6%. Figure 1 shows the contribution of early retirees due to the RACL scheme to total early retirement. The proportion of RACL recipients among early retirees amounts to 20.9% for the 1945 cohort, 25.2% for the 1947 cohort and 44.0% for the 1949 cohort[18]. Clearly, the increase in early retirement observed among the youngest birth cohorts is strongly related to the introduction of the early career scheme.

In Figure 2, we take into account the eligibility status for the RACL scheme. As the numbers of validated and contributed quarters required for full rate duration are unobservable in our data, we

[17] Since we do not have longitudinal data, we are not able to account for unobserved heterogeneity at the individual level. That is why it is potentially important to account for the role of working conditions in our regressions since those covariates may affect both the choice to retire early and the health status.

[18] This contribution is slightly lower for the 1950 cohort (37.7%). This may be related to changes in the eligibility conditions to the RACL scheme.

define eligibility as a function of birth cohort and starting age of activity[19]. With this definition, the eligibility rate for people born from 1945 amounts to 65%. The proportion of early retirees who are non-eligible to the RACL scheme is around 40% for cohorts born between 1945 and 1948 and 50% for cohorts born either in 1949 or 1950. This proportion appears much higher for respondents eligible to the RACL scheme. The gap is equal to 12.1 percentage points for the 1945 cohort, 24.4 points for the 1946 cohort, 12.7 points for the 1947 cohort, 28.7 points for the 1948 cohort, 18.8 points for the 1949 cohort and 28.6 points for the 1950 cohort. When considering all birth cohorts, the average gap is equal to 20.9 percentage points.

Insert Figure 2

So, eligibility for the RACL scheme is highly correlated with the increase in the proportion of early retirees. This is the first condition which is needed for eligibility to be a valid instrumental variable. Among the eligibility criteria, the respondent's birth cohort is clearly exogenous. At first sight, the situation sounds different for the starting age of activity as less educated people or blue-collar workers have presumably entered earlier the labor market. At the same time, what matters in our context is that respondents are unlikely to have deliberately chosen (in the sense that they could have manipulated) their date of entry in the labor market while thinking that this entry age could have more than 40 years later an influence on the possibility to retire early from the labor market.

The second condition for the eligibility variable to be a valid instrument is that it should not be correlated with the various health outcomes. We expect the two criteria considered in the empirical definition of eligibility to be correlated with health. First, it is well acknowledged that health declines with age even though the rate at which health decreases with age is much lower after 60-65 (see for instance Case and Deaton, 2005). Second, there is a large positive association between health and education, which suggests a negative relationship between health and starting age of activity. The influence of education increases with years of education, although its magnitude tends to be larger at young ages and declines after 50-60 (Cutler and Lleras-Muney, 2008). However, eligibility for the RACL scheme depends on the combination of specific conditions for both birth cohort and starting age of activity. Once controlling for age and education, there is no reason to observe any correlation between health and the eligibility status of the respondent.

[19] Among those born in 1945, the group of respondents eligible to the RACL scheme comprises individuals with a starting age of activity less or equal to 17 (they can only retire at 59). For the 1946 birth cohort, the potential recipients of the RACL scheme include people having started their activity at most at 16 for those deciding to retire at 58 and above and people having started their activity at 17 at most for those deciding to retire at 59 and above.

5. Empirical results

5.1. The effect of early retirement

In this section we explore the effects of early retirement on different health outcomes, depending on whether the endogeneity of retirement decision is accounted for or not. First, we run Probit models including a set of explanatory variables to check whether retiring before 60 is really associated to health problems in later life once we control for observable heterogeneity. However, for this part of the study, we do not account for the differences in past working conditions. We will explore their incidence on the retirement-health relationship in next section.

We report marginal effects in Panel A of Table 3. Each column corresponds to each health outcome considered. We see that early retirement is positively associated with deterioration in retiree's health some years later. Note that this effect is quite substantial and ranges from 7 and 10 percentage points depending on the dependent variable. Then we look at the causal effect of early retirement on health using the identification strategy presented in section 4. Panel B shows results from a 2SLS model, presenting the first-stage estimates and then the coefficient associated to early retirement from the second stage of the 2SLS procedure. Note that the F-test statistic testing the weakness of the instrument is above the critical value of 10. This ensures that our instrument is a strong predictor of early retirement decision (Staiger and Stock, 1997). When we control for the endogeneity bias, the causal effect of early retirement on health is not so clear-cut. Looking at estimated coefficient from the second-stage of the SLS procedure, we see that this effect is no more significant for each health outcome. We obtain similar results when we estimate a bivariate Probit model, accounting for the binary nature of both the endogenous and the dependent variables.

