School of Economics and Management
Department of Economics
Master Thesis NEKP01

Master Thesis II

Occupational-Based Effects of Retirement on Health

28/05/2012

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Abstract

Many European countries have recently decided to increase their statutory retirement ages because the demographic change poses a challenge to the stability of social security systems. The success of this policy depends among others on the health effect of such a delayed retirement. This study analyzes the effect of retirement on mental and physical health and further examines whether the health effect depends on the type of occupation. For this purpose, a cross-country analysis is applied on the basis of the *Survey of Health, Ageing and Retirement in Europe (SHARE)* dataset. To control for endogeneity, country-specific eligibility ages for early and full retirement are used for an instrumental variable approach. Overall, the results suggest a health-preserving effect of retirement as indicated by a 12 percent decrease in the likelihood of reporting bad health and by an improvement in a defined health index by a one-quarter standard deviation. Concerning the occupational-based effects of retirement on health, the results are as expected: Retiring from a blue collar occupation has significant positive effects on health whereas retiring from a white collar occupation influences health negatively. The policy implication of these findings is to increase the statutory retirement ages for white collar workers and to implement special pension schemes for blue collar workers which allow them to retire earlier according to the number of years they have been working in a physically harmful occupation.

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List of Abbreviations

ADL	Activities of Daily Life
ATE	Average Treatment Effect
ATET	Average Treatment Effect on Treated
BMI	Body Mass Index
CAPI	Computer-Assisted Personal Interviewing
DID	Difference-In-Difference
HRS	Health and Retirement Study
ISCED	International Standard Classification of Education
ISCO	International Standard Classification of Occupation
IV	Instrumental Variable
LATE	Local Average Treatment Effect
MCAR	Missing Completely at Random
MIMIC	Multiple Indicators and Multiple Causes Model
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Squares
SAH	Self-Assessed Health
SD	Standard Deviation
SE	Standard Error
SEM	Structural Equations Modeling
SHARE	Survey of Health, Ageing and Retirement in Europe
2SLS	Two-Stage Least-Squares

1. Introduction

Growing life expectancy and lower fertility rates lead to a change in the population structure of most European countries. The proportion of the active labor force is shrinking while the share of older people in a population is increasing. As a result, less young workers have to bear the extended burden of social expenditures such as pension payments and health care costs. This dilemma of an aging population calls for the extended labor market participation of older people. Around half of the OECD countries are in the process of increasing pension ages or have already legislated increases for the future (see OECD (2011), p. 19). The success of this policy implementation depends among others on the health effects of such a delayed retirement. In the case that retirement has a positive impact on the overall well-being, it might be favorable to keep the retirement age low in order to save public expenditures on health care. Thus, policy makers have to consider the trade-off between pension expenditures and health care expenditures. In the case of a negative influence of retirement on the pensioner's health, setting a higher state retirement age would decrease public expenditures both through the channel of the pension and the health care system. However, if the negative effect of health is even worse when retirement is delayed, this savings advantage might be offset by even higher health care expenditures in later years. Therefore, a detailed examination of the costs and benefits of retirement at different ages both at the individual and societal level is necessary in order to evaluate the overall policy effect of delaying retirement.

This research field has attracted a wide range of empirical studies presenting different methodological approaches, datasets and ambiguous results. My master thesis contributes to the existing literature by considering occupational-based retirement effects. My hypothesis is that the effect of retirement on health depends on the type of profession an individual was pursuing. Taking into account whether one retires from an office job or from a physically demanding activity might bring important aspects into the scientific dissensions about the health effects of retirement and at the same time it contributes to the conception of new public policies. The main research questions of the study can thus be formulated as follows: How does retirement affect the mental and physical health of an individual? Are the effects varying for different occupational groups?

The biggest challenge when estimating the health effect of retirement is the potential endogeneity since retirement can be a decision based on the health status itself. The methodology of this paper follows Coe and Zamarro (2011) who use different statutory retirement ages across eleven European countries as instrumental variables. By exploiting this exogenous variation to predict the retirement behavior of individuals, it is possible to prevent biases arising from endogenous health variables.

The analysis is done on the basis of a rich data set called the *Survey on Health, Ageing, and Retirement in Europe (SHARE)*. This cross-country data set includes demographic and socioeconomic information of 45 000 individuals in 14 European countries. Furthermore, the dataset contains detailed health information which enables to apply different measures of the health status and this makes the dataset greatly useful for the analysis of the retirement effects on health. An additional wave called SHARE-LIFE collects detailed retrospective life-histories and therefore complements the usual SHARE data by providing information about the family characteristics, housing, leisure and work history of the respondents.

