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**Working Paper**

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# Who gets a Mammogram amongst European women aged 50-69 years and why are there such large differences across European countries?

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# Who gets a Mammogram amongst European women aged 50-69 years and why are there such large differences across European countries?

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## Abstract

On the basis of the Survey of Health, Ageing, and Retirement (SHARE), we analyse the determinants of who engages in mammography screening focusing on European women aged 50-69 years. A special emphasis is put on the measurement error of subjective life expectancy and on the measurement and impact of physician quality. Our main findings are that physician quality, better education, having a partner, younger age and better health are associated with higher rates of receipt. The impact of subjective life-expectancy on screening decision substantially increases after taking measurement error into account. In light of the enormous differences in mammography screening rates between the European countries that can be detected even if several individual characteristics are taken into account, we explore in a second step the causes of these screening differences using newly available data from the SHARELIFE. The results reveal that in countries with low screening rates (e.g. Denmark, Greece and Poland) many reasons (financial restrictions, time costs, access barriers, lack of information, "not usual" and low perceived benefits of screening) are significant predictors of not receiving a mammogram. In contrast in countries with high screening rates such as the Netherlands only beliefs regarding the benefits of mammograms ("Not considered to be necessary") and the cause "Not usual to get this type of care" seem to be important screening barriers.

JEL-Classification: C 26, I 11, I 18,

KEY WORDS: mammogram, physician quality, life expectancy, instrumental variables

## 1. Introduction

Breast Cancer is the most common cause of cancer death in the member states of the European Union (COM 2008). According to estimates of incidence and mortality by the International Agency for Research on Cancer (IARC), there were 331,000 new cases and 90,000 deaths due to breast cancer in the EU in 2006 (COM 2008). Breast cancer accounts for almost one out of three (30 per cent) new cancer cases and one out of six (17 per cent) cancer deaths. One in nine women gets breast cancer at some point in her life and one in thirty perishes as a consequence of the disease (OECD 2009). Due to demographic trends, significantly more women per capita will be confronted with this disease in the future (Ferlay et al. 2007). Moreover breast cancer is associated with high costs for national health care. Overall spending for breast cancer typically amounts to about 0.5-0.6 per cent of the total health care expenditure of developed countries (OECD 2009).

Breast cancer takes years to develop. At the onset of the disease, most breast cancers cause no symptoms. As long as cancer has not metastasized, i.e. that has not moved to the lymph system or to other organs of the body, patients have a five-year survival rate of 96 per cent. If the cancer has spread to the nearby lymph nodes, the rate drops down to 81 per cent. Women whose breast cancer has metastasized to other organs of the body have a five-year survival rate of 21 percent (US Department of Health and Human Services 2002).

A mammogram screening is the best tool available for detecting breast cancer in the early stage, i.e. before symptoms appear. Mammography can detect a breast lump before it can be palpated; it can save live by detecting breast cancer in the earliest stage. For women aged 50-69, mammography has been shown to lower the risk of dying from breast cancer by 35 per cent (Fang, Wang 2010). Moreover it has shown to be highly cost-effective for women in this age group (Moore et al. 2009). In light of the evidence available, the International Agency for Research on Cancer expert working group (IARC Working Group 2002) advises that mammography screening should be offered as a public health policy directed to women aged 50–69 every two years in order to reduce the risk of death from breast cancer. EU guidelines (European Commission 2006) promote a target screening rate of at least 75 per cent of eligible women in European countries. Even though mammography is officially recommended both on the national and European level, screening rates in most European

countries remain far from 100 percent.[2] For example, in the Slovak Republic only around 20 per cent of women aged 50-69 are screened annually (OECD 2009). Correspondingly, increasing mammography for women aged 50-69 is an important public health goal in Europe (Com 2008).

There exists a considerable amount of empirical and theoretical research in health economics on the predictors of screening and preventive behaviour. Theoretical economic models include those of Grossman (1972), Cropper (1977), Giuffrida and Gravelle (1998), Byrne and Thompson (2001), Howard (2005) or Fang and Wang (2010). Jepson et al. (2000) and Schueler et al. (2008) provide good reviews of the empirical literature on determinants of mammography screening uptake and recommendations for increasing uptake. Although the literature on factors associated with mammography screening is abundant, the reasons for underparticipation remain unclear, because empirical results are inconclusive and still incomplete. Identifying the reasons behind lower screening rates is of high importance, since screening is a crucial first step in the process of early detection and treatment. Once the disease is detected, medical providers and the health care system have a major influence in what is done (Lairson, Chan and Newmark 2005).

The purposes of this paper are twofold: First we conduct an empirical analysis of the determinants ("Analysis of Screening Determinants") of participation in mammography screening. The analysis focuses on European women aged 50-69. The data base used is the first and second wave of the Survey of Health Aging and Retirement in Europe (SHARE). The first part of the analysis reveals some important and in empirical research so far widely neglected impact factors of mammography screening. However, it will also show that large differences in mammography screening rates remain between different European countries even after taking several individual characteristics into account. Therefore, the second aim of this paper is to identify the causes of screening differences between the European countries ("Analysis of Country Differences") by exploring differences between countries in the reasons for not undertaking mammograms. With respect to this second aim, we analyse newly available data from the third wave of the SHARE-questionnaire ("SHARELIFE"). SHARELIFE directly asks women for the reasons why they had never had, or stopped having mammograms done regularly focusing on perceived benefits, information issues, financial

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[2] There is serious controversy regarding the effectiveness and cost-effectiveness of mammography screening especially for women younger than 50 years and older than 70 years. Thus we focus on women aged 50-69 years.

restrictions, time costs and availability of mammography services. This part of the analysis will disclose high differences in these factors between European countries.

In the "Analysis of Screening Determinants" the impact of physician quality and life expectancy on screening decisions will be of special interest, because economic theory suggests, as will be argued below, an important impact of these factors. However, due to data limitations, empirical evidence is lacking or is insufficient.

No empirical study so far includes physician quality as a potential factor for the decision for screening. The reason is that survey data including this information are scarce.[3] Physician quality can be expected to influence the decision for screening, since asymmetric information is particularly widespread in health care markets often forcing expert physicians to act on behalf of their less informed patients (e.g. McGuire 2000). Moreover, individual perception of risks is often biased (e.g. Viscusi 1990). Breast cancer is no exception in this regard and even women with a high risk of getting breast cancer tend to have false perceptions of the risks and the seriousness of breast cancer (Richards et al. 2010). For this reason, physicians often need to act as agents for their less-informed patients, and they play an important role in determining mammography screening take-up. Empirical evidence clearly indicates that women follow physician advice for mammography screening (e.g. May et al. 1999, Meissner et al. 2008). Thus, we hypothesize that a better physician – as measured by an index defined in section 2 – will more often suggest mammography screening in line with the official national and EU screening guidelines, thus inducing higher screening rates.

A second focus within the "Analysis of Screening Determinants" lies on the impact of subjective live expectancy on mammography screening. Economic theory suggests (Ehrlich, Chuma 1990, Khwaja 2001) that the motivation to invest in one's own health should depend on the subjective life expectancy. Women who expect a longer life should be more inclined to invest in health in order to spend more years in good health than women expecting to live only for another few years. A corresponding phenomenon has been empirically detected for smoking behaviour in the US-context by Fang et al. (2007) who call it the "Mickey Mantle Effect".[4] However – as will be shown in section 3.2 – empirical analysis has to consider that stated life expectancy suffers from measurement error, leading to attenuation bias. Moreover

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[3] Maurer (2009) as well as Schmitz and Wübker (2010) used physician quality to explain influenza vaccination decision in Germany and Europe using the SHARE. We base our paper on the quality score introduced by Maurer (2009).

[4] The phenomenon is named after the legendary American baseball player Mickey Mantle who exhibited a very unhealthy behaviour because he expected to die at an early age because several of his family members died of a rare hereditary disease at a young age.

life expectancy may be endogenous for two reasons. The first reason is reverse causality: investment in health increases life expectancy. The second reason is omitted variables: a healthier person, *ceteris paribus*, expects to live longer and thus has a larger return to investments that increase quality of life in old age (Fang et al. 2007). We follow Fang et al. (2007) and apply their empirical approach to mammography take-up and control for measurement error and endogeneity of the subjective life-expectancy through an IV-approach (compare section 3).