5.2. The influence of working conditions on the retirement-health relationship

In this section, we exploit the information on the physical burden of the past occupation to investigate how it influences the effect of early retirement on health. First, we add the variables concerning past job's physical burden in our regressions for each health outcome. The estimates obtained from Probit, 2SLS and bivariate Probit models are shown respectively in Panels A, B and C of Table 4. We see that individuals who had occupied a physically demanding job have a strongly higher probability of self-reporting bad health, having a chronic illness or being limited in their daily activities because of health problem. However, it does change neither the magnitude nor the significance of the coefficient associated with early retirement in the OLS estimates. In addition, when controlling for endogeneity of early retirement, either through a 2SLS or through a bivariate Probit, this effect is not significant anymore, as in Table 3.

To analyze the heterogeneity of the early retirement effect on health across types of jobs, we construct an index of past job's physical burden using a principal component analysis. Then, we

classify the level of physical burden of past job as high (low) if the index is above (below) its median value. To check whether this index has well extracted the most important information from our data on past job's working conditions, we compute difference in means for each of these variables according to whether the index is below or above its median value. Table 5 shows that a high index is strongly correlated with adverse working conditions in past job. So, we can group respondents into two categories: retirees who occupied more physically demanding jobs and retirees who were employed in less physically demanding jobs. Table 6 presents the results obtained with OLS (Panel A), 2SLS (Panel B) and Bivariate Probit (Panel C) for each health outcome, separating our sample into two groups according to the value of past job physical burden index. We see first that the positive correlation between early retirement and deterioration in health is high and significant but only for retirees who used to work in less physically demanding jobs. For these individuals, we have the already discussed reverse causality issue. But, this correlation is strongly lower for retirees who used to work in more physically demanding jobs and even non significant if we consider self-reported bad health or limitations in daily life as dependent variables. This apparently puzzling finding would suggest that occupying a physically demanding job has deleterious effects on individual's health, as shown in Table 4 but irrespective of their retirement date. When we control for endogeneity of the early retirement through a 2SLS procedure (Panel B), we find that the causal effect of early retirement on health is never significant regardless of the level of the past job's physical burden. However, the point estimates turn out to be negative for individuals who occupied jobs with low physical burden. We obtain the same findings when we correct for endogeneity through a Bivariate Probit approach (Panel C) and this negative effect becomes significant when we consider the probability of having limitations in their daily activities because of health problem. This implies that early retirement may have improved the retirees' health but only if their past occupation was not too physically demanding. This contrasts with previous findings of Mazzonna and Peracchi (2017) as they have shown that retirement would improve health status for workers who were employed in very demanding occupations. However, they consider cognitive abilities while we look at more general health outcomes.

6. Concluding comments

In this paper we explore the retirement-health relationship. In contrast to the standard literature that identifies this effect only for people who retire around the legal retirement age, we look at the effect of effective retirement before this date on health at later life. We focus on the French case to avoid too much cross-country heterogeneity and also because early retirement is frequently observed in France. To estimate the causal effect of early retirement on health, we exploit the introduction of a specific early retirement scheme targeted on individuals who started working early.

From 2004, individuals were allowed to claim their pension age before the legal age of 60, provided that they started working at 17 or before. As eligibility to the program varies across cohorts and starting working age, we use these criteria as instrumental variable to control for the endogeneity of the early retirement decision in health equations.

We find first that early retirement is strongly correlated with bad health in later life. This results from a reverse causality issue implying that people who retire early are in poorer health than those who leave their job just at the legal retirement age. When we correct for endogeneity, this positive correlation is no more significant. Then we investigate the heterogeneity of the effect according to the past job's physical burden, differentiating individuals who occupied physically demanding jobs from those who were employed in jobs with a low physical burden. We show that the aforementioned positive correlation is only valid for the latter group and that this effect turns out to be negative if we correct for endogeneity bias. This would suggest that early retirement leads to a reduction in the probability of being in bad health in later life, but only for individuals who were employed in jobs with low physical burden. Our findings also suggest that occupying a physically demanding job is harmful to individuals' health regardless of their retirement date. In that case, early retirement has no effect on health.

As it stands, our study presents some limitations. First, we do not explore the effect of early retirement on cognitive abilities, while this mental health outcome has been widely studied in the previous literature. Second, we highlight a long-term effect of early retirement on health, without studying the evolution of health outcomes over time. Using panel data to look at different health trajectories across cohorts and starting age of activity would provide a broader picture of the early retirement-health relationship.

References

Bazzoli G., (1985), The early retirement decision: New empirical evidence on the influence of health, *Journal of Human Resources*, vol. 20, pp. 214-34.

Behncke S., (2012), Does retirement triger ill health ?, *Health Economics*, vol. 21, pp. 282-300.

