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Abstract

Pension systems and reforms thereof are often discussed in the context of financial viability. In industrialized countries, these debates grow in intensity with the aging of the population; however, an increase in retirement age may create unintended side effects with regards to retiree health or healthcare costs. This study empirically analyzes the effect of (early) retirement on individual inpatient and outpatient healthcare expenditure in Austria. We use comprehensive labor market and retirement data from the Austrian Social Security Database, together with detailed information about individual inpatient and outpatient healthcare service utilization in the province of Upper Austria. To account for endogeneity in retirement decisions, we exploit exogenous variation in the early retirement age as induced by two Austrian pension reforms (i.e., those in 2000 and 2003). We find there to be significant negative effects of retirement on healthcare expenditure. For both genders, retirement reduces subsequent expenditure for outpatient medical attendance and hospitalization. Analyses of disaggregated components of healthcare expenditure confirm a positive health effect caused by physical and emotional relief following retirement. Apart from direct health effects, the results also reveal behavioral changes in the utilization of healthcare services. These changes in health behavior seem particularly relevant among blue-collar workers.

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1 Introduction

Many Organisation for Economic Co-operation and Development (OECD) countries have introduced reforms to encourage or enforce longer working lives among their citizens. Population aging, a decline in fertility, and the recent economic crisis have certainly increased the pressure to keep pension systems financially sustainable. However, pension reforms or related policies by which to keep elderly workers active in the labor market for longer periods may be accompanied by adverse social and economic effects at the individual level. For example, an increase in retirement age can create unintended side effects with regards to retiree health or healthcare costs. From a policy perspective, it is important to analyze and quantify these spillover effects from longer employment, on health and healthcare utilization: if these effects are quantitatively important, they may lead to questions regarding the employability of older workers. Hence, understanding these spillover effects is relevant to the effective design of policies that keep elderly workers employed; if these effects are ignored, retirement policies might be prone to failure.

Most of the literature on the health effects of retirement focuses on subjective self-reported health status. Such studies can be criticized, not least due to the fact that answers to questions about mental and physical health can be expected to vindicate the retirement decision. In this study, we examine retirement effects on inpatient and outpatient healthcare expenditure, using administrative register data. One advantage of using these data is their objective nature. First, the effects of retirement on out-of-pocket healthcare expenditure are important in terms of financing the healthcare system; causation-related empirical evidence would allow health insurance funds to undertake an informed assessment of future healthcare costs as triggered by (early) retirement reforms. Second, healthcare expenditure serves as a proxy for individual-level health status. However, different expenditure categories reflect individual-level health to varying extents. For example, the utilization of certain healthcare services—for example, routine dental visits or other medical examinations—has a clear preventative character. Health-conscious people can be expected to utilize such services more frequently than less health-conscious people. As a consequence, higher healthcare expenditure may not necessarily indicate a worse health status, but may reflect more risk-averse behavior among patients and/or physicians. Even if it were difficult to unequivocally distinguish health effects from behavioral effects, the level of detail in our register data allows for indication of whether different components of expenditure reflect the utilization of curative (i.e., improve poor health) or preventative (i.e., maintain good health) services. As such, we interpret the number and length of hospital stays and the consumption of medical drugs as more accurate indicators of individual-level health status, rather than expenditure on medical attendance in the outpatient sector. In our empirical analysis, we look to identify retirement effects for these different expenditure categories.

To empirically analyze the effect of (early) retirement on individual-level inpatient and outpatient healthcare expenditure, we use labor market and retirement data from a comprehensive matched employee–employer dataset and combine this information with detailed individual-level health register data from the province of Upper Austria. To account for the endogeneity of retirement decisions, we exploit exogenous variation in the early retirement age, as induced by two Austrian pension reforms (i.e., those in 2000 and 2003). With these reforms, the eligibility age for early retirement was gradually increased from 60 to 65 for men and 55 to 60 for women.

We find retirement to have significant effects on healthcare expenditure. For both genders, retirement reduces subsequent expenditure in relation to outpatient medical attendance and hospitalization. The retirement of women (men) reduces their expenditure for outpatient doctor visits by 25.5% (6.7%) of the standard deviation. The expenditure reduction for the inpatient treatment of men is 20.5% per standard deviation. The decrease in hospital expenditure for women is quantitatively important but statistically insignificant. In contrast, we find retirement to have no significant effects on medication expenditure. On a disaggregated level, we find reductions in outpatient doctor expenditure for general physicians (GPs), ear–nose–throat (ENT) specialists, orthopedists, internists, psychiatrists and psychologists, dentists, and diagnostic service practitioners. The results indicate a positive causal effect of retirement on individual-level health on one hand; on the other, the effects reveal behavioral changes in the utilization of healthcare services. The latter finding is also reinforced by a lower participation rate in basic preventative screening programs among men. Overall, the changes in health behavior seem particularly relevant for blue-collar workers.

Literature The empirical literature on retirement effects on health provides conflicting evidence. Those who find retirement to have a positive effect tend to stress the workplace burden (both physical and mental) that will be eliminated by virtue of retirement. In contrast, negative retirement effects refer to the loss of professional responsibilities, the lack of physical and mental activities after retirement, and the emergence of unhealthy lifestyles, including alcohol abuse. Assessments of the existing evidence are difficult, since the studies rely on different outcomes and identification strategies. This leads one to question the external validity of any one study's results, especially given that pension systems differ widely among countries.

Cross-sectional studies generally find that people who retire early have worse health after retirement. Obviously, these results cannot be interpreted causally, as (many) persons who retire early can be expected to do so for health reasons. The selection into retirement is not adequately addressed in such studies. A growing body of literature addresses selection into retirement by using longitudinal data or quasi-experiments. Most of these studies—many of which are based on subjective health measures—report the positive effects of retirement on health. In their longitudinal study of civil servants in the United Kingdom, Mein *et al.* (2003) find that retiring at the mandatory age of 60 (in comparison to continuing to work) has no effects on self-reported physical health, but is associated with improved mental health—particularly among high-socioeconomic status (SES) groups. Coe and Lindeboom (2008) use an early retirement window offer to instrument for retirement; they find early retirement to have no detrimental health effects on men. The authors report a temporary increase in self-reported health and improvements in health among highly educated workers. The results of the GAZEL cohort study for older workers from the French national gas and electricity company (Westerlund *et al.*, 2003) suggest that retirement brings relief in the burden of self-perceived ill health, in all groups of workers other that those with perfect working conditions.[1]

Studies utilizing Survey on Health, Aging, and Retirement in Europe (SHARE) data assert the positive effects of retirement on self-reported health. For example, Coe and Zamarro (2011) exploit variation in retirement ages in several European countries and find a reduced probability for reporting deterioration in health after retirement. Shai (2015) identifies the retirement decision by leveraging an exogenous increase in Israel's mandatory retirement age for men. The author argues that compulsory employment at older ages impairs self-reported health and that the effects are stronger among lower-SES groups. These findings are supported by data captured through the Israeli Household Expenditure and Health Surveys. In utilizing SHARE data and two other datasets (i.e., the English Longitudinal Study of Ageing [ELSA] and the US Health and Retirement Study [HRS]), Horner (2014) finds retirement to have a large and positive effect on subjective well-being that attenuates over subsequent years in retirement. Two studies that exploit changes in pension regulation in France and the Netherlands also find positive health effects (Blake and Garrouste, 2012) and a reduction in the probability of death (Bloemen *et al.*, 2013). Hallberg *et al.* (2015) analyze a retirement offer to Swedish military officers 55 years of age or older, and they find both a significant reduction in the number of days of inpatient care and lower mortality risk; additionally, that reduction in the number of hospital days is greater for lower-SES groups. The given interpretation is that the effect may be linked to lower stress and less exposure to workplace hazards. Finally, Eibich (2015) uses a regression discontinuity in the financial incentives of the German pension system and also confirms improvements in subjective health status and mental health, as well as a reduction in outpatient care utilization. He argues that relief from work-related stress or that more frequent physical exercise are key mechanisms of the retirement effect.

Among the studies that identify the negative health consequences of retirement, Dave *et al.* (2008) find an increase in difficulties with mobility and daily activities, and in mental illness. Rohwedder and Willis (2010), who exploit changes in retirement policies in the United States and in certain European countries, find that retirement is associated with a deterioration in cognitive abilities. Kuhn *et al.* (2010) exploit an exogenous change in

[1]Using the same database, Vahtera *et al.* (2009) additionally find a decrease in sleep disturbances.

Austrian unemployment rules that allowed workers in eligible regions to withdraw from the workforce up to 3.5 years earlier than their noneligible counterparts. They find that among male workers, earlier job exit increases the probability of dying before the age of 67, by 13%; they find it to have no such effect on female workers. Analysis of the causes of death among men indicates a higher incidence of cardiovascular disorders. In a similar vein, based on the ELSA database, Behncke (2012) finds that retirement increases the risk of cardiovascular disease and cancer, which also reflect in increased risk factors such as body mass index and blood pressure. Hernaes *et al.* (2013) exploit data from a series of changes in retirement policies in Norway. Based on administrative data that cover the Norwegian population, instrumental variable (IV) estimates show that retirement age has no effect on mortality. The study that most closely resembles ours is Hagen (2018), who studies the health consequences of a two-year increase in the normal retirement age of local government workers in Sweden. That study is limited to women working as personal care workers, nursing professionals, cleaners, and restaurant service workers. The results show that the reform had no impact on drug prescriptions, the number of hospital admissions, or on mortality.

