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## Retirement and healthcare utilization

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# Retirement and healthcare utilization<sup>†</sup>

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## Abstract

Pension systems and their reforms are often discussed in the context of financial viability. These debates grow in intensity with the aging of the population in industrialized countries. However, an increase in retirement age may create unintended side effects for retirees' health or healthcare costs. This paper 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 combined with detailed information about individual inpatient and outpatient healthcare service utilization for the province of Upper Austria. To account for the endogeneity in retirement decisions, we exploit exogenous variation in the early retirement age induced by two Austrian pension reforms in 2000 and 2003. We find significant negative effects of retirement on healthcare expenditure. For both sexes, retirement decreases 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 after retirement. Apart from direct health effects, the results also reveal behavioral changes in the utilization of healthcare services. These changes in health behavior seem in particular relevant for blue collar workers.

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*Keywords:* retirement, healthcare expenditure, health behavior, instrumental variable

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# 1 Introduction

A lot of OECD countries have introduced reforms to encourage or enforce people to work for longer periods of their lifetimes. 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 to keep elderly workers active in the labor market for a longer period may be accompanied by adverse social and economic effects for individuals. For example, an increase in retirement age can create unintended side effects for retirees' health or healthcare costs. From a policy perspective, it is important to analyze and quantify these spillover effects from longer employment to health and healthcare utilization, because if these effects are quantitatively important, they may question the employability of older workers. Hence, understanding these spillover effects is relevant for the effective design of policies to keep elderly workers employed. By ignoring them, retirement policies might be prone to fail.

Most of the literature on 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 paper, we study retirement effects on inpatient and outpatient healthcare expenditure using administrative register data. An advantage of 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. Causal empirical evidence would allow the health insurance funds an informed assessment of future healthcare costs triggered by (early) retirement reforms. Second, healthcare expenditure serve as a proxy for the individual health status. However, different expenditure categories reflect individual health to different extents. For example, the utilization of certain healthcare services such as routine dental visits or other medical check-ups have a clear preventive character. Health-conscious people can be expected to utilize such services more often than less health-conscious patients. As a consequence, higher healthcare expenditure may not necessarily indicate a worse health status, but also reflect more risk-averse behavior of patients and/or physicians. Even if it is difficult to unequivocally distinguish health effects from behavioral effects, the level of detail in our register data allows indication whether different components of expenditure reflect the utilization of curative (to improve poor health) or preventive (to maintain good health) services. As such, we interpret the number and length of hospital stays and the consumption of medical drugs as better indicators of individual health status rather than expenditure on medical attendance in the outpatient sector. In our empirical analysis, we try to identify retirement effects for these different expenditure categories.

To empirically analyze the effect of (early) retirement on individual inpatient and outpatient healthcare expenditure, we use labor market and retirement data from a compre-

hensive matched employee-employer dataset and combine this information with detailed individual health register data for the province of Upper Austria. To account for the endogeneity of retirement decisions, we exploit exogenous variation in the early retirement age induced by two Austrian pension reforms in 2000 and 2003. In these reforms, the eligibility age of early retirement was gradually increased from 60 to 65 for men and 55 to 60 for women, respectively.

We find significant effects of retirement on healthcare expenditure. For both sexes, retirement decreases subsequent expenditure for outpatient medical attendance and hospitalization. Retirement of women (men) reduces their expenditure for outpatient doctor visits by 25.5% (6.7%) of the standard deviation. The reduction of expenditure for 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 do not find significant effects of retirement on expenditure for medication. On a disaggregated level, we find reductions in outpatient doctor expenditure for GPs, ENT (ear-nose-throat) specialists, orthopedists, internists, psychiatrists, dentists, and diagnostic services. The results indicate a positive causal effect of retirement on individual health on the one hand and, on the other, the effects reveal behavioral changes in the utilization of healthcare services. The latter finding is also reinforced by a lower participation in basic preventative screening programs of males. Overall, the changes in health behavior seem in particular relevant for blue collar workers.

*Literature* The available empirical literature on retirement effects on health provides conflicting evidence. Those who find a positive impact of retirement stress the workplace burden in physical and mental terms that will be eliminated by retirement. In contrast, negative retirement effects refer to the loss of professional responsibilities, the lack of physical and mental activities after retirement, and unhealthy lifestyles including alcohol abuse. A judgement of the existing evidence is difficult since the studies rely on different outcomes and identification strategies. This questions external validity of single results together with the fact that pension systems in different countries vary widely.

Cross sectional studies find in general that people who retire early have worse health after retirement. Obviously, these results cannot be interpreted causally since (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, and the results cannot be interpreted causally. There is a growing literature addressing the selection into retirement by using longitudinal data or quasi-experiments. Most of these studies – often based on subjective health measures – report positive effects of retirement on health. In their longitudinal study of civil servants in the UK, Mein *et al.* (2003) find that retiring at the mandatory age of 60 (as compared to continuing working) had no effects on self-reported physical health, but was associated with improved mental health, in particular among high socio-economic status (SES) groups. Coe and Lindeboom (2008) use an early retirement

window offer to instrument for retirement and do not find detrimental health effects for men due to early retirement. The authors report a temporary increase in self-reported health and improvements in health of highly educated workers. The GAZEL cohort study for older workers from the French national gas and electricity company (Westerlund *et al.*, 2003) suggests a relief in the burden of self-perceived ill health by retirement in all groups of workers apart of the ones with perfect working conditions.<sup>1</sup>

Studies utilizing SHARE (Survey on Health, Aging, and Retirement in Europe) data support 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 an exogenous increase in the mandatory retirement age for men in Israel. 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 from the Israeli Household Expenditure and Health Surveys. In utilizing SHARE data and two other datasets for the UK (English Longitudinal Study of Ageing, ELSA) and the U.S. (Health and Retirement Study, HRS), Horner (2014) finds a large positive effect of retirement on subjective well-being which fades out 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 find a significant reduction in days of inpatient care and a lower mortality risk. The reduction in days of hospitalization is greater for lower SES groups. The given interpretation is that the effect may be linked to less stress and less exposure to workplace hazards. Finally, Eibich (2015) uses a regression discontinuity in 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 more frequent physical exercise are key mechanisms of the retirement effect.

Among the papers that identify negative health consequences of retirement, Dave *et al.* (2008) find an increase in difficulties in mobility, daily activities and mental illness. Rohwedder and Willis (2010) who exploit changes in retirement policies in the U.S. and in European countries, find that retirement is associated with a deterioration in cognitive abilities. Kuhn *et al.* (2010) exploit an exogenous change in Austrian unemployment rules that allowed workers in eligible regions to withdraw from the workforce up to 3.5 years earlier as compared to their counterparts in non-eligible areas, and find that earlier job exit increases the probability of dying before the age of 67 by 13 percent for males and no effect on females. The analysis of causes of death for men indicates a higher incidence of cardiovascular disorders. In a similar vein, based on the UK ELSA database, Behncke

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<sup>1</sup>Using the same database, Vahtera *et al.* (2009) find in addition a decrease in sleep disturbances.

(2012) finds that retirement increases the risk of cardiovascular disease and cancer which is also reflected in increased risk factors such as body mass index (BMI) 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 population of Norway, IV estimates show no effect of retirement age on mortality. The paper which comes closest to our contribution is Hagen (2018). The author studies the health consequences of a 2-year increase in the normal retirement age for local government workers in Sweden. The study is limited to women working as personal care-related 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, nor on mortality.