Bingley P., Martinello A., (2013), Mental retirement and schooling, *European Economic Review*, vol. 63, pp. 292-298.

Blake H., Garrouste C., (2012), Collateral effects of a pension reform in France, mimeo, University of York Working Paper 12/16.

Bonsang E., Adam S., Perelman S., (2012), Does retirement affect cognitive functioning ?, *Journal of Health Economics*, vol. 31, pp. 490-501.

Braakmann N., (2011), The causal relationship between education, health and health related behaviour: Evidence from a natural experiment in England, Journal of Health Economics, vol. 30, pp. 753-763.

Browning M., Heinesen E., (2012), Effect of job loss due to plant closure on mortality and hospitalization, *Journal of Health Economics*, vol. 31, pp. 599-616.

Case A., Deaton A.S., (2005), Down by Work and Sex: How Our Health Declines, in Wise D., eds, *Analyses in the Economics of Aging*, University of Chicago Press, Chicago, pp. 185-212.

Charles K., (2004), Is retirement depressing ? Labor force inactivity and psychological well-being in later life, *Research in Labor Economics*, vol. 23, pp. 269-299.

Coe N.B., von Gaudecker H.M., Lindeboom M., Maurer J., (2012), The effect of retirement on cognitive functioning, *Health Economics*, vol. 21, pp. 913-927.

Coe N.B., Zamarro G., (2011), Retirement effects on health in Europe, *Journal of Health Economics*, vol. 30, pp. 77-86.

Cutler D.M., Lleras-Muney A., (2008), Education and health: Evaluating theories and evidence, in House J., Schoeni R., Kaplan G., Pollack H., eds., *Making Americans Healthier: Social and Economic Policy as Health Policy*, Russell Sage Foundation, New York.

Cutler D., Lleras-Muney A., (2010), Understanding differences in health behaviors by education, *Journal of Health Economics*, vol. 29, pp. 1-28.

Dave D., Rashad I., Spasojevic J., (2006), The effect of retirement on physical and mental health outcomes, *NBER Working Paper*, n° 12123.

Dave D., Rashad I., Spasojevic J., (2008), The effect of retirement on physical and mental health outcomes, *Southern Economic Journal*, vol. 75, pp. 497-523.

Denayrolles E., Guilain M., (2015), Retraite anticipée pour carrière longue: 10 années d'évolutions réglémentaires, *Retraite et Société*, n° 70, pp. 151-166.

De Grip A., Lindeboom M., Montizaan R., (2012), Shattered dreams: The effects of changing the pension system late in the game, *Economic Journal*, vol. 122, pp. 1-25.

Dwyer D.S., Mitchell O.S., (1999), Health problems as determinants of retirement: Are self-rated measures endogenous ? *Journal of Health Economics*, vol. 15, pp. 67-85.

Eibich P., (2015), Understanding the effect of retirement on health: Mechanisms and heterogeneity, *Journal of Health Economics*, vol. 43, pp. 1-12.

Falba T., Gallo W., Sindelar J., (2009), Work expectations, realizations and depression in older workers, *Journal of Mental Health Policy and Economics*, vol. 12, pp. 175-186.

Godard M., (2016), Gaining weight through retirement ? Results from the SHARE survey, *Journal of Health Economics*, vol. 45, pp. 27-46.

Grossman M., (1972), On the concept of health capital and the demand for health, *Journal of Political Economy*, vol. 80, pp. 223-255.

Grossmann M., (2006), Education and nonmarket outcomes, in Hanushek E., Welch F., (eds.), *Handbook of the Economics of Education*, North-Holland, Elsevier, vol. 1, pp. 577-633.

Hagen J., (2016), What are the health effects of postponing retirement ? An instrumental variable approach, *mimeo*, Institute for Evaluation of Labour Market and Education Policy Working Paper 2016:11.

Heller-Sahlgren G., (2016), Retirement blues, *IFN Working Paper*, n° 1114.

Hofäcker D., Hess M., König S., eds, (2016), *Delaying retirement. Progress and challenges of active ageing in Europe, the United States and Japan*, Palgrave Macmillan.

Insler M., (2014), The health consequences of retirement, *Journal of Human Resources*, vol. 49, pp. 195-233.

Mazzonna F., Peracchi F., (2012), Ageing, cognitive abilities and retirement, *European Economic Review*, vol. 56, pp. 691-710.

Mazzonna F., Peracchi F., (2017), Unhealthy retirement ? Evidence of occupation heterogeneity, *Journal of Human Resources*, forthcoming.

McGarry K., (2004), Health and retirement: Do changes in health affect retirement expectations, *Journal of Human Resources*, vol. 39, pp. 624-648.

