Does retirement affect secondary preventive care use?
Evidence from breast cancer screening[*]

Peter Eibich[†] and Léontine Goldzahl[‡]

This Version: January 31, 2019

Abstract

This paper examines the causal impact of retirement on secondary preventive care use, focusing on breast cancer screening. We use data from Eurobarometer surveys conducted between 1996 and 2006, covering 25 different European countries. We address the endogeneity of retirement by using age thresholds for pension eligibility as instrumental variables. We find that retirement reduces secondary preventive care use. This effect is not driven by changes in health or income. Instead, our evidence suggests that generosity of the social health insurance system and women's beliefs concerning cancer prevention and treatment are important mechanisms.

Keywords: retirement, secondary preventive care, mammography, breast cancer, Eurobarometer, instrumental variables

JEL codes: I12, I18, J26

---

[*] Peter Eibich acknowledges generous support by the Wellcome Trust (Society & Ethics Research Fellowship 203208/Z/16/Z). We would like to thank Thomas Allen, Clémentine Garrouste, Alastair Gray, Mikko Myrskylä, Ansgar Wübker and Nicolas Ziebarth as well as seminar participants at the University of Oxford, University of Bergen, the University of Paderborn, the Université Paris Dauphine, the Université Paris 5 and Newcastle University as well as participants of the EuHEA 2016 and 2018 conferences, the Annual Conference of the German Association of Health Economists, the Annual Conference of the Scottish Economic Society and the 2018 Annual Conference of the French Health Economic Association for their helpful comments and discussion.
[†] Max Planck Institute for Demographic Research, Konrad-Zuse-Str. 1, 18057 Rostock, Germany, and Health Economics Research Centre, Nuffield Department of Population Health, University of Oxford. E-Mail: eibich@demogr.mpg.de. Tel.: +49 (0)381 2081-220.
[‡] EDHEC Business School. E-mail: leontine.goldzahl@edhec.edu

1 Introduction

As life expectancy increases and fertility rates decline, the absolute number of older individuals and their proportion of the total population are both increasing in many countries. Older persons (aged 65 or over) represent a share of 19.2% of the EU-28 population, and it has increased by 2.2 percentage points in the last decade. Population ageing is resulting in an increasing burden of non-communicable diseases for which age is a major risk factor, such as cardiovascular diseases, cancer or diabetes type 2. For instance, the incidence of cancer in those over 65 is 10 times greater than in those younger than 65 and the cancer death rate is 16 times greater in patients over 65 compared to younger people during the early 2000s (Berger et al., 2006). In the US, adults aged 65 years and above accounted for 82% of all deaths attributable to cardiovascular diseases in 2005 (Yazdanyar and Newman, 2009).

However, many of these diseases are amenable to prevention. Changes in health behavior such as exercise or quitting smoking (i.e., primary prevention) can reduce the incidence of these diseases, while early detection (i.e., secondary prevention) can improve treatment outcomes and result in higher survival and fewer complications. Thus, preventive care could play a major role in maintaining the health of an ageing population.

Retirement is a major transition for this ageing population, and a growing part of the economic literature has examined the health effects of retirement since the early 2000s (see Nishimura et al. (2018) for an overview). A lot of attention has been devoted to the effect of retirement on primary prevention such as exercise (Celidoni and Rebba, 2017; Eibich, 2015; Insler, 2014; Kämpfen and Maurer, 2016; Motegi et al., 2016; Zantinge et al., 2014). In contrast, there are only two studies that analyzed secondary prevention. Both Coe and Zamarro (2015) and Frimmel and Pruckner (2018) studied the effect of retirement on healthcare use. While Coe and Zamarro (2015) found no effect of retirement on prostate cancer screening, Frimmel and Pruckner (2018) found a negative effect. Only Frimmel and Pruckner (2018) studied the impact of retirement on mammography utilization (using Austrian register data), and found no effect on this outcome.

This paper extends the literature by examining the causal effect of retirement on secondary preventive care with a particular focus on breast cancer screening participation, since breast cancer is the most common cancer among women aged 50 and above. Our study makes contributions along several dimensions. First of all, this is the first study to provide comprehensive evidence of the effect of retirement on secondary preventive care among women. Then, we examine whether the effect of retirement on breast cancer screening participation differs between countries with and without national organized screening programs.[1] We also systematically investigate potential theoretical mechanisms, including some mechanisms that have not been considered previously, such as perceptions on breast cancer prevention and treatment as well as social health insurance (SHI) coverage. Finally, we apply a novel method, specification curve analysis, to assess the robustness of our results.

In this paper we draw on repeated cross-section data from the Eurobarometer surveys ranging from 1996 to 2006. The data cover 25 EU countries[2] and allow us to exploit variation in pension eligibility ages between countries as well as within countries over time for our identification strategy. We use state pension ages as instrumental variables to address the endogeneity of retirement, and we assess the robustness of our results by estimating specification curves.

The results indicate that retirement reduces the probability of breast cancer screening through mammography use by about 26 percentage points. This effect is slightly smaller in countries with an organized screening program, but even in those countries retirement significantly reduces mammography use. The estimates of the mitigating impact of organized screening programs are also less robust than our estimate of the impact of retirement. Retirement further reduces use of other preventive care interventions, such as pap smear tests and ovary examinations, but these effects are smaller than the reduction in mammography use. The negative effect of retirement on mammography use is unlikely to be driven by changes in time constraints, health or income. Instead, we find that retirement affects women's beliefs concerning prevention and treatment of breast cancer. Specifically, retired women were less likely to agree that early detection improves the chances of successfully treating breast cancer, and they were less likely to agree that there are effective treatments for breast cancer. Finally, we find that the reduction in mammography use is larger in countries with lower coverage of the social health insurance system. This suggests that the loss of employment might affect women's access to preventive healthcare, potentially through a reduction in complementary health insurance.

[1] While the benefits of breast cancer screening are generally considered to outweigh the harms from misdiagnosis and overtreatment (Marmot et al., 2013), this is less clear for prostate cancer screening (Haines et al., 2016). Therefore, there are no national screening programs for prostate cancer to date.

[2] Romania, Bulgaria and Croatia are not covered by the survey, since they joined the EU after 2006.

The paper proceeds as follows: in section 2 we review the possible mechanisms linking retirement and mammography use. Section 3 describes the institutional setting as well as the data, and we discuss our methodological approach in section 4. Section 5 presents the results and several robustness checks. Section 6 examines potential mechanisms and section 7 concludes.

2 Theoretical considerations and relevant empirical literature

In the following we review potential mechanisms for the effect of retirement on preventive care use. Previous empirical studies have primarily considered time constraints as the main mechanism linking retirement to changes in primary prevention. Theoretical considerations suggest that income, health, health insurance coverage as well as knowledge and perceptions of secondary prevention could also explain the relationship between retirement and secondary preventive care use.

At retirement, income may impact healthcare consumption through two mechanisms. First, retirement typically leads to a reduction in income. Healthcare might therefore be less accessible after retirement if retirees have less income to pay for co-payments, out-of-pocket expenditures or transportation costs. Second, Galama et al. (2013) suggest an interesting theoretical mechanism based on Grossman's health capital model (Grossman, 1972). Their theoretical model predicts that healthcare consumption should decrease after retirement. Post-retirement income is independent of health. While health still has a direct effect on utility, it ceases to affect utility indirectly through consumption, and therefore retirees are expected to reallocate resources from health investments into higher consumption. According to both of these income-driven mechanisms, retirement may lead to a decrease in mammography use.

There is a large literature investigating the health effects of retirement, with studies reporting both positive effects (Blake and Garrouste, 2013; Bloemen et al., 2017; Celidoni and Rebba, 2017; Coe and Zamarro, 2011; De Grip et al., 2011; Eibich, 2015; Grøtting and Lillebø, 2017; Hallberg et al., 2015; Insler, 2014; Nishimura et al., 2017) and negative effects.[3] At the same

[3] The survey by Nishimura et al. (2018) suggests that the difference in findings can be attributed to methodological differences, and that a unified approach based on state pension ages provides mostly positive or insignificant results. However, there remains considerable heterogeneity, e.g., across countries. In addition, while all studies focusing on cognitive functioning find negative effects of retirement (Bingley and Martinello, 2013; Bonsang et al., 2012; Mazzonna and Peracchi, 2016, 2012; Rohwedder and Willis, 2010), while studies focusing on mortality mostly find a reduction in mortality (Blake and Garrouste, 2013; Bloemen et al., 2017;

time, several studies find that health is correlated with participation in breast cancer screening (Bouckaert and Schokkaert, 2016; Courtney-Long et al., 2011; Gandhi et al., 2015; Guilcher et al., 2014; Jensen et al., 2015, Carrieri and Wuebker, 2016; Wu, 2003). Taken together, these findings suggest that retirement could affect mammography use through its effect on health but the sign is ambiguous.

Retirement might lead to or coincide with changes in health insurance coverage. For example, in the US, individuals become eligible for Medicare coverage at 65. In contrast, European countries typically have a social health insurance system covering both workers and retirees. However, employees might benefit from employer-sponsored complementary health insurance, workplace-based prevention programs or incentives to participate in existing prevention programs. Retirement might reduce the likelihood to use secondary preventive care if retirees are not covered by such schemes.

Previous studies have sometimes included information on income, health or health insurance coverage as control variables rather than explicitly investigating them as potential mechanisms. In this paper, we investigate if those potential mechanisms could explain the relationship between retirement and mammography use.

Transitions out of the labour force at older ages may induce changes in individual's social networks in terms of both size and composition of the network. Evidence from the US shows that retirement reduces the size and density of social networks (Patacchini and Engelhardt, 2016). Interestingly, this effect is more pronounced for women. Evidence from Europe is mixed. Fletcher (2014) finds that retirement had little impact on social network size while Börsch-Supan and Schuth's (2013) results show that retirement negatively impacts cognitive health through a reduction of the social network. Social networks can influence individual's behaviour by circulating information and beliefs on the effectiveness of recommended health behaviour. For example, Christakis and Fowler (2008) reported that social networks play an important role for smoking cessation. Cancer risk perceptions are often biased (Ziebarth, 2018), and changes in social networks and cognitive decline induced by retirement might exacerbate existing biases, thus affecting secondary preventive care use. We explore whether changes in beliefs about breast cancer screening and treatment effectiveness explain the

---

Hallberg et al., 2015) or no significant effects (Hagen, 2017; Hernaes et al., 2013) with two studies reporting an increase in mortality after retirement (Fitzpatrick and Moore, 2018; Kuhn et al., 2010).

relationship between retirement and mammography use.

Previous studies show that retirement improves health behavior, and in particular those behaviors that require a time investment, e.g., exercise (Eibich, 2015; Insler, 2014; Kämpfen and Maurer, 2016; Motegi et al., 2016), sleep duration (Eibich, 2015; Motegi et al., 2016) and GP or specialist visits (Caroli et al., 2016). This suggests that retirement affects primary and secondary preventions through lower time constraints, since retirees have more leisure time available, which decreases the time costs of health investments. While it is not possible to test this mechanism directly with our data, we would expect that retirement increases mammography use if the effect is indeed driven by time constraints.

Organized screening programs might interact with several of these potential mechanisms. Screening programs aim to reduce access barriers to healthcare by offering screening free of charge. Programs also reduce the time costs by inviting women directly for screening without the need to obtain a referral from their GP first. Lastly, the information provided alongside an invitation for screening in an organized program could affect women's perceptions of their cancer risk and of the benefit of screening (Martínez-Alonso et al., 2017; Woloshin et al., 2012). Therefore, it appears plausible that the effect of retirement on mammography use might differ between countries with a screening program and those without a program.

In the following section we provide a short overview over breast cancer screening organization in Europe and on the eligibility rules for retirement in Europe.