The remainder of the paper is as follows. Section 2 covers briefly 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 show descriptive statistics (3.3). Section 4 presents the estimation results. Section 5 includes a discussion of results and concludes.

## 2 The Austrian pension and healthcare system

*The Austrian healthcare system* Austria represents a Bismarckian-type healthcare system providing universal access to medical services for the whole population. The mandatory health insurance 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 responsible for all private sector employees and their dependents and represent approximately 75% of the population.<sup>2</sup> Patients pay a prescription charge for medical drugs, and several insurance funds charge a small deductible or copayment. The expenses for doctor visits and medication are funded by wage-related social security contributions of employers and employees. The expenditure for hospitalization are co-financed by social security contributions and general tax revenues from different federal levels. After retirement, insured persons still have unlimited access to healthcare services. However, retirees do not pay social security contributions any longer.

*The Austrian pension system* The public pension system in Austria covers all private sector workers and provides early retirement pensions<sup>3</sup>, old-age pensions and disability pensions. Public pensions are by far the most important income source of retirees in Austria. The amount of the pension depends on the number of insurance months collected

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<sup>2</sup>The rest of the population is covered by special social insurance institutions providing health insurance for farmers, civil servants, and self-employed people.

<sup>3</sup>The most common form of early retirement is due to long periods of insurance. There was an early retirement option for the long-term unemployed until 2004 and for disabled workers until May 2000.

during working life and the assessment base, which consists of the 15 best annual earnings years for most individuals in our sample.<sup>4</sup> With an average gross pension replacement rate of 76.6 percent, as compared to the total OECD average of 54.4 percent (in 2012), Austria has one of the most generous pension systems among the OECD countries. At the same time, Austria is among the countries with the lowest average age of retirement. With a statutory retirement age of 65 (60) for men (women), the actual retirement age for men (women) in 2012 is only 61.9 (59.4) years (OECD, 2013).<sup>5</sup>

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

During our sample period 1998 to 2012, several reforms of the Austrian pension system took place. While the more recent reforms (2004 or later) do not strongly affect retirees in our sample given the typically long transition periods, earlier reforms changed retirement eligibility, early retirement age and financial incentives for workers in our sample. In particular, we exploit two pension reforms in 2000 and 2003 and use the gradual increase of early retirement age for different quarters of birth cohorts as an exogenous variation in the probability of retirement (for details, see section 3.2).

### 3 Research design

In this section, we present the data to be used in the empirical analysis and discuss the estimation strategy to identify a causal effect. The section also provides descriptive statistics for our variables of interest.

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<sup>4</sup>In 2003, the system has been changed to a so-called pension account where all contributing insurance years are part of the assessment base.

<sup>5</sup>Note that these averages exclude disability pensions. Taking disability pensions into account, the average retirement age for men would even fall to 59.4 years (women: 57.4 years).

### 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 gathered from the Austrian Social Security Database (ASSD). It is a matched employee-employer dataset collected to verify pension claims for all Austrian workers in the private sector (Zweimüller *et al.*, 2009) and contains detailed information on workers’ employment and earnings histories and basic socio-economic characteristics such as age, broad occupation, experience or tenure. The ASSD also records information on the start of the pension and pathways into retirement, i.e. disability pension, early retirement or regular old-age retirement.

We combine the 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 medication including the ATC (“Anatomical, Therapeutic, Chemical”) classification system code.<sup>6</sup> Moreover, outpatient register data include 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 check free of charge. The health check includes a comprehensive anamnesis and a series of age- and sex specific diagnostic tests. Objectives of the program are the identification of health risks, early detection of diseases, and the provision of helpful information on lifestyle choices. Further, we observe participation of females in gynecological (pap smear, colposcopy) and mammography screening, and for men their participation in PSA (prostate-specific antigen) tests. Inpatient information covers hospital expenditure, the number of days in hospitalization, 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<sup>7</sup>. Individuals are required to retire after 1998, and we exclude individuals who have special retirement regulations, i.e. heavy labor workers, workers with 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 if we 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, respectively. The panel is unbalanced given that a certain number of individuals died before the end of the observation period.

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<sup>6</sup>We do not have data for over-the-counter-medicines such as headache pills.

<sup>7</sup>Outpatient healthcare expenditures for dentists are only available since 2002, and disaggregated hospital expenditures since 2005.



### 3.2 Estimation strategy

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

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

where we explain healthcare expenditure of individual  $i$  in quarter  $q$  depending on a binary indicator 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 socio-economic characteristics, since the longitudinal structure of our dataset allows us to estimate individual fixed effects captured by the parameter  $\mu_i$ . 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 individual's healthcare expenditure and the retirement decision, e.g. unanticipated health shocks. So even including individual fixed effects, we cannot perfectly rule out a remaining correlation between retirement and further time-varying confounding factors of  $\epsilon_{iq}$ . In order to account for this potential omitted variable bias, we suggest an IV approach where we exploit exogenous variation in the decision to retire from two Austrian pension reforms in 2000 and 2003.

*Pension reforms* To guarantee 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 was 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 step-wise for different quarters of birth cohorts. More precisely, men born before October 1940 were still eligible for early retirement at age of 60, whereas for men born in the fourth quarter of 1940 the eligibility age was increased by 2 months. For every subsequent birth quarter, the eligibility age was further raised until the total increase of 1.5 years was reached. The same rule applied for women, where women born after September 1945 had a 2 months higher eligibility age than women born before. Overall, the 2000 pension reform aimed at increasing 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 increased the eligibility age for early retirement further from 61.5 to 65 for men and from 56.5 to 60 years for women by a similar step-wise increase for each quarter of a birth cohort. Figure 1 shows the development of early retirement age over birth quarters for men and women. It must be noticed that the introduction of the corridor pension at age 62 for men circumvented the gradual increase in early retirement age. Hence their

eligibility age is practically capped at age 62. Men (women) with more than 45 (40) insurance years were exempted from the reform.

Further relevant changes of the reforms were the step-wise extension of the assessment base from the best 15 earning years to lifetime earnings, increased penalties for early retirement from 2 to 4 percent of the pension per year (capped at 10%) and also 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) analyzed the employment effects of both pension reforms. Staubli and Zweimüller (2013) found that the increase in the eligibility age for early retirement raised 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. Whereas the reforms had generated substantial spillovers on the unemployment insurance program, the effects on the disability insurance were reported to be small (+1.3 percentage points). Using a regression-kink design and a slightly different sample of more labor market attached workers, Manoli and Weber (2016) found that a one year increase in the early retirement age increased average job exiting age by 0.4 years. They did not find 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 pension reforms described above. Individuals of different birth quarter cohorts are endowed with a different exogenously determined eligibility age of early retirement. We define a binary instrumental variable equal to 1 if the individual is below the early retirement age in quarter  $q$ , conditional on quarter-year fixed effects and a second-order polynomial of age in months. Hence, the first-stage estimation can be written as

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

with  $era_i$  as an individual's eligibility age for early retirement. Our parameter of interest in the first-stage is  $\gamma_1$  which measures the impact of the individual-specific eligibility age of early retirement (with respect to the birth quarter of an individual) on the probability of being retired. In a given quarter  $q$ , being below the birth-cohort specific eligibility age of early retirement is expected to lower the probability of being retired in quarter  $q$ , so we expect  $\gamma_1$  to be negative. It should be noted that  $\gamma_1$  is identified only by the exogenous variation in the eligibility age of early retirement generated by the two pension reforms.