The main finding of the study is that the type of occupation is actually relevant for the health effect of retirement. Retiring from a white collar job leads to a decrease in health after retiring, therefore an increase in the statutory retirement ages would decrease public expenditures both through the channel of the public pension system and the healthcare system. In contrast to this, retiring from a blue collar job has significant positive impacts on health, therefore an increase in the statutory retirement age could lead to the problem that the potential gains from the pension system are offset by the potential increased health care costs. This pattern suggests the implementation of differentiated statutory retirement ages for different occupational groups allowing individuals with arduous jobs to retire earlier.

The paper is organized as follows: The next chapter introduces previous research both on a theoretical and empirical level and based on this I present three main hypotheses on the occupational-based retirement effects that should be empirically tested in the analysis. Chapter 3 provides an overview of the retirement patterns in Europe. The theoretical background of the methodology used for the analysis is presented in Chapter 4. A detailed description of the data including the sample selection, variable choice and descriptive statistics can be found in Chapter 5. Chapter 6 approves the instrumental validity and provides an interpretation of the empirical estimates as well as a discussion of the statistical robustness of the results. Chapter 7 presents the implications of the occupational-based differences in the retirement effect of health and Chapter 8 concludes the preceding analysis.

2. Theory and Empirical Evidence behind Health Effects of Retirement

The relationship between retirement and health has gained considerable attention especially in the empirical literature. Different methodologies and datasets have been applied to examine the link between retirement and health in different settings. According to Kuhn et al. (2011), this substantial attention in the empirical literature is not reflected in the theoretical work within the field of economics. However, theoretical models on the health effect of retirement were developed especially in recent years. This section first gives a short overview of these theories and in the second part, the empirical literature is briefly reviewed.

2.1. Theoretical Literature Review

Michael Grossman's (1972) model of health production can be considered as one of the most influential models within the field of health economics. Numerous studies build their empirical analysis on the Grossman model or further develop the theoretical model by additional components such as labor market circumstances or technological changes. In its original version, the Grossman model was intended to explain the demand for health care, but the framework can also be applied in other contexts. Important for my study is the adoption of the model in the context of the retirement decision as has been done by several studies (see Neuman (2004), Galama et al. (2008), Behncke (2012), Mazzonna (2012)). To provide a better understanding of the extensions to the model, the basic framework of the Grossman model is first presented.

In the Grossman model, health is regarded as a human capital stock that can be improved by continuous investments. However, health is not only an investment good but also a consumption good. The individual can derive utility directly from the consumption of health and from the consumption of commodities, which is indirectly determined by the health investments since improved health increases the individual's productivity and earnings. The individual chooses the optimal levels of commodity consumption and health investments such as to maximize its lifetime utility, which takes the form of $U_i = (C_i, LT_i, h_i)$ with C_i

representing commodity consumption, LT_i leisure time and h_i healthy time. The amount of healthy time is supposed to increase with the level of health stock. The individual can divide its total time between leisure time (LT) and work time (WT). Additionally, an individual is assumed to have a certain amount of sick time (ST), such that the total time is composed by $TT = WT + LT + ST$. Another time component is depicted by the health investments, because the individual has to decide how much time he wants to invest in health preserving activities such as exercising. To find out about the optimal time allocation and the optimal level of demand for health, the lifetime utility is maximized subject to a budget constraint containing medical costs, financial resources and wages. The simplified result of the theoretical analysis is that the optimal level of investment in health is the level at which the marginal cost of health investment are equal to the marginal benefits.

Studying the retirement decision within the Grossman framework is appropriate since it does not only cover the related health aspects, but also takes into account the financial incentives and the individual economic variables, which are sometimes found to be even more important for the retirement decision than health (see Bazzoli (1985)). The subsequent review of four recent studies will show that different propositions regarding the optimal retirement decision and the impact on health can be derived from the Grossman model.

Behncke (2012) argues that the incentives to invest in health in order to increase productivity disappear with retirement. After retiring, the individuals therefore only derive direct utility from the investments in health. As noted above, the optimal amount of health investments depends on the related marginal costs and benefits, which are determined by the marginal value of time. If the value of time decreases after retirement, then the costs for investing in time-intensive health care decrease. However, at the same time the marginal benefit of spending healthy time decreases with the declining value of time. Behncke (2012) concludes that the theoretical effect of retirement cannot be generalized to be positive or negative but depends on the time preferences of the individual.