3 Contextual setting and data

3.1 Contextual setting

3.1.1 Breast cancer screening in Europe

We focus on breast cancer screening for three reasons: First, breast cancer is the most common type of cancer in women worldwide (WHO, 2017a). The incidence of breast cancer is estimated to be 494,176 in Europe and 361,608 in the 28 countries of the European Union in 2012 (WHO, 2017b). Thus, 1 in 8 women in the EU-28 will develop breast cancer before the age of 85 (Ferlay et al., 2007). In 2015, roughly 91,585 women in the 28 countries of the European Union and 142,979 women in Europe died of breast cancer (WHO, 2017b). Second, breast cancer is most common in women above 50 years of age (WHO, 2017a), i.e., those women close to retirement or already retired. Third and last, if detected early, breast cancer is highly treatable with very high rates of survival. Survival rates depend crucially on the stage at which breast cancer is detected. Early screening increases the probability to detect a cancer at a more local stage, hence improving survival. The most common method for early detection of breast cancer is mammography - low dose X-ray imaging of the breasts. Based on evidence from clinical trials indicating that screening mammography reduces mortality by detecting tumors at an earlier stage (Marmot et al., 2013) expert organizations (World Health Organization's International Agency for Research on Cancer and the American Cancer Society) recommend regular, biennial screening mammograms starting at age 50 (Perry et al., 2008). Nearly every European country has now established a national breast cancer screening program (Altobelli and Lattanzi, 2014). They usually provide free mammography for women aged over 50 years until 69 or 74 years old every two to three years. Those programs have successfully increased mammography use in Europe (Buchmueller and Goldzahl, 2018; Carrieri and Wuebker, 2016; Pletscher, 2017) and decreased mortality in the US and in the UK (Leive and Stratmann, 2015).

However, there is an ongoing debate about how the benefits of mammography (i.e., reduced mortality) should be weighed against the cost associated with false positive results and overdiagnosis possibly leading to overtreatment (Gøtzsche and Jørgensen, 2013). A U.K. expert panel conducted a meta-analysis of the randomized trial evidence and concluded that screening mammograms reduced the relative risk of mortality by 20 percent, while acknowledging the problems of overdiagnosis and false-positive biopsies (Marmot et al., 2013). Recent evidence based on a discrete choice experiment showed that women would be willing to accept a higher ratio of overdiagnosis and false-positive biopsies for one life saved from breast cancer than the actual ratio estimated in the medical and epidemiological literature (Sicsic et al., 2017).

In the absence of a screening program, women can still have screening procedures but only through the usual healthcare pathways: for example, they might need a referral from a gynecologist or GP for a mammogram and then book an appointment with the radiologist. In some countries with a screening program (France, Switzerland, Luxemburg, Austria or Belgium), women within the age range can be screened in the program as well as outside the program: called opportunistic screening. Screening outside of the program might incur out-of-pocket expenditures.

Table 1 shows the year of the program implementation and the targeted age range for breast cancer screening in each European country. In 1996, only two European countries had a screening program, while by 2006 ten countries had implemented a program. Since 2010, 23 out of the 25 European countries in our dataset have had a breast cancer screening program. Most countries include women between 50 and 69 (in some cases 74) years old.

Table 1

Survey years	1996		1997		1998		2003		2006		Breast cancer Screening program characteristics	
	ERA	ORA	ERA	ORA	ERA	ORA	ERA	ORA	ERA	ORA	Year of implementation	Age range
A. Screening program introduced before observed period (pre-1996)												
Finland	58	65	58	65	60	65	60	65	62	65	1989	50-69
UK	60	60	60	60	60	60	60	60	60	60	1995	50-70
Sweden	61	65	61	65	61	65	61	65	61	65	1996	40-74
B. Screening program introduced during observed period (1996-2006)												
Netherlands	60	65	60	65	61	65	61	65	61	65	1997	50-74
Belgium	60	65	60	61	60	61	60	63	60	64	2001	50-69
Hungary									57	62	2002	45-65
France	55	60	55	60	55	60	55	60	55	60	2004	50-74
Lithuania									55	60	2005	50-69
Portugal									55	60	2005	45-69
Cyprus									63	65	2006	50-69
C. Screening program introduced after observed period (post-2006)/no existing screening program												
Czech republic									56.5	59.8	2007	45-69
Estonia									56.5	59.5	2007	50-65
Italy	52	55	52	55	54	58	57	60	57	60	2007	50-69
Poland	60	65	60	65	60	65	65	65	62	65	2007	50-69
Luxembourg	60	65	60	65	60	65	60	65	60	65	2007	50-69
Austria	60	60	55	60	55	60	56.5	60	57	60	2008	40-69
Ireland	65	65	65	65	65	65	65	65	65	65	2008	50-64
Slovenia									62	62	2008	50-69
Germany	60	65	60	65	60	65	60	65	60	65	2009	50-69
Latvia									59	61	2009	50-69
Malta									60	60	2009	50-59
Spain									58	61	2009	50-69
Denmark	60	67	60	67	60	67	60	67	60	65	2010	50-69
Greece	55	60	55	60	55	60	55	60	55	60	None	-
Slovakia	60	62	60	62	60	64.5	55	65	55	65	None	-

Retirement ages of European women (1996–2006 columns).

Notes: Empty cells mean that our dataset does not contain observations for the country in that specified year. Source: Social protection in the member states of the European Union, MISSOC (1994, 1997, 1998, 2003), Celidoni and Rebba (2017), Euwals et al.(2010), Jousten et al.(2010), Mazzonna and Peracchi (2014) and Staubli and Zweimuller (2013) for the retirement ages and Altobelli and Lattanzi (2014) for the program characteristics.

3.1.2 Retirement eligibility

The pension systems of most European countries involve both an Official Retirement Age (ORA) and an Early Retirement Age (ERA). The ORA represents the age at which all workers can claim a full old age pension, while the ERA offers specific subgroups the opportunity to retire at an earlier age. As pension eligibility might involve other criteria,[4] our data does not allow us to ascertain pension eligibility on the individual level. Therefore, for the purpose of this study we define the ORA as the age at which all women are able to claim a pension, while the ERA is defined as the earliest age at which a woman might be eligible for a pension.

We use data on the ORA and ERA for each survey year and country from the database of the Mutual Information System on Social Protection (MISSOC, 2017). Table 1 shows that there is considerable variation in the ERA and ORA, both between countries as well as within countries over time. The table also shows that retirement ages differ from breast cancer screening programs eligibility ages – all programs start screening at 50 years of age or below, while the earliest recorded retirement age is 52.

3.2 Data

3.2.1 Eurobarometer

The analysis is based on data from the Eurobarometer. The Eurobarometer is a series of cross-sectional surveys conducted on behalf of the European Commission. The surveys are conducted several times per year and include individuals from all current member states of the European Union. The surveys cover a range of different topics, which are based on current information needs of the European Commission and the European Parliament. Data from the Eurobarometer surveys are available to the scientific community via the Eurobarometer Data Service at GESIS (GESIS, 2017). The two main advantages of this survey compared to similar ones (such as the Survey of Health Ageing Retirement in Europe) is the availability of questions on preventive care utilization as well as on breast cancer perception in several waves. In addition, the cross-country nature of the survey enables us to investigate the heterogeneity of the effect of retirement by institutional settings such as the existence of a screening program.

[4] Retirement at the ORA might also involve a minimum period of social security contributions. In contrast, early retirement at the ERA might be limited to certain occupations or sectors. In addition, schemes offering an ERA might also involve a trade-off between an earlier retirement entry and a reduced pension.

3.2.2 Outcomes

For this paper, we use a set of questions on women's preventive healthcare use that was included five times between 1996 and 2006.[5] These questions asked whether the woman had any of the following medical check-ups in the past 12 months: a mammography, a manual breast examination, a pap smear test (i.e., cervical cancer screening), an examination of the ovaries, a test for osteoporosis, or any other gynecological examination.[6] Our focus is on mammography, since manual breast examinations are less effective at detecting early-stage breast cancer. Ovarian and cervical cancers are less common than breast cancer for the age group of interest. Furthermore, very few countries had cervical cancer screening programs (and none had programs for ovarian cancer) at the time of the survey and if they had one, the maximum age for eligibility would be 65 years old. Likewise, osteoporosis tests are rarely conducted and there are no screening programs for osteoporosis.

Secondary preventive care use is reported retrospectively. This means that for women who passed the retirement age threshold in the past 12 months, we cannot distinguish between preventive care use that occurred before crossing the threshold and preventive care use that occurred afterwards, since we have neither exact age (in months) nor the exact date of the reported health check. This introduces measurement error into our outcome variable. Specifically, this might bias our estimates upwards, since some of the positive outcomes reported in the treatment group (i.e., those women over the ERA/ORA threshold) might have occurred before these women retired. To address this measurement error, we conduct a robustness check in which we exclude women in the first 12 months after passing the age threshold (see section 6).[7]

For the analysis of potential mechanisms, we also investigate women's belief concerning breast cancer prevention and treatment. In 1997 and 1998, women were asked whether they thought the following statements were true or false:

- "The sooner a cancer is detected, the better it can be treated.";
- "A mammography will detect signs of breast cancer.";
- "There are effective treatments for breast cancer.";
- "In most cases, you can be cured of breast cancer if it is detected early enough.";
- "Removal of the breast is the only way to be cured of breast cancer.".

---

[5] In detail, these are the EB44.3 (1996), EB47.2 (1997), EB49 (1998), EB59 (2003) and EB66.2 (2006).

[6] In some years, the question also asked whether they ever had the specified check-up done, or whether they intend to participate in the next 12 months. Unfortunately, this additional information is not available for all years. Therefore, our main specification focuses on a binary indicator of participation to maximize sample size.

[7] This is sometimes referred to as a "donut-design".

Women were also asked whether they personally thought that cancer can be prevented.

3.2.3 Retirement definition and covariates

We define women as retired if their self-reported occupational status is either "retired", "permanently sick or injured", or "homemaker", since these women are unlikely to re-enter the labor market. In contrast, unemployed individuals are not considered to be retired, since they are looking for work and might re-enter the labor market.[8] To address selective labor market participation, we exclude women from the analysis who reported they had never done paid work.[9]

Age is measured in years. We control for education by including dummies for the age when finishing full-time education. The suggested categories are "15 or younger", "16 to 19", "20 and above", and "still studying". While there are small differences in school starting age across countries, these categories should capture any major differences in education between individuals. Moreover, the primary purpose of these control variables is to account for correlations between educational attainment and state pension ages across countries as noted by Bingley and Martinello (2013).

3.2.4 Sample selection and summary statistics

We complement the survey data with information on state pension ages and existence and coverage of screening programs as discussed in the previous section. We restrict our working sample to women aged between 45 and 75 to ensure that for every country we include observations below the ERA and above the ORA.[10] In addition, in some countries screening programs invite women from age 40 onwards, and almost all screening programs offer screening up to the age of 69 or 74. Table 2 shows summary statistics for the working sample. We note that about 35% of the women had a mammography in the past 12 months, while 39% had a manual breast examination (i.e., either a self-examination or an examination by a clinician). Agreement to the statements on early detection, prevention and treatment of breast cancer was generally very high, with the exception of "Removal of the breast is the only way

[8] Unfortunately, we cannot distinguish between "retired" and "permanently sick or injured". However, we conduct robustness checks to assess whether including homemakers as retired and excluding unemployed women as not retired affects our results.

[9] This does not completely solve the issue of selective labor market participation. In particular, our sample might include women who permanently left the labor market after having children, and thus will not have done any paid work for a number of years. Unfortunately, we do not have any further information, e.g., when the respondent left their previous job.