Mosca I., Barrett A., (2016), The impact of voluntary and involuntary retirement on mental health: Evidence from older Irish adults, *Journal of Mental Health Policy and Economics*, vol. 19, pp. 33-44.

Motegi H., Nishimura Y., Oikawa M., (2016a), Retirement and cognitive decline: Evidence from global aging data, *mimeo*, University of York Working Paper 16/11.

Motegi H., Nishimura Y., Oikawa M., (2016b), What explains the difference in the effect of retirement on health ? Evidence from global aging data, *mimeo*, University of York Working Paper 16/13.

OECD (2015), *Pensions at a Glance 2015: OECD and G20 indicators*, OECD Publishing, Paris.

Rabaté, S. et Rochut, J., (2016), Impact de la réforme des retraites de 2010 sur l'activité des seniors en France, contribution au dossier du Conseil d'Orientation des Retraites : "Report de l'âge de la retraite, effets macroéconomiques", document n°11.

Rohwedder S., Willis R.J., (2010), *Mental retirement, Journal of Economic Perspectives*, vol. 24, pp. 119-138.

Schaller J., Stevens A.H., (2015), Short-run effects of job loss on health conditions, health insurance, and health care utilization, *Journal of Health Economics*, vol. 43, pp. 190-203.

Schnittker J., Bacak. V., (2014), The increasing predictive validity of self-rated health, PLoS ONE, vol. 9, e84933.

Silles M.A., (2009), The causal effect of education on health: Evidence from the United Kingdom, Economics of Education Review, vol. 28, pp. 122-128.

Staiger, D. and Stock, J.H. (1997) Instrumental variables regression with weak instruments, *Econometrica*, vol. 65, no 3, p. 557-586.

Strully K.W., (2009), Job loss and health in the US labor market, *Demography*, vol. 46, pp. 221-246.

Table 1. Description of the RACL scheme (2004-2008 period)

Retirement age	Birth cohort 1942	1943	1944	1945	1946	1947	1948	1949
56							SAA≤16 VQ=168 CQ=168	SAA≤16 VQ=168 CQ=168
57						SAA≤16 VQ=168 CQ=168	SAA≤16 VQ=168 CQ=168	SAA≤16 VQ=168 CQ=168
58		NOT ELIGIBLE			SAA≤16 VQ=168 CQ=164	SAA≤16 VQ=168 CQ=164	SAA≤16 VQ=168 CQ=164	SAA≤16 VQ=168 CQ=164
59				SAA≤17 VQ=168 CQ=160	SAA≤17 VQ=168 CQ=160	SAA≤17 VQ=168 CQ=160	SAA≤17 VQ=168 CQ=160	SAA≤17 VQ=168 CQ=160
≥60	Legal retirement age							
Full rate duration	160	160	160	160	160	160	160	161

Source: adapted from Denayrolles and Guilain (2015, p. 156).

Note: SAA = starting age of activity, VQ = validated quarters, CQ = contributed quarters.

Table 2. Descriptive statistics of the sample

Variables	(1) All	(2) Early retirement	(3) Normal retirement	(4)=(2)-(3) Difference
Health outcomes				
Self-reported bad health	0.417	0.462	0.358	0.104***
Has chronic health problems	0.460	0.507	0.397	0.110***
Health limitation	0.255	0.292	0.205	0.086***
Individual characteristics				
Age	64.338	64.013	64.771	-0.758***
In couple	0.820	0.828	0.808	0.020
Number of children	2.131	2.093	2.182	-0.089
Education: no diploma	0.416	0.463	0.353	0.110***
Education: secondary/vocational	0.394	0.422	0.356	0.066**
Education: high-School	0.085	0.055	0.125	-0.069***
Education: undergraduate/graduate	0.105	0.059	0.166	-0.107***
Occupation: executive	0.188	0.137	0.257	-0.120***
Occupation: intermediate	0.253	0.246	0.262	-0.016
Occupation: employee	0.060	0.057	0.065	-0.008
Occupation: blue-collar workers	0.497	0.560	0.414	0.146***
At least one unemployment spell	0.437	0.445	0.426	0.019
Eligibility to the RACL scheme	0.528	0.627	0.396	0.232***
Working conditions				
Night working	0.179	0.210	0.137	0.073***
Shift work	0.162	0.195	0.118	0.077***
Short repetitive tasks	0.227	0.248	0.199	0.049**
Work physically demanding	0.515	0.569	0.443	0.126***
Exposed to toxic products	0.346	0.381	0.300	0.081***
Exposed to loud noise	0.440	0.477	0.390	0.087***
Exposed to low/high temperatures	0.435	0.480	0.375	0.105***
Supporting tensions with an audience	0.267	0.248	0.293	-0.045*
High pace of work	0.488	0.507	0.462	0.045*
Number of observations	1359	775	584	

Source: authors' calculations, Passage from Employment to Retirement 2012 survey.