*Identifying assumptions* First, the validity of the instrument requires a significant effect of the early retirement age 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 through the changed probability of retirement only, and there is no direct channel of the reform on healthcare expenditure. The exclusion restriction of the instrument requires the

individual-specific early retirement age to be uncorrelated with any confounding factors included in  $\epsilon_{iq}$ , conditional on covariates and individual fixed-effects.

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

Obviously, retirement is associated with a reduction in earnings, because pension claims are typically lower than earnings. Moreover, the pension reforms raised income penalties for retirement before the statutory retirement age. Therefore, one may be worried that the reforms induce income effects which may spill-over to the healthcare sector. Although these income effects should be negligible due to the small step-wise increase of the early retirement age, we cannot fully rule them out (Manoli and Weber, 2016). In a robustness check, we additionally include earnings (labor income or pension payment if already retired) into our model to control for potential income effects.<sup>8</sup>

### 3.3 Descriptive statistics

Our sample comprises of 46,999 men born between 1940 and 1955 and 81,916 women born between 1945 and 1957.<sup>9</sup> Table 1 summarizes the descriptives for men (Column (I)) and women (Column (II)). 77.3 percent of men and 73.0 percent of women retire until the end of our observation period in 2012. Men are more likely blue-collar workers, and their monthly average income is almost twice as high than those of women.

Further, we observe significant differences in the utilization of healthcare services between men and women. Women have higher average outpatient healthcare expenditure than men. On average, they spend €114.8 per quarter for doctor visits as compared to €86.5 for men. Similarly, drug expenditure of €77.3 per quarter for females outweigh men's expenditure of €61.8. For hospitalization, we observe higher expenditure for men (€221.0 versus €181.9). Disaggregated outpatient expenditure reveal higher service utilization for females in all medical fields and a higher consumption of medicines in all subcategories. Men cause twice as many inpatient expenditure for cardiovascular treatment than women. Conversely, hospital expenditure for treatment of musculoskeletal and urogenital diseases are higher for women than for men.

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<sup>8</sup>We refrain from including income into our baseline specification, as we consider this variable as a potential bad control.

<sup>9</sup>The evident gender difference in the number of individuals is due to heavy-labor workers and workers with long insurance times who are exempted from the pension reform. Both groups are typically found in men.

Figures ?? and 3 depict the expenditure for healthcare utilization for men and women before and after retirement. The graphs notice two particularities. First, inpatient and outpatient expenditure drop significantly in the quarter of retirement. This decline is particularly strong for hospital expenditure in men and women. Cost decreases for outpatient components are less pronounced but also clearly recognizable, in particular for men. This pattern can be considered as first descriptive evidence that healthcare expenditure decrease after retirement. Second, we observe a clear upward trend in all expenditure categories in the quarters before retirement. This indicates the selection of unhealthy individuals into retirement and justifies the instrumental variable approach to identify causal effects of retirement on health expenditure.

## 4 Results

This section presents our empirical findings. We provide the first stage fixed effects estimation results in Section 4.1 and summarize fixed effects and fixed effects IV results for aggregated healthcare expenditure in Section 4.2. 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 the 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-collar and white-collar workers and for employees from different industry sectors are provided in Section 4.4. Finally, Section 4.5 includes robustness checks.

### 4.1 First stage estimation results

Table 2 depicts the first-stage results of equation (2). As was pointed out before, the instrument is equal to one 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 instrumental variable indicates that it is sufficiently strong. In line with the findings by 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 for doctors, medication, hospitalization, and for hospital days.

*Fixed effects estimation results* The first columns in each of the four healthcare measures show the impact of retirement based on the individual fixed effect estimation. For men, we find significant effects for all outcomes. Doctor expenditure per quarter decrease by €2.8, hospital expenditure decrease by €55.3, and hospital days also decrease slightly (0.06 days) whereas medication expenditure increase by €5.9. For females, we find similar effects including a non-significant and negative effect on expenditure for medical drugs. 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 effects instrumental variable estimation results* The second columns for each outcome show the results of the instrumental variable estimation. As compared to simple fixed effects estimators, the IV results yield qualitatively similar results. There are, however, quantitative differences, indicating that unobserved time-varying factors have an impact on healthcare expenditure and the probability of retirement. For men, doctor expenditure per quarter decrease by €11.2, which is 6.7 percent of a standard deviation of this variable. The causal effect of retirement on hospital expenditure has remarkably increased to €-328.6, which is 20.5 percent 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 which is equivalent to 15.2 percent of a standard deviation. The effect on aggregate medication expenditure is not statistically significant.

The estimation results for women are similar in quantitative terms. Doctor expenditure decrease even stronger by €50.5 whereas the impact on medication expenditure is still insignificant. The negative effect on hospital expenditure is large (€-256.6 or 19.2 percent of the standard deviation), however, given the high standard error, the coefficient remains insignificant. The same holds true for the negative impact on days of hospitalization. The reduction of hospital expenditure and days of hospitalization and the negative impact of retirement on expenditure for medical attendance in both sexes indicate a positive health effect caused by retirement. However, the decrease in expenditure for healthcare services does not necessarily reflect improvement in health. For example, the reduction in expenditure for doctor visits can simply mean that people see their doctors irrespective of the health status less often once they are retired. Therefore, the decline in expenditure may rather express a change in health behavior than in health status. In order to separate health from behavioral effects, we provide a more thorough analysis of outcomes on a disaggregated level, i.e., to examine whether the retirement effects vary depending on 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-up category for all remaining specialists (Other). The figure illustrates that the lower doctor expenditure at the aggregate level result from a decrease in several categories. For men, we find expenditure reductions for GPs ( $-\text{€}4.2$ ), diagnostic services ( $-\text{€}1.5$ ), psychiatrists and psychologists ( $-\text{€}0.9$ ), orthopedists ( $-\text{€}1.2$ ) and ENT specialists ( $-\text{€}0.9$ ). Given the means of the outcome variables, the effects are not only statistically but also quantitatively significant. The negative effects on disaggregated doctor expenditure for females are even more pronounced. We find significant expenditure reductions for GP visits ( $-\text{€}5.9$ ), diagnostic services ( $-\text{€}4.7$ ), internists ( $-\text{€}2.7$ ), orthopedists ( $-\text{€}4.7$ ), psychiatrists and psychologists ( $-\text{€}3.6$ ), and most surprisingly dentists ( $-\text{€}21.8$ ).

The reductions of revenues for psychiatrists and orthopedists may indicate improved mental health of retirees due to lower stress levels and a reduction of joint- and back pains triggered by the absence of heavy physical labor. Similarly, the reductions of revenues for ENT specialists and also for outpatient internal medicine suggest an improvement in health status after retirement. To interpret the expenditure reduction for diagnostic services, GPs, and in particular dentists as a direct health effect is less evident. These expenditure categories include preventative components and may rather reflect behavioral changes in the utilization of healthcare services. Three further arguments help explain the negative causal impact of retirement on healthcare service utilization: (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 time; (iii) the reduction of GP expenditure may relate to the fact that retirees are not requested anymore to see their family doctor for receipt of a sick note certification for the employer.