The remainder of this paper is organized as follows. Section 2 briefly covers the institutional background of the Austrian pension and healthcare system. In Section 3, we describe our data (3.1), discuss the estimation strategy (3.2), and present descriptive statistics (3.3). Section 4 presents the estimation results. Section 5 includes a discussion of results and concludes this paper.

2 The Austrian pension and healthcare system

The Austrian healthcare system Austria has a Bismarckian-type healthcare system that provides the whole of its population with universal access to medical services. The mandatory health insurance system covers all expenses for medical care in the inpatient and outpatient sector, including those for medication. Health insurance is offered by nine provincial health insurance funds (in German, "Gebietskrankenkassen"), depending on occupation and place of residence. The insurance funds are earmarked for all private-sector employees and their dependents, who represent approximately 75% of the population.[2] Patients pay a prescription charge for medical drugs, and several insurance funds charge a small deductible or copayment. Expenses relating to doctor visits and medication are funded by the wage-related social security contributions of employers and employees. Hospitalization expenditures are cofinanced by social security contributions and general tax revenues from various federal levels. After retirement, insured persons continue to have unlimited access to healthcare services, but retirees do not pay social

[2]The rest of the population is covered by special social insurance institutions that provide farmers, civil servants, and self-employed individuals with health insurance.

security contributions.

The Austrian pension system The public pension system in Austria covers all private-sector workers and provides early retirement pensions,[3] old-age pensions, and disability pensions. Public pensions are by far the most important income source among retirees in Austria. The pension amount depends on the number of insurance months collected during one's working life and the assessment base, which for most individuals in our sample consists of the 15 best annual earnings years.[4] With an average gross pension replacement rate of 76.6%—compared to the total OECD average of 54.4% (in 2012)—Austria has one of the most generous pension systems among the OECD countries. Austria also has one of the lowest average retirement ages: although it has a statutory retirement age of 65 (60) for men (women), the actual retirement age for men (women) in 2012 was only 61.9 (59.4) years (OECD, 2013).[5]

The low level of labor force participation among the elderly can be attributed partly to disincentives provided by the Austrian pension system (Hofer and Koman, 2006). Hanappi (2012) calculates Austria's social security wealth and accrual rates and finds that social security wealth peaks at the age of 63 for men, hence creating strong disincentives for working beyond that age. To smooth the transition into retirement, the Austrian government introduced in the early 2000s old-age part-time schemes for older employees, where the working-time reductions of elderly workers are subsidized. This scheme often results in early retirement (Graf *et al.*, 2011). Finally, employers also play an important role in their workers' retirement decisions. Special severance payments (i.e., "golden handshakes") paid to the workers if they leave the job early are associated with tax advantages for the employer and employee alike. Frimmel *et al.* (2015) show that steeper seniority wage profiles in firms lead to significantly earlier job market exit.

During our sample period of 1998–2012, several reforms took place within the Austrian pension system. More recent reforms (i.e., 2004 or later) did not strongly affect retirees in our sample; nonetheless, given the typically long transition periods, earlier reforms changed the retirement eligibility, early retirement age, and financial incentives of the workers in our sample. In particular, we exploit two pension reforms—namely, those in 2000 and 2003—and use the gradual increase in early retirement age for different birth-quarter cohorts as an exogenous variation in the probability of retirement (for details, see section 3.2).

[3]The most common form of early retirement stems from long periods of insurance. There was an early retirement option for the long-term unemployed (until 2004) and for disabled workers (until May 2000).

[4]In 2003, the system changed to a so-called pension account, where all contributing insurance years become part of the assessment base.

[5]Note that these averages exclude disability pensions. When one takes into account disability pensions, the average retirement age for men (women) would fall to 59.4 (57.4) years.

3 Research design

In this section, we present the data used in the empirical analysis and discuss the estimation strategy by which to identify causal effects. This section also provides descriptive statistics for our variables of interest.

3.1 Data

The empirical analysis is based on several administrative data sources for the province of Upper Austria. All labor market and retirement-related information is drawn from the Austrian Social Security Database (ASSD), which is a matched employee–employer dataset collected to verify pension claims for all Austrian private-sector workers (Zweimüller *et al.*, 2009). It contains detailed information on workers' employment and earnings histories and basic socioeconomic characteristics (e.g., age, broad occupation, experience, and tenure). The ASSD also contains information on the start of the pension, as well as pathways into retirement (i.e., disability pension, early retirement, or regular old-age retirement).

We combine labor market and retirement information with inpatient and outpatient healthcare expenditure data from the Upper Austrian Health Insurance Fund. These register data include detailed information on expenditure for medical attendance in the outpatient sector (for GPs and medical specialists) and for medication within the "Anatomical, Therapeutic, Chemical" (ATC) classification system code.[6] Moreover, outpatient register data include information on participation in preventative health screening examinations. Adults are eligible and recommended to participate in a general health screening program (in German, "Allgemeine Vorsorgeuntersuchung"). The program offers participants a yearly health examination, free of charge. This health examination includes a comprehensive anamnesis and a series of age and gender-specific diagnostic tests. The objectives of the program are the identification of health risks, the early detection of disease, and the provision of helpful information with regards to lifestyle choices. Further, we observe women's participation in gynecological (i.e., pap smear, colposcopy) and mammography screening, and men's participation in prostate-specific antigen (PSA) tests. Inpatient information covers hospital expenditure, the number of hospital days, and admission diagnoses for each individual according to the ICD-10 classification scheme.

We include all male and female private-sector workers born between 1938 and 1957 and observe their healthcare expenditure per quarter in the period between 1998 and 2012.[7] The individuals within our data were required to retire after 1998, and we exclude those individuals with special retirement regulations (i.e., heavy-labor workers, workers with

[6] We do not have data for over-the-counter-medicines such as headache pills.

[7] Outpatient healthcare expenditure figures relating to dentistry are available only since 2002, and disaggregated hospital expenditure figures only since 2005.

more than 45 insurance years, and public-sector workers). We do not exclude individuals retiring due to disability pension, even if this may indicate a health problem. However, as a robustness check, we present results for if we were to exclude those who retire through disability pensions. This leaves us with $1,319,969$ individual-quarter observations for men and $2,073,845$ individual-quarter observations for women; this corresponds to $46,999$ men and $81,916$ women. The panel is unbalanced, given that a certain number of individuals died before the end of the observation period.

3.2 Estimation strategy

To analyze the effect of retirement, we examine a series of important healthcare expenditure variables for the inpatient and outpatient sectors, for male and female workers separately. We estimate the following empirical model:

$$expenditure_{iq} = \beta_0 + \beta_1 retired_{iq} + \beta_2 age_{iq} + \beta_3 age_{iq}^2 + time_q + \mu_i + \epsilon_{iq}, \tag{1}$$

where we explain the healthcare expenditure of individual i in quarter q, depending on a binary indicator of whether the individual is retired in the same quarter (*retired*). We further control for a second-order polynomial of age in months (age, age^2) and add year–quarter fixed effects (*time*) to account for trends or time-related effects in healthcare expenditure or retirement behavior. We do not include further socioeconomic characteristics, since the longitudinal structure of our dataset allows us to estimate individual fixed effects captured by the parameter μ_i. The individual fixed effects control for all time-invariant individual characteristics, such as occupation, industrial sector, educational attainment, ability, general health status, or genetic endowment. However, the fixed effects cannot account for time-varying heterogeneity, which may influence an individual's healthcare expenditure and retirement decision (e.g., unanticipated health shocks). Hence, even when including individual fixed effects, we cannot altogether rule out a remaining correlation between retirement and further time-varying confounding factors of ϵ_{iq}. To account for this potential omitted-variable bias, we suggest an IV approach where we exploit exogenous variation in the decision to retire, deriving from two Austrian pension reforms (i.e., in 2000 and 2003).

Pension reforms To guarantee the fiscal sustainability of the public pension system, the Austrian government implemented two large pension reforms, in 2000 and 2003. One important feature of both reforms is the gradual increase in the eligibility age for early retirement. The first reform, in 2000, increased the early retirement age by 1.5 years. This increase was conducted stepwise for different birth-quarter cohorts—more precisely, men born before October 1940 were still eligible for early retirement at the age of 60, whereas for men born in the fourth quarter of 1940, the eligibility age was increased by two months. For every subsequent birth quarter, the eligibility age was further raised, until the total increase of 1.5 years was reached. The same stepwise increase was applied to women, where women born after September 1945 had a two-month higher eligibility age than women born before. Overall, the 2000 pension reform aimed to increase the eligibility age for early retirement from 60 to 61.5 for men, and from 55 to 56.5 for women. The second reform, in 2003, further increased the eligibility age for early retirement, from 61.5 to 65 years for men and from 56.5 to 60 years for women, via a similar stepwise increase for each birth-quarter cohort. Figure 1 shows the development of the early retirement age over birth quarters, for men and women. One should note that the introduction of the corridor pension at age 62 for men circumvented the gradual increase in early retirement age; hence, their eligibility age was practically capped at age 62. Men (women) with more than 45 (40) insurance years were exempted from the reform.

Further relevant changes on account of the reforms included a stepwise extension of the assessment base, from the best 15 earning years to lifetime earnings; increased penalties for early retirement, from 2% to 4% of the pension per year (capped at 10%); and a temporary extension of the duration of unemployment benefits for certain birth cohorts, from 52 to 78 weeks. Staubli and Zweimüller (2013) and Manoli and Weber (2016) analyze the employment effects of both pension reforms. Staubli and Zweimüller (2013) find that the increase in the early-retirement eligibility age increased employment by 9.75 percentage points for men and 11 percentage points for women. The employment effects were largest for high-wage and healthy workers. While the reforms had generated substantial spillovers on the unemployment insurance program, the effects on the disability insurance were reportedly small (i.e., 1.3 percentage points). Using a regression-kink design and a slightly different sample of more labor market attached workers, Manoli and Weber (2016) find that a one-year increase in the early retirement age increased the average job exit age by 0.4 years. They find there to be no significant spillover effects on the disability insurance.