The results of the "Analysis of Screening Determinants" show that better physician quality, better education, being married, being a "high user" of healthcare, younger age and better health are associated with higher rates of screening take-up. Moreover subjective life expectancy strongly influences screening probability once the measurement error is controlled for. The results of the "Analysis of Country Differences" reveal that in countries with low screening rates (e.g. Denmark, Greece and Poland) a battery of reasons (low expected benefits of screening, perception that it is "not usual", a lack of information about this type of care, financial restrictions, time costs and access barriers) are significant predictors of not getting a mammogram. In contrast in countries with high screening rates such as the Netherlands only beliefs regarding the benefits ("not necessary") and the cause "not usual to get this type of care" seem to be important screening barriers. The remainder of the paper is organized as follows: Section 2 provides some information on the data set and the theoretical and empirical screening determinants. Section 3 discusses the empirical strategy, while section 4 presents the results. Section 5 summarises the results and adds some concluding remarks.

**2 Data, Determinants of Mammography Screening and Variables**

**2.1 Data**

We use data from the first (2004) and second (2006) wave of the Survey of Health, Ageing and Retirement in Europe (SHARE) to analyze the determinants of mammography screening. SHARE is a large representative micro data set of more than 30 000 individuals above the age of 50 years from 14 European countries and Israel starting in 2004. It provides detailed information on health status and on a variety of other socioeconomic characteristics. The data was collected using a computer assisted personal interviewing (CAPI) program, supplemented

by a self-completion paper and pencil questionnaire.[5] The pencil questionnaire ("drop-off questionnaire") includes a question about mammography take-up in the last two years. This questionnaire was only sent to a subgroup of the sample and no respondent received it in both waves.

We restrict our sample to women aged 50-69, since for this group mammography screening is officially recommended at both European level and the national level of the countries included. Moreover, we exclude women if they reported a history of cancer as they are not representative and we discard observations with missing or unreliable values for the variables of interest and the other explanatory variables. Therefore, our estimation sample consists of two cross-sections with 6893 women in total (4412 from the first wave surveyed in 2004 and 2481 from the second wave surveyed in 2006).

To get a deeper understanding of the causes of not undergoing mammography screening and in the causes for differences in country-specific screening rates we analyse newly available data from the third wave (2009) of the SHARE ("SHARELIFE"). SHARELIFE focuses on people's life histories. The SHARELIFE questionnaire contains detailed information on historical mammography screening use and provides evidence on the reasons why women did not regularly take-up mammography screening. This additional sample consists of 4595 women. Table 1 provides descriptive statistics of the variables included in the empirical analysis.

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[5] For more details on the sampling procedure, questionnaire contents and fieldwork methodology, readers should refer to Börsch-Supan and Jürges (2005).

## Table 1: Sample Means and Description

| Variable | Definition | Mean (N=6893) |
| --- | --- | --- |
| *Variables from Wave 1 and 2 of the SHARE* | | |
| *Dependent Variable* | | |
| Mammogram | Mammogram screening in the last two years (Yes=1, No=0) | 0.647 |
| *Explanatory Variables* | | |
| Physician Quality Index | GP quality between 0 and 1 as explained in the text | 0.301 |
| Life Expectancy | Self-stated probability of being alive in about 10 years | 0.670 |
| $50 \leq Age < 55$ | | 0.288 |
| $55 \leq Age < 60$ | | 0.273 |
| $60 \leq Age < 65$ | | 0.243 |
| $65 \leq Age < 70$ | | 0.195 |
| Self Assessed Health | Excellent=1 to poor = 5 | 2.907 |
| Limitations in ADL | Number of limitations in Activities of Daily Living | 0.113 |
| Heart attack | Chronic Conditions: Heart attack | 0.067 |
| Stroke | Chronic Conditions: Stroke | 0.019 |
| Diabetes | Chronic Conditions: Diabetes | 0.074 |
| Lung disease | Chronic Conditions: Lung Disease | 0.041 |
| Has Partner | Binary Variable for whether to women has a partner | 0.744 |
| Children in HH | Number of children living in household | 0.462 |
| ISCED Low | Education ISCED[1] level between 0 and 2 | 0.444 |
| Doctor visits $\geq 10$ | Number of doctor visits $\geq 10$ within the previous 12 month | 0.221 |
| No drugs | Binary Variable for whether the woman regularly takes prescription drugs | 0.314 |
| Hospital Stays $\geq 2$ | Number of hospital stays $\geq 2$ within the previous 12 month | |
| *Country and year dummies* | | |
| Year 2006 | | 0.361 |
| Austria | | 0.079 |
| Germany | | 0.098 |
| Sweden | | 0.068 |
| Netherlands | | 0.088 |
| Spain | | 0.068 |
| Italy | | 0.093 |
| France | | 0.071 |
| Greece | | 0.044 |
| Switzerland | | 0.059 |
| Belgium | | 0.099 |
| Czech | | 0.068 |
| Poland | | 0.068 |
| Ireland | | 0.038 |
| Denmark | | 0.059 |
| *Instruments* | | |
| Father Age at Death $\leq 65$ | | 0.262 |
| Father Age at Death 65 to 69 | | 0.111 |
| Father Age at Death 70 to 74 | | 0.111 |
| Father Age at Death 75 to 79 | | 0.126 |
| Father Age at Death 80 to 84 | | 0.139 |
| Father Age at Death $\geq 85$ | | 0.093 |
| Age Father_IV | Age at death or current age of father if still alive | 72.02 |
| Mother Age at Death $\leq 65$ | | 0.144 |
| Mother Age at Death 65 to 69 | | 0.070 |
| Mother Age at Death 70 to 74 | | 0.092 |
| Mother Age at Death 75 to 79 | | 0.116 |
| Mother Age at Death 80 to 84 | | 0.125 |
| Mother Age at Death $\geq 85$ | | 0.118 |
| Age Mother_IV | Age at death or current age of mother if still alive | |
| *Variables from the SHARELIFE - Questionnaire* | | (N= 4595) |
| Not Affordable | Not affordable | 0.023 |
| Not Covered | Not covered by health insurance | 0.010 |
| No Insurance | Did not have health insurance | 0.003 |
| Time Constraints | Time constraints | 0.043 |
| No Information | Not enough information about this type of care | 0.091 |
| Not Usual | Not usual to get this type of care | 0.143 |
| Not Necessary | Not considered to be necessary | 0.659 |
| Not Available | No place to receive this type of care close to home | 0.025 |

[1]International Standard Classification of Education

## 2.2 Determinants of Mammography Screening and Variables

Economic theory suggests all variables mentioned in Table 1 could be important determinants of individual screening decision. From an economic perspective the decision to undergo mammography screening is an investment decision. Such an investment is worthwhile if the expected present value of the reduction in disease and in the probability of death is larger than the opportunity costs of the intervention (comp. Grossman 1972, Cropper 1977, Dardanoni and Wagstaff 1990 or Chang 1996 for a formalization of these notions). However, the question whether people actually decide to invest in mammography screening is largely an empirical one as we will argue in the following paragraphs. The paragraphs discuss certain hypotheses that would seem to be implied by economic theory and relate them to existing empirical results. Moreover the paragraphs describe the variables that we use in the empirical analysis in order to test the hypotheses.

*Age*

First of all, according to economic theory, age should influence mammography screening decision but the theoretical impact is offsetting. According to health human capital models (based on Grossman 1972) health depreciates at an increasing rate as one gets older, reducing the returns on investment. Moreover, the potential years of life saved due to mammography screening decline with age (Cropper 1997). Alternatively, older women should be more likely to take up mammography screening, because they have a greater risk for breast cancer than younger women (e.g. Grunfeld, Hunter Ramirez, Richards 2003) and thus expected benefits to mammography screening should be higher for those at higher risk for breast cancer. The great majority of empirical studies however indicate that older women are less likely to engage in mammography screening (e.g. Wu 2003, Kenkel 1994). To account for age we include dummy variables of different age groups.