*Hospitalization* Figures 5 and 6 and Table A.2 in the Web appendix depict the causal impact of retirement on days of hospitalization and inpatient expenditure for different admission diagnoses according to the ICD-10 classification code system. The estimation results support the previous findings of positive health effects caused by retirement. For men, we find a reduction of days of hospitalization and/or inpatient expenditure for treatment of cardiovascular diseases, stroke, musculoskeletal disorders and the residual category of other diseases. The effects for women are qualitatively similar but quantitatively smaller. Inpatient expenditure for treatment of musculoskeletal disorders decrease significantly and days of hospitalization decline (at the 10 percent level) for 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 there is no causal effect on drug expenditure, or the effects for different types of drugs cancel out. In order to test these hypotheses, we estimate the effect of retirement on different drug categories according to the ATC classification code system, i.e. antiinfectives, drugs for cardiovascular diseases, musculoskeletal disorders, respiratory diseases, ENT diseases, anticancer drugs, psychotropic drugs, and a catch-up 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 accordance with estimation results for outpatient psychiatric and orthopedic healthcare services, we find significantly negative causal effects of retirement on the consumption of psychotropic drugs and medication for musculoskeletal disorders in men. Both reductions support the aforementioned positive health effects. For women, the estimation results also correspond with those on disaggregated expenditure for medical attendance and hospitalization. Retirement decreases consumption of drugs for musculoskeletal disorders. The negative effect of  $-\text{€}3.6$  for psychotropics is imprecisely estimated and therefore insignificant.

Overall, our IV estimates for disaggregated expenditure categories clearly indicate a positive health effect of retirement for both sexes. The decrease of inpatient and outpatient healthcare expenditure for cardiovascular, musculoskeletal and neurological or psychiatric medical treatment suggests physical and emotional relief of employees after their retirement. This interpretation is supported by the reduced consumption of psychotropics 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 dentists (for women) may indicate changes in retirees' health behavior after retirement. For further evidence on behavioral changes, we provide estimation results for participation in medical screening exams. Medical checkups 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 the basic screening, a gynecological screening (colposcopy and pap smear test), and a mammography screening. Whereas the impact of retirement on the screening behavior of females remains consistently insignificant, we find significant and negative effects for screening participation of males (see Table 4). Retirement decreases participation in the basic screening program by 1.3 percentage points and PSA test participation by 1.5 percentage points. The results complement those of a reduction in outpatient expenditure for GP visits and diagnostic services and support the hypothesis that – apart from direct health effects – particularly males also change their health behavior after retirement.

## 4.4 Heterogeneous effects

In this section, we analyze heterogeneous treatment effects of retirement to identify socio-economic groups who may be differently affected by retirement. First, we distinguish blue-collar from white-collar workers since these occupation groups obviously differ in physical and psychological work load (Table 5). Second, we differentiate between economic sectors (Table A.4).

We find substantial differences between male blue and white-collar workers. Doctor expenditure for blue-collar workers decrease 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 holds true for the expenditure reduction for inpatient treatment of cardiovascular diseases as well. 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 is a significant reduction in GP expenditure for female blue-collar females, whereas the effect for white-collar workers remains insignificant. Interestingly, the observed negative coefficient for dentist expenditure is only apparent for female white-collar workers indicating that behavioral changes in the utilization of healthcare services are more prevalent among this group, whereas female blue-collar workers 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 do not find a clear pattern according to their economic sector. Significant reductions in inpatient and outpatient expenditure categories can be found in the industry and service sector. For women, the overall observed effects are mainly driven by women employed in the service sector.

## 4.5 Robustness checks

Our baseline sample consists of individuals who retire either through an old-age pension, early retirement or due to disability. The latter way of retiring depends on the health status of the individual and has become a common way of retirement particularly of male blue-collar workers.<sup>10</sup> To see 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

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<sup>10</sup>Approximately one third of male blue-collar workers retire through disability pension (Frimmel *et al.*, 2015).



who retire through disability pension.<sup>11</sup> Columns 3 and 6 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 partly driven by the less healthy group of disability pensioners. For both men and women, the previous estimates remain qualitatively the same, but are somewhat smaller in size.

In order to check 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.<sup>12</sup> The results are shown in columns 2 and 5 of Table A.5. Income plays an important role for the retirement decision, but is less relevant for the utilization of healthcare services which can be explained by the full coverage of the Austrian healthcare system independent from individual income. Comparing the estimates with our baseline model (columns 1 and 4), we see almost identical results. We conclude that our estimates should not be biased from a potential income effect.

## 5 Summary and concluding remarks

In this paper, we look at the causal effect of retirement on healthcare expenditure. We identify the causal effect by exogenous variation induced by two pension reforms in Austria, which gradually increased the early retirement age for men and women. We find significant effects of retirement on healthcare expenditure. For both sexes, retirement decreases subsequent expenditure for outpatient medical attendance and hospitalization. The quantitative effects are stronger for females in the outpatient sector and for males in the inpatient sector. 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 female hospital expenditure is quantitatively important but statistically insignificant. Moreover, on the disaggregated level, we find reductions for males in outpatient doctor expenditure for GPs, ENT specialists, orthopedists, psychiatrists, and diagnostic services. Female outpatient expenditure decrease for GPs, internists, dentists, orthopedists, psychiatrists, and diagnostic services. The results indicate a positive causal effect of retirement on individual health. However, the analysis also reveals behavioral changes in the utilization of healthcare services that do not necessarily reflect health status improvement. The latter argument seems in particular relevant for white-collar workers.

At least three (preliminary) conclusions can be drawn from our analysis. First, the attempt of the Austrian government to increase the (early) retirement age of workers is likely be accompanied by negative health effects. Second, health improvements of earlier

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<sup>11</sup>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.

<sup>12</sup>Income comprises either labor income, unemployment benefits or pension payments for retired individuals.

retirement are most likely due to lower mental and physical stress. Third, it is important to be noticed that retirement has not only an impact on people's health status, but may also change their health behavior. The behavioral changes in the utilization of healthcare services may be associated with the availability of time, shirking at the workplace (doctor consultations during working hours), and eventually lower incentives for preventative measures after retirement.

From a policy point of view, spillover effects of longer employment on the individual health status is 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, at least part of it is due to significant changes in health behavior. The latter, however, should not affect the employability negatively. Based on our empirical findings, one may conclude that policies aiming at longer employment of older workers should focus on tasks which are less prone to mental and physical health problems. In other words, an increase in effective retirement age requires that older workers are fit enough to fulfill their duties and responsibilities at the workplace.