[10] The ERA varies between 52 and 65, while the ORA varies between 55 and 67.

to be cured of breast cancer". However, it is worth noting that 40% of the women thought that cancer cannot be prevented. 32% of the women lived in a country with an organized screening program in the year of the survey. 56% of the women are retired, and the average age was 59 years. Table 2 also shows that uptake rates for preventive care differ significantly between retired and working women. Retired women have lower uptake rates than working women for all procedures considered in this paper, with the exception of osteoporosis tests, where uptakes rates are higher among retired women.

Table 2: Summary statistics

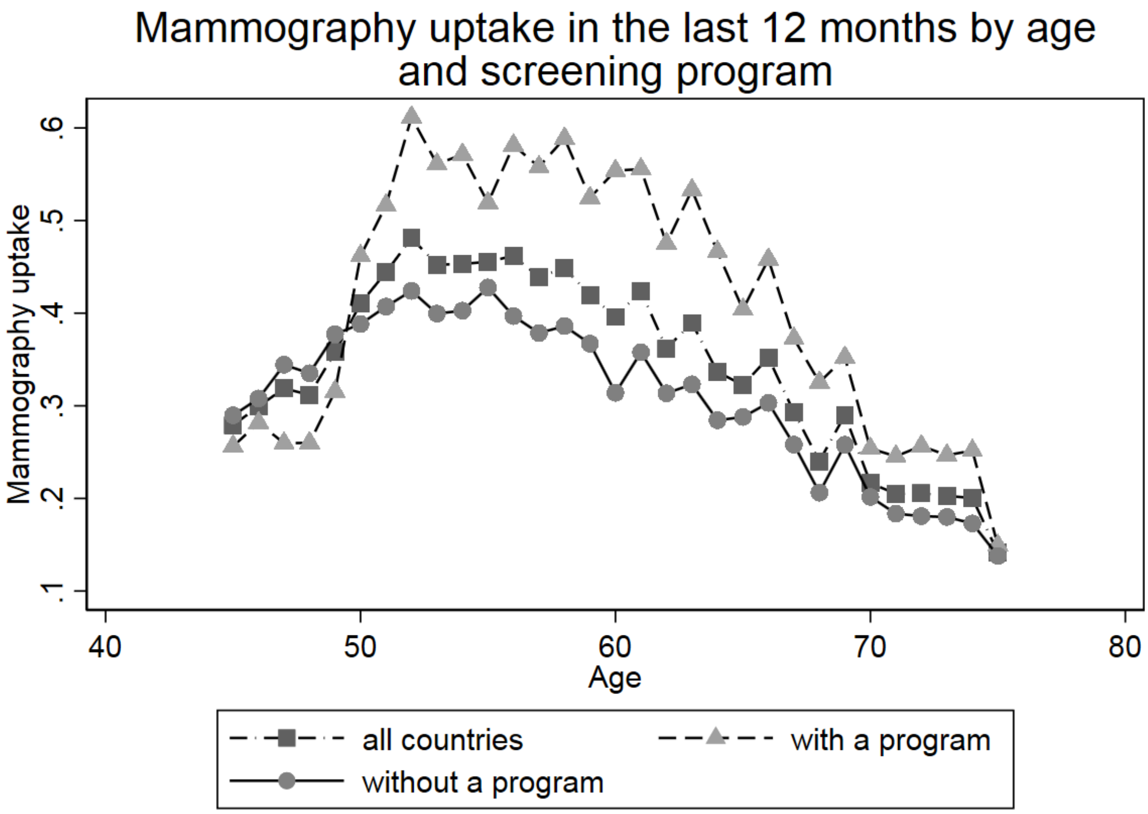
Variable	Mean	SD	Min	Max	N	Mean retired	Mean working	
Preventive care use								
Mammography in the past 12 months	0.351	0.477	0	1	21,042	0.335	0.401	***
Manual breast examination in the past 12 months	0.387	0.487	0	1	21,031	0.359	0.457	***
Ovary examination in the past 12 months	0.222	0.416	0	1	20,960	0.188	0.286	***
Pap smear test in the past 12 months	0.332	0.471	0	1	21,011	0.275	0.435	***
Osteoporosis test in the past 12 months	0.158	0.365	0	1	20,933	0.179	0.131	***
Any other gynecological examination in the past 12 months	0.311	0.463	0	1	21,035	0.266	0.392	***
Perceptions of early detection, prevention and treatment of breast cancer								
Agreed: The sooner a cancer is detected, the better it can be treated.	0.979	0.143	0	1	5,347	0.978	0.980	
Agreed: A mammography will detect signs of breast cancer.	0.964	0.187	0	1	5,217	0.967	0.959	
Agreed: There are effective treatments for breast cancer.	0.896	0.305	0	1	4,744	0.894	0.898	
Agreed: In most cases, you can be cured of breast cancer if it is detected early enough.	0.937	0.242	0	1	5,030	0.935	0.940	
Agreed: Removal of the breast is the only way to be cured of breast cancer.	0.232	0.422	0	1	4,626	0.266	0.190	***
Agreed: Do you personally think that cancer cannot be prevented?	0.405	0.491	0	1	5,108	0.429	0.376	***
Organized screening program	0.317	0.465	0	1	21,156	0.324	0.366	***
Retired	0.560	0.496	0	1	18,042			
Age	58.739	8.778	45	75	21,156	62.974	52.597	***
Survey year								
Year 1996	0.168	0.374	0	1	21,156	0.167	0.158	
Year 1997	0.161	0.368	0	1	21,156	0.154	0.149	
Year 1998	0.160	0.367	0	1	21,156	0.152	0.153	
Year 2003	0.176	0.381	0	1	21,156	0.165	0.189	***
Year 2006	0.334	0.472	0	1	21,156	0.362	0.350	*
Age when finished full-time education								
15 or younger	0.426	0.495	0	1	21,061	0.475	0.259	***
16 -19	0.363	0.481	0	1	21,061	0.354	0.417	***
20 and above	0.208	0.406	0	1	21,061	0.171	0.318	***
Still studying	0.003	0.053	0	1	21,061	0.000	0.006	***

Sources: EB66.2, EB59.0, EB49, EB47.2, EB44.3. Notes: The last column shows the significance of a t-test for equality of means between working and non-working women. *** p<0.01, ** p<0.05, * p<0.1.

Figure 1 shows mammography use by age for all countries as well as separately for countries with and without an organized screening program. Between ages 40 and 50, there is little difference in mammography use across countries. At age 50, mammography uptake rates increase sharply in countries with an organized screening program. For both groups of countries, uptake rates peak between age 50 and age 55 and decline thereafter; however, between ages 50 and 70 uptake rates in countries with a screening program are consistently higher than in countries without a screening program. For example, at age 52 the uptake rate is about 60% for women in countries with a program, while it is only slightly above 40% for women in countries without a program. Beyond age 70, uptake rates become very similar for both groups of countries. Overall, the uptake rate decreases after 60 years old. This age trend in mammography utilization has been previously found (Buchmueller and Goldzahl, 2018; Carrieri and Wuebker, 2016). This pattern is not related to the underlying risk of developing breast cancer since its risk does not decrease at 60 years old (Jemal et al., 2007). The literature has not yet provided alternative explanation to this trend. It should be noted that Figure 1 presents average uptake rates across years and countries. Reproducing this figure by year[11] shows that mammography uptake increased over time, and the gap between countries with and without a screening program has narrowed. Still, we find the same pattern for all five years observed in our sample.

[11] Figures are available upon request.

Figure 1



Source: Eurobarometer, own calculations. The figure shows of average rates of mammography use in the last 12 months by age in years.

4 Methods

4.1 Identification and estimation

The retirement decision of an individual is endogenous. While mandatory retirement rules exist in some countries or in specific sectors, most people decide themselves when to withdraw from the labor market. Consequently, the decision to retire could be influenced by factors that are associated with screening participation. For example, previous studies report that deteriorating health has a major impact on retirement decisions (McGarry, 2004), while others found that health status is associated with screening participation (Bouckaert and Schokkaert, 2016; Carrieri and Wuebker, 2016; Courtney-Long et al., 2011; Gandhi et al., 2015; Guilcher et al., 2014; Jensen et al., 2015; Wu, 2003). We need to address this endogeneity in order to interpret our estimates as causal effects.

In line with previous studies on retirement and health (see, e.g., Coe and Zamarro, 2011; Godard, 2016; Mazzonna and Peracchi, 2012), we exploit age thresholds for pension eligibility as a source of exogenous variation in retirement status in an instrumental variable estimation. In many countries, eligibility for a state pension is tied to a minimum age

threshold. These thresholds provide a financial incentive for individuals to postpone retirement until they have reached a certain age, since they are not able to draw upon their state pension beforehand. Assuming that other factors do not change once an individual exceeds the age threshold, we can use this information on whether an individual is above the relevant age threshold as an instrument for retirement. Confounding factors (such as health) vary with age, and hence we need to control for age. Conditional on age, these confounders should not be correlated with the state pension ages, especially given that the state pension ages vary between countries as well as within countries over time.
The resulting model can be written as follows:

$$retired_i = \alpha + f(Age_i) + \tau_1 ERA_i + \tau_2 ORA_i + \sum_{j=1}^{4} \beta_j Educ_{j,i} + c_{l,i} + t_{w,i} + c_{l,i}t_{w,i} + \varepsilon_i$$

$$Screen_i = \theta + g(Age_i) + \pi Retired_i + \sum_{j=1}^{4} \rho_j Educ_{j,i} + c_{l,i} + t_{w,i} + c_{l,i}t_{w,i} + \nu_i$$

In the first stage of the model, we regress retirement status of individual *i* on a continuous age trend $f(Age_i)$ as well as binary indicators for whether an individual is above the threshold for early retirement (ERA_i) or official retirement (ORA_i). We also control for education. The variables $Educ_{j,i}$ measures the age when individual *i* finished full-time education using four categories – *(i)* 15 years or younger, *(ii)* 16 to 19 years, *(iii)* 20 years and above, or *(iv)* still studying. $c_{l,i}$ is a set of country-fixed effects, and similarly $t_{w,i}$ is a set of year-fixed effects. We also include country-by-year-fixed effects into the model. ε_i is the idiosyncratic error term. Similarly, in the second stage of the model we control for age, education, country-, year- and country-by-year fixed effects. Under the assumptions described above, π is the causal effect of retirement on screening participation.[12]We choose the age trend for our model based on goodness-of-fit. We consider linear, quadratic, cubic, country-specific linear and country-specific quadratic age trends. The Akaike Information Criterion (AIC) indicates that a

[12] We note that the identifying assumptions in our IV model are very similar to those required in a fuzzy regression discontinuity design (RDD). However, we use two age thresholds as instruments in our model, and these age thresholds vary across observations. Thus, standard methods for RDD estimation cannot be readily applied to our data, and we therefore follow a standard IV framework.

country-specific quadratic age trend provides the best fit.[13] We estimate the model as a linear probability model using two-stage least squares.[14]

4.2 Specification curve analysis

The estimates from our preferred IV specification might be sensitive to several analytical choices, including the specification of the age trend, the sample selection or the definition of retirement. We assess the robustness of our results using a novel approach suggested by Simonsohn et al. (2015) (see also Christensen and Miguel (2018) for an overview and Rohrer et al. (2017) for an application in psychology). They propose that researchers define an extensive set of a priori plausible specifications, which are then estimated and visualized in a so-called "specification curve". For this paper, we focus on 36 different specifications, defined through a combination of age trend, age range, retirement definition and exclusion of observations within 12 months of the state pension age. The resulting specification curves allow us to assess the robustness of the results and identify the specification characteristics that affect our conclusions.[15] Moreover, it is possible to test the joint significance of the curve with a permutation test. For this test, we generate 500 datasets that are consistent with the null hypothesis of no effect of retirement on mammography use. This is done by jointly permuting the assignment of the retirement variable as well as the instrument.[16] Then, we estimate a specification curve on each of these generated datasets. The chosen test statistic for this analysis is the number of specifications that showed the same sign as the estimate from our preferred specification and are significant at the 5 percent level. We compare the value for the observed specification curve against the 500 values obtained from the generated specification curves to derive an exact p-value. This p-value can be interpreted as the probability that the statistic is at least as extreme as the observed value if the null hypothesis holds.