*Health Status*

Health Status should also be associated with the decision for screening. Those in poorer health should be more likely to undergo mammography screening, since they potentially have higher cost to getting other diseases. For example rehabilitation and treatment may be more difficult for people in poor health than for those who are otherwise in good health (Nordin et al. 2002). Alternatively, it may be the case that people in poor health have less time to receive treatment or screens given their physical limitations. Furthermore women – as well as the physician

acting as their agent (McGuire 2000)[6] – could set priority on other medical measures when sick, since mammography is associated with a future related and uncertain benefit (Gøtzsche and Nielsen 2009). Overall, it remains largely an empirical question whether poor health is associated with more or less mammography screening. The empirical literature is inconclusive whether poor health is a barrier to screening. To address this question, we control for health using a detailed set of health indicators. These include self-assessed health (i.e. excellent, very good, good, fair, or poor), as well as a number of objective measures such as binary indicators for whether the respondent was ever diagnosed with stroke, heart disease, lung disease and diabetes as well as an index of limitations in activities of daily living (ADLs).[7] ADLs refer to daily self-care activities within an individual's place of residence, in outdoor environments, or both.

*Education and Cognitive abilities*

Better education may increase the use of screening services, implying more efficiency in producing health (e.g. Grossman 1972). For example, a better educated woman may be more likely to understand the benefits of mammography screening. In addition, these women may be more prone to recognize the early warning signs of breast cancer and be more apt to visit a physician when symptoms first occur. Education is captured by a dummy variable for low education as defined by ISCED equivalents.[8] Since educational attainment in the past might not fully mirror the current skills to process information (Avitabile et al., 2008), we also analyse the role of current cognitive abilities captured by the variables "recall" and "verbal fluency". Verbal fluency is measured by the number of different animals the respondent is able to state within one minute. Recall is measured by the number of words the respondent can recall from a list of ten words that has been shown her some minutes before. Both measures reflect cognitive functions as identified by the cognitive psychology literature (Richards et al., 2004). Empirical studies (e.g. Mehta et al. 2010) find that cognitive impairment is associated with lower screening mammography rates. We hypothesise that the

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[6] For example Yaskaskas et al. (2010) show that women with disabilities are less likely than those without disabilities to receive a physician recommendation for screening mammography.

[7] This variable describes the number of limitations with activities of daily living (ADL). Six activities are included: Dressing, including putting on shoes and socks, Walking across a room, Bathing or showering, Eating, such as cutting up your food, Getting in and out of bed, using the toilet, including getting up or down.

[8] The International Standard Classification of Education (ISCED) was designed by UNESCO in the early 1970`s to serve as a tool to facilitate comparisons of education statistics and indicators of different countries on the basis of uniform and internationally agreed definitions. The higher the ISCED value the higher the education-level. The levels are as follows defined: Level 0: Pre-primary education; Level 1: Primary education or first stage of basic education; Level 2: Lower secondary or second stage of basic education; Level 3: (Upper) secondary education; Level 4: Post-secondary non-tertiary education; Level 5: First stage of tertiary education (not leading directly to an advanced research qualification); Level 6: Second stage of tertiary education (leading to an advanced research qualification, e.g. a Ph.D.). We define low education by ISCED values between 0 and 2.

worse the cognitive skills the lower the probability to screen, since cognitive impairments limit the patients' ability to gather and process information.

By increasing the actual or perceived costs of processing information, they can act as a barrier for mammography screening. The positive influence of information on the demand of prevention is shown by Parente et al. (2004), who find that consumer knowledge has a substantial positive effect on the use of preventive services.

*Family Structure*

Having a partner should be associated with higher screening rates as empirical studies reveal (e.g. Coughlin et al. 2008, Mehta et al. 2010). Those who have a partner and/or have children are probably reminded more often of the importance of mammography by their loved ones. Thus living not alone should lower information costs. We include controls for the number of children living in the household and a dichotomous variable for whether a woman has partner.

*High Users*

Another factor for the screening decision should be how much prior health care one has used. Some individuals are simply "high users" of medical care, while others may choose not to utilize health care, even when it is readily available and affordable. Wu (2003) finds empirical evidence for this regarding mammography screening in the US-context. To address "using behaviour" in the European context, we follow the empirical strategy of Wu (2003) and include three dichotomous variables for whether a women i) had at least ten doctor's office visits in the last year, ii) more than two hospital stays in the last year and iii) regularly takes prescription drugs.

*Financial Restrictions, Time Costs and Availability of Care Close to Home*

According to health human capital models (Grossman 1972) financial barriers should have a negative effect on the demand for mammography screening. Indeed empirical studies find that insurance coverage of breast cancer screening – which reduces the price of care at the point of service – inreases the probability of getting mammography screening (e.g. Kenkel, 1994, Lairson et al. 2005). Moreover empirical studies (e.g. Piccone et al. 2004, Lairson et al. 2005) suggest a positive impact of higher income on screening probability, since high income increases the ability to purchase services. Furthermore, economic theory implies a negative influence of higher time costs on health care utilization (e.g. Acton 1975). The only empirical study considering time costs (Lairson et al. 2005) reveals that for women veterans in the

United States waiting time is inversely related to the likelihood of mammography screening. Finally – as it even lowers time costs of screening –, availability of mammography screening service close to home seems to be an important determinant for getting a mammogram (compare Coughlin et al. 2008 for empirical evidence).

We address the role of financial restrictions, availability of care close to home and time costs in a separate analysis in section 4 using the SHARELIFE. More Precisely, SHARELIFE includes the question "Have you ever had mammograms regularly over the course of several years?" If the women answered "No" the SHARELIFE continues "What are the reasons you [have never had/stopped having] mammograms regularly?" providing the response-options "1. Not affordable "2. Not covered by health insurance", "3. Did not have health insurance", "4. Time constraints", "5. Not enough information about this type of care" "6. Not usual to get this type of care" "7. No place to receive this type of care close to home", "8. Not considered to be necessary", "9. Other reasons". We construct for each response-option a binary variable and analyse in section 4 the magnitude of each response option in explaining the decision not to undergo a mammogram.

*Life Expectancy*

The motivation to invest in one's own health should depend on the subjective life expectancy of the respondent as well. Individuals who expect a longer life should be more inclined to invest in health, since the potential payoff of health investments is greater for people in good health than for people who believe to live for a few more years only (Ehrlich and Chuma 1990). Fang et al. (2007) find that individuals who expect a longer life are significantly less likely to be currently smoking. They find no effect, however, for other health behaviours like heavy drinking or obesity. We calculate a variable indicating subjective life expectancy from following question of the SHARE: What are the chances that you will live to be age 75/80/85/90/95/100/105/110/120 or more?" (either 75 or current age plus about 10 years, see, e.g., Hurd and McGarry (2002) for a discussion on the reasonability of this measure).

*Physician Quality*

Finally, we want to analyse the impact of physician quality on the decision to undergo mammography screening. As argued by Maurer (2009), health literacy of the typical patient is limited, and patients rely heavily on their physician's advice. Usually, they follow their doctor's recommendation, which also applies to mammography screening. May et al. (1999)

find in an US-study that 66 percent of women who received a recommendation adhered and of women receiving a documented recommendation, 75 percent adhered. Alternatively Meissner et al. (2008) found for the US that 80 percent of non-screeners who reported having access to healthcare did not receive a recommendation for a mammogram.

Unfortunately, we cannot test directly for the impact of physician's advice on the probability of screening decision. We therefore follow Maurer (2009) as well as Schmitz and Wübker (2011) and compute a physician quality score and assume that better physicians are more likely to recommend mammography screening.[9] The quality score is computed in the following way. We use the answers of individuals to five questions in the drop-off questionnaire concerning specific geriatric assessments, which any general practitioner should routinely perform. These are how frequently a doctor i) asks about physical exercise, ii) suggests regular physical exercise, iii) asks about falls, iv) checks balance, and v) asks about drugs used. We sum up all the answers where we assign the category "at every visit" a 2, "at some visits" a 1 and "never" a 0. Like Maurer (2009) and Schmitz and Wübker (2011) we acknowledge that some questions are the more important the older the women are and the less important the younger the women are. Therefore, we do not consider balance checks and queries about falls if the respondent is aged 50-59. For women aged 60-69 we weight the answers to these two questions with 0.5. To get a quality indicator that falls into the range of 0 and 1 we divide the sum by the age-adjusted maximum possible number of points.