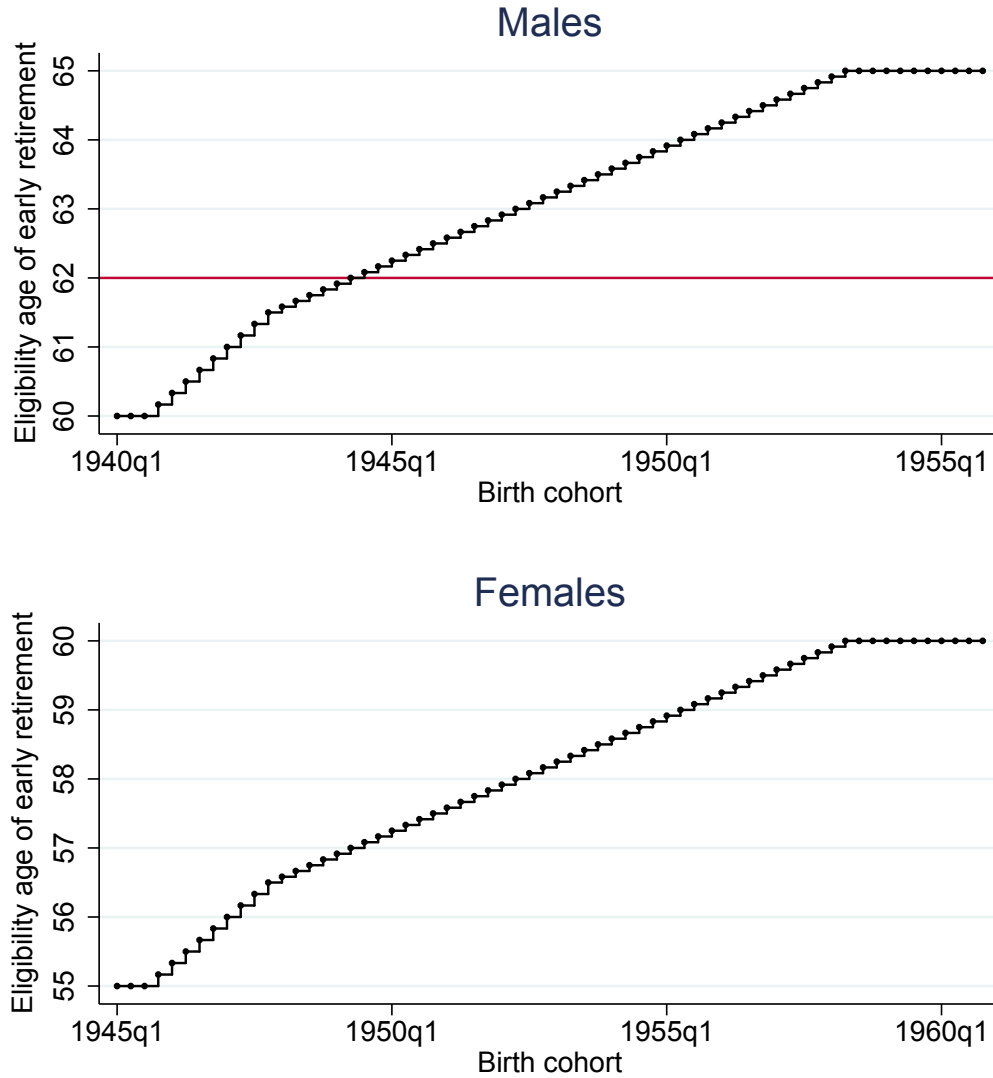
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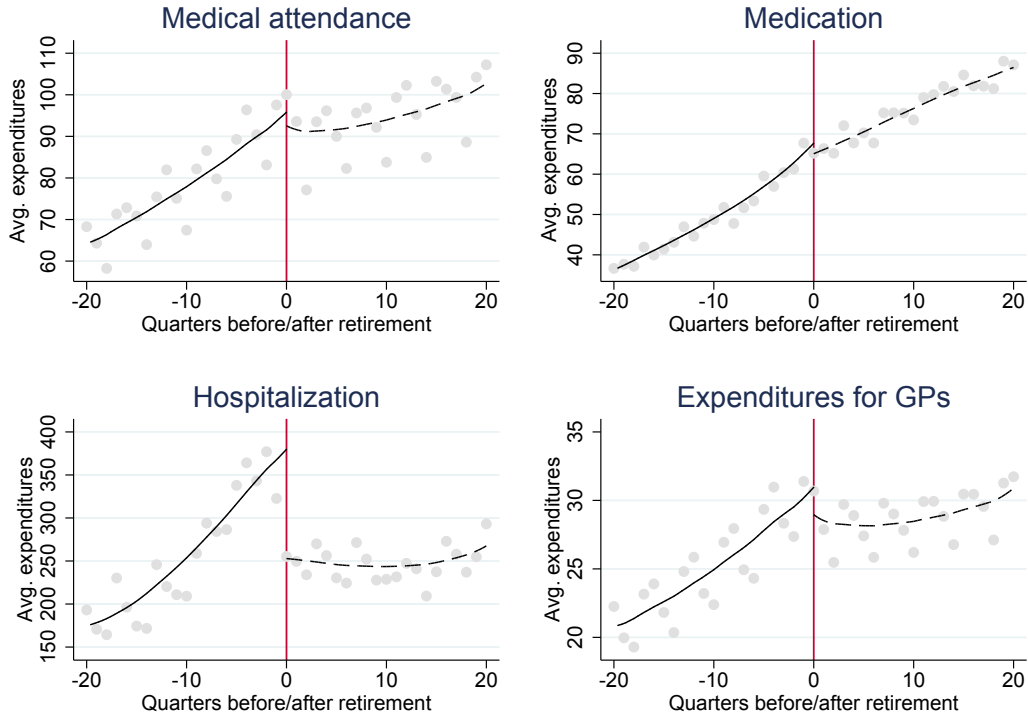
## 6 Figures and tables

Figure 1: Eligibility age of early retirement over birth quarter cohorts



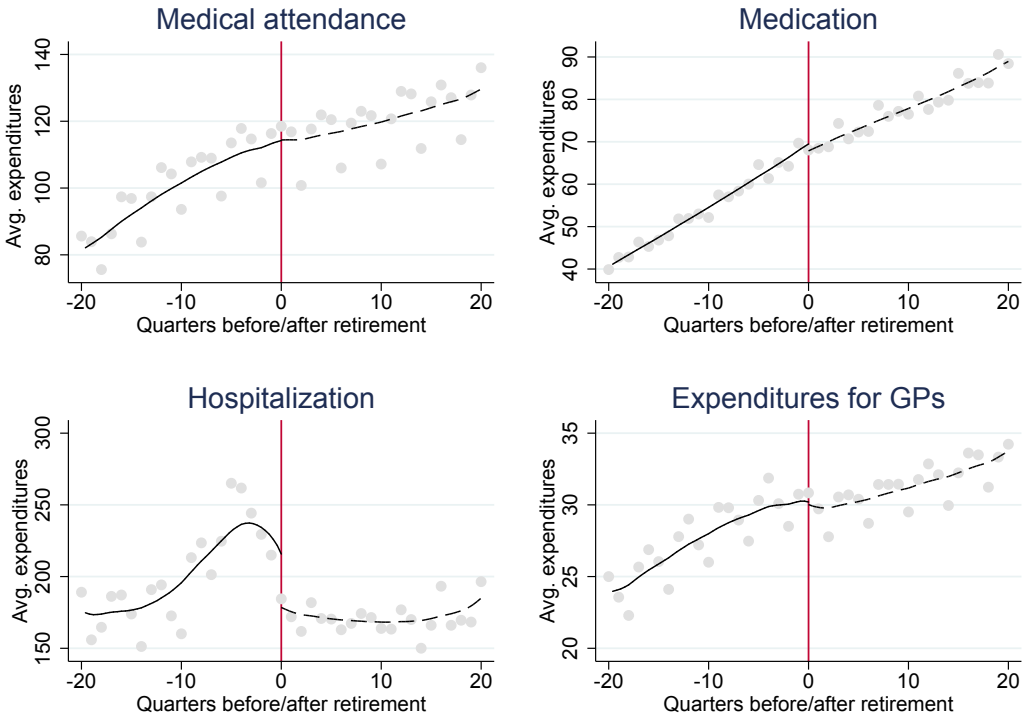
Notes: The figures show the development of the eligibility age of early retirement over birth quarter cohorts for males and females according to the pension reforms 2000 and 2003. The corridor pension at age 62 for is displayed by the red horizontal line.