4.3 Visual evidence

First, we examine the data visually to confirm that the retirement probability increases at the respective state pension age. Since the state pension age varies across countries and over time, we first create a new variable "years to state pension age" by centering age at the state

[13] Results are available upon request.

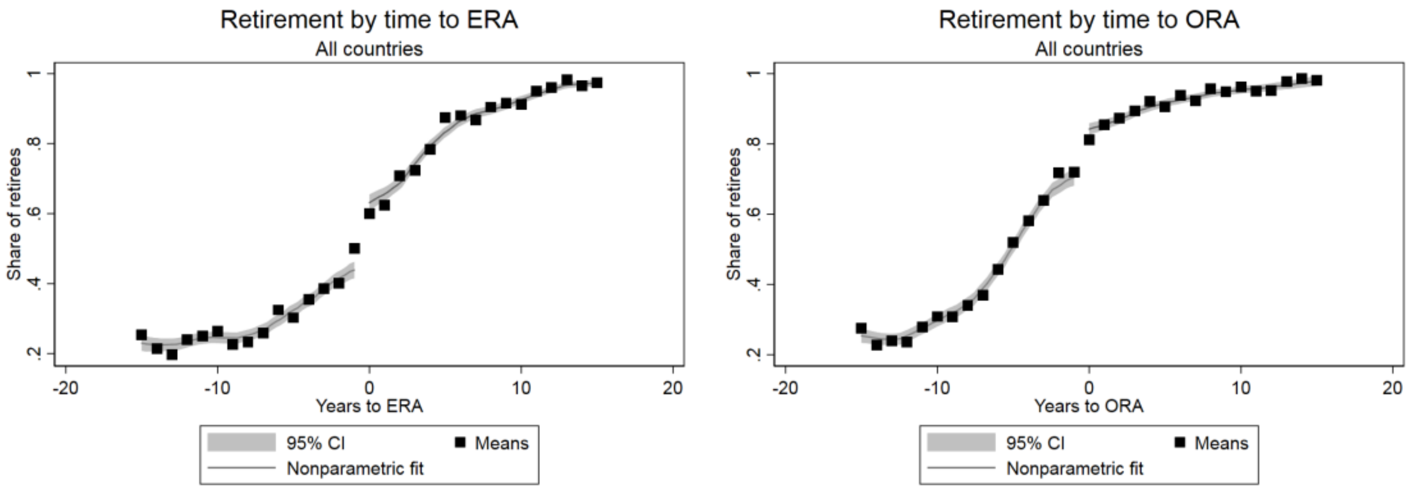
[14] All estimations are done using the ivreg2-command in Stata 15, see Baum et al. (2002).

[15] Specification curve analysis cannot be used to select a preferred specification. Instead, it complements model selection procedures by visualizing differences across specifications.

[16] We permute treatment and instrument assignment as a block to preserve the relationship between instrument and treatment. If we were to permute only one of these variables, the instrument would no longer affect the treatment status and our empirical model would not be valid.

pension age for each observation. Then, we plot the share of retired women against this new variable. The left panel in Figure 2 shows a plot of the share of retirees against "years to ERA", and the right panel plots the share of retirees against "years to ORA".

Figure 2

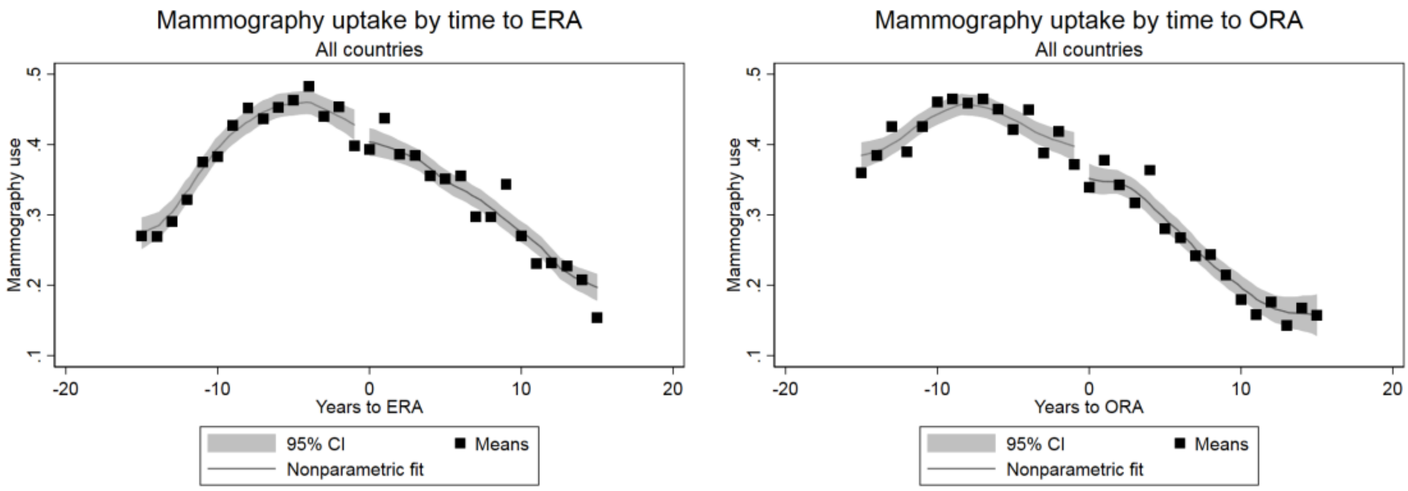


Source: Eurobarometer, own calculation. "Years to ERA" and "Years to ORA" are calculated by subtracting age from the relevant ERA or ORA. The markers show average retirement rates against year to ERA/ORA. The lines show local polynomial fits on both sides of the threshold, and the gray areas show 95 percent confidence intervals around the fit.

For early retirement, the share of retirees increases almost linearly. However, there is a clear increase at the ERA, where the share of retirees increases by about 15 percentage points. Similarly, the share of retirees increases with years to ORA, however, there is a sudden increase at zero. This suggests that there is a change in the retirement probability at these age thresholds, and therefore we can use those thresholds as instruments for retirement status.

Similarly, we examine whether mammography use changes at the state pension age and whether this effect differs between countries with and without an organized screening program.

Figure 3

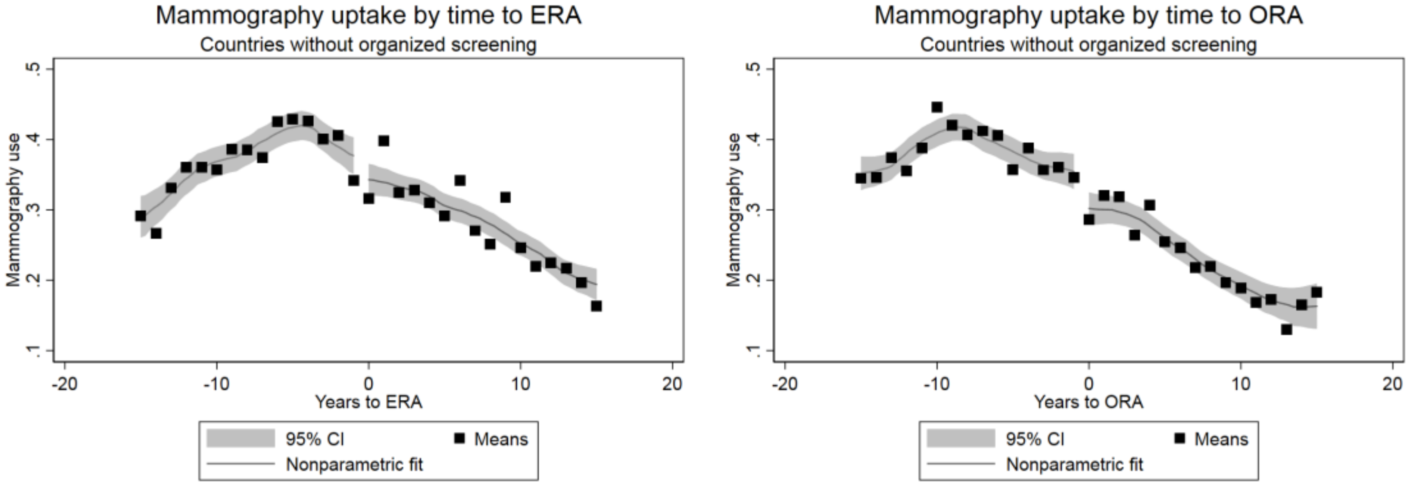


Source: Eurobarometer, own calculation. "Years to ERA" and "Years to ORA" are calculated by subtracting age from the relevant ERA or ORA. The markers show average mammography use rates against year to ERA/ORA. The lines show local polynomial fits on both sides of the threshold, and the gray areas show 95 percent confidence intervals around the fit.

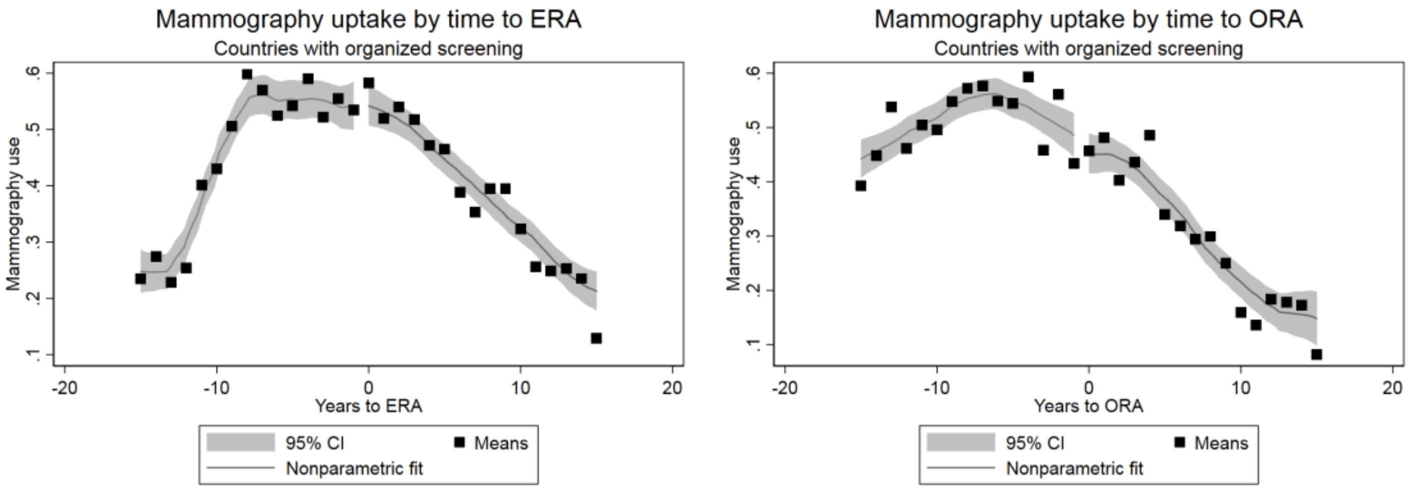
Figure 3 shows average mammography use against years to ERA and to ORA. The points mark average levels for every year ranging from 15 years before to 15 years after the respective state pension age. The lines show a local polynomial fit, and the grey areas provide a 95% confidence interval around the fitted line. While there is a clear downward trend in mammography use, there is no clear change at the ERA. In contrast, there appears to be a sudden decrease at the ORA, which suggests that retirement might negatively affect mammography use for women retiring at the official retirement age. There is also important heterogeneity in the data. In Figure 4, we plot mammography use against years to state pension age separately for countries without an organized screening program and those with an organized screening program. For countries with an organized screening program (Panel B), there is no change while for countries without an organized screening program (Panel A), there is a clear decrease at both the ERA and the ORA. While it is not a priori clear whether these differences are significant, the figures suggest that retirement could affect mammography use negatively at least in countries without a screening program. All in all, the figures suggest that retirement could affect mammography use.