Galama et al. (2008) extend the basic Grossman model by allowing health stocks to be lower than the optimal level and by including a distinct retirement decision. Their main result is that the demand for health decreases after retirement because of the lack of market incentives to invest in health. Therefore individuals reduce the investments in health after retirement up to the point where health has depreciated to the lower optimal level at which investments become necessary again to maintain the consumption value of health. Furthermore the authors examine the optimal retirement age and find that white collar workers tend to invest more in health and as a consequence they stay healthier and retire later than blue collar workers whose health deteriorates faster (see Galama et al. (2008), p. 26).

Neuman (2004) studies the link between retirement and health investments by theoretically comparing the behavior of two individuals, one being eligible for early retirement benefits and the other not. He develops an advanced framework built on the Grossman model by including a benefit function into the budget constraint. The benefit function represents non-labor income and in the context of retirement it includes the level of pension benefits available to the individual in each period once reaching the retirement eligibility age. Neuman (2004) finds that the health effect of retirement depends on the income elasticity of healthy time, leisure and consumption commodities. Taking into account the empirical evidence for income elasticities, Neuman (2004) argues that the increased health investments are a response to the greater demand for healthy time caused by the increase in real income. Unlike the studies before, his analysis predicts that health investments will increase after retirement.

Another study predicting that health investments will increase after retirement is presented by Fonseca et al. (2008). The authors introduce the Grossman model extended by the inclusion of a realistic social security system and by the allowance for both unemployment and health shock risks. Their reasoning for an increase in health investments after retirement is based on the proposition that individuals may not invest in health if the optimal health level is lower than the current health. Since ill health often influences the decision to retire, retirement is modeled as the turning point where the current health falls under the optimal health level. The authors conclude that retirement induces individuals to move away from investing in other forms of capital and focus on health investments, which will consequently increase after retiring.

This review of the four studies using the Grossman framework in order to explain the relationship between retirement and health investments shows that it is possible to reason for both an increased and decreased level of health investment after retirement. It is important to state at this point that an increase (decrease) in health investments does not automatically lead to better (worse) health since one must also consider other aspects such as the natural process of aging and the respective decline in health.

Another important note is that there are many different channels through which retirement can affect health besides the change in the incentives for health investments considered so far. Retirement might for example also have psycho-social consequences in models where retirement is seen as a stressful life event. Even if an individual values retirement positively, the retirement experience disrupts the usual daily routines and requires adjustments to new circumstances. Therefore retirement can cause stress even if the event itself is perceived as positive. Stress in turn is assumed to have negative impacts on health related behavior such as smoking or sleeping habits and stress can lead to a decline in both mental and physical health. Furthermore, individuals often experience "social losses involved in retiring, including loss of income, of status identity, and of supportive networks within a familiar work setting" (Minkler 1981, p.119). Therefore, retirement is seen as a major factor of stress leading to increased illness vulnerability and as a consequence in the single-time life event framework, retirement is thus said to have negative effects on health.

For other individuals, retirement is not stressful since they are mentally prepared for the retirement period and see the event of retirement as a relief from a stressful or arduous working life. A related theory contains a process approach and was first introduced by Atchley (1976). Retirement is defined as a continuous process starting long before the actual retirement and ending with death. The process involves seven phases, namely the remote and near phase; the anticipation phase; the occurrence phase; the honeymoon phase; the disenchantment phase; stability phase and the termination phase. The effect of retirement on health is different in each phase and is influenced by the respective psychological, social and economic circumstances in each phase. Atchley concludes that "retirement generally has no adverse effect on physical health and if anything tends to improve it" (Atchley 1976, p.107).

The review so far shows that on the theoretical level there is no unambiguous relationship between the retirement decision and the health effect. According to the theoretical results, it does not seem reasonable to anticipate that retirement categorically leads to an improvement or decline in health for all individuals. One would rather expect heterogeneous effects depending on the individual characteristics and preferences as well as on the external circumstances such as the social security system or labour market conditions. To bring the theoretical propositions to a practical level, the next part gives an overview of the empirical studies related to the health effect of retirement.

2.2. Empirical Literature Review

Early studies tried to empirically analyze the health effect of retirement already in the 1970s, but their reliability is deficient mainly because of two reasons. First, the lack of data was a problem and most of the studies were based on surveys and therefore were subject to measurement errors. Second, the econometric methods back then were not straightforward enough to account for the fact that the retirement decision is often lead by health characteristics, which results in the fact that health might be endogenous. Many studies were based on a comparison of the pre- and post-retirement health status and without identifying the endogenous variable, the authors could only derive a correlation between retirement and health, but not the causal inference. Since the causation is what one is usually interested in and what necessarily needs to be known for any policy implementation, improved methods were applied in the subsequent decades. These can be categorized mainly in three groups: Fixed-effects estimations, instrumental variables approaches and cross-country studies.