Note: significance levels for the mean-comparison tests reported in column (4) are $p<0.001$ (***), $p<0.05$ (**) and $p<0.01$ (*).

Table 3. Estimates of early retirement effect on health status

Variables	(1) Bad health		(2) Chronic problem		(3) Health limitation	
Panel A. Probit models – marginal estimates						
Early retirement: exogenous	0.092***	(3.25)	0.103***	(3.62)	0.074***	(2.99)
Age	0.019***	(2.96)	0.006	(1.02)	0.008	(1.53)
In couple	-0.089**	(-2.48)	-0.041	(-1.13)	-0.032	(-1.02)
Number of children	0.007	(0.71)	0.002	(0.25)	0.010	(1.18)
Education: secondary/vocational	-0.072**	(-2.39)	0.018	(0.59)	0.000	(0.00)
Education: high-School	-0.150***	(-3.01)	-0.065	(-1.25)	-0.114***	(-2.63)
Education: undergraduate/graduate	-0.226***	(-4.92)	-0.059	(-1.22)	-0.127***	(-3.15)
At least one unemployment spell	0.084***	(3.06)	0.077***	(2.82)	0.081***	(3.40)
Number of observations	1,359		1,359		1,359	
Log likelihood	-885.8		-922.1		-746.5	
Panel B. IV linear probability models						
Early retirement equation						
Instrument: eligible to RACL scheme	0.117***	(3.85)	0.117***	(3.85)	0.117***	(3.85)
Individual covariates	YES		YES	YES	YES	YES
F-test of excluded instrument	14.81		14.81		14.81	
Health outcome						
Early retirement: ATT	0.082	(0.31)	0.061	(0.22)	0.235	(0.99)
Individual covariates	YES		YES		YES	
Number of observations	1,359		1,359		1,359	
R^2 (centered)	0.053		0.021		0.001	
Panel C. Bivariate Probit models						
Early retirement equation						
Instrument: eligible to RACL scheme	0.304***	(3.68)	0.307***	(3.75)	0.308***	(3.73)
Individual covariates	YES		YES		YES	
Second stage: health outcome						
Early retirement: ATE	0.013	(0.08)	0.022	(0.14)	0.092	(0.43)
Individual covariates	YES		YES		YES	
Number of observations	1,359		1,359		1,359	
Log likelihood	-1,752.6		-1,788.9		-1,613.4	

Source: authors' calculations, Passage from Employment to Retirement 2012 survey.

Note: ATT and ATE stand for Average effect of the Treatment on the Treated and Average Treatment Effect, respectively. T-values are in parentheses, significance levels being p<0.001 (***), p<0.05 (**) and p<0.01 (*).

Table 4. Estimates of early retirement effect on health status accounting for the physical burden of past occupation

Variables	(1) Bad health		(2) Chronic problem		(3) Health limitation	
Panel A. Probit models – marginal estimates						
Early retirement: exogenous	0.089***	(3.08)	0.104***	(3.59)	0.072***	(2.91)
Age	0.020***	(3.12)	0.007	(1.14)	0.009	(1.59)
In couple	-0.090**	(-2.45)	-0.044	(-1.21)	-0.034	(-1.08)
Number of children	-0.000	(-0.03)	-0.001	(-0.05)	0.005	(0.57)
Education: secondary/vocational	-0.034	(-1.08)	0.036	(1.13)	0.026	(0.95)
Education: high-School	-0.038	(-0.69)	-0.010	(-0.18)	-0.043	(-0.86)
Education: undergraduate/graduate	-0.119**	(-2.22)	-0.002	(0.04)	-0.045	(-0.94)
At least one unemployment spell	0.069***	(2.48)	0.070***	(2.50)	0.070***	(2.91)
Working conditions when employed						
Night working	-0.026	(-0.62)	0.008	(0.19)	-0.011	(0.30)
Shift work	-0.025	(-0.56)	-0.022	(-0.49)	-0.018	(-0.47)
Short repetitive tasks	0.058	(1.64)	0.050	(1.39)	0.024	(0.80)
Work physically demanding	0.122***	(3.55)	0.075**	(2.16)	0.072**	(2.44)
Exposed to toxic products	0.032	(0.99)	0.069**	(2.12)	0.035	(1.26)
Exposed to loud noise	0.116***	(3.42)	0.066*	(1.94)	0.081***	(2.77)
Exposed to low/high temperatures	-0.027	(-0.78)	-0.059*	(-1.66)	0.036	(1.19)
Supporting tensions with an audience	0.020	(0.61)	0.106***	(3.30)	0.071**	(2.52)
High pace of work	0.059**	(2.03)	0.001	(0.03)	0.018	(0.71)
Number of observations	1,359		1,359		1,359	
Log likelihood	-856.39		-905.29		-721.63	
Panel B. IV linear probability models						
Early retirement equation						
Instrument: eligible to RACL scheme	0.113***	(3.66)	0.113***	(3.66)	0.113***	(3.66)
Individual covariates	YES		YES	YES	YES	YES
Working conditions	YES		YES		YES	
F-test of excluded instrument	7.39		7.39		7.39	
Health outcome						
Early retirement: ATT	-0.210	(-0.75)	-0.038	(-0.14)	0.042	(0.17)
Individual covariates	YES		YES		YES	
Working conditions	YES		YES		YES	
Number of observations	1,359		1,359		1,359	
R^2 (centered)	0.021		0.029		0.070	
Panel C. Bivariate Probit models						
Early retirement equation						
Instrument: eligible to RACL scheme	0.298***	(3.52)	0.307***	(3.75)	0.308***	(3.73)
Individual covariates	YES		YES		YES	YES
Working conditions	YES		YES		YES	
Second stage: health outcome						
Early retirement: ATE	-0.108	(-0.68)	0.016	(0.11)	-0.041	(-0.27)
Individual covariates	YES		YES		YES	
Working conditions	YES		YES		YES	
Number of observations	1,359		1,359		1,359	
Log likelihood	-1,752.6		-1,788.9		-1,613.4	