Instrumental variable To identify the causal effect of retirement on health expenditure, we exploit exogenous variation induced by the two aforementioned pension reforms. Individuals of different birth-quarter cohorts are endowed with different exogenously determined eligibility ages for early retirement. We define a binary IV as equal to 1 if the individual is below the early retirement age in quarter q, conditional on year–quarter fixed effects and a second-order polynomial of age in months. Hence, the first-stage estimation can be written as:

$$retired_{iq} = \gamma_0 + \gamma_1 \mathbf{1}[age_{iq} < era_i] + \gamma_2 age_{iq} + \gamma_3 age_{iq}^2 + time_q + \mu_i + \eta_{iq}, \tag{2}$$

with era_i as an individual's eligibility age for early retirement. Our parameter of interest in the first stage is γ_1, which measures the impact of the individual-specific eligibility age for early retirement (with respect to the individual's birth quarter) on the probability of being retired. In a given quarter q, being younger than the early-retirement eligibility age specific to one's birth-quarter cohort is expected to lower the probability of being retired in quarter q, and so we expect γ_1 to be negative. One should note that γ_1 is identified only by the exogenous variation in the eligibility age for early retirement as generated by the two pension reforms.

Identifying assumptions First, the validity of the instrument requires that the early retirement age has a significant effect on the probability of being retired, so $\gamma_1 \neq 0$. Second, we need to assume that the change in the early retirement age affects healthcare expenditure solely through the changed probability of retirement, and that there is no direct channel of the reform to healthcare expenditure. The exclusion restriction of the instrument requires that the individual-specific early retirement age does not correlate with any confounding factors included in ϵ_{iq}, conditional on covariates and individual fixed effects.

There may be some potential concerns with respect to the instrument's credibility. One objection to the instrument may be that the impact of an exogenous increase in early retirement age on healthcare expenditure not only captures the effect of retirement but also includes age effects or time trends. In response, we add to our estimation model a second-order polynomial of age measured in months and year–quarter fixed effects, to control for these potential age and time effects of the increased early retirement age.

Obviously, retirement is associated with a reduction in earnings, as pension claims are typically lower than earnings. Moreover, the pension reforms increased income penalties for retirement taken prior to the statutory retirement age. Therefore, one should consider that the reforms induce income effects that in turn spill over to the healthcare sector. Although these income effects should be negligible due to the small stepwise increase in the early retirement age, we cannot fully rule them out (Manoli and Weber, 2016). As a robustness check, we additionally include earnings (labor income, or pension payment if already retired) in our model, to control for potential income effects.[8]

3.3 Descriptive statistics

Our sample comprises 46,999 men born between 1940 and 1955, and 81,916 women born between 1945 and 1957.[9] Table 1 summarizes the descriptive statistics for the men (Column (I)) and women (Column (II)) in our sample. In all, 77.3% of men and 73.0% of women retired by the end of our observation period in 2012. The men were more likely to be blue-collar workers, and their monthly average income was almost twice as high that of their female counterparts.

[8]We refrain from including income in our baseline specification, as we consider this variable a potentially bad control.

[9]The large gender-based difference in the number of individuals stems from heavy-labor workers and workers with long insurance times, both of whom were exempt from the pension reforms; both groups typically comprise men.

Further, we observe significant gender-based differences in the utilization of healthcare services. Women had a higher average outpatient healthcare expenditure than men: on average, they spent €114.8 per quarter for doctor visits, compared to €86.5 for men. Similarly, women's per-quarter drug expenditure of €77.3 exceeded that of men (€61.8). For hospitalization, we observe a higher expenditure for men (€221.0) compared to that of women (€181.9). Analysis of disaggregated outpatient expenditure data reveal higher service utilization among women in all medical fields, and a higher consumption of medicines in all subcategories. Men incurred twice as much inpatient expenditure for cardiovascular treatment than women; conversely, hospital expenditure relating to the treatment of musculoskeletal and urogenital diseases were higher for women than for men.

Figures 2 and 3 depict the expenditure for healthcare utilization for men and women, before and after retirement. The graphs bear two particularities. First, inpatient and outpatient expenditure drops significantly in the quarter of retirement; this decline is particularly strong for hospital expenditure for men and women. Cost decreases for outpatient components are less pronounced, but likewise clearly discernible—particularly for men. This pattern can be considered the first descriptive evidence that healthcare expenditure decreases after retirement. Second, we observe a clear upward trend in all expenditure categories in the quarters leading up to retirement. This indicates the selection of unhealthy individuals into retirement; it also validates the IV approach to identifying the causal effects of retirement on health expenditure.

4 Results

This section presents our empirical findings. We provide the first-stage fixed-effect estimation results in Section 4.1, and in Section 4.2 summarize the fixed effects and fixed-effect IV results for aggregated healthcare expenditure. To analyze whether the retirement effects on healthcare expenditure are mainly health or behavior-driven, we present further evidence based on disaggregated expenditure categories and screening participation. Section 4.3 includes graphical representations of estimation results for disaggregated inpatient and outpatient expenditure. The full estimation output is shown in Tables A.1, A.2, and A.3 in the appendix. Heterogeneous treatment effects for blue and white-collar workers and for employees from different industry sectors are provided in Section 4.4. Finally, Section 4.5 includes the results of our robustness checks.

4.1 First-stage estimation results

Table 2 depicts the first-stage results of equation (2). As mentioned, the instrument is equal to 1 if the individual's age in quarter q is below the early retirement age. We find—conditional on covariates and individual fixed effects—a statistically significant negative effect of early retirement eligibility in quarter q on the probability of being retired in the same quarter. The estimated effects differ between men and women: retirement probabilities decrease by 16.6 percentage points for men, and 6.0 percentage points for women. The high F-statistic of the IV indicates that it is sufficiently strong. In line with the findings of Staubli and Zweimüller (2013) and Manoli and Weber (2016), our first-stage results confirm an increase in the job exit age.

4.2 Aggregate healthcare expenditure

Table 3 presents our estimates for quarterly aggregated healthcare expenditure with respect to doctors, medication, and hospitalization, and for hospital days.

Fixed-effect estimation results The first column in each of the four healthcare measures shows the impact of retirement based on the individual fixed-effect estimation. For men, we find significant effects for all outcomes. Doctor expenditure per quarter decreased by €2.8, hospital expenditure decreased by €55.3, and hospital days also decreased slightly (0.06 days); on the other hand, the medication expenditure increased by €5.9. For women, we find similar effects, including a nonsignificant and negative effect on medication expenditure. Overall, the results indicate a positive impact of retirement on health, at least in terms of expenditure. However, it must be noted that these results could still be biased, due to time-varying confounders.

Fixed-effect instrumental variable estimation results The second column for each outcome shows the results of the IV estimation. Compared to the simple fixed-effect estimators, the IV results yield qualitatively similar results. There are, however, quantitative differences, which indicate that unobserved time-varying factors have an impact on healthcare expenditure and the probability of retirement. For men, doctor expenditure per quarter decreased by €11.2, or 6.7% of a standard deviation of this variable. The causal effect of retirement on hospital expenditure increased remarkably to €-328.6, or 20.5% of the standard deviation. This highly significant and large effect is mirrored by the reduction in the length of hospitalization, by 0.4 days per quarter; this is equivalent to 15.2% of a standard deviation. The effect on aggregate medication expenditure is not statistically significant.

Quantitatively, the estimation results for women are similar. Doctor expenditure decreased to an even greater degree—by €50.5—although the impact on medication expenditure remains insignificant. The negative effect on hospital expenditure is large (i.e., €-256.6, or 19.2% of the standard deviation); however, given the high standard error, the coefficient remains insignificant. The same holds true for the negative impact on hospital days. The reduced hospital expenditure and number of hospital days—as well as the negative impact of retirement on expenditure for medical attendance, in both genders—indicate a positive heath effect caused by retirement. However, the decrease in expenditure for healthcare services does not necessarily reflect improvements in health. For example, the reduction in expenditure for doctor visits can simply mean that people see their doctors, irrespective of health status, less frequently once they are retired. Therefore, the decline in expenditure may rather express a change in health behavior, rather than in health status. To separate health from behavioral effects, we provide a more thorough analysis of outcomes on a disaggregated level—that is to say, to examine whether the retirement effects vary by certain diagnoses and medical treatments.

4.3 Disaggregated healthcare expenditure

Medical attendance Figure 4 and Table A.1 in the Web appendix summarize the IV estimates for different doctor expenditure categories. We consider outpatient expenditure for GPs, internists, diagnostic services, psychiatrists and psychologists, orthopedists, dentists, ENT specialists, and a catch-all category for all remaining specialists ("Other"). The figure illustrates that the lower doctor expenditure at the aggregate level stems from decreases in several categories. For men, we find expenditure reductions for GPs (−€ 4.2), diagnostic services (−€ 1.5), psychiatrists and psychologists (−€ 0.9), orthopedists (−€ 1.2), and ENT specialists (−€ 0.9). Given the mean values of the outcome variables, the effects are not only statistically but also quantitatively significant. For women, the negative effects on disaggregated doctor expenditure are even more pronounced, with significant expenditure reductions for GP visits (−€ 5.9), diagnostic services (−€ 4.7), internists (−€ 2.7), orthopedists (−€ 4.7), psychiatrists and psychologists (−€ 3.6), and most surprisingly, dentists (−€ 21.8).