Fixed-effects estimations

Kerkhofs and Lindeboom (1997) use a Dutch panel data set to construct a fixed-effects model in order to control for the endogeneity in the retirement decision. By assuming that the sources of endogeneity are time invariant and specific for each person, they argue that the endogenous factors will disappear when controlling for individual fixed-effects. They find different results depending on age cohorts and gender, but overall retirement has a health-preserving effect. It is important to note that the existence of time variant sources of endogeneity would lead to biased results because they are not controlled for. In a later study, Lindeboom et al. (2002) claims to capture such potential biases by including a broad range of explanatory variables to account for shocks varying between the waves of the survey. They find no evidence that early retirement leads to higher depressive feelings. Another way to capture the endogeneity problem has been done by Dave et al. (2008) who use data from the US Health and Retirement Study (HRS). They also apply a fixed-effects model but unlike the other studies they limit the sample to individuals who reported not having health problems before the retirement, such that health cannot be the driving factor behind a retirement decision and therefore the endogeneity problem should be solved. This approach however is questionable because firstly, the sample is very selective on those with good health and secondly, there could be sudden changes in health between the waves leading to immediate retirement, which are not captured by this approach. These problems might be the reason why this study finds negative effects of retirement on health compared to the other fixed-effects studies.

Instrumental variables approach

The fixed-effects models improved the reliability of the empirical investigations, but the endogeneity problem could not be solved completely. Therefore, several authors tried to apply different identification strategies by finding adequate instruments, which are variables that are strongly correlated with retirement but not itself determined by the health of the individual. Charles (2004) concentrates on the effects that retirement has on mental health as indicated by depression and feelings of loneliness. The author exploits changes in laws for compulsory retirement and different incentives in social security systems across ages as exogenous variation in order to control for the endogenous health effect on retirement. Charles (2004) finds that retirement has a positive effect on the well-being of men measured by a reduction in depressive and loneliness feelings. Due to limitations in the data, Charles (2004) could not examine the effects of retirement on physical health. Neuman (2008) fills in this gap by using data from the US Health and Retirement Study (HRS) and applying a similar identification strategy as Charles (2004), namely he exploits exogenous variation in public and private pensions. His findings also point into a health-preserving effect of retirement. Coe et al. (2009) use the same data from HRS and choose the variation in early retirement windows by employers as instrumental variables strategy. What is noteworthy about this study, is that they allow for heterogeneity in occupation by estimating different effects for blue collar and white collar workers. Without controlling for the endogeneity, they find a significant negative relationship between the time spent in retirement and measures of cognitive functions for both occupational groups. After instrumenting retirement with the help of early retirement windows, they find no evidence for a negative relationship of retirement and different objective cognition measures. Moreover, they find a statistically positive relationship for blue collar workers, which stresses the importance for occupational-based investigations.

Cross-country studies

The previous part shows that variations in the social security systems and public policies often serve as adequate instruments. The problem is that such variation is rare because there are not many changes and reforms of such social security systems within a country. However, such variation can be extensively found across countries and this leads us to the third wave of empirical studies analyzing the health effect of retirement with the help of cross-country designs. Rohwedder and Willis (2010) show that there is a strong relationship between the public policy of a country and the timing of retirement by plotting unused labor capacity and the average tax rate on earnings. (see Figure 1)

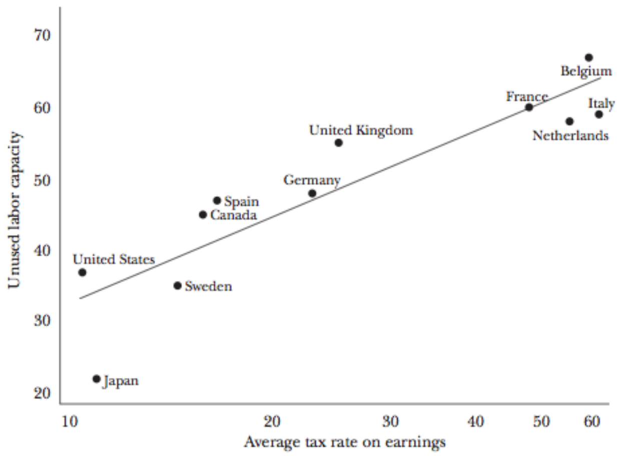

Figure 1: Effects of public policy on retirement in selected countries[1]

According to Rohwedder and Wilis (2010), the marginal tax rates on earnings have a powerful effect on the retirement decision. For example, a social security systems with high marginal tax rates is organized so that an additional year of working at a specific age does not increase the monthly pension benefits and this creates disincentives to prolong retirement. These differences in tax rates and the related working incentives lead to exogenous variation in retirement ages across countries and therefore these public policies that affects the age of retirement can be used as instruments in order to identify the causal effect of retirement on health. This cross-country method circumvents the endogeneity problem which challenged all previous micro-level studies.