Figure 4

A. Countries without an organized screening program



B. Countries with an organized screening program



Source: Eurobarometer, own calculation. "Years to ERA" and "Years to ORA" are calculated by subtracting age from the relevant ERA or ORA. The markers show average mammography use rates against year to ERA/ORA. The lines show local polynomial fits on both sides of the threshold, and the gray areas show 95 percent confidence intervals around the fit. The upper panel (A) is based on observations without an organized screening program in the year of the survey, the lower panel (B) shows data for countries with an organized screening program in the year of the survey.

5 Results

5.1 Regression results

5.1.1. Mammography use

Based on the visual evidence, we expect heterogeneity between countries with and without an organized screening program. Thus, in addition to our main model described in section 4, we also estimate a model with an interaction term between retirement and existence of a program. Table 3 presents the estimated effect of retirement on mammography use. The Kleibergen-Paap Wald F-statistics for weak instruments are above the often used value of 10 and suggest that the instruments are jointly significant as predictors of retirement status. The change at ERA is considerably larger than the change at the ORA, suggesting that the ERA is a stronger predictor of retirement behavior than the ORA.[17] Hansen's J-statistic is not significant at the 5 percent level, suggesting that ERA and ORA are both jointly valid instruments. Nevertheless, we examine treatment effect heterogeneity between ERA and ORA in the appendix (section A.1). For now, we note that under treatment effect heterogeneity, the 2SLS estimator with multiple instruments provides a weighted average treatment effect (Angrist and Imbens, 1995).

Table 3: Regression results

	Basic model	*Interacted model*
Retired	-0.258***	-0.286***
	(0.060)	(0.064)
Retired x program	-	0.088
	-	(0.059)
Above ERA	0.195***	0.199***
	(0.014)	(0.017)
Above ORA	0.112***	0.089***
	(0.013)	(0.015)
Wald F	*188.5*	*94.4*
Hansen's J	*0.935*	*0.898*
N	*17,875*	*17,875*

Sources: Eurobarometer, own calculations. All models include a country-specific quadratic age trend, education, country-, year- and country-by-year fixed effects. The interacted model includes a control variable for program existence and age range of the program. The sample includes women aged 45-75. *** p<0.01; ** p<0.05; * p<0.1.

[17] This finding is in line with, e.g., findings reported by Godard (2016) and Eibich (2015), although other studies found that the official retirement age is a more important predictor than the early retirement age (Celidoni and Rebba, 2017; Coe and Zamarro, 2011).

The estimated effects show that being retired reduces the probability of mammography use by about 26 percentage points.[18] The reduction in mammography use upon retirement is 8.8 percentage points lower in countries with an organized screening program. However, this estimate is not statistically significant. The interacted model suggests that the negative main effect of retirement clearly dominates and is not mitigated by the existence of an organized screening program.

5.1.2. Other secondary preventive care procedures

We further extend our analysis by investigating the effect of retirement on other preventive healthcare procedures such as manual breast examinations, ovary examinations, pap smear tests, osteoporosis tests as well as any other gynecological examination. The estimated effects in Table 4 are negative and statistically significant for almost all tests, with the exception of osteoporosis tests. This is likely due to the fact that osteoporosis tests are relatively uncommon – only 16 percent of the women reported that they had an osteoporosis test done in the last 12 months. Thus, we conclude that the negative effect of retirement on mammography use is unlikely to be specific to the procedure or the disease. Instead, it likely reflects a general reduction in preventive healthcare use of retired women. However, it is worth noting that the estimated effect on mammography use is considerably larger than the point estimates for other procedures.

Table 4: Secondary outcomes

	Manual breast examination	**Ovary examination**	**Pap smear test**	**Osteoporosis test**	**Any other gynecological examination**
Retired	-0.204***	-0.191***	-0.167***	-0.061	-0.192***
	(0.059)	(0.049)	(0.056)	(0.045)	(0.054)
Wald F	*189.3*	*189.1*	*188.3*	*190.2*	*190.2*
N	*17,865*	*17,804*	*17,850*	*17,788*	*17,868*

Sources: Eurobarometer, own calculations. All models include controls for education, country-, year- and country-by-year fixed effects as well as a country-specific quadratic age trend. The sample includes women aged 45-75. For all outcomes women were asked whether they had the examination done in the past 12 months. *** p<0.01; ** p<0.05; * p<0.1.

[18] To put the effect size into perspective, we note that mammography use declines by about 30 percentage points between the ages of 60 and 70 in our sample (Figure 1). Moreover, the estimated causal effect of retirement is a local treatment effect, i.e., it only affects the complier population (those individuals who retire when reaching the ERA or ORA) – 20 percent of the sample at the ERA and 9 to 11 percent of the sample at the ORA. Hence, a reduction in mammography use by about 26 percentage point appears plausible.

5.2 Robustness checks

5.2.1 Specification curve analysis

The specification curves display all specifications resulting from the combination of the following characteristics: the degree of the polynomial, a country-specific age trend, restricting the sample to women within the age range of their country's screening program[19], retirement definition (excluding homemakers, or including unemployed women) and omitting observations within the first 12 months after passing the ERA/ORA to address potential measurement error stemming from retrospective measurement of secondary preventive care use.

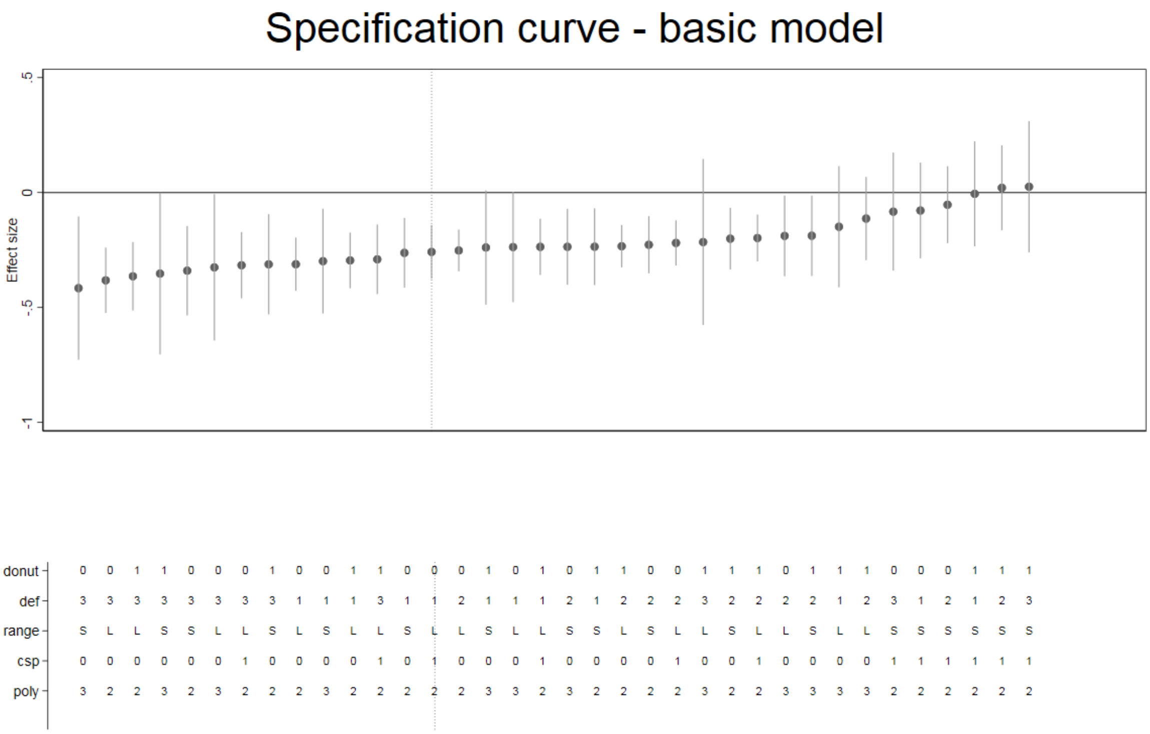
Figure 5 shows the specification curve for the main model (column 1 in Table 3). First, we note that our results are robust to changes in specification. While a quarter of the specifications provide non-significant point estimates at the 5% level, the majority of specifications are negative and significant. There is not one specific characteristic that leads to find a non-significant result. However, it seems that the combination of selecting a small age range and a country-specific age trend leads to an insignificant result.

The permutation test suggests that the specification curve is significantly different from randomly generated curves at the 1 percent level (p=0.002).[20] Thus, we conclude that our results are fairly robust to changes in specification.

[19] For the two countries that have to this date not introduced a screening program, we included observations within the most common age range, i.e., between 50 and 69 years old.

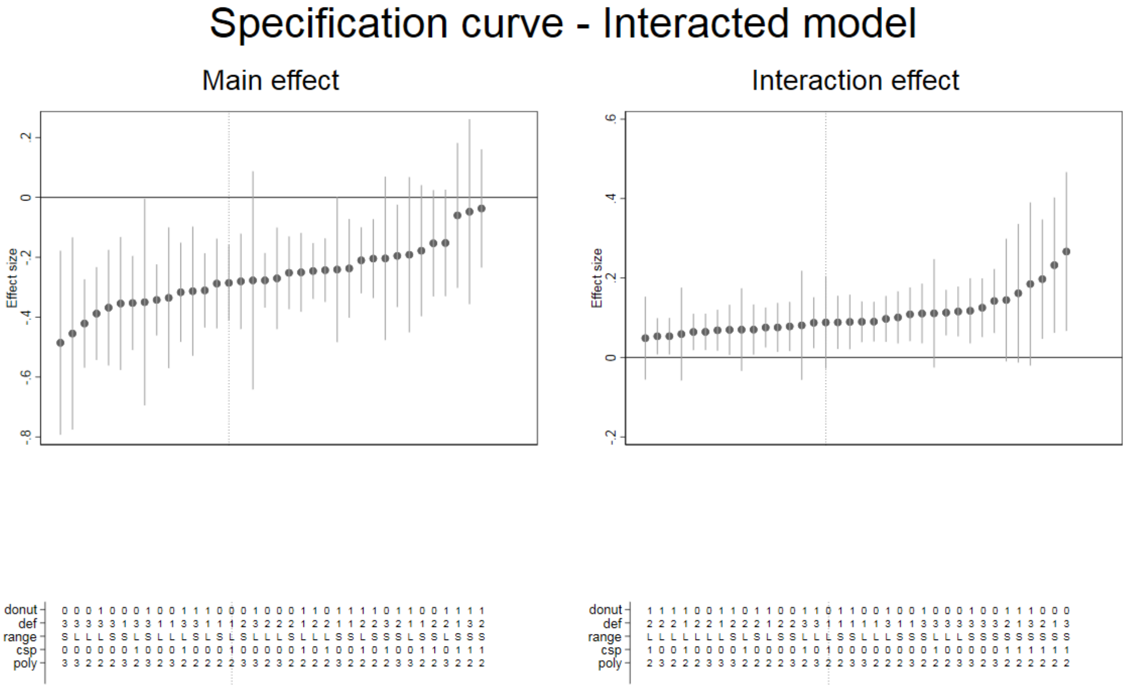
[20] For the simulated specification curves, the number of negative and significant point estimates ranged from 0 to 12 (out of 36 specifications), while in our observed specification curve 25 estimates are negative and significant at the 5% level.