The reduction in revenues for psychiatrists/psychologists and orthopedists may indicate improved mental health among retirees due to lower stress levels and a reduction of joint and back pain as a result of a lack of heavy physical labor. Similarly, the reduction of revenues for ENT specialists and also for outpatient internal medicine suggests improvements in health status after retirement. Interpretations of the expenditure reduction for diagnostic services, GPs, and in particular dentists as a direct health effect are less evident: these expenditure categories include preventative components and may rather reflect behavioral changes in the utilization of healthcare services. Three arguments help explain the negative effect of retirement on healthcare service utilization based on changes in behavior: (i) according to the Grossman model, the disappearance of the investment motive will lead retirees to reduce their health stock and demand for healthcare services after retirement; (ii) retirees can be expected to move their medical treatment forward and take advantage of the opportunity to make medical appointments during working hours; (iii) the reduction of GP expenditure may relate to the fact that retirees no longer need to see their family doctor to acquire employer-requested "sick notes."

Hospitalization Figures 5 and 6 and Table A.2 in the Web appendix show the effect of retirement on hospital days and inpatient expenditure, by various admission diagnoses according to the ICD-10 classification code system. The estimation results support previous findings regarding the positive health effects of retirement. For men, we find a reduction of hospital days and/or inpatient expenditure for the treatment of cardiovascular diseases, stroke, musculoskeletal disorders, and “other” diseases. The effects for women are qualitatively similar but quantitatively smaller. Inpatient expenditure for the treatment of musculoskeletal disorders decreased significantly and the number of hospital days declined (at the 10% level) for the treatment of musculoskeletal and neurological diagnoses.

Medication On an aggregate level, we did not detect significant changes in medication expenditure induced by retirement. This means that either there is no causal effect on drug expenditure, or the effects for different types of drugs cancel out. To test these hypotheses, we estimate the effect of retirement on different drug categories as per the ATC classification code system (i.e., antiinfectives; drugs for cardiovascular diseases, musculoskeletal disorders, respiratory diseases, or ENT diseases; anticancer drugs; psychotropic drugs) and use a catch-all variable for the remaining drug expenditure.

Figure 7 and Table A.3 in the Web appendix summarize the IV estimates for the different drug categories. In line with the estimation results for outpatient psychiatric and orthopedic healthcare services, we find that for men, retirement has significantly negative causal effects on the consumption of psychotropic drugs and medication for musculoskeletal disorders. Both reductions support the aforementioned positive health effects. For women, the estimation results also correspond with those regarding disaggregated expenditure for medical attendance and hospitalization. Retirement reduces the consumption of drugs for musculoskeletal disorders. The negative effect of −€ 3.6 for psychotropic drugs is imprecisely estimated and therefore insignificant.

Overall, our IV estimates for disaggregated expenditure categories clearly indicate that for both genders, retirement has a positive health effect. The decrease in inpatient and outpatient healthcare expenditure for cardiovascular, musculoskeletal, and neurological or psychiatric medical treatment suggests that employees experience physical and emotional relief upon retiring. This interpretation is supported by the reduced consumption of psychotropic and musculoskeletal drugs.

The health effects seem to be accompanied by changes in health behavior after retirement. Lower outpatient doctor expenditure for GPs, diagnostic services, and (for women) dentists may indicate changes in retirees’ health behavior after retirement. For further evidence of behavioral changes, we provide estimation results for participation in medical screening exams. Medical examinations represent preventative healthcare services, and their utilization is informative about health behavior. For men, we estimate participation in a basic screening program (Vorsorgeuntersuchung) and a PSA blood test; for women, we consider participation in basic screening, gynecological screening (colposcopy and pap smear test), and mammography screening. Whereas the impact of retirement on the screening behavior of women remains consistently insignificant, for men, we find significant and negative effects on screening participation (see Table 4). Retirement reduces participation in the basic screening program by 1.3 percentage points and in the PSA test by 1.5 percentage points. The results complement those of a reduction in outpatient expenditure for GP visits and diagnostic services, and they support the hypothesis that—apart from direct health effects—men in particular also change their health behavior after retirement.

4.4 Heterogeneous effects

In this section, we analyze the heterogeneous treatment effects of retirement to identify socioeconomic groups that may be differentially affected by retirement. First, we distinguish blue and white-collar workers, since these occupation groups obviously differ in terms of physical and psychological workload (Table 5). Second, we differentiate in terms of economic sector (Table A.4).

We find substantial differences between male blue and white-collar workers. Doctor expenditure for blue-collar workers decreased by €28.7 per quarter, while the effect for white-collar workers remains insignificant. Similarly, the reduction in hospital expenditure for blue-collar workers (−€448.6) is substantially higher than the reduction for white-collar workers (−€269.6). This also holds true for the expenditure reduction for the inpatient treatment of cardiovascular diseases, and a similar pattern can be observed for GP expenditure. Overall, male blue-collar workers seem to benefit from retirement substantially more than their white-collar counterparts.

For women, we find a reduction in doctor expenditure for both blue and white-collar workers, of €45.5 and €54.5, respectively. Moreover, there was a significant reduction in GP expenditure among female blue-collar workers, whereas the effect for white-collar workers remained insignificant. Interestingly, the observed negative coefficient for dentist expenditure is apparent only for female white-collar workers, which indicates that behavioral changes in the utilization of healthcare services are more prevalent among this group; female blue-collar workers, on the other hand, tend to benefit from a positive health effect. The point estimates for hospital expenditure are negative and quantitatively relevant in both occupational groups; however, given the high standard errors, the effects are statistically insignificant.

We also look at different economic sectors (i.e., the industry or service sector). The regression results are depicted in Table A.4 in the appendix. For male retirees, we find no clear pattern by economic sector. Significant reductions in the inpatient and outpatient expenditure categories can be found in the industry and service sector. For women, the overall observed effects are driven mainly by those employed in the service sector.

4.5 Robustness checks

Our baseline sample consists of individuals who retired by taking an old-age pension or early retirement, or due to disability. Retirement on account of disability depends on the health status of the individual, and it has become common, particularly among male blue-collar workers.[10] To determine whether and to what extent the results are driven by this less-healthy group of workers, we conduct a robustness check where we exclude all individuals who retire with a disability pension.[11] The third and sixth columns of Table A.5 summarize the results for men and women, based on the reduced sample. We find that reductions in healthcare expenditure induced by retirement are only partially driven by the less-healthy group of disability pensioners. For both men and women, the previous estimates remain qualitatively similar, but are somewhat smaller in size.

To determine whether our estimates are influenced by potential income effects generated by the retirement decision or the pension reform, we include income as a covariate and re-estimate our model for aggregate outcomes.[12] The results are shown in the second and fifth columns of Table A.5. Income plays an important role in the retirement decision, but is less relevant to the utilization of healthcare services—something that can be explained by the full coverage of the Austrian healthcare system, independent of individual-level income. In comparing the estimates with our baseline model (first and fourth columns), we see almost identical results. We conclude that our estimates should not be biased on account of any potential income effect.

5 Summary and concluding remarks

In this study, we examine the causal effects of retirement on healthcare expenditure. We identify the causal effect via exogenous variation induced by two pension reforms in Austria, both of which gradually increased the early retirement age for both men and women. We find significant effects of retirement on healthcare expenditure. For both genders, retirement reduces the subsequent expenditure for outpatient medical attendance and hospitalization. The quantitative effects are stronger for women in the outpatient sector and for men in the inpatient sector. The retirement of women (men) reduces their expenditure for outpatient doctor visits by 25.5% (6.7%) of a standard deviation. The decrease in hospital expenditure for men is 20.5% of the standard deviation. The point estimate for women's hospital expenditure is quantitatively important but statistically insignificant. Moreover, on the disaggregated level, we find reductions for men in outpatient doctor

[10] Approximately one-third of male blue-collar workers retire with a disability pension (Frimmel *et al.*, 2015).

[11] Staubli and Zweimüller (2013) show that the spillover effects of an increase in early retirement age on the take-up of disability pensions are small.

[12] Income comprises either labor income, unemployment benefits, or pension payments for retired individuals.

expenditure for GPs, ENT specialists, orthopedists, psychiatrists and psychologists, and diagnostic services. Women's outpatient expenditure decreased for GPs, internists, dentists, orthopedists, psychiatrists and psychologists, and diagnostic services. The results indicate a positive causal effect of retirement on individual-level health. However, the analysis also reveals behavioral changes in the utilization of healthcare services that do not necessarily reflect health status improvement; this argument seems particularly relevant for white-collar workers.

At least three (preliminary) conclusions can be drawn from our analytical results. First, attempts by the Austrian government to increase the (early) retirement age of workers are likely be accompanied by negative health effects. Second, health improvements relating to earlier retirement are most likely due to lower levels of mental and physical stress. Third, it is important to note that retirement has not only an impact on people's health status, but may also change their health behavior. Behavioral changes in the utilization of healthcare services may correlate with the availability of time, shirking at the workplace (i.e., doctor consultations during working hours), and eventually lower incentives for preventative measures after retirement.

From a policy viewpoint, the spillover effects of longer employment on individual-level health status are of particular importance, since health is a key determinant of the employability of older workers. We find evidence for spillover effects from pension reforms and longer employment; however, they are at least partially due to significant changes in health behavior. The latter, however, should not adversely affect employability. Based on our empirical findings, one may conclude that policies that aim to extend the employment of older workers should focus on tasks that are less likely to inflict or exacerbate mental or physical health problems. In other words, an increase in the effective retirement age requires that older workers be fit enough to fulfill their workplace duties and responsibilities.