[1]Source: Rohwedder and Willis (2010)

Interestingly, Rohwedder and Willis (2010) find that early retirement has a significant negative impact on the cognitive ability of people in their early 60s. Coe and Zamarro (2011) investigate the retirement effects on health by exploiting country-specific retirement ages of 11 European countries as an instrument in a regression discontinuity design. The authors find significant evidence that overall retirement has a health-preserving effect. Adam et al. (2006) use the SHARE dataset to study how different factors influence the cognitive functions of older people in Europe and find that all types of labor market activities have a positive effect on cognitive reserve constitution and argue for negative effects of early retirement on health.

To sum up the empirical literature review, it can be said that even though both the data and the different methods improved over time, the results show mixed evidence for the health effect of retirement. It is however difficult to compare the studies since the objects of investigation vary between different kinds of mental and physical health and between the choice of the method or instrument which determines the analyzed point of time in the life cycle. Another conclusion is that there are a lot of influencing factors such as health insurance aspects, social security benefits, macroeconomic circumstances or life-style aspects, that are interesting to analyze in this context. One important aspect, that has not been investigated extensively in previous empirical studies are the occupational-based effects of retirement, which will be described in more detail in the next section.

2.3. Hypotheses on Occupational effects

How does the retirement effect on health depend on different occupational levels? This question has been raised in earlier studies but it has not been studied to an end and therefore gains special interest in upcoming studies. Minkler (1981) asked: "If retirement does affect health in an adverse way, is this relationship more significant among blue-collar workers than among white-collar workers?" (p. 118) The importance of such occupational effects faded into the background in the last decade because most studies focused on solving the endogeneity problem. One of the first studies taking up this topic again was the study by Coe et al. (2009) who controlled for heterogeneity in occupation and who found significant differences in the health effect of retirement for blue collar and white collar workers. However, they worry about the estimation precision of their results due to methodological pitfalls. In their later cross-country study, the methodological problems could be solved but Coe and Zamarro (2011) were not able to control for heterogeneous effects due to data limitations. However, they are "concerned that retirement might have different effects on health for different individuals. For example, retirement from a job that requires strenuous physical labor might affect one's health differently than retiring from a desk job" (Coe and Zamarro (2001), p. 79). This considerations show the need for a new study capturing different occupational effects based on the two groups of blue collar and white collar workers, but also on more differentiated socio-psychological aspects of work.

For this purpose, I consider two models which describe the relation between the psycho-social characteristics of work and the health of a worker. According to the model of Karasek and Theorell (1991) a low level of control in the job combined with strong demand represents a risk for health. They support their hypothesis by pointing out that those individuals who report a low level of control and a high level of demand show a higher prevalence of symptoms of heart disease.

The main idea behind the second model following Siegrist (1996) is that "an imbalance between demand and reward exposes workers to high psychological stress, leading in the long term to the appearance of pathologies, such as cardiovascular disease, mental or psychical health problems" (Debrand, T., Lengagne, P. (2008), p.4). Several empirical studies have confirmed Siegrist's hypothesis by analyzing the effect of demand and reward on cardiovascular diseases (Bosma et al. 1998), mental illness (Pikhart et. al. 2004), self reported decline in health and chronic diseases (Ostry et al. (2003)).

Following these two models I set up three hypotheses which should be tested in the empirical analysis. It must be noted at this point that all health measures serving as dependent variables are constructed such that a higher value of the health measure indicates worse health.

Hypothesis H1: Retiring from a job that implies a low level of control and strong demand has positive impacts on health. Therefore the probability of reporting bad health or having worse objective health measures after retirement decreases and implies negative coefficient signs of the retirement variable.

Hypothesis H2: Retiring from a job that implies an imbalance between the level of demand and reward has positive impacts on health. Therefore the probability of reporting bad health or having worse objective health measures after retirement decreases and implies negative coefficient signs of the retirement variable.

Recalling the theoretical models about health effects of retirement according to Minkler (1981) and Atchley (1976), I develop one further hypothesis. The stressful life event theory predicted a negative effect of retirement on health due to the loss of social status, income and network. These aspects apply especially for white collar workers. The process theory in contrast predicted a positive effect of retirement on health due to the omission of harmful aspects of work. These aspects apply especially for blue collar workers. This leads to the following hypothesis.