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



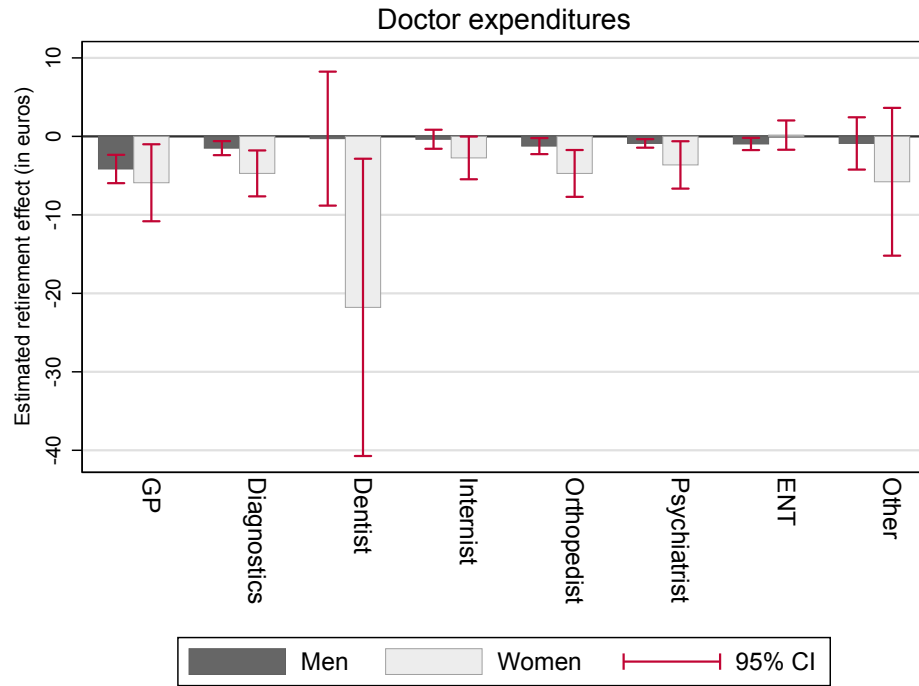
Notes: The figures show the development of various types of healthcare expenditure for men 20 quarters before and after retirement. The figures are based on a sample described in Section 3.1.

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



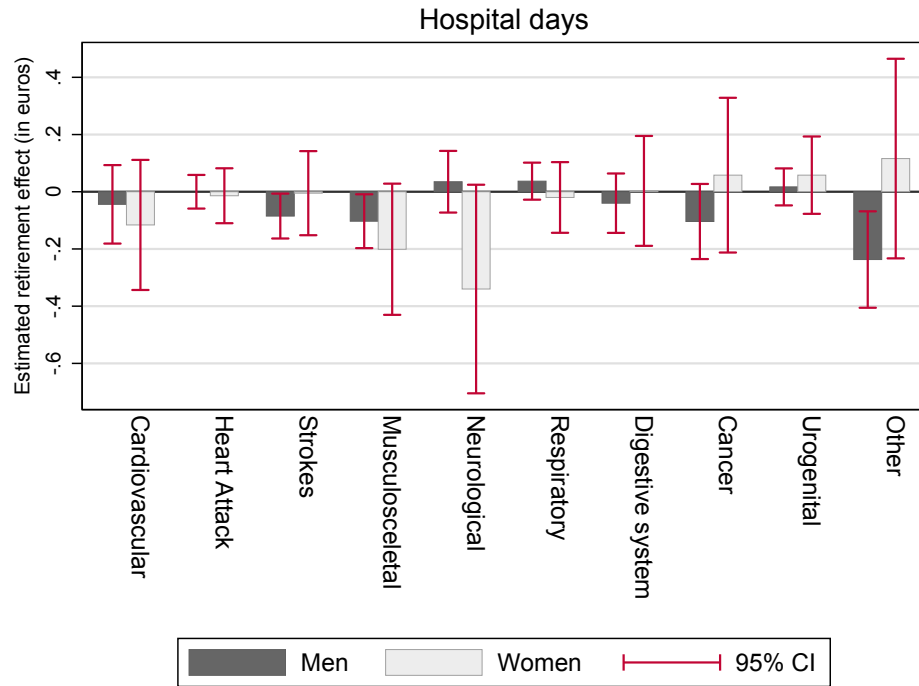
Notes: The figures show the development of various types of healthcare expenditure for women 20 quarters before and after retirement. The figures are based on a sample described in Section 3.1.

Figure 4: Disaggregated outpatient expenditure: medical attendance



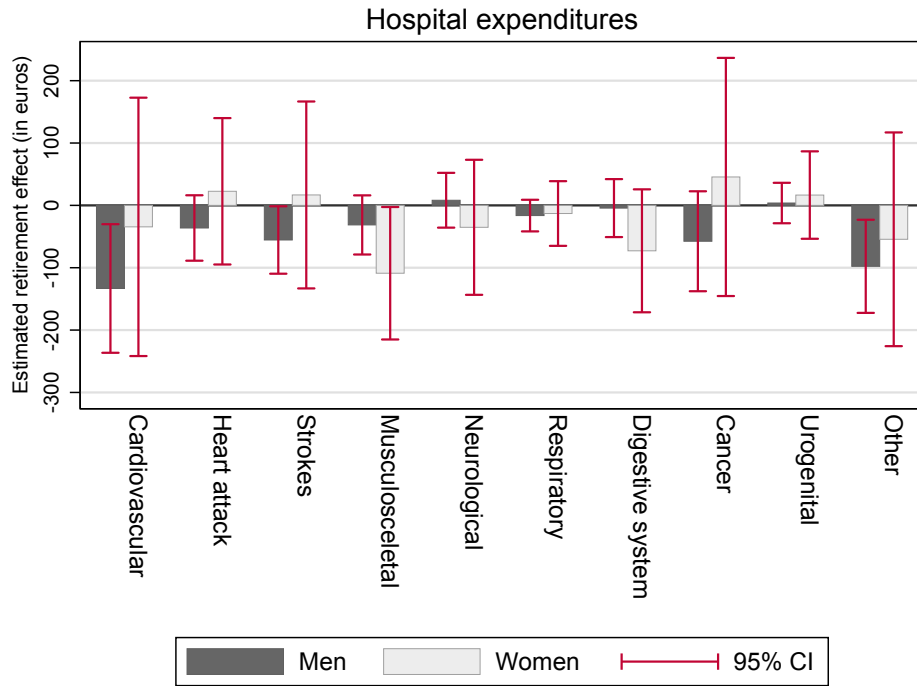
Notes: The figure summarizes retirement effects on expenditure categories of medical attendance for men and women. The bars represent the coefficients of the standard specification presented in Table 3.