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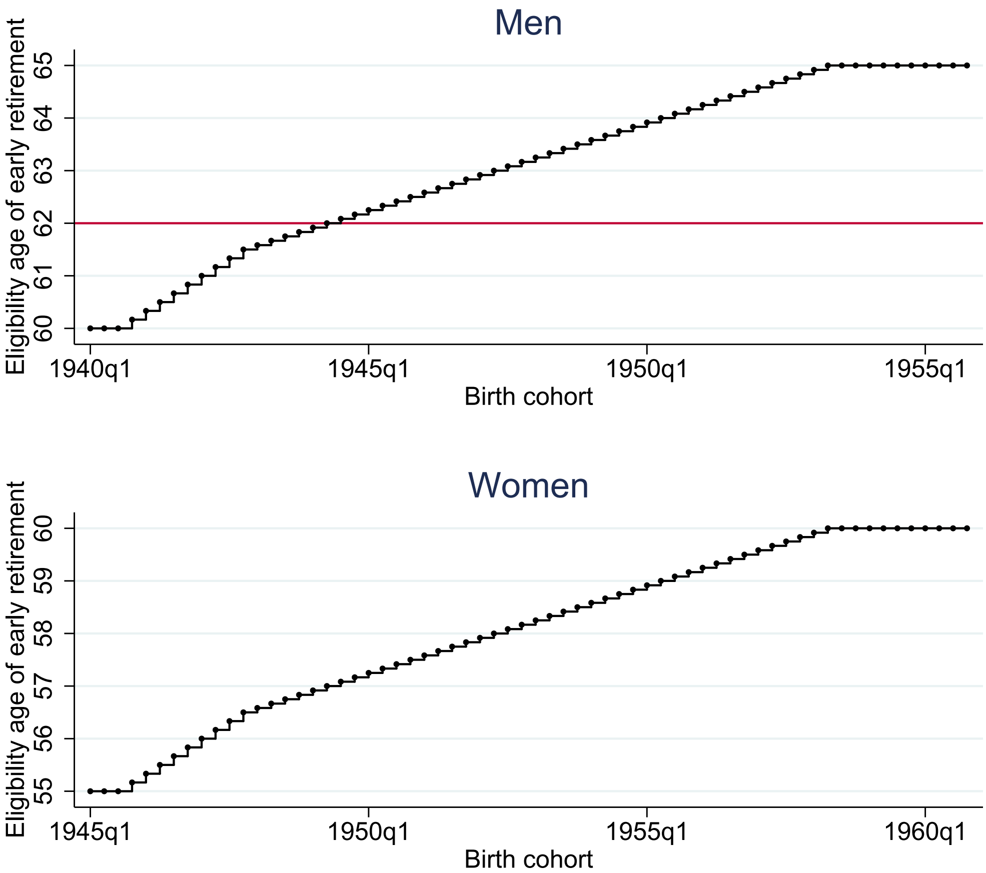
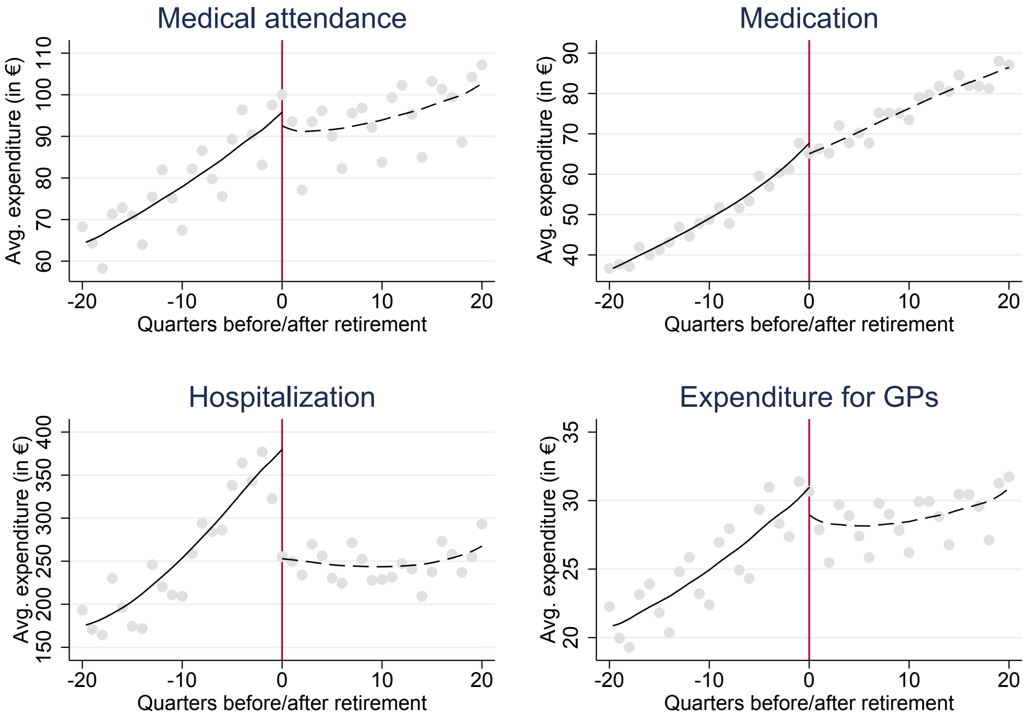
6 Figures and tables

Figure 1: Eligibility age for early retirement over birth-quarter cohorts



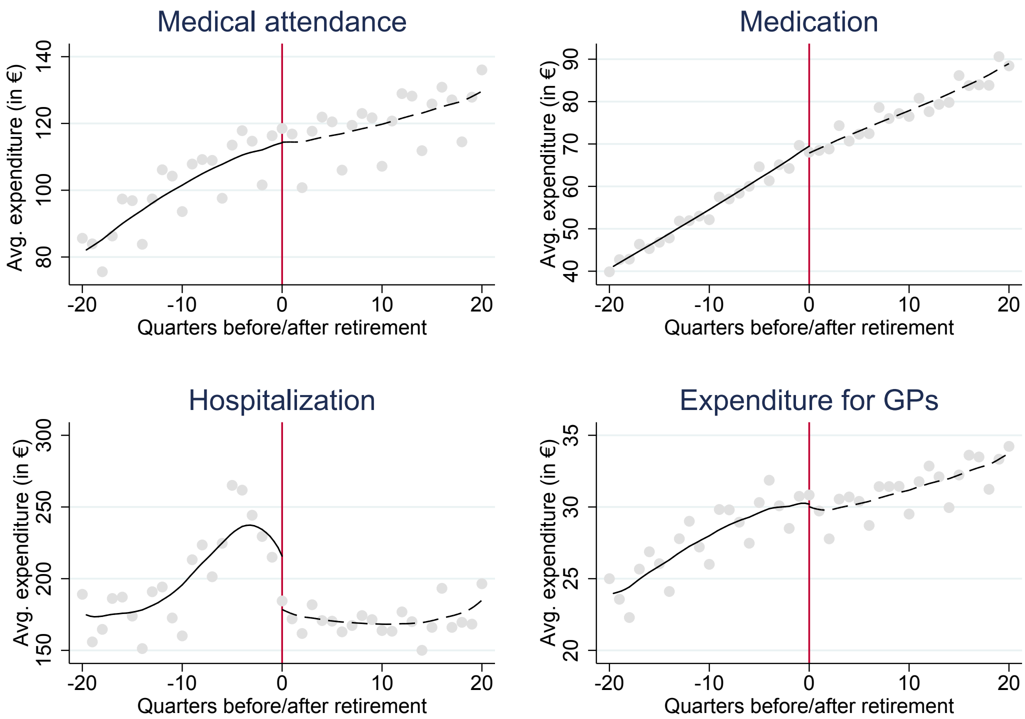
Notes: The figure shows the development of the eligibility age for early retirement over birth-quarter cohorts for men and women, in line with the 2000 and 2003 pension reforms. The corridor pension at age 62 is depicted by the red horizontal line.

Figure 2: Healthcare utilization for men: before/after retirement



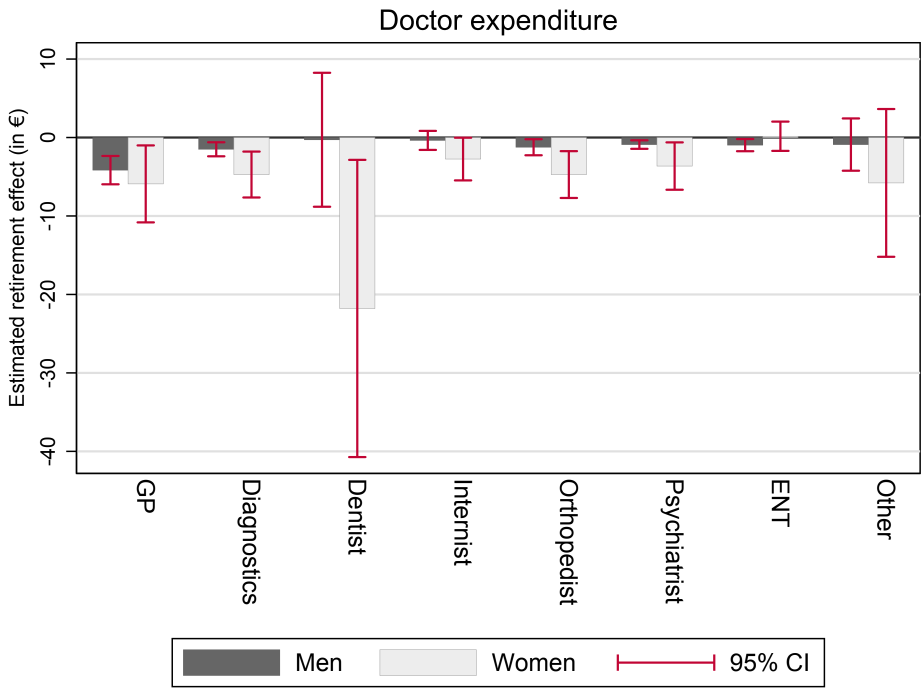
Notes: The figures show the development of various types of healthcare expenditure for men 20 quarters before and after retirement. The figures are based on a sample described in Section 3.1.