Hypothesis 3: Retiring from a white collar job has negative impacts on health and therefore I expect positive coefficient signs. Retiring from a blue collar job has positive impacts on health and therefore I expect negative coefficient signs.

3. Retirement Patterns in Europe

Before starting the analysis it is necessary and interesting to have a closer look at the retirement patterns in Europe in order to get a feeling for the dimension and importance of the research question. Figure 2 shows the relation between the total number of the eligible working population, that is individuals aged between 20-64, and the total number of retired persons for the eleven countries which will be subject of the upcoming analysis.

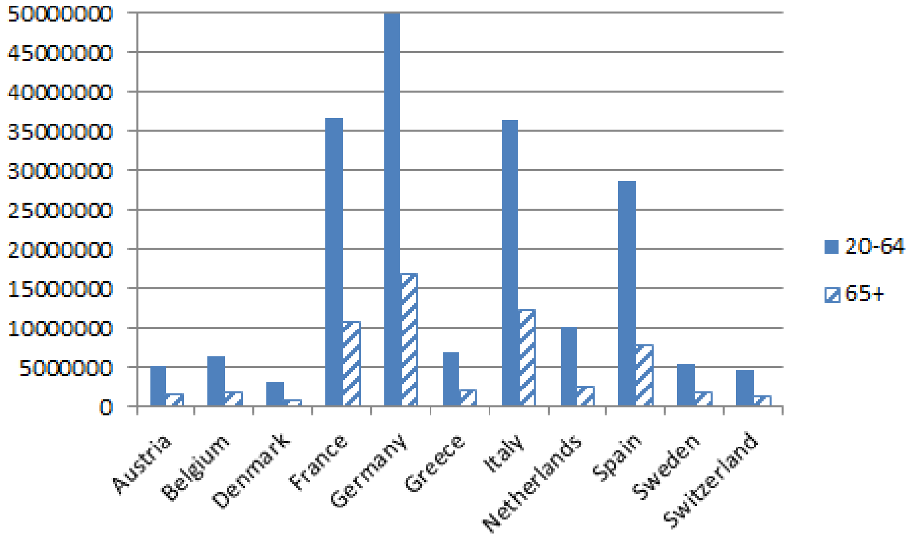

Figure 2: Working population and retirement population in absolute numbers for selected countries in year 2011 [2]

Germany has both the highest number of workers with approximately 50 million persons and the highest number of retirees with 17 million persons in the year 2011. In terms of absolute numbers, Germany is followed by France, Italy and Spain. All other countries have lower population rates under 10 million for both workers and retirees. However, what is more important for the analysis of public pension systems is the ratio between the number of workers and the number of pensioners in a country. This ratio between those two populations is called the "Old-support ratio" and measures how many young workers there are to come up with the contribution necessary for the pension benefit of one retired person. The ratio is illustrated in Table 1 and it can be seen that the ratio is worse for Germany with 2.92 and the Netherlands depict the most advantageous situation with 3.84. On average, the numbers from the year 2011 illustrate that one pensioner is supported by three workers. In comparison to that, in 1950 more than seven people from the working population could account for one pensioner. This development illustrates the population aging problem and the threat to the sustainability of the public pension systems.

According to OECD (2011), there are three main routes out of the dilemma of population aging. One of them is to concentrate the efforts of public retirement provision on the most vulnerable with the aim of a greater redistribution and improved sustainability. The second approach is to encourage young people to save for their own retirement to compensate potential shortages of future public benefits. The third solution is to promote longer working lives by increasing statutory pension ages. Since the retirement age is a visible parameter of the public pension system that has actual impact on the individual's in-

[2] Source: Own elaboration with statistical data information from OECD (2011)

centives to retire, this policy instrument is assumed to have great impacts on the overall retirement patterns.

There are different statutory retirement ages across the European countries. Full retirement age is defined as the age at which people can first draw full benefits without reductions. In the years 2004 and 2006 most countries have a full retirement age of 65 as is shown in Table 1. All countries allow some type of early retirement. In most pension systems after reaching the early retirement age, one can retire with a cut in the benefit of a certain percentage for each year of early retirement reflecting the longer time period the pensions are paid. In some countries, such as for example Belgium or Italy, there is no reduction in the pension benefit if a certain amount of years of contributions were paid (see OECD (2011), p. 112).