Figure 5: Inpatient sector: days of hospitalization



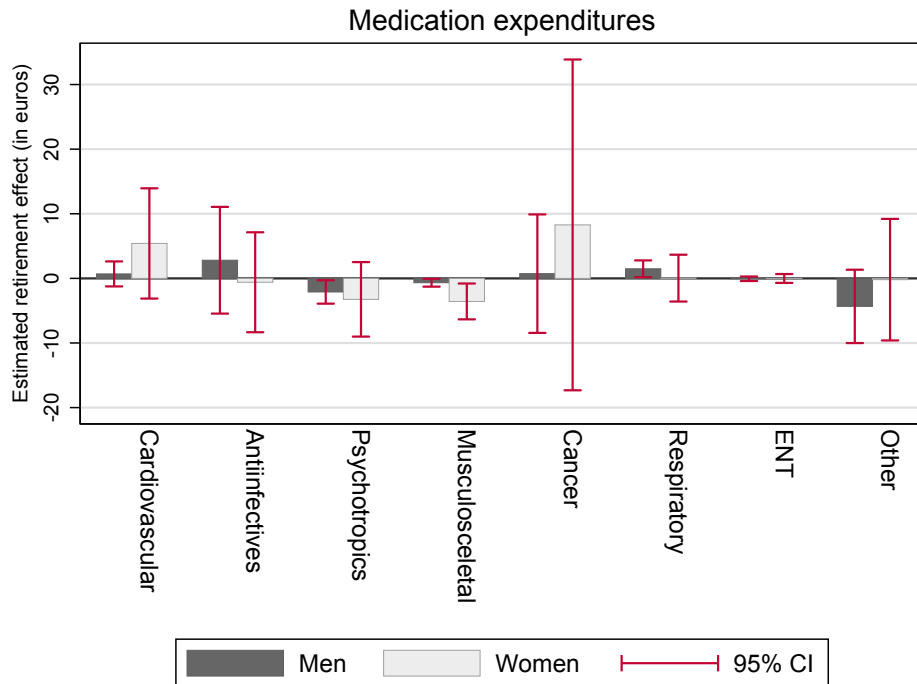
Notes: The figure summarizes retirement effects on days of hospitalization for different types of diseases for men and women. The bars represent the coefficients of the standard specification presented in Table 3.

Figure 6: Inpatient sector: disaggregated expenditure



Notes: The figure summarizes retirement effects on hospital expenditure for different types of diseases for men and women. The bars represent the coefficients of the standard specification presented in Table 3.

Figure 7: Disaggregated outpatient expenditure: medication



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



Table 1: Descriptive statistics

	(I)		(II)	
	Men		Women	
Retired until 2012	0.773		0.730	
Early retirement for long 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)
<i>Individual characteristics</i>				
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)
<i>Aggregated healthcare expenditure</i>				
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)
<i>Disaggregated healthcare expenditure: medical attendance</i>				
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)
Psychiatry	1.22	(11.36)	2.22	(17.99)
Orthopedics	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)
<i>Disaggregated healthcare expenditure: medication (ATC)</i>				
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)
<i>Disaggregated healthcare expenditure: hospitalization (ICD)</i>				
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)
<i>Disaggregated hospital days</i>				
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)
<i>Screening participation</i>				
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 in €. Standard deviations in parentheses.

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

	(I)	(II)
	<b>Men</b>	<b>Women</b>
Eligibility of early retirement	−0.166*** (0.003)	−0.060*** (0.002)
Quadratic age in months	yes	yes
Calendar time fixed-effects	yes	yes
Mean of dep. variable	0.413	0.520
S.d. 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-effects 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-percent, 5-percent and 1-percent level. 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	
<i>Outpatient sector</i>								
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	
<i>Expenditure: medication</i>								
	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	
<i>Inpatient sector</i>								
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	
<i>Days of hospitalization</i>								
	−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 effects estimation, and the second column reports estimates from a fixed effects instrumental variable approach. The latter uses the gradual increase of early retirement age for different birth-quarter cohorts as an instrumental variable. 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-percent, 5-percent and 1-percent level. Standard errors (in parentheses) are clustered at the individual level.

Table 4: Screening participation

	Men		Women	
<b>Basic screening</b>	−0.013***	(0.004)	0.010	(0.011)
Mean of dep. variable	0.05		0.06	
<b>Gynecological screening</b>			0.017	(0.015)
Mean of dep. variable			0.12	
<b>Mammography screening</b>			−0.003	(0.011)
Mean of dep. variable			0.06	
<b>PSA-test</b>	−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 effects instrumental variable approach for different outcomes. All regressions include a quadratic age in months trend and calendar time fixed effects. We use the gradual increase of early retirement age for different birth-quarter cohorts as an instrumental variable. \*, \*\* and \*\*\* indicate statistical significance at the 10-percent, 5-percent and 1-percent level. 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
<b>Aggregate doctor expenditure</b>	−28.680** (11.155)	−4.384 (4.335)	−45.461*** (16.377)	−54.469*** (15.208)
<b>Psychotropics</b>	−3.648 (2.331)	−1.478 (0.939)	−3.689 (3.543)	−2.794 (4.216)
<b>Musculoskeletal disease (drugs)</b>	−1.298* (0.727)	−0.409 (0.324)	−3.277* (1.902)	−3.843* (1.978)
<b>GP</b>	−8.045*** (2.202)	−2.384** (0.962)	−10.544*** (3.681)	−2.831 (3.439)
<b>Dentist</b>	−6.175 (10.397)	2.666 (4.432)	−7.475 (13.361)	−33.385** (14.148)
<b>Diagnostic services</b>	−1.348 (1.083)	−1.515*** (0.477)	−2.903 (2.076)	−5.943*** (2.102)
<b>Psychiatry</b>	−2.089*** (0.690)	−0.496* (0.285)	−4.432** (1.883)	−3.371 (2.255)
<b>Orthopedist</b>	−1.505 (1.288)	−1.051* (0.542)	−1.248 (2.114)	−6.989*** (2.153)
<b>Screening participation</b>	−0.023** (0.011)	−0.008* (0.004)	0.047*** (0.016)	−0.013 (0.015)
<b>Gynecological screening</b>			0.037* (0.022)	0.005 (0.021)
<b>Mammography</b>			−0.016 (0.015)	0.006 (0.015)
<b>PSA-test</b>	−0.040** (0.016)	−0.005 (0.007)		
F-statistic of IV No. of observations	846.58 532099	3966.42 780883	348.134 504139	407.28 1298748
<b>Aggregate hospital expenditure</b>	−448.621** (203.148)	−269.630** (108.595)	−265.521 (181.643)	−248.232 (435.463)
<b>Aggregate hospital days</b>	−0.929** (0.384)	−0.198 (0.198)	−0.368 (0.348)	−0.558 (0.805)
<b>Inpatient cardiovascular diseases</b>	−216.461* (112.488)	−92.546* (55.620)	−85.458 (61.249)	33.660 (231.557)
<b>Inpatient musculoskeletal diseases</b>	9.489 (49.836)	−51.374* (26.483)	−88.177 (60.879)	−135.366 (98.730)
F-statistic of IV No. of observations	447.42 343044	3966.42 483601	195.87 405462	56.25 1055176

*Notes:* This table summarizes estimation results of the effect of being retired on different outcomes for men and women by their occupation status. Each coefficient is from a separate estimation and reports estimates from a fixed-effect instrumental variable approach for different outcomes. All regressions include a quadratic age in months trend and calendar time fixed effects. We use the gradual increase of early retirement age for different birth-quarter cohorts as an instrumental variable. \*, \*\* and \*\*\* indicate statistical significance at the 10-percent, 5-percent and 1-percent level. 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 - causal evidence from Austria’ by Wolfgang Frimmel and Gerald J. Pruckner.