Figure 3: Healthcare utilization for women: before/after retirement



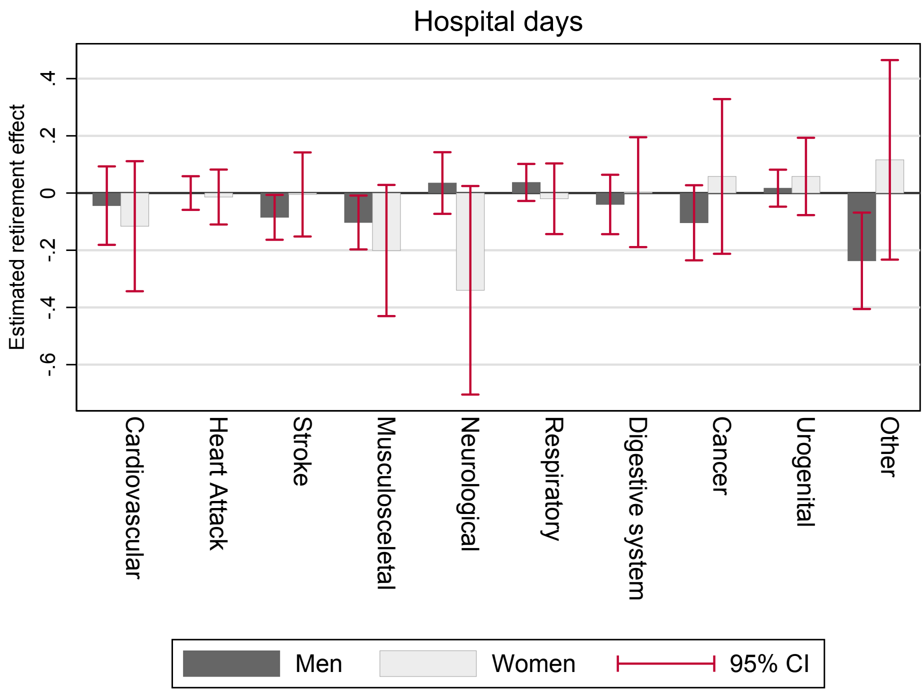
Notes: The figures show the development of various types of healthcare expenditure for women 20 quarters before and after retirement. The figures are based on a sample described in Section 3.1.

Figure 4: Disaggregated outpatient expenditure per quarter: medical attendance



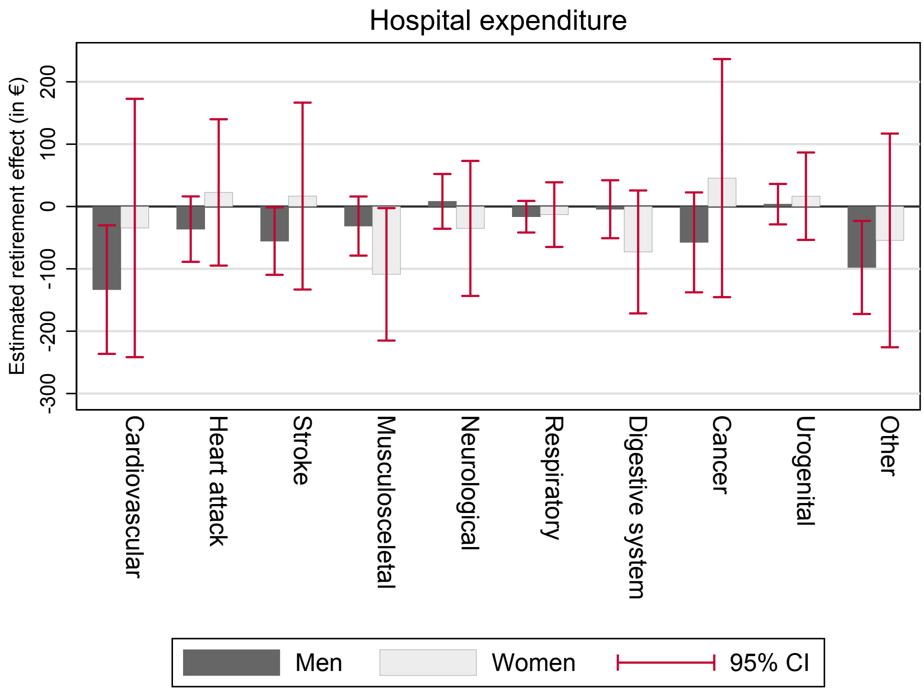
Notes: The figure summarizes retirement effects on expenditure categories of medical attendance, for men and women. The bars represent the coefficients of the standard specification presented in Table A.1 in the Web appendix.

Figure 5: Inpatient sector: hospital days per quarter



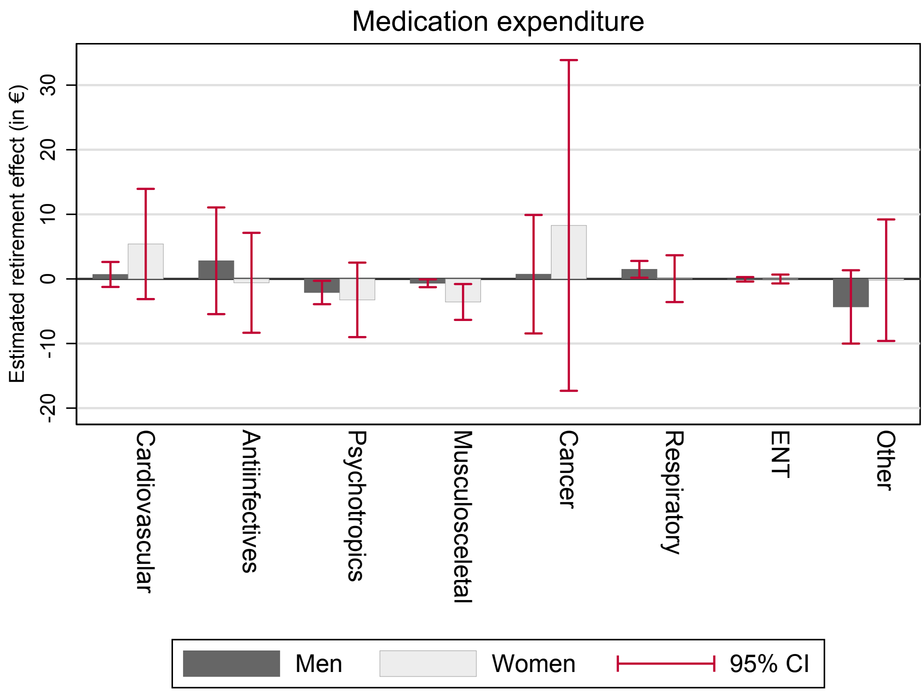
Notes: The figure summarizes retirement effects on hospital days for different types of disease, for men and women. The bars represent the coefficients of the standard specification presented in Table Table A.2 in the Web appendix.

Figure 6: Inpatient sector: disaggregated expenditure per quarter



Notes: The figure summarizes retirement effects on hospital expenditure for different types of disease, for men and women. The bars represent the coefficients of the standard specification presented in Table A.2 in the Web appendix.

Figure 7: Disaggregated outpatient expenditure per quarter: medication



Notes: The figure summarizes retirement effects on several categories of medication expenditure, for men and women. The bars represent the coefficients of the standard specification presented in Table A.3 in the Web appendix.