Source: authors' calculations, Passage from Employment to Retirement 2012 survey.

Note: ATT and ATE stand for Average effect of the Treatment on the Treated and Average Treatment Effect, respectively. T-values are in parentheses, significance levels being p<0.001 (***), p<0.05 (**) and p<0.01 (*).

Table 5. Difference in means of indicators of past adverse working conditions according to the index of physical burden

Variables	(1) All	(2) Low physical burden	(3) High physical burden	(4)=(3)-(2) Difference
Working conditions				
Night working	0.179	0.051	0.308	0.256***
Shift work	0.162	0.020	0.305	0.284***
Short repetitive tasks	0.227	0.085	0.370	0.285***
Work physically demanding	0.515	0.193	0.840	0.647***
Exposed to toxic products	0.346	0.107	0.587	0.480***
Exposed to loud noise	0.440	0.108	0.775	0.667***
Exposed to low/high temperatures	0.435	0.098	0.775	0.677***
Supporting tensions with an audience	0.267	0.305	0.229	-0.075***
High pace of work	0.488	0.319	0.658	0.339***
Number of observations	1359	683	676	

Source: authors' calculations, Passage from Employment to Retirement 2012 survey.

Note: Individuals are classified according to values of a synthetic index of physical burden built through a Principal Component Analysis. Low (high) physical burden is associated with index below (above) its median value. Significance levels for differences in means are $p<0.001$ (***), $p<0.05$ (**) and $p<0.01$ (*).

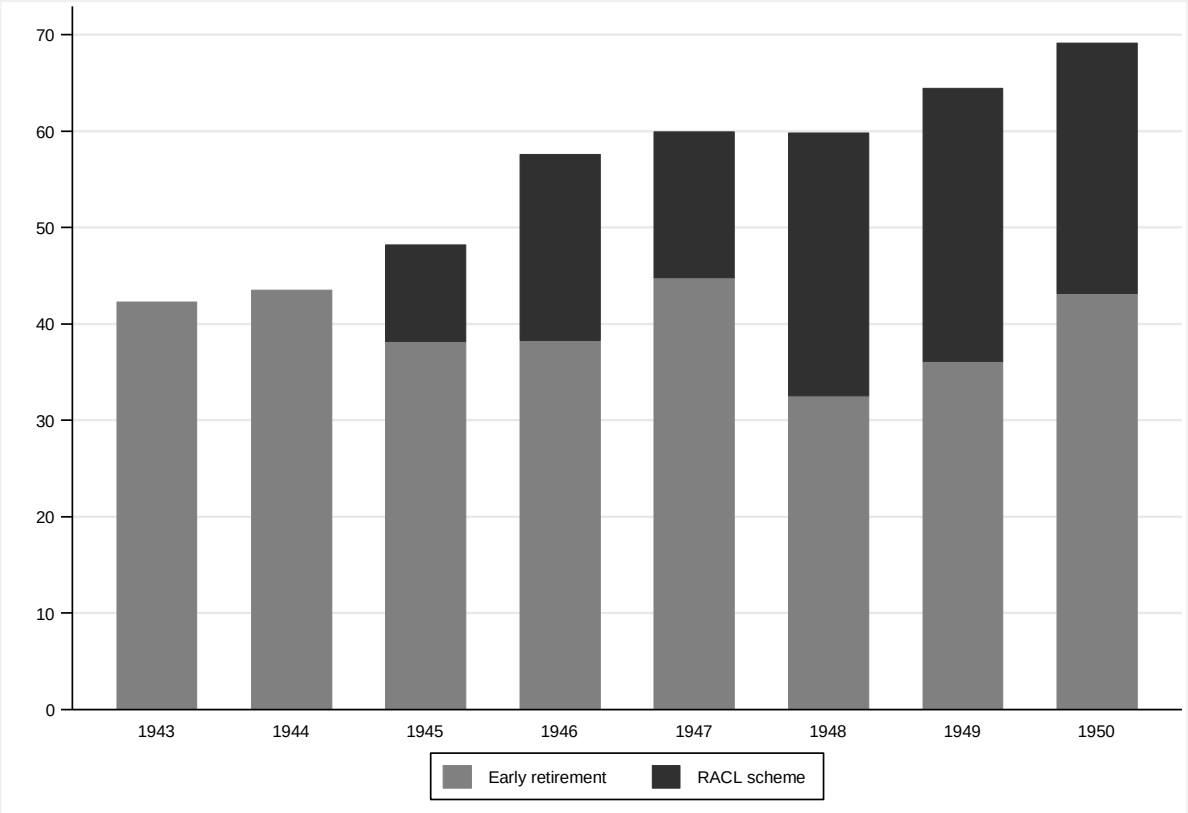
Table 6. Estimates of early retirement effect on health by index of past job's physical burden