## 3. Empirical Strategy and Estimation Results

### 3.1. Basic Analysis

We apply two basic regression models: First the linear probability model, that is, an OLS-regression of the variable indicating a mammography screening on the above-mentioned exogenous variables.[10] Second the probit regression model, which in contrast to the OLS-regression imposes the restriction that a predicted value lies inside the range of [0,1]. To control for institutional and cultural differences in screening behaviour we include a full set of

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[9] The indicator used by Schmitz and Wübker (2011) differs slightly from the one that Maurer (2009) uses. The reason is, firstly, that one question ("How often does your GP check your weight?") is only asked in the first wave. Schmitz and Wübker (2011) ignore this one and use only five instead of six questions. Furthermore, Maurer does not weight the answers but assigns a 1 if the GP asked a specific question during at least some visits. The pros and cons of this approach can be debated. On the one hand, Maurer's method comes with an information loss. On the other hand, his approach might be more robust to recall error as it is easier to remember if a GP ever asked this question than how regular she does. However, we tried both quality scores and did not find qualitative differences in our results. Moreover we tested analogue to Schmitz and Wübker (2011) different weighting schemes of the questions in order to test robustness of the results. We find only small differences in our results. The results are available upon request.

[10] It turns out that less than 1 percent (55 observations) of all observations have a predicted value outside the range of [0, 1]. We feel that this is a reasonably low figure.

country dummies. Table 2 reports the results of the linear probability model in the first column.

**Table 2: Estimation Results from OLS and Probit**

| | (OLS) | | (Probit) | |
| --- | --- | --- | --- | --- |
| | Mammogram | | Mammogram | |
| Physician Quality Index | 0.107** | (0.041) | 0.116*** | (0.042) |
| Life Expectancy | 0.065** | (0.030) | 0.072** | (0.031) |
| 55 <= Age < 60 (d) | 0.015 | (0.015) | 0.020 | (0.018) |
| 60 <= Age < 65 (d) | 0.005 | (0.013) | 0.007 | (0.015) |
| 65 <= Age < 70 (d) | -0.095** | (0.032) | -0.102*** | (0.035) |
| Self Assessed Health | -0.009** | (0.004) | -0.011** | (0.005) |
| Number of ADL | -0.029** | (0.011) | -0.032*** | (0.012) |
| Heart attack (d) | -0.020 | (0.021) | -0.023 | (0.024) |
| Stroke (d) | -0.083** | (0.031) | -0.099*** | (0.036) |
| Diabetes (d) | -0.055** | (0.019) | -0.063*** | (0.021) |
| Lung disease (d) | 0.012 | (0.025) | 0.010 | (0.030) |
| ISCED Low (d) | -0.056** | (0.020) | -0.066*** | (0.021) |
| Verbal Fluency | 0.002* | (0.001) | 0.003** | (0.001) |
| Recall Delayed | 0.001 | (0.004) | 0.000 | (0.004) |
| Has Partner (d) | 0.046*** | (0.014) | 0.053*** | (0.016) |
| children_hh | -0.008 | (0.013) | -0.009 | (0.014) |
| Doctor visits = 10 (d) | 0.041** | (0.016) | 0.046*** | (0.018) |
| Regularly Drugs (d) | 0.055*** | (0.010) | 0.064*** | (0.011) |
| Hospital Stays = 2 (d) | 0.019 | (0.047) | 0.016 | (0.051) |
| Year 2006 | 0.006 | (0.010) | 0.007 | (0.013) |
| Austria (d) | 0.477*** | (0.009) | 0.318*** | (0.004) |
| Germany (d) | 0.251*** | (0.006) | 0.209*** | (0.004) |
| Sweden (d) | 0.634*** | (0.008) | 0.365*** | (0.001) |
| Netherlands (d) | 0.645*** | (0.011) | 0.378*** | (0.002) |
| Spain (d) | 0.470*** | (0.021) | 0.312*** | (0.007) |
| Italy (d) | 0.452*** | (0.018) | 0.314*** | (0.008) |
| France (d) | 0.614*** | (0.010) | 0.362*** | (0.002) |
| Greece (d) | 0.225*** | (0.020) | 0.191*** | (0.014) |
| Switzerland (d) | 0.271*** | (0.010) | 0.217*** | (0.007) |
| Belgium (d) | 0.538*** | (0.009) | 0.349*** | (0.003) |
| Czech (d) | 0.343*** | (0.021) | 0.257*** | (0.012) |
| Poland (d) | 0.238*** | (0.025) | 0.200*** | (0.018) |
| Ireland (d) | 0.285*** | (0.023) | 0.224*** | (0.015) |
| Observations | 6893 | | 6893 | |

Marginal effects; Standard errors in parentheses; (d) for discrete change of dummy variable from 0 to 1
$^{*} p < 0.10$, $^{**} p < 0.05$, $^{***} p < 0.01$

The results indicate that physician quality has a positive and significant impact on the decision to undergo mammography screening.[11] Specifically, our estimates show on average 10.4 percentage points higher screening rates among women whose family physician performs all geriatric assessments relative to those whose doctor does not undertake any

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[11] This basic result holds independently of the refinement of the physician quality measure.

evaluation.[12] Given that the average screening rate in this age-group is 64 per cent, this is a considerable amount.

Besides physician quality, the main variable explaining the demand for mammography screening is age. Older women are less likely to get mammograms. In example, being in the 65–69 age group decreases the probability of getting a mammography screening by 9.5 percentages points compared with the 50–54 age group. Generally, sicker women as measured by objective and subjective measures of health status are less likely to get mammograms. More precisely, lower ability to perform activities of daily living and suffering from chronic conditions like a stroke and diabetes are similarly associated with lower screening rates. Moreover, even after controlling for those objective measures of health status, worse self assessed health is associated with lower mammography screening rates. Education and the capability of processing information affect the mammography screening decision. Both having a higher than low education and yielding more points in the verbal fluency test are associated with higher screening rates. The number of children in the household does not seem to play an important role, whereas whether a woman has a partner significantly increases the screening probability.

Being "high-users" of medical care is significantly positive associated with mammography screening. Specifically, our estimates show on average 5.5 percentage points higher screening rates among women who regularly take drugs compared to women who do not take drugs regularly. Moreover, women who had at least ten doctor visits in the last year have on average 4 percentage points higher screening rates than those with less than ten doctor visits.

Finally, higher subjective life-expectancy significantly increases the likelihood of getting a mammogram. A 10 percentage point increase in subjective life expectancy reduces probability of mammography screening by about 0.6 percentage points. The results for the probit estimation are quite similar to those of the OLS estimation for most variables as can be seen in the right column of Table 2. Noteworthy is, however, that the coefficient of physician quality and life expectancy are a little bit higher using probit specification compared to OLS. Moreover, we find significantly smaller differences in the coefficients of the country dummies in the probit estimates, since the probit model imposes the restriction that a predicted value has to lie inside the range of [0, 1].

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[12] Alternatively, women who are treated by a physician with a one standard deviation higher quality score have roughly 3 percentage points' higher screening rates.

### 3.2. Measurement error and endogeneity Concerns

As stated in the introduction, we are seriously concerned that subjective life expectancy as one of our most important covariates suffers from measurement error leading to attenuation bias. Measurement error arises if an explanatory variable is measured with additive random errors. The higher the part of variability that is due to errors, the larger is the magnitude of the attenuation bias (e.g. Angrist and Kruger 2001). Hurd, McFadden and Gan (1998) reveal that due to cognitive disability a lot of respondents systematically provided focal-point answers (0, 0.5 or 1) to the questions on subjective survival probabilities in the sample of older individuals (aged 70 and over) in the Study of Assets and Health Dynamics among the Oldest Old (AHEAD). A similar response pattern comes up for women aged 50-69 in the SHARE-data with many focal answers at 0, 0,5 and 1 as shown by Figure 1. These cannot represent the true probabilities, both because the distribution of true probabilities should be continuous and because the true probabilities cannot be exactly either zero or one (Hurd, McFadden and Gan 1998). In the consequence the coefficient on that variable in an ordinary least squares regression will be biased towards zero.