Table 1: Descriptive statistics

	(I) Men		(II) Women	
Retired until 2012	0.773		0.730	
Early retirement for long-time insured	0.500		0.375	
Disability retirement	0.211		0.078	
Old-age pension	0.025		0.243	
Other retirement	0.036		0.034	
Legal early retirement age	61.68	(0.617)	56.76	(1.336)
Individual characteristics				
Age in years	59.62	(3.02)	58.89	(2.97)
Income per month	2,566.82	(1,064.46)	1,355.24	(840.07)
Blue-collar worker	0.406		0.279	
Work experience (in years)	28.27	(8.272)	19.44	(10.43)
Tenure (in years)	14.233	(11.113)	11.61	(8.66)
Insurance months	457.58	(124.26)	355.73	(144.93)
Aggregated healthcare expenditure				
Medical attendance	86.50	(168.42)	114.76	(197.84)
Medication	61.82	(247.46)	77.29	(292.36)
Hospitalization	221.02	(1,605.44)	181.94	(1,346.70)
Hospital days	0.523	(2.89)	0.487	(2.84)
Disaggregated healthcare expenditure: medical attendance				
GP (general practitioner)	26.19	(39.10)	30.61	(44.70)
Internist	4.88	(25.69)	5.21	(26.28)
Diagnostic services	5.99	(20.27)	11.05	(29.12)
Psychiatrist/psychologist	1.22	(11.36)	2.22	(17.99)
Orthopedist	2.46	(19.97)	3.48	(23.83)
ENT specialist	4.37	(15.69)	5.39	(17.59)
Dentist	21.61	(122.35)	25.19	(139.22)
Other doctor	8.94	(32.58)	13.61	(37.72)
Disaggregated healthcare expenditure: medication (ATC)				
Cardiovascular diseases	14.00	(39.67)	15.01	(101.34)
Antiinfectives	2.25	(79.45)	2.80	(54.83)
Psychotropics	3.71	(34.25)	8.77	(49.80)
Muscular diseases	1.76	(10.44)	4.73	(21.96)
Cancer	4.66	(144.94)	11.79	(219.67)
Respiratory diseases	3.97	(28.60)	4.22	(29.19)
Sensory organ diseases	0.48	(6.49)	0.59	(6.74)
Other drugs	11.81	(74.44)	15.16	(66.92)
Disaggregated healthcare expenditure: hospitalization (ICD)				
Cardiovascular diseases	58.29	(919.02)	25.75	(593.22)
Musculoskeletal diseases	29.69	(438.09)	32.43	(464.11)
Psychological diseases	16.42	(423.95)	17.68	(376.46)
Respiratory diseases	7.79	(236.59)	5.28	(179.88)
Digestive system diseases	21.56	(390.68)	15.91	(367.88)
Cancer	28.68	(648.47)	25.99	(593.31)
Urogenital diseases	9.61	(248.53)	12.20	(260.76)
Other diseases	48.99	(636.58)	46.69	(581.75)
Disaggregated hospital days				
Cardiovascular diseases	0.099	(1.164)	0.058	(0.881)
Musculoskeletal diseases	0.069	(0.879)	0.082	(0.970)
Psychological diseases	0.054	(1.080)	0.070	(1.336)
Respiratory diseases	0.026	(0.571)	0.020	(0.511)
Digestive system diseases	0.055	(0.769)	0.045	(0.754)
Cancer	0.054	(0.979)	0.047	(0.899)
Urogenital diseases	0.026	(0.507)	0.029	(0.518)
Other diseases	0.138	(1.344)	0.135	(1.279)
Screening participation				
Basic screening	0.055		0.056	
Gynecological screening			0.120	
Mammography screening			0.059	
PSA–test	0.104			
No. of observations	1,319,229		1,807,170	
No. of individuals	46,999		81,916	

Notes: Expenditure per quarter and category. Expenditure and income figures are in €. Standard deviations in parentheses.

Table 2: First-stage regression of retirement eligibility age for early retirement

	(I) Men	(II) Women
Eligibility of early retirement	−0.166***	−0.060***
	(0.003)	(0.002)
Quadratic age in months	yes	yes
Calendar time fixed effects	yes	yes
Mean of dep. variable	0.413	0.520
SD of dep. variable	0.492	0.499
F-statistic of IV	4,415.99	759.76
No. of observations	1,312,982	1,802,887

Notes: This table summarizes first-stage fixed-effect estimation results of the effect of eligibility age for early retirement on being retired, for men and women. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors (in parentheses) are clustered at the individual level.

Table 3: Aggregate healthcare outcomes per quarter

	Men				Women			
	FE		FE-IV		FE		FE-IV	
Outpatient sector								
Expenditure: medical attendance	−2.798***	(0.643)	−11.211***	(4.335)	−2.302***	(0.627)	−50.542***	(11.080)
Mean of dependent variable	86.48		86.48		114.77		114.77	
Standard deviation of dep. variable	168.42		168.42		197.84		197.84	
F-statistic of IV			4,415.99				759.76	
No. of observations	1,312,982		1,312,982		1,802,887		1,802,887	
Expenditure: medication	5.864***	(1.375)	2.097	(7.925)	−0.347	(1.393)	0.395	(16.440)
Mean of dependent variable	61.63		61.63		75.97		75.97	
Standard deviation of dep. variable	247.78		247.78		289.56		289.56	
F-statistic of IV			4,408.28				869.87	
No. of observations	1,312,982		1,312,982		1,852,991		1,852,991	
Inpatient sector								
Expenditure: hospitalization	−55.301***	(11.406)	−328.598***	(98.979)	−19.135***	(7.155)	−256.579	(213.444)
Mean of dependent variable	219.76		219.76		177.73		177.73	
Standard deviation of dep. variable	1,605.44		1,605.44		1,333.80		1,333.80	
F-statistic of IV			1,730.04				202.88	
No. of observations	826,645		826,645		1,460,638		1,460,638	
Hospital days	−0.056***	(0.021)	−0.439**	(0.184)	−0.050***	(0.015)	−0.441	(0.398)
Mean of dependent variable	0.52		0.52		0.48		0.48	
Standard deviation of dep. variable	2.89		2.89		2.82		2.82	
F-statistic of IV			1,730.04				202.88	
No. of observations	826,645		826,645		1,460,638		1,460,638	

Notes: This table summarizes estimation results of the effect of being retired on aggregated healthcare expenditure, for men and women. Two estimation methods are used. The first column of each gender reports estimates from a simple fixed-effect estimation, and the second column reports estimates from a fixed-effect IV approach. The latter uses as an IV the gradual increase in early retirement age for different birth-quarter cohorts. Each coefficient is from a separate estimation. All regressions include a quadratic age in months trend and calendar time fixed effects. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors (in parentheses) are clustered at the individual level.

Table 4: Screening participation

	Men		Women	
Basic screening	−0.013***	(0.004)	0.010	(0.011)
Mean of dep. variable	0.05		0.06	
Gynecological screening			0.017	(0.015)
Mean of dep. variable			0.12	
Mammography screening			−0.003	(0.011)
Mean of dep. variable			0.06	
PSA–test	−0.015**	(0.006)		
Mean of dep. variable	0.10			
F-statistic of IV	4,415.99		759.76	
No. of observations	1,312,982		1,802,887	

Notes: This table summarizes estimation results of the effect of being retired on screening participation, for men and women. Each coefficient is from a separate estimation and reports estimates from a fixed-effect IV approach for different outcomes. All regressions include a quadratic age in months trend and calendar time fixed effects. We use as an IV the gradual increase in early retirement age for different birth-quarter cohorts. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors (in parentheses) are clustered at the individual level.

Table 5: Treatment heterogeneity: occupation

	Men		Women	
	Blue-collar	**White-collar**	**Blue-collar**	**White-collar**
Expenditure: medical attendance	−28.680** (11.155)	−4.384 (4.335)	−45.461*** (16.377)	−54.469*** (15.208)
GP	−8.045*** (2.202)	−2.384** (0.962)	−10.544*** (3.681)	−2.831 (3.439)
Dentist	−6.175 (10.397)	2.666 (4.432)	−7.475 (13.361)	−33.385** (14.148)
Diagnostic services	−1.348 (1.083)	−1.515*** (0.477)	−2.903 (2.076)	−5.943*** (2.102)
Psychiatrist/psychologist	−2.089*** (0.690)	−0.496* (0.285)	−4.432** (1.883)	−3.371 (2.255)
Orthopedist	−1.505 (1.288)	−1.051* (0.542)	−1.248 (2.114)	−6.989*** (2.153)
Psychotropics	−3.648 (2.331)	−1.478 (0.939)	−3.689 (3.543)	−2.794 (4.216)
Musculoskeletal disease drugs	−1.298* (0.727)	−0.409 (0.324)	−3.277* (1.902)	−3.843* (1.978)
Screening participation	−0.023** (0.011)	−0.008* (0.004)	0.047*** (0.016)	−0.013 (0.015)
Gynecological screening			0.037* (0.022)	0.005 (0.021)
Mammography screening			−0.016 (0.015)	0.006 (0.015)
PSA–test	−0.040** (0.016)	−0.005 (0.007)		
F-statistic of IV	846.58	3966.42	348.134	407.28
No. of observations	532099	780883	504139	1298748
Expenditure: hospitalization	−448.621** (203.148)	−269.630** (108.595)	−265.521 (181.643)	−248.232 (435.463)
Inpatient cardiovascular diseases	−216.461* (112.488)	−92.546* (55.620)	−85.458 (61.249)	33.660 (231.557)
Inpatient musculoskeletal diseases	9.489 (49.836)	−51.374* (26.483)	−88.177 (60.879)	−135.366 (98.730)
Hospital days	−0.929** (0.384)	−0.198 (0.198)	−0.368 (0.348)	−0.558 (0.805)
F-statistic of IV	447.42	3966.42	195.87	56.25
No. of observations	343044	483601	405462	1055176

Notes: This table summarizes estimation results of the effect of being retired on different outcomes, for men and women and by occupation status. Each coefficient is from a separate estimation and reports estimates from a fixed-effect IV approach for different outcomes. All regressions include a quadratic age in months trend and calendar time fixed effects. We use as an IV the gradual increase in early retirement age for different birth-quarter cohorts. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors (in parentheses) are clustered at the individual level.

Web Appendix

This Web Appendix (not for publication) provides additional material discussed in the manuscript 'Retirement and healthcare utilization' by Wolfgang Frimmel and Gerald J. Pruckner.