Variables	Bad health		Chronic health problem		Health limitation	
	Low physical burden	High physical burden	Low physical burden	High physical burden	Low physical burden	High physical burden
Exogenous early retirement	0.148***	0.024	0.121***	0.084***	0.101***	0.041
	(3.97)	(0.58)	(3.06)	(2.04)	(3.32)	(1.07)
Individual characteristics						
Age	0.017**	0.020***	0.017	-0.004	0.020***	-0.005
	(2.08)	(2.18)	(1.97)	(0.44)	(3.06)	(-0.55)
In couple	-0.100***	-0.054	-0.054	-0.026	-0.043	-0.013
	(-1.96)	(-1.12)	(-1.00)	(-0.54)	(-1.02)	(-0.28)
Number of children	-0.006	0.004	0.004	-0.002	0.02	0.011
	(-0.41)	(0.32)	(0.26)	(-0.13)	(0.19)	(0.90)
Education: secondary/vocational	-0.048	-0.037	0.043	0.026	0.018	0.021
	(-1.08)	(-0.91)	(0.90)	(0.65)	(0.49)	(0.54)
Education: high-School	-0.063	-0.107	-0.037	0.063	-0.062	-0.038
	(-1.10)	(-0.88)	(-0.58)	(0.52)	(-1.34)	(-0.33)
Education: undergraduate/graduate	-0.112***	-0.251*	0.004	-0.096	-0.045	-0.167
	(-2.11)	(-1.76)	(0.06)	(-0.66)	(-1.34)	(-1.24)
At least one unemployment spell	0.058	0.087**	0.097***	0.049	0.074***	0.074**
	(1.56)	(2.24)	(2.48)	(1.28)	(2.46)	(2.03)
Predicted probability (at sample means)	0.305	0.522	0.406	0.512	0.169	0.326
Number of observations	683	676	683	676	683	676
Panel B. IV linear probability models						
Early retirement equation						
Instrument: eligible to RACL scheme	0.144***	0.086**	0.144***	0.086**	0.144***	0.086**
	(3.30)	(1.98)	(3.30)	(1.98)	(3.30)	(1.98)
Individual covariates	YES	YES	YES	YES	YES	YES
F-test of excluded instrument	9.15	6.53	9.15	6.53	9.15	6.53
Health outcome						
Early retirement: ATT	-0.178	0.125	-0.182	0.145	-0.085	0.390
	(-0.59)	(0.23)	(-0.57)	(0.27)	(-0.35)	(0.73)
Individual covariates	YES	YES	YES	YES	YES	YES
Number of observations	683	676	683	676	683	676
Panel C. Bivariate Probit models						
Early retirement equation						
Instrument: eligible to RACL scheme	0.348***	0.214	0.367***	0.226*	0.265**	0.223
	(2.54)	(1.63)	(2.98)	(1.90)	(2.27)	(1.77)
Individual covariates	YES	YES	YES	YES	YES	YES
Second stage: health outcome						
Early retirement: ATE	-0.170	-0.099	-0.150	0.059	-0.231***	0.001
	(-0.84)	(-0.28)	(-0.77)	(0.20)	(-4.33)	(0.256)
Individual covariates	YES	YES	YES	YES	YES	YES
Number of observations	683	676	683	676	683	676

Source: authors' calculations, Passage from Employment to Retirement 2012 survey.