Country	Early age	Full age	Old-support ratio
Austria	60	65	3.463013918
Belgium	63	65	3.395031338
Denmark	60	65	3.424055149
France	57	60	3.382708305
Germany	63	65	2.953526756
Greece	57	65	3.375415682
Italy	57	65	2.917725672
Netherlands	60	65	3.840557716
Spain	60	65	3.637792089
Sweden	61	65	3.126155132
Switzerland	63	65	3.499807654

Table 1: Early and full retirement ages in different countries for the years 2004 and 2006[3]

Due to the change in old-support ratios, many countries adopted the retirement ages in the last years. Figure 3 shows the development in retirement ages from 1950-2050 and the forecast for the retirement ages predicts an ongoing increasing trend. Austria, Belgium, Netherlands, Spain and Switzerland are not illustrated in the graph since there has not been a change in the retirement ages in the last 60 years and there are no indications for an increase or reduction of the retirement age. Sweden is the only country that permanently lowered the retirement age from 67 to 65 in 1985 and there seems no intention to increase it in the next 40 years. Denmark reveals a changing pattern in the retirement age with an increase from 65 to 67 in the early 1960s and a change back in the year 2005. There is a prediction that they will go back to the age 67 again in the year 2020. Although France, Italy, Greece and Germany are on historically different levels of retirement ages ranging between 55 and 65, these countries show one common trend of increasing retirement ages, especially starting around the year 2000 and further in the future. These countries recognized the long-term effects of the changing structure in the population ratios and they rely on the increase in statutory retirement ages as a policy instrument. On the first sight, the instrument seems very straightforward and easy to implement, but many different aspects have to be taken into account when evaluating the total impact of the policy instrument. One of these aspects is the impact of a delayed retirement on the health of the individuals, which will be now analyzed in the subsequent sections.

[3]Source: Own elaboration with statistical data information from OECD (2011)

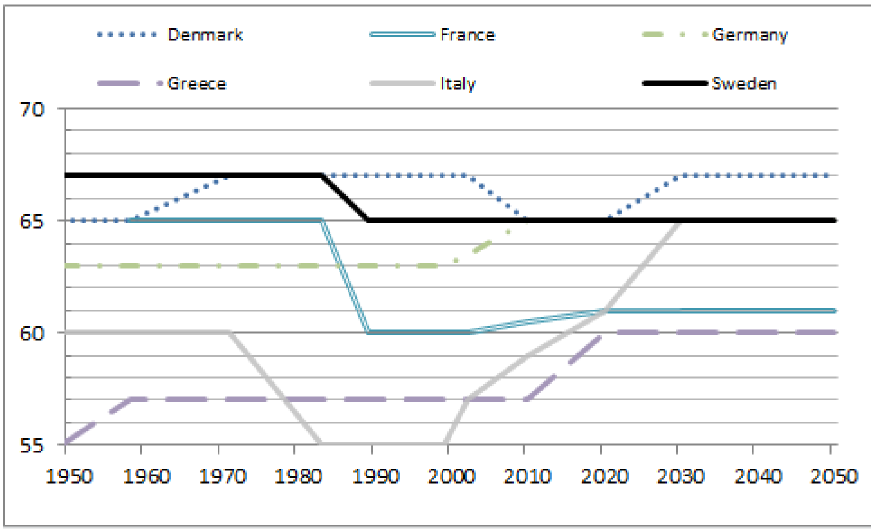

Figure 3: Development of retirement ages between 1950-2050 for selected countries [4]

4. Methodology

The basic aim of the empirical analysis of this study is to determine the effect of retirement on different measures of health. A linear probability model describes this relationship in the following way:

$$Y_{it} = \alpha + R_{it}\beta + X_{it}\theta + u_{it} \tag{1}$$

where Y_{it} denotes a certain measure of health, R_{it} describes the binary retirement decision and the vector X_{it} includes a set of explanatory variables such as age, family status, education and others. The error term u_{it} in the model contains all unsystematic, unobserved influences and is assumed to be uncorrelated with any other regressors, thus $E(u|X) = 0$. If this assumption is violated by a correlation between the error term and a covariate, the estimates will be biased and inconsistent. Estimating equation (1) by OLS is the most straightforward way, but leads to inconsistent estimates if endogeneity problems are present and not taken into account.

Endogeneity problems can be evoked by different reasons. First, unobserved heterogeneity might occur because relevant variables are omitted from the regression model. Even if the model is carefully specified by necessary explanatory variables, there might still be variables that have a systematic influence on the dependent variable but are not observable. In our specific case there could be unobserved individual variables such as genetic characteristics, time preferences and life-cycle factors that influence the current health status and the retirement decision. Since those variables cannot be depicted in the model, their influence is included in the error term, leading to endogeneity.