Table A.1: Disaggregated expenditure: medical attendance

	Men		Women	
GP	−4.157***	(0.921)	−5.910**	(2.503)
Mean of dependent variable	26.17		30.61	
Diagnostic services	−1.499***	(0.456)	−4.718***	(1.492)
Mean of dependent variable	5.99		11.05	
Dentist	0.287	(4.356)	−21.789**	(9.663)
Mean of dependent variable	21.63		25.20	
Internist	−0.368	(0.619)	−2.745**	(1.388)
Mean of dependent variable	4.88		5.21	
Orthopedist	−1.239**	(0.522)	−4.721***	(1.522)
Mean of dep. variable	2.45		3.48	
Psychiatrist/psychologist	−0.898***	(0.277)	−3.637**	(1.540)
Mean of dependent variable	1.22		2.22	
ENT	−0.969**	(0.396)	0.162	(0.951)
Mean of dependent variable	4.37		5.39	
Other	−0.899	(1.700)	−5.785	(4.804)
Mean of dependent variable	8.94		13.61	
F-statistic of IV	4,415.99		759.76	
No. of observations	1,312,982		1,802,887	

Notes: This table summarizes estimation results of the effect of being retired on disaggregated doctor expenditure, for men and women. Each coefficient is from a separate estimation and reports estimates from a fixed-effect IV approach for different outcomes. All regressions include a quadratic age in months trend and calendar time fixed effects. We use as an IV the gradual increase in early retirement age for different birth-quarter cohorts. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors (in parentheses) are clustered at the individual level.

Table A.2: Disaggregated hospital expenditure and days

	Men		Women	
Cardiovascular diseases				
Expenditure	−133.287**	(52.617)	−34.441	(105.710)
Hospital days	−0.044	(0.070)	−0.116	(0.116)
Heart attack				
Expenditure	−36.254	(26.781)	22.609	(59.889)
Hospital days	−0.000	(0.030)	−0.014	(0.049)
Stroke				
Expenditure	−55.511**	(27.591)	16.739	(76.475)
Hospital days	−0.085**	(0.040)	−0.005	(0.075)
Musculoskeletal diseases				
Expenditure	−31.348	(24.205)	−108.835**	(54.195)
Hospital days	−0.103**	(0.048)	−0.201*	(0.117)
Psychological/Neurological diseases				
Expenditure	8.230	(22.413)	−35.161	(55.254)
Hospital days	0.035	(0.055)	−0.340*	(0.186)
Respiratory diseases				
Expenditure	−16.358	(12.938)	−13.043	(26.470)
Hospital days	0.037	(0.033)	−0.020	(0.063)
Digestive system diseases				
Expenditure	−4.338	(23.713)	−72.861	(50.311)
Hospital days	−0.040	(0.053)	0.003	(0.098)
Cancer				
Expenditure	−57.529	(40.886)	45.582	(97.433)
Hospital days	−0.104	(0.067)	0.058	(0.138)
Urogenital diseases				
Expenditure	3.777	(16.553)	16.567	(35.777)
Hospital days	0.017	(0.033)	0.058	(0.069)
Other diseases				
Expenditure	−97.745**	(38.100)	−54.387	(87.439)
Hospital days	−0.237***	(0.086)	0.116	(0.178)
F-statistic of IV	1,730.04		202.88	
No. of observations	826,645		1,460,638	

Notes: This table summarizes estimation results of the effect of being retired on disaggregated hospital expenditure and hospital days, for men and women. Each coefficient is from a separate estimation and reports estimates from a fixed-effect IV for different outcomes. All regressions include a quadratic age in months trend and calendar time fixed effects. We use as an IV the gradual increase in early retirement age for different birth-quarter cohorts. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors (in parentheses) are clustered at the individual level.

Table A.3: Disaggregated expenditure: medication

	Men		Women	
Cardiovascular diseases	0.692	(0.986)	5.409	(4.354)
Mean of dependent variable	13.96		14.77	
Antiinfectives	2.808	(4.214)	−0.602	(3.946)
Mean of dependent variable	2.27		2.75	
Psychotropics	−2.103**	(0.923)	−3.245	(2.942)
Mean of dependent variable	3.70		8.60	
Musculoskeletal diseases	−0.673**	(0.309)	−3.568**	(1.415)
Mean of dependent variable	1.75		4.65	
Cancer	0.731	(4.679)	8.279	(13.061)
Mean of dependent variable	4.65		11.56	
Respiratory diseases	1.485**	(0.663)	0.040	(1.848)
Mean of dependent variable	3.94		4.14	
ENT diseases	−0.062	(0.178)	−0.014	(0.350)
Mean of dependent variable	0.48		0.58	
Other medical drugs	−4.335	(2.896)	−0.199	(4.799)
Mean of dependent variable	11.75		14.93	
F-statistic of IV	4,408.28		869.87	
No. of observations	1,311,274		1,850,427	

Notes: This table summarizes estimation results of the effect of being retired on disaggregated medication expenditure, for men and women. Each coefficient is from a separate estimation and reports estimates from a fixed-effect IV approach for different outcomes. All regressions include a quadratic age in months trend and calendar time fixed effects. We use as an IV the gradual increase in early retirement age for different birth-quarter cohorts. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors (in parentheses) are clustered at the individual level.

Table A.4: Treatment heterogeneity: economic sectors

	Men			Women	
	Industrial	**Construction**	**Service**	**Industrial**	**Service**
Expenditure: medical attendance	−19.075***	−50.118***	−5.235	21.477	−56.667***
	(6.759)	(15.837)	(5.665)	(19.729)	(11.591)
GP	−4.280***	−10.059***	−4.585***	−4.435	−6.038**
	(1.343)	(3.052)	(1.220)	(4.657)	(2.605)
Dentist	1.519	−8.000	−2.013	27.698	−26.670***
	(6.837)	(15.556)	(5.840)	(16.952)	(9.291)
Diagnostic services	−1.703**	−3.860**	−1.404**	0.593	−4.485***
	(0.710)	(1.679)	(0.601)	(2.691)	(1.544)
Psychiatrist/psychologist	−1.480***	−1.941*	−0.670*	−0.174	−4.479***
	(0.415)	(1.004)	(0.365)	(2.438)	(1.588)
Orthopedist	−1.648**	−1.103	−0.581	−3.198	−1.627
	(0.829)	(2.050)	(0.656)	(2.724)	(1.505)
Psychotropics	−2.313*	−0.839	−0.861	1.962	−6.196**
	(1.403)	(3.529)	(1.164)	(4.091)	(2.530)
Musculoskeletal disease drugs	−0.490	−1.035	−0.793**	1.179	−2.270
	(0.514)	(1.651)	(0.367)	(2.957)	(1.437)
Screening participation	−0.015**	−0.035**	−0.008	0.012	0.014
	(0.007)	(0.016)	(0.006)	(0.020)	(0.012)
Gynecological screening				0.017	0.017
				(0.028)	(0.016)
Mammography screening				0.007	−0.003
				(0.020)	(0.011)
PSA–Test	−0.029***	−0.047**	−0.006		
	(0.010)	(0.024)	(0.008)		
F-statistic of IV	1947.33	340.53	2416.11	200.471	657.78
No. of observations	669043	172061	554144	272654	998269
Expenditure: hospitalization	−303.194**	−620.196	−378.572***	−513.784*	−119.279
	(150.031)	(386.076)	(138.315)	(311.966)	(148.284)
Inpatient cardiovascular diseases	1.648	−329.553	−245.491***	−221.897*	−42.558
	(86.332)	(230.841)	(68.087)	(113.255)	(56.744)
Inpatient musculoskeletal diseases	−18.099	10.886	−50.604	−5.811	−94.534**
	(37.525)	(77.067)	(31.372)	(104.807)	(43.365)
Hospital days	−0.422*	−0.457	−0.591**	−0.878	−0.055
	(0.256)	(0.663)	(0.270)	(0.692)	(0.286)
F-statistic of IV	752.16	138.54	910.91	54.15	285.40
No. of observations	407981	102657	357901	217490	806995

Notes: This table summarizes estimation results of the effect of being retired on different outcomes, for men and women and by occupation status. Each coefficient is from a separate estimation and reports estimates from a fixed-effect IV approach for different outcomes. All regressions include a quadratic age in months trend and calendar time fixed effects. We use as an IV the gradual increase in early retirement age for different birth-quarter cohorts. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors (in parentheses) are clustered at the individual level.

Table A.5: Aggregate healthcare expenditure: robustness checks

	Men			Women		
	Baseline	**include income**	**w/o disabled**	**Baseline**	**include income**	**w/o disabled**
Expenditure: medical attendance	−11.211***	−12.021**	−6.143*	−50.542***	−59.892***	−48.973***
	(4.335)	(5.646)	(3.390)	(11.080)	(12.985)	(11.354)
Expenditure: medication	2.097	2.629	4.017	0.395	1.285	2.571
	(7.925)	(10.521)	(5.462)	(16.440)	(18.450)	(15.441)
F-statistic of IV	4408.28	2976.08	6440.05	869.87	284.24	695.55
No. of observations	1312982	1275509	1035981	1852991	1531198	1662172
Expenditure: hospitalization	−328.598***	−351.859***	−207.863***	−256.579	−384.140	−158.095
	(98.979)	(130.214)	(74.904)	(213.444)	(248.667)	(229.594)
Hospital days	−0.439**	−0.437*	−0.258*	−0.441	−0.457	−0.215
	(0.184)	(0.239)	(0.144)	(0.398)	(0.500)	(0.417)
F-statistic of IV	1730.04	1200.73	2284.23	202.88	114.64	144.25
No. of observations	826645	795683	668138	1460638	1231348	1342916

Notes: This table summarizes estimation results of the effect of being retired on different outcomes, for men and women and for different samples. The baseline estimates summarize the results for the full sample, the second column includes quarterly income as an additional covariate, and the third column excludes all individuals who retired through a disability pension. Income could not be calculated for every individual, due to data unavailability. Each coefficient is from a separate estimation and reports estimates from a fixed-effect IV procedure for a different outcome. All regressions include a quadratic age in months trend and calendar time fixed effects. We use as an IV the gradual increase in early retirement age for different birth-quarter cohorts. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors (in parentheses) are clustered at the individual level.