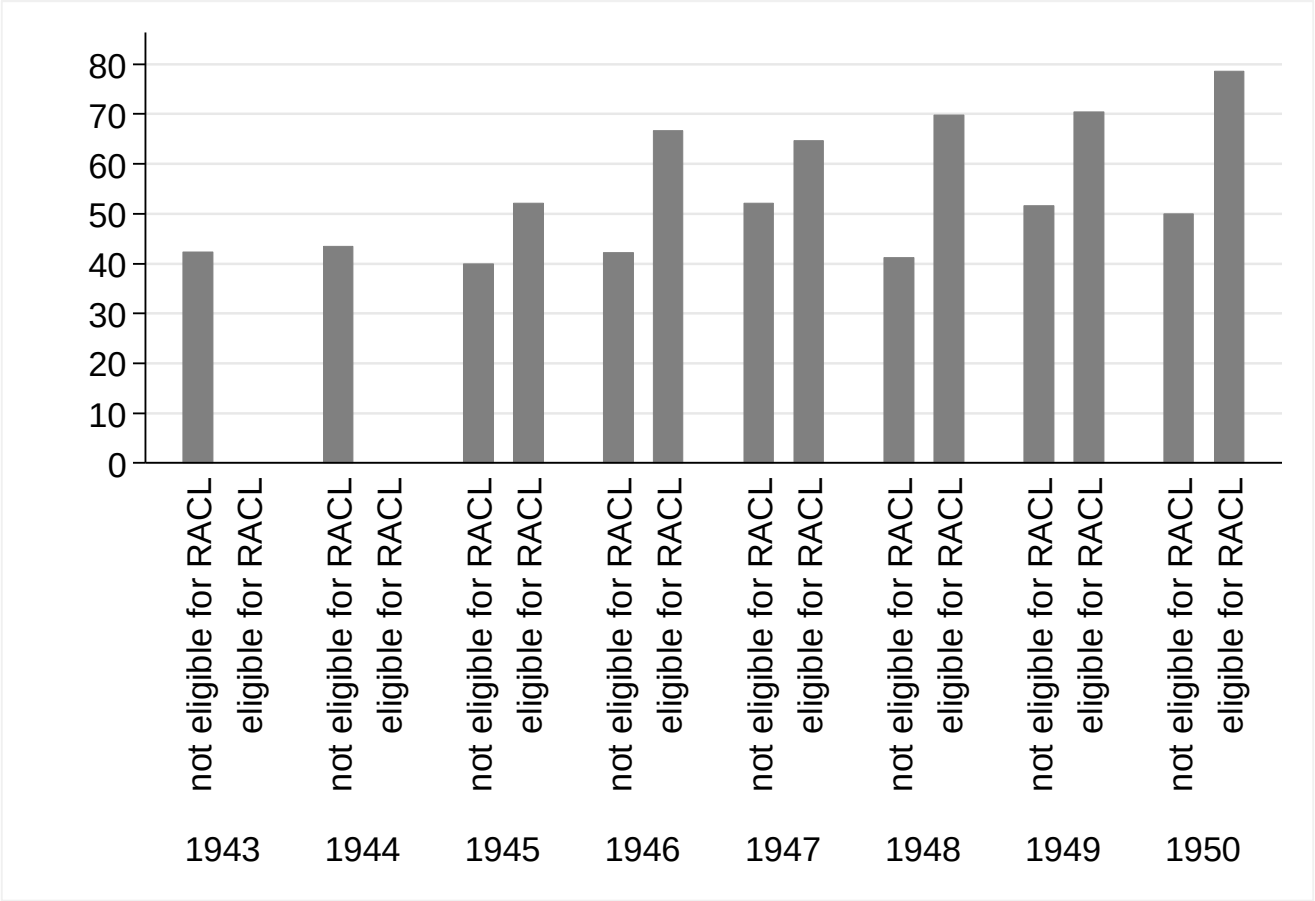
Note: Individuals are classified according to values of a synthetic index of physical burden built through a Principal Component Analysis. Low (high) physical burden is associated with index below (above) its median value. ATT and ATE stand for Average effect of the Treatment on the Treated and Average Treatment Effect, respectively. T-values are in parentheses, significance levels being p<0.001 (***), p<0.05 (**) and p<0.01 (*).

Figure 1 .Proportion of early retirees, by birth cohort



Source: authors' calculations, Passage from Employment to Retirement 2012 survey.

Figure 2. Proportion of early retirees, by birth cohort and eligibility to the RACL scheme



Source: authors' calculations, Passage from Employment to Retirement 2012 survey.