**Figure 1: Heterogeneity of survival beliefs and measurement error**
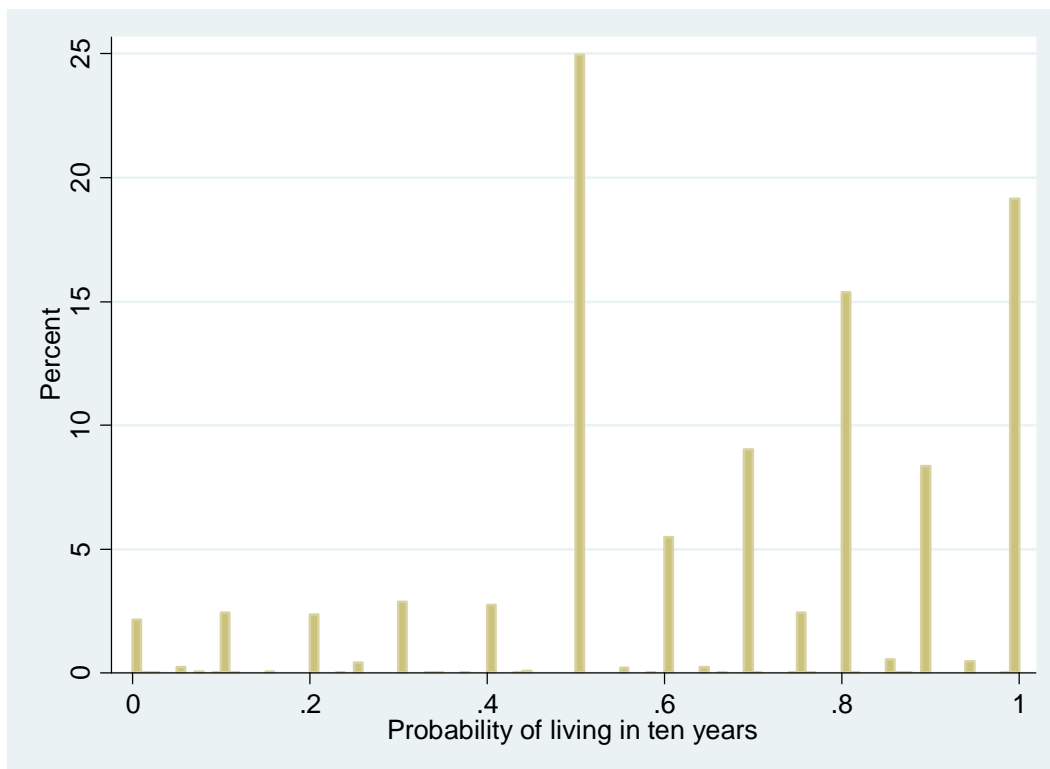


Moreover, following the discussion of Fang et al. (2007) the impact of subjective life expectancy on investment in health is endogenous, mainly due to reversed causality. While

investment in health might depend on subjective life expectancy (which is to be analysed here), subjective life expectancy is also likely to depend on investment in health. Individuals who generally invest more in health might believe in a pay-off of their behaviour, resulting in the expectancy of a longer life. We follow Fang et al. (2007) and Bloom et al. (2006) in using age at death of respondents' parents (or their current age if still alive), as well as age², age³ and binary indicators of whether the father or mother died at an age that fell in the range of under 65, 66 to 70, 71 to 75, 76 to 80, 81 to 85, or 86 and over.[13] The instruments can be seen as proxies for health endowment like genetic factors that are transfused from parents to children. Individuals with older parents are likely to have a better health endowment than those whose parents died early, possibly due to a genetic disease.

The identifying assumption here is that genetic factors affect subjective life-expectancy but not the decision to get a mammography screening once health and subjective life-expectancy are controlled for. According to our strategy in the "Basic-Analysis" section, we perform both linear Instrumental Variable Two-Stage Least Squares (IV-2SLS) estimation (following Fang et al. 2007), and a non-linear two-stage procedure following Newey (1987) to correct standard errors in the presence of a dichotomous dependent variable in the second stage. The 2SLS method is usually chosen even in cases where the dependent variable is dichotomous (e.g. Wooldridge 2002) since strong specification assumptions are required to justify the Newey (1987) method. We present both for completeness and find quite similar results with all specifications.

Table 3 reports the results of linear and non-linear two-stage procedure.[14] While the other coefficients remain quite stable when the instrumental variables regression is performed, the impact of subjective life expectancy increases.[15]

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[13] Good instruments should show a considerable explanatory power for subjective life expectancy but must not affect the decision to undergo a mammography screening once the remaining explanatory variables are controlled for.

[14] Table A 1 in the Appendix reports the first-stage results from two-stage estimation. The dependent variable is self-stated probability of being alive in about 10 years. Clearly, health status as measured by self assessed health is a very important determinant of life expectancy. Moreover, parents' ages at death have large and significant effects in the expected direction. For instance, having a father who died between 65 and 69 years reduces the subjective probability of being alive in about 10 years by 4.5 percentage points, *ceteris paribus* (compared to those women, whose father is still alive). The F-test for the joint significance of the parental age at death variables is 14.54 indicating that the instruments are not weak.

[15] Note, however that the coefficients measuring health status (e.g. Self Assessed Health) change in the IV-OLS compared to OLS. This is due to the correlation of the health measures with the instruments.

**Table 3: Estimation results from IV OLS and IV Probit model**

| | (IV-OLS) Mammogram | | (IV-Probit Model) Mammogram | |
|---|---|---|---|---|
| Second Stage Regression | | | | |
| Physician Quality Index | 0.108*** | (0.039) | 0.115*** | (0.042) |
| Life Expectancy | 0.256* | (0.131) | 0.361* | (0.203) |
| 55 <= Age < 60 (d) | 0.012 | (0.015) | 0.015 | (0.018) |
| 60 <= Age < 65 (d) | -0.001 | (0.012) | -0.003 | (0.015) |
| 65 <= Age < 70 (d) | -0.091*** | (0.031) | -0.094*** | (0.036) |
| Self Assessed Health | 0.000 | (0.009) | 0.004 | (0.012) |
| Number of ADL | -0.025** | (0.011) | -0.025** | (0.012) |
| Heart attack (d) | -0.012 | (0.019) | -0.009 | (0.023) |
| Stroke (d) | -0.083** | (0.033) | -0.098** | (0.041) |
| Diabetes (d) | -0.048*** | (0.018) | -0.051** | (0.022) |
| Lung disease (d) | 0.022 | (0.027) | 0.025 | (0.031) |
| ISCED Low (d) | -0.054*** | (0.020) | -0.061*** | (0.021) |
| Verbal Fluency | 0.002* | (0.001) | 0.002 | (0.001) |
| Recall Delayed | 0.000 | (0.004) | -0.001 | (0.004) |
| Has Partner (d) | 0.046*** | (0.014) | 0.052*** | (0.017) |
| children_hh | -0.007 | (0.012) | -0.008 | (0.014) |
| Doctor visits = 10 (d) | 0.040** | (0.016) | 0.045** | (0.018) |
| Regularly Drugs (d) | 0.057*** | (0.010) | 0.065*** | (0.011) |
| Hospital Stays = 2 (d) | 0.022 | (0.048) | 0.020 | (0.055) |
| Year 2006 | 0.003 | (0.009) | 0.003 | (0.013) |
| Austria (d) | 0.493*** | (0.016) | 0.326*** | (0.006) |
| Germany (d) | 0.263*** | (0.011) | 0.220*** | (0.007) |
| Sweden (d) | 0.644*** | (0.011) | 0.368*** | (0.003) |
| Netherlands (d) | 0.649*** | (0.010) | 0.379*** | (0.002) |
| Spain (d) | 0.466*** | (0.019) | 0.309*** | (0.008) |
| Italy (d) | 0.453*** | (0.017) | 0.313*** | (0.008) |
| France (d) | 0.622*** | (0.013) | 0.365*** | (0.003) |
| Greece (d) | 0.236*** | (0.024) | 0.200*** | (0.016) |
| Switzerland (d) | 0.277*** | (0.011) | 0.221*** | (0.007) |
| Belgium (d) | 0.554*** | (0.016) | 0.356*** | (0.006) |
| Czech (d) | 0.387*** | (0.036) | 0.287*** | (0.022) |
| Poland (d) | 0.263*** | (0.031) | 0.223*** | (0.022) |
| Ireland (d) | 0.296*** | (0.023) | 0.231*** | (0.014) |
| Observations | 6893 | | 6893 | |
| F-Stat. instruments first stage | 14.54 | | | |
| Overid. Statistics² | 27.15 (p = 0.101) | | | |

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
$^*$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$; ²p-values in parenthesis

The change is as predicted. It indicates that the effect of life expectancy is strongly underestimated when measurement error and endogeneity is not taken into account. Subjective life expectation heavily increases the probability of investing in one's own health (by taking a mammogram). Specifically, the estimates imply that a 10 percentage point increase in this subjective probability reduces probability of mammography screening by about 2.3 percentage points. This effect is much stronger than before (0.6 percentage points)

and still significant on the 10 per cent level. Possibly, this effect is too high, since the large standard errors associated with the IV approach leads to large 90 percent confidence intervals of [0.0073438; 0.4492358]. However, this result does not seem to be due to weak instruments as the F-statistics exceeds the Staiger-Stock rule-of-thumb of 10 (Staiger and Stock, 1997) when testing for the exclusion of the instruments in the first-stage regression. Furthermore, over-identification tests support the validity of our instruments. If one is willing to assume that the mother's age of death is exogenous to the individual mammography screening decision, the hypothesis that all other instruments are valid cannot be rejected.