Figure 5



Source: Eurobarometer, own calculations. The markers show the point estimates and the lines show 95 percent confidence intervals for the effect of retirement on mammography use in the past 12 months. The dotted line shows the preferred specification from Table 3. The lower panel shows the model specification. “poly” gives the degree of the polynomial, “csp” indicates whether the age trend is country-specific. “Range” indicates the age range, with “L” standing for ages 45-75, and “S” indicating the age range of the country’s screening program (Table 1). “Def” gives the definition of retirement status, definition 1 includes homemakers as retired but excludes unemployed women. For definition 2 homemakers are coded as non-retired, and in definition 3 both homemakers and unemployed women are coded as retired. “Donut” indicates whether the first 12 months after the ERA and ORA were excluded or not. All models include further controls for education, country-, year- and country-by-year fixed effects.

Figure 6

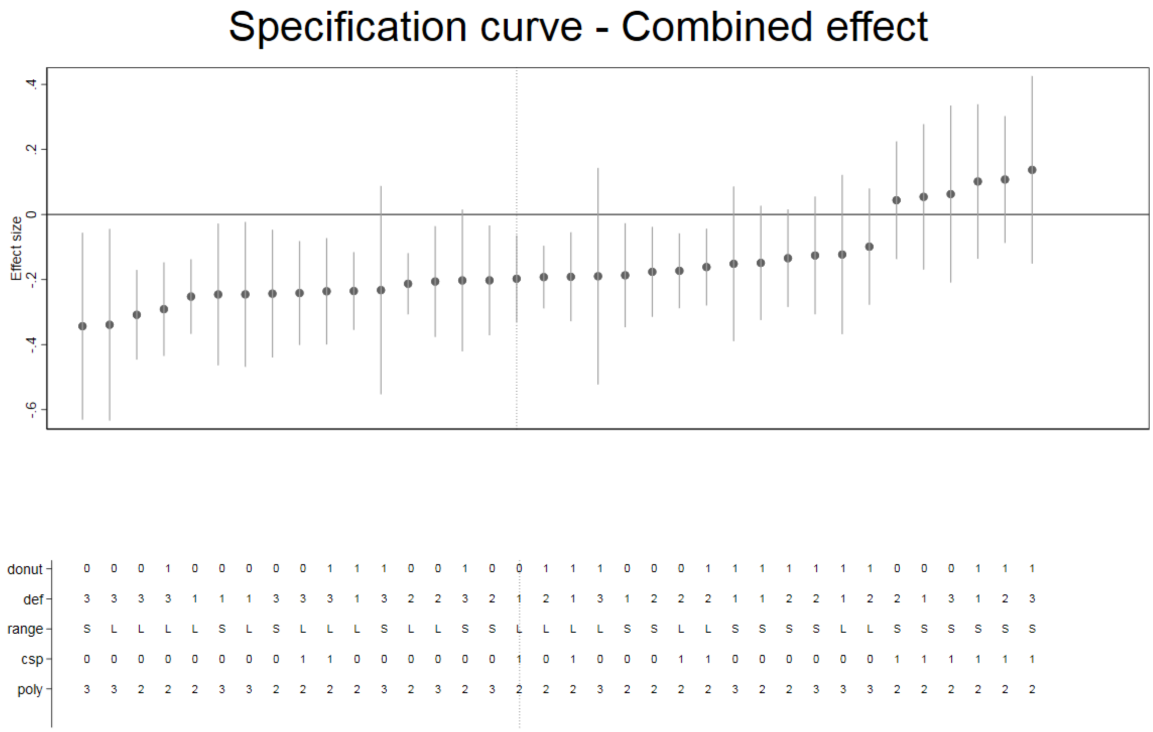


Source: Eurobarometer, own calculations. Panel a shows the main effect of retirement, and panel b shows the interaction effect between retirement and screening program existence. The markers show the point estimates and the lines show 95 percent confidence intervals for the effect of retirement on mammography use in the past 12 months. The dotted line shows the preferred specification from Table 3. The lower panel shows the model specification. "poly" gives the degree of the polynomial, "csp" indicates whether the age trend is country-specific. "Range" indicates the age range, with "L" standing for ages 45-75, and "S" indicating the age range of the country's screening program (Table 1). "Def" gives the definition of retirement status, definition 1 includes homemakers as retired but excludes unemployed women. For definition 2 homemakers are coded as non-retired, and in definition 3 both homemakers and unemployed women are coded as retired. "Donut" indicates whether the first 12 month after the ERA and ORA were excluded or not. All models include further controls for education, country-, year- and country-by-year fixed effects.

Figure 6 shows specification curves for the main effect of retirement and the interaction effect between retirement and screening programs. Panel a shows that the main effect of retirement follows a very similar pattern to Figure 5. For the interaction effect a third of the specifications provide non-significant point estimate (Panel b), including our preferred specification. For the remaining specifications, the interaction effect between retirement and program existence is positive and significant although of a rather small magnitude.

Adding the two coefficients up provides the estimated effect of retirement for countries with a screening program. The specification curve of this combined effect is available in Figure 7 and shows that retirement still has a strong negative impact on mammography use even if an organized screening program exists.

Figure 7



Source: Eurobarometer, own calculations. The markers show the point estimates and the lines show 95 percent confidence intervals for the effect of retirement on mammography use in the past 12 months for countries with an organized screening program. The dotted line shows the preferred specification from Table 3. The lower panel shows the model specification. “poly” gives the degree of the polynomial, “csp” indicates whether the age trend is country-specific. “Range” indicates the age range, with “L” standing for ages 45-75, and “S” indicating the age range of the country’s screening program (Table 1). “Def” gives the definition of retirement status, definition 1 includes homemakers as retired but excludes unemployed women. For definition 2 homemakers are coded as non-retired, and in definition 3 both homemakers and unemployed women are coded as retired. “Donut” indicates whether the first 12 month after the ERA and ORA were excluded or not. All models include further controls for education, country-, year- and country-by-year fixed effects.

The permutation test suggests that the specification curves for both the effect of retirement and the interaction term are significant at the 5 percent level (p=0.002 for both). We can also conduct a joint test by using the number of specifications with a negative and significant effect of retirement and a positive and significant interaction term as our test statistic. In this case, the observed specification curves are jointly significant at the 1 percent level (p=0.002).[21] Therefore, we conclude that the effect of retirement on mammography use is negative overall, but it might be mitigated to a small extent by the existence of organized screening programs.

Table A.2 in the appendix reports the estimated coefficients for robustness checks, in which we only change one aspect at a time. With one exception, these robustness checks are all included in the specification curves. The exception is that we drop one country at a time to check whether our effect was driven by a specific country. In unreported regressions, we also estimate our model for each country individually. While the sample sizes are too small to draw robust conclusions for individual countries, we note that the point estimate is negative for 19 out of 25 countries.

5.2.2 Placebo tests

Table 5: Placebo outcomes

	Finished education before age 16	**Finished education between ages 16 and 19**	**Finished education after age 19**	**Mammography use - women who never did paid work**	**Mammography use - placebo state pension ages**
			A. Full sample		
Retired	0.013	0.034	-0.047	-3.57	-0.081
	(0.056)	(0.058)	(0.048)	(4.707)	(0.237)
Wald F	*188.8*	*188.8*	*188.8*	*0.5*	*10.4*
N	*17,917*	*17,917*	*17,917*	*3,074*	*17,875*
			B. Interacted model		
Retired	-0.005	0.043	-0.038	0.552	-0.012
	(0.060)	(0.062)	(0.051)	(4.319)	(0.239)
Retired x program	0.044	-0.018	-0.026	-3.737	-0.08
	(0.055)	*(0.057)*	*(0.047)*	*(3.731)*	*(0.098)*
Wald F	95.0	95.0	95.0	0.2	5.4
N	*17,917*	*17,917*	*17,917*	*3,074*	*17,875*

Sources: Eurobarometer, own calculations. All models include controls for education, country-, year- and country-by-year fixed effects as well as a country-specific quadratic age trend. The sample includes women aged 45-75.

[21] For the observed specification curve, 20 out of 36 models provide a negative and significant estimate for the effect of retirement and a positive and significant estimate for the interaction term. Among the simulated curves, the number of specifications with such results ranges from 0 to 12.

We conduct a placebo test and estimate our main specification with our three levels of education (finished full-time education before age 16, between ages 16 and 19, after age 19) as outcome variables. Since education is a pre-determined variable, it should not be affected by retirement. We also restrict the sample to women who never did paid work as they should not change their screening uptake at the state pension age. Furthermore, we test the effect of placebo state pension ages. The results are shown in Table 5. All estimated effects are close to zero and not statistically significant at conventional levels.

We conclude that the specification curves and the placebo analyses confirm the robustness of our findings.

6 Mechanisms

In this section, we study the mechanisms through which the effect of retirement affects mammography use. First, we investigate whether the effect of retirement on mammography use operates indirectly through changes in income or health status (Table A.3 in the appendix). The estimates of the effect of retirement, adjusted for income and health are not substantially different from our baseline estimate. It suggests that neither income nor health status mediate the effect of retirement on mammography use.[22]

Next, we examine whether the negative effect of retirement on mammography use can be explained by lower health insurance coverage, e.g., due to the loss of employer-sponsored complementary health insurance, large-scale workplace-based screening programs or incentive schemes. Unfortunately, there is no available data describing these features for all European countries for the time periods of interest. Therefore, we conduct two surrogate analyses. First, we look at self-employed versus employed women. If the estimated effect is driven by workplace-based screening or incentive schemes, then we would expect to find a reduction for employed but not self-employed women. The results (shown in Table A.3 in the appendix) are ambiguous – while the point estimate is negative for both self-employed and employed women (and even larger for self-employed women), it is not significant for self-employed women, partly due to weak instrument problems.

We exploit heterogeneity in the coverage of Social Health Insurance (SHI) at the country level to examine the role of (potentially employer-sponsored) complementary health

[22] It should be noted that this analysis does not account for potential endogeneity of the potential mediators.

insurance coverage. All European countries in our study have a SHI system that covers a large share of healthcare expenditures for both working and retired individuals. In countries where all expenditures are covered by SHI retirement should not affect healthcare access, since complementary health insurance plays no role in providing access to healthcare. In contrast, we would expect that the effect of retirement on secondary preventive care use is more pronounced in countries with a lower share of costs covered by SHI, since complementary health insurance is (relatively) more important in providing access to secondary preventive care. Hence, we investigate heterogeneity across institutional settings based on differences in coverage of SHI. We use OECD data on healthcare expenditures (OECD, 2017) covering 23 out of the 25 countries in our analysis.[23] We construct an indicator for "SHI coverage", which we define as the ratio of government and compulsory healthcare expenditures to total healthcare expenditures. A value of 1 would indicate that all healthcare expenditures are covered by the SHI system (e.g., tax financed as in the UK, or funded by compulsory health insurance schemes as in Germany), while a value of 0 indicates that all healthcare expenditures are voluntary (i.e., either out-of-pocket payments or covered by private health insurance schemes). In our sample, this indicator ranges from 0.49 to 0.92. Then, we divide the sample based on the median value of this indicator into a subsample with lower SHI coverage (ratio below 0.75) and a subsample with higher SHI coverage (ratio above 0.75). While this indicator mostly captures variation between countries, we note that there is some variation within countries. Five countries (Austria, Belgium, Ireland, Italy and the Netherlands) change their assigned group between years. The results in Table 6 indicate that the reduction in mammography use following retirement is driven by countries with lower SHI coverage of healthcare expenditures. This indicates that transitioning out of employment has a larger effect in countries where complementary health insurance covers a larger share of healthcare expenditures. This effect is not mitigated by the existence of organized screening programs.

[23] There are no data on Malta and Cyprus.