Table A.1: Disaggregated expenditure: medical attendance

	Men		Women	
<b>GP</b>	−4.157***	(0.921)	−5.910**	(2.503)
Mean of dependent variable	26.17		30.61	
<b>Diagnostic Services</b>	−1.499***	(0.456)	−4.718***	(1.492)
Mean of dependent variable	5.99		11.05	
<b>Dentist</b>	0.287	(4.356)	−21.789**	(9.663)
Mean of dependent variable	21.63		25.20	
<b>Internist</b>	−0.368	(0.619)	−2.745**	(1.388)
Mean of dependent variable	4.88		5.21	
<b>Orthopedist</b>	−1.239**	(0.522)	−4.721***	(1.522)
Mean of dep. variable	2.45		3.48	
<b>Psychiatrist</b>	−0.898***	(0.277)	−3.637**	(1.540)
Mean of dependent variable	1.22		2.22	
<b>ENT</b>	−0.969**	(0.396)	0.162	(0.951)
Mean of dependent variable	4.37		5.39	
<b>Other</b>	−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 effects instrumental variable approach for different outcomes. All regressions include a quadratic age in months trend and calendar time fixed effects. We use the gradual increase of early retirement age for different birth-quarter cohorts as an instrumental variable. \*, \*\* and \*\*\* indicate statistical significance at the 10-percent, 5-percent and 1-percent level. 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)
Days in hospital	−0.044	(0.070)	−0.116	(0.116)
Heart attack				
Expenditure	−36.254	(26.781)	22.609	(59.889)
Days in hospital	−0.000	(0.030)	−0.014	(0.049)
Stroke				
Expenditure	−55.511**	(27.591)	16.739	(76.475)
Days in hospital	−0.085**	(0.040)	−0.005	(0.075)
Musculoskeletal diseases				
Expenditure	−31.348	(24.205)	−108.835**	(54.195)
Days in hospital	−0.103**	(0.048)	−0.201*	(0.117)
Psychological/Neurological diseases				
Expenditure	8.230	(22.413)	−35.161	(55.254)
Days in hospital	0.035	(0.055)	−0.340*	(0.186)
Respiratory diseases				
Expenditure	−16.358	(12.938)	−13.043	(26.470)
Days in hospital	0.037	(0.033)	−0.020	(0.063)
Digestive system diseases				
Expenditure	−4.338	(23.713)	−72.861	(50.311)
Days in hospital	−0.040	(0.053)	0.003	(0.098)
Cancer				
Expenditure	−57.529	(40.886)	45.582	(97.433)
Days in hospital	−0.104	(0.067)	0.058	(0.138)
Urogenital diseases				
Expenditure	3.777	(16.553)	16.567	(35.777)
Days in hospital	0.017	(0.033)	0.058	(0.069)
Other diseases				
Expenditure	−97.745**	(38.100)	−54.387	(87.439)
Days in hospital	−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 days spent in hospital for men and women. Each coefficient is from a separate estimation and reports estimates from a fixed effects instrumental approach for different outcomes. All regressions include a quadratic age in months trend and calendar time fixed effects. We use the gradual increase of early retirement age for different birth-quarter cohorts as an instrumental variable. \*, \*\* and \*\*\* indicate statistical significance at the 10-percent, 5-percent and 1-percent level. Standard errors (in parentheses) are clustered at the individual level.



Table A.3: Disaggregated expenditure: medication

	Men		Women	
<b>Cardiovascular diseases</b>	0.692	(0.986)	5.409	(4.354)
Mean of dependent variable	13.96		14.77	
<b>Antiinfectives</b>	2.808	(4.214)	−0.602	(3.946)
Mean of dependent variable	2.27		2.75	
<b>Psychotropics</b>	−2.103**	(0.923)	−3.245	(2.942)
Mean of dependent variable	3.70		8.60	
<b>Musculoskeletal diseases</b>	−0.673**	(0.309)	−3.568**	(1.415)
Mean of dependent variable	1.75		4.65	
<b>Cancer</b>	0.731	(4.679)	8.279	(13.061)
Mean of dependent variable	4.65		11.56	
<b>Respiratory diseases</b>	1.485**	(0.663)	0.040	(1.848)
Mean of dependent variable	3.94		4.14	
<b>ENT diseases</b>	−0.062	(0.178)	−0.014	(0.350)
Mean of dependent variable	0.48		0.58	
<b>Other medical drugs</b>	−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-effects instrumental variable approach for different outcomes. All regressions include a quadratic age in months trend and calendar time fixed effects. We use the gradual increase of early retirement age for different birth-quarter cohorts as an instrumental variable. \*, \*\* and \*\*\* indicate statistical significance at the 10-percent, 5-percent and 1-percent level. Standard errors (in parentheses) are clustered at the individual level.

Table A.4: Treatment heterogeneity: Economic sectors

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

*Notes:* This table summarizes estimation results of the effect of being retired on different outcomes for men and women by their occupation status. Each coefficient is from a separate estimation and reports estimates from a fixed-effect instrumental variable approach for different outcomes. All regressions include a quadratic age in months trend and calendar time fixed effects. We use the gradual increase of early retirement age for different birth-quarter cohorts as an instrumental variable. \*, \*\* and \*\*\* indicate statistical significance at the 10-percent, 5-percent and 1-percent level. 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
<b>Aggregate doctor expenditure</b>	−11.211*** (4.335)	−12.021** (5.646)	−6.143* (3.390)	−50.542*** (11.080)	−59.892*** (12.985)	−48.973*** (11.354)
<b>Aggregate medication expenditure</b>	2.097 (7.925)	2.629 (10.521)	4.017 (5.462)	0.395 (16.440)	1.285 (18.450)	2.571 (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
<b>Aggregate hospital expenditure</b>	−328.598*** (98.979)	−351.859*** (130.214)	−207.863*** (74.904)	−256.579 (213.444)	−384.140 (248.667)	−158.095 (229.594)
<b>Aggregate hospital days</b>	−0.439** (0.184)	−0.437* (0.239)	−0.258* (0.144)	−0.441 (0.398)	−0.457 (0.500)	−0.215 (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 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 missing information in the dataset. Each coefficient is from a separate estimation and reports estimates from a fixed-effect instrumental variable procedure for a different outcome. All regression include a quadratic age in months trend and calendar time fixed effects. We use the gradual increase of early retirement age for different birth-quarter cohorts as an instrumental variable. \*, \*\* and \*\*\* indicate statistical significance at the 10-percent, 5-percent and 1-percent level, respectively. Standard errors (in parentheses) are clustered on individual level.