Again, most of the coefficients in the IV-Probit Model are quite similar to those of the IV-OLS Model, as can be seen in the right column of Table 3. However, the impact of life expectancy is about 40 percent higher (0.361 versus 0.256) in the IV-Probit Model compared to the IV-OLS Model. Moreover, once more the coefficients of the country dummies in the IV-probit estimates are significantly smaller compared to the IV-OLS estimates. However in both models they remain always jointly significant indicating huge differences across countries that are not picked up by individual differences in our observed variables.[16]

## 4 Additional insights from the SHARELIFE

### 4.1 Causes of not undergoing mammography screening in European countries

To get a deeper understanding why women do not undergo mammography we analyse in addition data from the third wave of the SHARE ("SHARELIFE"). As described in the data section, the SHARELIFE directly asked women for the reasons why they did never had or stooped having mammograms regularly. The response options include the following answers: "1. Not affordable "2. Not covered by health insurance", "3. Did not have health insurance", "4. Time constraints", "5. Not enough information about this type of care" "6. Not usual to get this type of care" "7. No place to receive this type of care close to home", "8. Not considered to be necessary". Out of a sample of 13491 women aged 50-69 years 4595 women never had or stopped having mammograms regularly.

Table 4 presents the means, the standard errors (robust), and the 95 percent confidence intervals of the different response options. "Not considered to be necessary" is by far the most important reason for not getting a mammogram. Nearly 66 percent of women state this reason. Moreover many women mention "Not usual to get this type of care" (14 percent) and "Not enough information about this type of care" (9 percent) as reasons for not undertaking

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[16] Unfortunately there are no tests for a) weak instrument and b) over-identification of instruments in cluster-robust IV-Probit models. However, the results of the F-test and over identification test in the linear model support the validity of our instruments and do not indicate that the robustness of the results suffer from weak instruments.

mammograms. Roughly 4 percent of women refer to "Time constraints" and 2.5 percent state that is "No place to receive this type of care close to home". Financial aspects like "Not affordable" (2.2 percent), "Not covered by health Insurance" (1 percent) and "Did not have health insurance" (0.1 percent) did play a minor role in not undergoing mammography screening. However, except for "Did not have health insurance" each reason is significant at a 5 percent level of significance.

**Table 4: Means, Standard Errors (robust) and 95 percent Confidence Intervals of the different response options**

|  | Mean | Robust Std. Error | 95 % Conf. Interval |
|---|---|---|---|
| Not Affordable | 0.02285*** | (0.00698) | [0.00763 ; 0.03807] |
| Not Covered | 0.01001*** | (0.00352) | [0.00232 ; 0.0176] |
| No Insurance | 0.00152 | (0.00101) | [-0.00068 ; 0.00373] |
| Time Constraints | 0.04265*** | (0.01063) | [0.01948 ; 0.06582] |
| No Information | 0.09140*** | (0.03672) | [0.01138 ; 0.17146] |
| Not Usual | 0.14276*** | (0.03196) | [0.07311 ; 0.21241] |
| Not Necessary | 0.65897*** | (0.04832) | [0.55369 ; 0.76426] |
| Not Available | 0.02546*** | (0.00864) | [0.00663 ; 0.04428] |
| Number of Observations | | 4595 | |

*p<0.1, **p<0.05, ***p<0.01, standard errors in parentheses, clustered by countries.

**4.2 Differences between screening rates across European countries**

As revealed by the coefficients of the country dummies in Tables 2 and 3 there remain considerable differences between countries in screening rates, even after taking several individual characteristics of women into account. Based on the first two waves (2004 and 2006) of the SHARE data, Figure 2 displays the enormous differences in mammography screening rates across European countries. Whereas in Sweden almost 85 percent of women reported that they had received a mammogram in the past two years, only about 25 percent of Danish women reported that they got a mammogram. What accounts for the differences in mammography screening between the countries? To further explore this question, we analyse more deeply the above mentioned question from the SHARELIFE database. In a first step, we calculate for each response-option a dichotomous variable indicating the special reason for not undertaking mammography. In a second step we regress country dummies on all eight dichotomous variables (reflecting the different response options) and analyse whether there are significant differences between the countries. Table 5 presents the results from our regression analysis.