Table 6: The effect of retirement on mammography use

	Lower public coverage		Higher public coverage	
	Mammography use in the past 12 months	*Mammography use in the past 12 months*	*Mammography use in the past 12 months*	*Mammography use in the past 12 months*
Retired	-0.531***	-0.593***	-0.084	-0.124*
	(0.113)	(0.139)	(0.068)	(0.066)
Retired x program		0.149		0.112
		(0.096)		(0.086)
Above ERA	0.155***	0.103***	0.236***	0.292***
	(0.021)	(0.026)	(0.019)	(0.022)
Above ORA	0.101***	0.100***	0.130***	0.114***
	(0.019)	(0.024)	(0.018)	(0.020)
Wald F	*59.7*	*22.2*	*138.7*	*55.3*
Hansen's J	*0.4*	*0.817*	*0.9*	*0.932*
N	*8,373*	*8,373*	*9,200*	*9,200*

Sources: Eurobarometer, OECD Health data, own calculations. All models include controls for education, country-, year- and country-by-year fixed effects as well as a country-specific quadraticage trend. The sample includes women aged 45-75. Significance: *** p<0.01; ** p<0.05; * p<0.1.

Table 7: Retirement and cancer beliefs

	The sooner a cancer is detected, the better it can be treated.	**A mammography will detect signs of breast cancer.**	**There are effective treatments for breast cancer.**	**In most cases, you can be cured of breast cancer if it is detected early enough.**	**Removal of the breast is the only way to be cured of breast cancer.**	**Do you personally think that cancer cannot be prevented?**
Retired	-0.111***	0.037	-0.222**	0.062	0.074	0.194*
	(0.034)	(0.048)	(0.088)	(0.063)	(0.114)	(0.117)
Wald F	*43.0*	*44.7*	*36.5*	*41.4*	*36.7*	*45.3*
N	*5,346*	*5,216*	*4,743*	*5,029*	*4,625*	*5,107*

Sources: Eurobarometer, own calculations. All models include controls for education, country-, year- and country-by-year fixed effects as well as a country-specific quadratic age trend. The sample includes women aged 45-75. The outcome variables are binary indicators showing whether respondents agreed or disagreed with the statement. Significance: *** p<0.01; ** p<0.05; * p<0.1.

Retirement might affect knowledge and perceptions of cancer prevention through, e.g., changes in social networks or social interactions after retirement. In Table 7, we examine the effect of retirement on women's perceptions and knowledge concerning breast cancer prevention and treatment. The results indicate that retirement negatively affects women's perceptions of breast cancer prevention and treatment. Retired women are 11 percentage points less likely to agree that early detection will result in better treatment for breast cancer. They are 22 percentage points less likely to agree that there are effective treatments for breast cancer, and the likelihood that they thought that cancer can be prevented was reduced by 19 percentage points. The first two estimates are respectively significant at the 1 and 5 percent level, while the latter estimate is significant at the 10 percent level.[24]

7 Discussion

We analyze the effect of retirement on mammography use using data from 25 European countries. We address the endogeneity of retirement by using state pension ages for early and official retirement as instruments. Our findings show that retirement reduces mammography use by about 26 percentage points. Organized screening programs might reduce the negative impact of retirement, but the overall effect of retirement is still negative. Retirement also reduces the use of other preventive health check-ups, such as manual breast examinations, ovary examinations, or pap smear tests. However, the reduction is considerably smaller than the effect of retirement on mammography use. Nonetheless, this suggests that the negative effect of retirement is neither specific to mammography nor to breast cancer. Our evidence does not suggest that the reduction in mammography use is driven by changes in health or income. We find that the negative effect of retirement is stronger in countries with lower SHI coverage of healthcare expenditures, which suggests that access to health care (e.g., due to employer-sponsored complementary health insurance) can partly explain the negative effect. We find that retirement negatively affects women's perceptions on breast cancer prevention and treatment. This could be caused by a change in the size and composition of social networks upon retirement. Our results are also in line with the health capital model (Galama et al., 2013; Grossman, 1972), which suggests that retirees have fewer incentives to invest in their health and will reallocate some of their health investments into consumption. It appears plausible that this effect would be more pronounced for preventive healthcare (such as cancer

[24] It should be noted that we control for education as well as country-by-year fixed effects, and therefore these results are unlikely to be confounded by cohort effects.

screening) than for curative healthcare. While our results are consistent with this hypothesis, we cannot draw any definite conclusions using reduced-form models.

This paper contributes to several strands of the literature: We contribute to the literature on the health effects of retirement by showing that retirement reduces secondary preventive care use. Our study also contributes to the literature on the determinants of preventive healthcare use by demonstrating in a causal analysis that socioeconomic factors (such as employment status) affect uptake of cancer screening as well as beliefs on breast cancer prevention and treatment. On the methodological side, we apply a novel technique, specification curve analysis, to assess the robustness of our findings. The specification curves provide evidence that our finding is unlikely to be caused by a type-I error ("false positive"). Lastly, we examine whether the effect of retirement differs between countries with and without an organized screening program. Since 2012, almost all countries in our sample routinely invite women to participate in their national breast cancer screening program. Yet, our results indicate that retirement reduces mammography use despite the existence of screening program. We provide suggestive evidence that this reduction is likely driven by both institutional factors (such as generosity of the healthcare system) and individual factors (knowledge and beliefs of cancer prevention of treatment). Taken together, this implies that public policy initiatives should specifically target retiring women and encourage them to pursue secondary preventive care. Providing information on breast cancer screening and treatment seems to be an avenue worth investigating.

References

Altobelli, E., Lattanzi, A., 2014. Breast cancer in European Union: an update of screening programmes as of March 2014. Int. J. Oncol. 45, 1785–1792.

Angrist, J.D., Imbens, G.W., 1995. Two-Stage Least Squares Estimation of Average Causal Effects in Models with Variable Treatment Intensity. J. Am. Stat. Assoc. 90, 431–442. https://doi.org/10.1080/01621459.1995.10476535

Baum, C.F., Schaffer, M.E., Stillman, S., 2002. IVREG2: Stata module for extended instrumental variables/2SLS and GMM estimation. Boston College Department of Economics.

Berger, N.A., Savvides, P., Koroukian, S.M., Kahana, E.F., Deimling, G.T., Rose, J.H., Bowman, K.F., Miller, R.H., 2006. Cancer in the Elderly. Trans. Am. Clin. Climatol. Assoc. 117, 147–156.

Bingley, P., Martinello, A., 2013. Mental retirement and schooling. Eur. Econ. Rev. 63, 292–298. https://doi.org/10.1016/j.euroecorev.2013.01.004

Blake, H., Garrouste, C., 2013. Killing me softly: work and mortality among French seniors (Health, Econometrics and Data Group (HEDG) Working Paper). HEDG, c/o Department of Economics, University of York.

Bloemen, H., Hochguertel, S., Zweerink, J., 2017. The causal effect of retirement on mortality: Evidence from targeted incentives to retire early. Health Econ. n/a-n/a. https://doi.org/10.1002/hec.3493

Bonsang, E., Adam, S., Perelman, S., 2012. Does retirement affect cognitive functioning? J. Health Econ. 31, 490–501. https://doi.org/10.1016/j.jhealeco.2012.03.005

Börsch-Supan, A., Schuth, M., 2013. Early Retirement, Mental Health, and Social Networks, in: Discoveries in the Economics of Aging. University of Chicago Press, pp. 225–250.

Bouckaert, N., Schokkaert, E., 2016. Differing types of medical prevention appeal to different individuals. Eur. J. Health Econ. HEPAC Health Econ. Prev. Care 17, 317–337. https://doi.org/10.1007/s10198-015-0709-6

Buchmueller, T.C., Goldzahl, L., 2018. The Effect of Organized Breast Cancer Screening on Mammography Use: Evidence from France. Natl. Bur. Econ. Res. Work. Pap. Ser. No. 24316. https://doi.org/10.3386/w24316

Caroli, E., Lucifora, C., Vigani, D., 2016. Is there a Retirement-Health Care utilization puzzle? Evidence from SHARE data in Europe. CEPREMAP Doc. Trav. Docweb N O 1609.

Carrieri, V., Wuebker, A., 2016. Quasi-Experimental Evidence on the Effects of Health Information on Preventive Behaviour in Europe. Oxf. Bull. Econ. Stat. 78, 765–791.

Celidoni, M., Rebba, V., 2017. Healthier lifestyles after retirement in Europe? Evidence from SHARE. Eur. J. Health Econ. 18, 805–830. https://doi.org/10.1007/s10198-016-0828-8

Christakis, N.A., Fowler, J.H., 2008. The Collective Dynamics of Smoking in a Large Social Network. N. Engl. J. Med. 358, 2249–2258. https://doi.org/10.1056/NEJMsa0706154

Christensen, G., Miguel, E., 2018. Transparency, Reproducibility, and the Credibility of Economics Research. J. Econ. Lit. 56, 920–80. https://doi.org/10.1257/jel.20171350

Coe, N.B., Zamarro, G., 2015. Does Retirement Impact Health Care Utilization? (SSRN Scholarly Paper No. ID 2714144). Social Science Research Network, Rochester, NY.

Coe, N.B., Zamarro, G., 2011. Retirement effects on health in Europe. J. Health Econ. 30, 77–86. https://doi.org/10.1016/j.jhealeco.2010.11.002

Courtney-Long, E., Armour, B., Frammartino, B., Miller, J., 2011. Factors associated with self-reported mammography use for women with and women without a disability. J. Womens Health 2002 20, 1279–1286. https://doi.org/10.1089/jwh.2010.2609

De Grip, A., Lindeboom, M., Montizaan, R., 2011. Shattered Dreams: The effects of changing the pension system late in the game. Econ. J. 122, 1–25.

Eibich, P., 2015. Understanding the effect of retirement on health: Mechanisms and Heterogeneity. J. Health Econ. 43, 1–12. https://doi.org/10.1016/j.jhealeco.2015.05.001

Euwals, R., van Vuuren, D., Wolthoff, R., 2010. Early Retirement Behaviour in the Netherlands: Evidence From a Policy Reform. Econ. 158, 209–236. https://doi.org/10.1007/s10645-010-9139-0

Ferlay, J., Autier, P., Boniol, M., Heanue, M., Colombet, M., Boyle, P., 2007. Estimates of the cancer incidence and mortality in Europe in 2006. Ann. Oncol. 18, 581–592.

Fitzpatrick, M.D., Moore, T.J., 2018. The mortality effects of retirement: Evidence from Social Security eligibility at age 62. J. Public Econ. 157, 121–137. https://doi.org/10.1016/j.jpubeco.2017.12.001

Fletcher, J.M., 2014. Late life transitions and social networks: The case of retirement. Econ. Lett., Economics Letters 125, 459–462. https://doi.org/10.1016/j.econlet.2014.10

Frimmel, W., Pruckner, G., 2018. Retirement and healthcare utilization. Verein für Socialpolitik / German Economic Association.

Galama, T., Kapteyn, A., Fonseca, R., Michaud, P.-C., 2013. A health production model with endogenous retirement. Health Econ. 22, 883–902. https://doi.org/10.1002/hec.2865

Gandhi, P.K., Gentry, W.M., Kibert, J.L., Lee, E.Y., Jordan, W., Bottorff, M.B., Huang, I.-C., 2015. The relationship between four health-related quality-of-life indicators and use of mammography and Pap test screening in US women. Qual. Life Res. Int. J. Qual. Life Asp. Treat. Care Rehabil. 24, 2113–2128. https://doi.org/10.1007/s11136-015-0968-9

GESIS, 2017. Eurobarometer Data Service [WWW Document]. URL https://www.gesis.org/eurobarometer-data-service/home/ (accessed 10.12.17).

Godard, M., 2016. Gaining weight through retirement? Results from the SHARE survey. J. Health Econ. 45, 27–46. https://doi.org/10.1016/j.jhealeco.2015.11.002

Gøtzsche, P.C., Jørgensen, K.J., 2013. Screening for breast cancer with mammography. Cochrane Libr.

Grossman, M., 1972. On the Concept of Health Capital and the Demand for Health. J. Polit. Econ. 80, 223–255.