**Figure 2: Mammography Screening Rates in European countries**
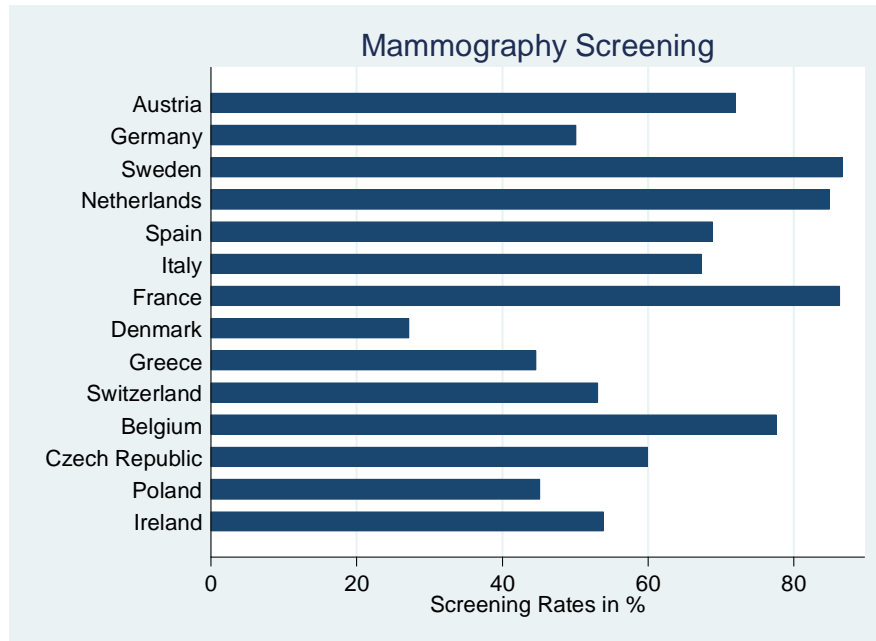


**Table 5: Reasons for not getting mammograms in European countries**

| | Not Afford | Not Cov. | No Insur. | Time costs | No Inform. | Not Usual | Not Nec. | Not Avail. |
|---|---|---|---|---|---|---|---|---|
| Austria | 0.035*** | 0.000 | 0.000 | 0.140*** | 0.076*** | 0.187*** | 0.216*** | 0.023** |
| | (0.011) | (0.008) | (0.003) | (0.015) | (0.021) | (0.026) | (0.034) | (0.012) |
| Germany | 0.022*** | 0.033*** | 0.000 | 0.017** | 0.054*** | 0.079*** | 0.767*** | 0.017*** |
| | (0.006) | (0.004) | (0.002) | (0.008) | (0.011) | (0.014) | (0.019) | (0.006) |
| Sweden | 0.000 | 0.014 | 0.000 | 0.087*** | 0.000 | 0.014 | 0.725*** | 0.000 |
| | (0.018) | (0.012) | (0.005) | (0.024) | (0.033) | (0.041) | (0.054) | (0.019) |
| Netherlands | 0.000 | 0.000 | 0.000 | 0.007 | 0.000 | 0.007 | 0.904*** | 0.000 |
| | (0.012) | (0.008) | (0.003) | (0.017) | (0.023) | (0.028) | (0.037) | (0.013) |
| Spain | 0.015 | 0.015** | 0.000 | 0.024* | 0.107*** | 0.117*** | 0.723*** | 0.034*** |
| | (0.010) | (0.007) | (0.003) | (0.014) | (0.019) | (0.024) | (0.031) | (0.011) |
| Italy | 0.026*** | 0.006 | 0.000 | 0.059*** | 0.053*** | 0.067*** | 0.756*** | 0.010 |
| | (0.007) | (0.004) | (0.002) | (0.009) | (0.012) | (0.015) | (0.020) | (0.007) |
| France | 0.006 | 0.000 | 0.000 | 0.050*** | 0.012 | 0.186*** | 0.609*** | 0.000 |
| | (0.012) | (0.008) | (0.003) | (0.016) | (0.022) | (0.027) | (0.035) | (0.012) |
| Denmark | 0.003 | 0.003 | 0.000 | 0.001 | 0.031*** | 0.260*** | 0.692*** | 0.009 |
| | (0.006) | (0.004) | (0.001) | (0.008) | (0.010) | (0.013) | (0.017) | (0.006) |
| Greece | 0.055*** | 0.004 | 0.006*** | 0.077*** | 0.277*** | 0.253*** | 0.453*** | 0.058*** |
| | (0.005) | (0.004) | (0.001) | (0.007) | (0.010) | (0.012) | (0.016) | (0.006) |
| Switzerland | 0.030*** | 0.012** | 0.000 | 0.021* | 0.030** | 0.030 | 0.815*** | 0.003 |
| | (0.008) | (0.005) | (0.002) | (0.011) | (0.015) | (0.019) | (0.025) | (0.009) |
| Belgium | 0.006 | 0.006 | 0.006*** | 0.047*** | 0.009 | 0.065*** | 0.664*** | 0.006 |
| | (0.008) | (0.006) | (0.002) | (0.011) | (0.015) | (0.019) | (0.025) | (0.009) |
| Czechia | 0.000 | 0.013* | 0.000 | 0.037*** | 0.158*** | 0.163*** | 0.550*** | 0.021** |
| | (0.010) | (0.006) | (0.003) | (0.013) | (0.018) | (0.022) | (0.029) | (0.010) |
| Poland | 0.028*** | 0.016*** | 0.000 | 0.049*** | 0.083*** | 0.098*** | 0.746*** | 0.080*** |
| | (0.008) | (0.005) | (0.002) | (0.010) | (0.014) | (0.017) | (0.023) | (0.008) |
| N | 4595 | 4595 | 4595 | 4595 | 4595 | 4595 | 4595 | 4595 |

*p<0.1, **p<0.05, ***p<0.01, standard errors in parentheses, clustered by countries.

The dummy coefficients reveal the percentage of women stating that the inquired aspect is relevant for their decision to not undertake regular mammography. In example – as can be

seen in the left column of Table 5 – 3.5 percent of Austrian women who never had or stopped having mammograms regularly declare that mammograms in Austria were "not affordable" (Not Afford). Note, however that the question in the SHARELIFE only asked women who never had, or stopped having, mammograms regularly. To get percentage values that relate to all women in the country (i.e. women stating to get a mammogram as well as women not stating to get a mammogram), we have to adjust the values of the coefficients of each country-dummy. More precisely, we multiply each dummy coefficient with the country-specific share of women who never had or stopped having mammograms regularly. For example, the coefficients for the dummies for the Netherlands (Germany) are multiplied by 0.25 (0.5), since in the Netherlands (Germany) 25 percent (50 percent) of women stopped or did not undergo a mammogram regularly. We present the adjusted values in Figure 2.

**Figure 3: Mammography Screening Barriers in European countries**
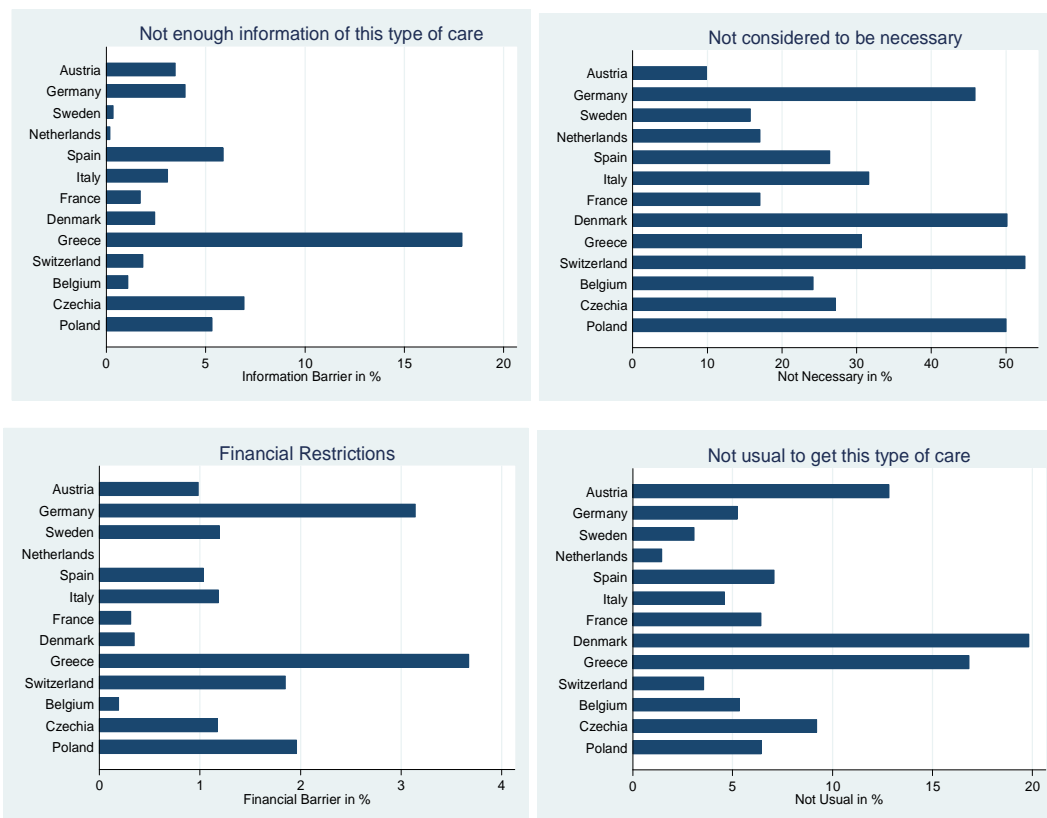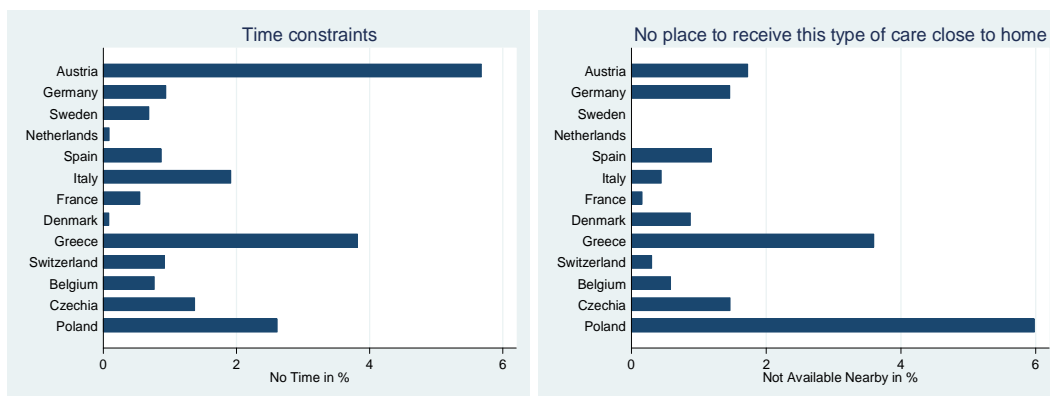
The results in Figure 3 clearly show that "Not considered to be necessary" (**Not Nec.**) is the most important reason for not undergoing screening in most countries. However the actual impact differs significantly between the countries as shown in Figure 3 top right. Whereas in Denmark 51.6 percent of women mention this factor as a cause for not getting a mammogram, only 10 percent of women in Austria state this as a reason.

Moreover "Not usual to get this type of care" (**Not Usual**) plays an important role in many countries (compare Figure 3 down right). Nearly 20 percent of women in Denmark state this as a reason. However in Sweden and the Netherlands this factor plays no significant role for not getting regular mammograms. "No information about this type of care" (No Info) is also relevant in many countries as shown in Figure 3 top left. Specifically, in Greece (18.5 percent), Czech (7.7 percent) and Poland (5.3 percent) this factor plays an important role, but also in Germany (3.2 percent), Austria (3.5 percent), Spain (3.9 percent), Italy (2.3 percent) and Denmark (2.3 percent) having not enough information is relevant for not undergoing mammograms. In Figure 3 down left the variables "Not affordable", "Not covered by health insurance" and "Did not have health insurance" are collapsed into the variable "Financial Restrictions". Financial Restrictions are most important in Greece (4 percent), Germany (2.7 percent) and Poland (1.9 percent). Time costs are mostly relevant in Austria (6.5 percent), Greece (5.1 percent) and Poland (3.2 percent) but also significant predictors in Italy (2.6 percent), Sweden (2.2 percent), Belgium (1.6 percent), Switzerland (1.4 percent) and Germany (1 percent). Finally "No place to receive this type of care close to home" is a significant predictor for not receiving a mammogram in Greece (3.8 percent), Poland (5.2 percent), Germany (1 percent) and Spain (1.4 percent).

To summarize, there are enormous differences in mammography take-up between European countries, and the reasons for not undertake mammogram screening vary strongly between them. Whereas in all countries beliefs regarding the benefits ("not necessary") seem to be important, only in some countries lack of information, financial restrictions, time costs and

access play an important role in not receiving a mammogram. Generally in countries with high screening rates like the Netherlands, Sweden or France only some aspects seem to be relevant. In contrast, in countries with low screening rates (e.g. Denmark, Greece and Poland) many reasons are significant predictors of not receiving a mammogram. Since "Not considered to be necessary" and "not usual get this type of care" are by far the most important factors, further research is necessary to explore what institutional and cultural factors determine stating these reasons for not taking part in mammography screening.

## 5. Discussion and Conclusion

Breast cancer is the main cause of cancer-mortality among women in Europe. Screening mammography helps to detect breast cancer before it becomes invasive, and mortality can be significantly reduced by regularly mammography screening. Moreover, for women aged 50-69 mammography screening has proven to be highly cost-effective. Even though mammography is officially recommended both on the national and European level for this group of women, screening rates in most European countries remain far from 100 percent and reasons for underparticipation remain unclear. One purpose of this paper was to conduct an empirical test of certain hypotheses implied by economic theory concerning the determinants of mammography screening focusing on European women aged 50-69 using the SHARE data-base ("Analysis of Screening Determinants"). Moreover, as there are enormous differences in mammography screening rates between the European countries, this paper explored the causes of these country differences ("Analysis of Screening Differences") using data from the third wave of the SHARE ("SHARELIFE").

The results of the "Analysis of Screening Determinants" indicate that better education, being married, younger age and better health consistently associated with higher rates of screening take-up. These results suggest that additional efforts may be needed to inform and convince the women living alone but also the elderly and women in poor health of the preventive benefits of mammography. Certain interventions such as invitations appointments and telephone calls have shown to be effective at increasing uptake (comp. Jepson et al. 2000).

The impact of physician quality and subjective life-expectancy was of special interest within the "Analysis of Screening Determinants". Having a family physician who generally complies with indicated geriatric assessments – as a proxy for physician quality – has a strongly significant positive effect on mammography screening propensity. Specifically, our estimates indicate on average 10.7 percentage points higher screening rates among respondents whose family physician performs all geriatric assessments relative to those whose doctor does not undertake any evaluation.

This result may imply that interventions could address the physicians as key communicator since the percentage of physicians who recommend mammography screening in Europe may be too low. In example, a study from Switzerland reveals (compare Keller et al. 2001) that among clinically practising physicians, only 22 per cent reported generally prescribing biannual screening mammography's for women aged 50–69. Thus, there might be a need to educate physicians regarding the preventive benefits of mammography screening. Moreover we find that the impact of subjective life-expectancy on screening decision substantially increases after taking measurement error and endogeneity into account. Women who expect a longer life are much more inclined to invest in mammography screening than women who believe to live a few more years only.

Finally, the results of the "Analysis of Country Differences" reveal that in countries with low screening rates (e.g. Denmark, Greece and Poland) many reasons (perceived benefits of screening, "not usual", lack of information, financial restrictions, time costs and access barriers) are significant predictors of not receiving a mammogram. In contrast in countries with high screening rates like the Netherlands only beliefs regarding the benefits ("not necessary") and the cause "not usual to get this type of care" seem to be important screening barriers. These results suggest that in countries with generally low screening rates a bundle of measures addressing all these reasons might be necessary to improve screening participation whereas in countries with high screening rates only selective measures like national promotions of mammography screening may be important to further enhance screening participation. Future research might investigate institutional and differences such as different national promotions of mammography screening, different access to physicians, different information strategies or other cultural differences in order to explore further the remarkable differences in the reasons for not undertaking mammograms in European countries.

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**Appendix**

**Table A1: First-Stage IV Regression Results: Predicting Life Expectancy**

| | Dependent variable: Life Expectancy i.e. Self-stated probability of being alive in about 10 years | |
|---|---|---|
| Physician Quality Index | -0.002 | (0.013) |
| $55 <= Age < 60$ | 0.010 | (0.008) |
| $60 <= Age < 65$ | 0.021[*] | (0.010) |
| $65 <= Age < 70$ | -0.031[***] | (0.010) |
| Self Assessed Health | -0.051[***] | (0.004) |
| Number of ADL | -0.020[**] | (0.009) |
| Heart attack | -0.041[***] | (0.013) |
| Stroke | 0.002 | (0.026) |
| Diabetes | -0.030[***] | (0.009) |
| Lung disease | -0.052[***] | (0.016) |
| ISCED Low | -0.009 | (0.009) |
| Verbal Fluency | 0.002[***] | (0.001) |
| Recall Delayed | 0.003 | (0.002) |
| Has Partner | -0.000 | (0.008) |
| children_hh | -0.006 | (0.004) |
| Doctor visits = 10 | 0.004 | (0.008) |
| Regularly Drugs | -0.007 | (0.006) |
| Hospital Stays = 2 | -0.013 | (0.017) |
| Year 2006 | 0.014[***] | (0.004) |
| Austria | -0.084[***] | (0.003) |
| Germany | -0.062[***] | (0.003) |
| Sweden | -0.057[***] | (0.004) |
| Netherlands | -0.023[***] | (0.004) |
| Spain | 0.012[*] | (0.006) |
| Italy | -0.006 | (0.006) |
| France | -0.047[***] | (0.003) |
| Greece | -0.062[***] | (0.006) |
| Switzerland | -0.039[***] | (0.004) |
| Belgium | -0.083[***] | (0.002) |
| Czech | -0.218[***] | (0.007) |
| Poland | -0.133[***] | (0.011) |
| Ireland | -0.056[***] | (0.010) |
| Father Age at Death $\leq 65$[++] | -0.029 | (0.018) |
| Father Age at Death 65 to 69 | -0.045[**] | (0.015) |
| Father Age at Death 70 to 74 | 0.001 | (0.016) |
| Father Age at Death 75 to 79 | -0.007 | (0.015) |
| Father Age at Death 80 to 84 | 0.010 | (0.008) |
| Father Age at Death $\geq 85$ | -0.000 | (0.015) |
| Mother Age at Death $\leq 65$[++] | -0.032 | (0.031) |
| Mother Age at Death 65 to 69 | -0.024 | (0.015) |
| Mother Age at Death 70 to 74 | -0.015 | (0.015) |
| Mother Age at Death 75 to 79 | 0.014 | (0.012) |
| Mother Age at Death 80 to 84 | -0.002 | (0.013) |
| Mother Age at Death $\geq 85$ | -0.014 | (0.015) |
| Age Father_IV[+++] | 0.005 | (0.009) |
| Age Father_IV² | -0.000 | (0.000) |
| Age Father_IV³ | 0.000 | (0.000) |
| Age Mother_IV[+++] | -0.001 | (0.010) |
| Age Mother_IV² | -0.000 | (0.000) |
| Age Mother_IV³ | 0.000 | (0.000) |
| Constant | -26.179[***] | (8.198) |
| Observations | 6893 | |
| R-squared | 0.161 | |
| F-Test for excluded Instruments | 14.54 | |

Standard errors in parentheses, clustered by countries. [*] $p < 0.10$, [**] $p < 0.05$, [***] $p < 0.01$

++ The omitted categories for the father and mother age at death dummies are mother still alive and father still alive.

+++ Age in the age polynomials is either current age or age at death.