Grøtting, M.W., Lillebø, O.S., 2017. Health effect of retirement. Evidence from Norwegian Survey and Register Data. Univ. Bergen Work. Pap. Econ. No 217.

Guilcher, S.J.T., Lofters, A., Glazier, R.H., Jaglal, S.B., Voth, J., Bayoumi, A.M., 2014. Level of disability, multi-morbidity and breast cancer screening: does severity matter? Prev. Med. 67, 193–198. https://doi.org/10.1016/j.ypmed.2014.07.025

Hagen, J., 2017. The effects of increasing the normal retirement age on health care utilization and mortality. J. Popul. Econ. 1–42. https://doi.org/10.1007/s00148-017-0664-x

Hallberg, D., Johansson, P., Josephson, M., 2015. Is an early retirement offer good for your health? Quasi-experimental evidence from the army. J. Health Econ. 44, 274–285. https://doi.org/10.1016/j.jhealeco.2015.09.006

Hernaes, E., Markussen, S., Piggott, J., Vestad, O.L., 2013. Does retirement age impact mortality? J. Health Econ. 32, 586–598. https://doi.org/10.1016/j.jhealeco.2013.03.001

Insler, M., 2014. The Health Consequences of Retirement. J. Hum. Resour. 49, 195–233.

Jemal, A., Ward, E., Thun, M.J., 2007. Recent trends in breast cancer incidence rates by age and tumor characteristics among U.S. women. Breast Cancer Res. 9, R28–R28. https://doi.org/10.1186/bcr1672

Jensen, L.F., Pedersen, A.F., Andersen, B., Vedsted, P., 2015. Self-assessed health, perceived stress and non-participation in breast cancer screening: A Danish cohort study. Prev. Med. 81, 392–398. https://doi.org/10.1016/j.ypmed.2015.10.004

Jousten, A., Lefèbvre, M., Perelman, S., Pestieau, P., 2010. The Effects of Early Retirement on Youth Unemployment: The Case of Belgium, in: Social Security Programs and Retirement around the World: The Relationship to Youth Employment. University of Chicago Press, pp. 47–76.
Kämpfen, F., Maurer, J., 2016. Time to burn (calories)? The impact of retirement on physical activity among mature Americans. J. Health Econ. 45, 91–102. https://doi.org/10.1016/j.jhealeco.2015.12.001
Kuhn, A., Wuellrich, J.-P., Zweimüller, J., 2010. Fatal attraction? Access to early retirement and mortality (IEW - Working Paper No. 499). Institute for Empirical Research in Economics - University of Zurich.
Leive, A., Stratmann, T., 2015. Do national cancer screening guidelines reduce mortality? J. Popul. Econ. 28, 1075–1095. https://doi.org/10.1007/s00148-014-0536-6
Marmot, M., Altman, D., Cameron, D., Dewar, J., Thompson, S., Wilcox, M., Screening, I.U.P. on B.C., others, 2013. The benefits and harms of breast cancer screening: an independent review. Br. J. Cancer 108, 2205.
Martínez-Alonso, M., Carles-Lavila, M., Pérez-Lacasta, M.J., Pons-Rodríguez, A., Garcia, M., Rué, M., 2017. Assessment of the effects of decision aids about breast cancer screening: a systematic review and meta-analysis. BMJ Open 7. https://doi.org/10.1136/bmjopen-2017-016894
Mazzonna, F., Peracchi, F., 2016. Unhealthy Retirement? J. Hum. Resour. https://doi.org/10.3368/jhr.52.1.0914-6627R1
Mazzonna, F., Peracchi, F., 2014. Unhealthy retirement? Evidence of occupation heterogeneity. USI Università della Svizzera italiana.
Mazzonna, F., Peracchi, F., 2012. Ageing, cognitive abilities and retirement. Eur. Econ. Rev. 56, 691–710. https://doi.org/10.1016/j.euroecorev.2012.03.004
McGarry, K., 2004. Health and Retirement: Do Changes in Health Affect Retirement Expectations? J. Hum. Resour. 39, 624–648.
MISSOC, 2017. Comparative tables [WWW Document]. URL http://www.missoc.org/INFORMATIONBASE/COMPARATIVETABLES/MISSOCDATABASE/comparativeTableSearch_de.jsp (accessed 10.11.17).
Motegi, H., Nishimura, Y., Terada, K., 2016. Does Retirement Change Lifestyle Habits? Jpn. Econ. Rev. 67, 169–191. https://doi.org/10.1111/jere.12104
Nishimura, Y., Oikawa, M., Motegi, H., 2018. What Explains the Difference in the Effect of Retirement on Health? Evidence from Global Aging Data. J. Econ. Surv. 32, 792–847. https://doi.org/10.1111/joes.12215
Nishimura, Y., Oikawa, M., Motegi, H., 2017. What Explains the Difference in the Effect of Retirement on Health? Evidence from Global Aging Data. J. Econ. Surv. forthcoming. https://doi.org/10.1111/joes.12215
OECD, 2017. Health at a Glance 2017. https://doi.org/10.1787/health_glance-2017-en
Patacchini, E., Engelhardt, 2016. Work, Retirement, and Social Networks at Older Ages. Center for Retirement Research.
Perry, N., Broeders, M., de Wolf, C., Törnberg, S., Holland, R., von Karsa, L., 2008. European guidelines for quality assurance in breast cancer screening and diagnosis. — summary document. Ann. Oncol. 19, 614–622.
Pletscher, M., 2017. The effects of organized screening programs on the demand for mammography in Switzerland. Eur. J. Health Econ. 18, 649–665.
Rohrer, J.M., Egloff, B., Schmukle, S.C., 2017. Probing Birth-Order Effects on Narrow Traits Using Specification-Curve Analysis. Psychol. Sci. 28, 1821–1832. https://doi.org/10.1177/0956797617723726
Rohwedder, S., Willis, R.J., 2010. Mental retirement. J. Econ. Perspect. 24, 119–138.

Sicsic, J., Pelletier-Fleury, N., Moumjid, N., 2017. Women's Benefits and Harms Trade-Offs in Breast Cancer Screening: Results from a Discrete Choice Experiment. Value Health. https://doi.org/10.1016/j.jval.2017.07.003
Simonsohn, U., Simmons, J.P., Nelson, L.D., 2015. Specification Curve: Descriptive and Inferential Statistics on All Reasonable Specifications (SSRN Scholarly Paper No. ID 2694998). Social Science Research Network, Rochester, NY.
Staubli, S., Zweimüller, J., 2013. Does raising the early retirement age increase employment of older workers? J. Public Econ. 108, 17–32. https://doi.org/10.1016/j.jpubeco.2013.09.003
WHO, 2017a. Breast cancer: prevention and control [WWW Document]. URL http://www.who.int/cancer/detection/breastcancer/en/index1.html (accessed 10.12.17).
WHO, 2017b. Cancer Fact Sheets: Breast Cancer [WWW Document]. URL http://gco.iarc.fr/today/fact-sheets-cancers?cancer=15&type=1&sex=2 (accessed 12.21.17).
Woloshin, S., Schwartz, L.M., Black, W.C., Kramer, B.S., 2012. Cancer Screening Campaigns — Getting Past Uninformative Persuasion. N. Engl. J. Med. 367, 1677–1679. https://doi.org/10.1056/NEJMp1209407
Wu, S., 2003. Sickness and preventive medical behavior. J. Health Econ. 22, 675–689.
Yazdanyar, A., Newman, A.B., 2009. The Burden of Cardiovascular Disease in the Elderly: Morbidity, Mortality, and Costs. Prev. Cardiol. Elder. 25, 563–577. https://doi.org/10.1016/j.cger.2009.07.007
Zantinge, E.M., van den Berg, M., Smit, H.A., Picavet, H.S.J., 2014. Retirement and a healthy lifestyle: opportunity or pitfall? A narrative review of the literature. Eur. J. Public Health 24, 433–439.
Ziebarth, N.R., 2018. Lung cancer risk perception biases. Prev. Med. 110, 16–23. https://doi.org/10.1016/j.ypmed.2018.01.020

Appendix

A.1 Treatment effect heterogeneity

W re-estimate our basic and interacted models using only one instrument at a time. The results are shown in Table A.1 below.

We note that the effect of retirement on mammography use is negative and significant in all specifications. For women retiring at the ORA the interaction term between retirement and program existence is relatively small and insignificant (i.e., similar to Table 3), while for women retiring at the ERA the interaction term is positive and significant. This suggests that organized screening programs mitigate the negative effect of retirement on mammography use, but only for women retiring early.

Table A.1: Treatment effect heterogeneity

	ERA		ORA	
	Full model	**Interacted model**	**Full model**	**Interacted model**
Retired	-0.256***	-0.276***	-0.266***	-0.281***
	-0.066	-0.071	-0.092	-0.106
Retired x program	-	0.097	-	0.043
	-	-0.066	-	-0.079
Above ERA/ORA	0.223***	0.215***	0.159***	0.130***
	-0.013	-0.015	-0.012	-0.014
Wald F	*276.1*	*137.9*	*178.5*	*76.4*
N	*17,875*	*17,875*	*16,471*	*16,471*

Sources: Eurobarometer, own calculations. All models include country-specific quadratic age trends, education, country-, year- and country-by-year fixed effects. Models in the left panel are estimated using only the ERA as an instrument for retirement, while the models in the right panel only use the ORA. The sample includes ages 45-75. *** p<0.01; ** p<0.05; * p<0.1.

Table A.2: Robustness checks

	Original model	Within program age range[a]	Retirement excludes homemakers	Retirement includes unemployed	Excluding observations <12months after ERA/ORA	Excluding one country at a time
			A. Full sample			
Retired	-0.258***	-0.051	-0.219***	-0.316***	-0.236***	[-0.226, -0.301][b]
	(0.060)	(0.103)	(0.050)	(0.074)	(0.062)	-
Wald F	*188.5*	*56.6*	*265.2*	*128.5*	*175.6*	-
N	*17,875*	*13,308*	*17,875*	*17,875*	*16,850*	-
			B. Interacted model			
Retired	-0.286***	-0.171	-0.239***	-0.355***	-0.250***	[-0.256, -0.343]b
	(0.064)	(0.109)	(0.053)	(0.081)	(0.067)	-
Retired x program	0.088	0.244***	0.077	0.097	0.059	[0.055, 0.125][c]
	(0.059)	(0.087)	(0.058)	(0.061)	(0.060)	-
Wald F	94.4	30.0	131.3	60.1	87.5	-
N	*17,875*	*13,308*	*17,875*	*17,875*	*16,850*	-

[a] The model includes only observations within the age range of the respective program. For countries without a mammography program, we only used observations between age 50 and age 69.

b All estimates were significant at the 1 percent level.

[c] One estimate is significant at the 5 percent level, three estimates are significant on the 10 percent level.

Sources: Eurobarometer, own calculations. All models include controls for education, country-, year- and country-by-year fixed effects as well as a country-specific quadratic age trend. All models except the one in column 3 include women aged 45 to 75. All models in panel B include a control variable for program existence and age range of the program. Significance: *** p<0.01; ** p<0.05; * p<0.1.

Table A.3: Heterogeneous effects by occupation

	Mammography use in the past 12 months				
	Full sample	**Self-employed women**	**Employed women**	**Controlling for health**	**Controlling for income**
			A. Simple model		
Retired	-0.258***	-0.459	-0.248***	-0.228***	-0.294***
	(0.060)	(0.284)	(0.061)	(0.078)	(0.086)
Wald F	*188.5*	*7.6*	*191.5*	*117.3*	*86.8*
N	*17,875*	*2,317*	*15,519*	*10,498*	*8,736*

Sources: Eurobarometer, own calculations. All models include controls for education, country-, year- and country-by-year fixed effects as well as a country-specific quadratic age trend. The sample includes women aged 45-75.