The second source of endogeneity stems from the potential self-selection problem. Retirement is not randomly distributed among the individuals in the sample, but the decision of retirement is a function of different factors. People might therefore self-select themselves into early retirement on the basis of individual preferences, for example individuals who are least satisfied with their job or least healthy are more likely to retire earlier. This can lead to the fact that retirement is correlated with unobservable

[4] Source: Own elaboration with statistical data information from OECD (2011)

individual preferences and therefore the assumption that $E(u|X) = 0$ is violated and the estimates would be inconsistent. At the same time, if the retirement decision is determined by the health status, the problem of reverse causality between those variables is present. That means that retirement can influence the health status of an individual but it can also be the case that health influences the retirement status.

In this study, an instrumental variable (IV) approach is used in order to address the endogeneity problem arising from the self-selection problem. The basic intuition behind this approach is that an IV regression breaks the endogenous variable into two parts: one part that is correlated with the error term and one part that is not. With the help of the exogenous variation of an instrumental variable, the uncorrelated part of the endogenous variable is isolated and used to estimate the intended coefficient. In this study, the instrumental variable needs to be a variable that strongly influences the retirement decision, but which is uncorrelated with the individual's health and all unobserved determinants of health and retirement or, in other words, with the error term. For this purpose I exploit the country-specific early and full retirement ages in Europe following Coe and Zamarro (2011). The idea behind using these institutional characteristics as instruments is that I assume retirement to be a function of age and that the probability of retiring discontinuously changes at the respective statutory retirement ages of a country.

It is important to note at this point that it is reasonable to assume treatment heterogeneity, meaning that not all people react to the instrument in the same way. Consequently I can define four different groups of individuals. The first group (compliers) react according to the instrument, which means that they will work until they reach the statutory retirement age and as soon as they become eligible for pension benefits, they retire. The second group (always-takers) is defined as the subpopulation that is already retired before they reach the statutory retirement age. The third group (never-takers) against consists of individuals that actively stay in the labour force even though they already reached the retirement age. The fourth group (defiers) reacts contrary to the instrument, which is not very realistic in the retirement setting since this would mean that individuals retire before they become eligible for pension benefits and start working as soon as they reach the statutory retirement age.

By instrumenting the retirement status by the statutory early and full retirement ages, the estimates are only valid for the those individuals who respond to the instrument by retiring exactly at the eligibility ages. Thus, instead of the average treatment effect (ATE) of the whole population or the average treatment effect on treated (ATET) for the retired individuals, this study identifies the local average treatment effect (LATE) only for the subpopulation of the compliers.

In the heterogeneous effect case, four assumptions have to be fulfilled for the instrumental variable to be valid and for an identification of the treatment effects to be valuable even if only covering the LATE. The independence assumption requires the instrument z to be independent of potential outcomes and potential treatment assignments or, in other words, the instrument must be as good as randomly assigned. The exclusion restriction says that an instrument should affect the outcomes only through one single known channel. In other words, the instrument must be uncorrelated with the error term, thus $cov(z, \epsilon) \neq 0$. The monotonicity assumption requires the instrument to affect the variable of interest only in one direction. This means that even if the heterogeneous treatment effects allow individuals to respond or not to respond to the instrument, those who are affected must be affected in the same way. This assumption therefore excludes the subpopulation of defiers. The last assumption addresses the instrument relevance and requires the instrument to be correlated with the endogenous variable x, thus $cov(x, z) \neq 0$. This condition can be tested by regressing the endogenous variable on the instrument and other explanatory variables. If the instrument coefficient is significantly different from zero, the instrument can be assumed to be relevant.

The exclusion restriction can unfortunately not be tested because an empirical test would require an unbiased error term ϵ, which is not given since the OLS estimator of ϵ is assumed to be biased because of the endogeneity and the IV estimator of ϵ itself depends on the $cov(z, \epsilon) \neq 0$ condition, which is the part that should be tested in the first place. Since the assumption is not testable, a convincing logical explanation for the instrument exogeneity based on common sense and institutional background must be found.

The validity of my instruments will be discussed in detail in section 6.1. Several econometric tests are presented which strongly support the instrument relevance. I further explain why the instruments can be assumed to be exogenous, but also discuss some potential threats to the instrument exogeneity as well as to the independence assumption.

On the supposition that my instruments are valid, consistent instrumental estimates are obtained by the Two-Stages Least-Squares method. Following equations describe the procedure:

$$\begin{aligned} Y_{it} &= \alpha + R_{it}\beta + X_{it}\theta + u_{it} && \text{(Structural Form)} \\ R_{it} &= X_{it}\beta_1 + I(S_i \geq \bar{S})\beta_2 + \epsilon_{it} && \text{(First Stage)} \\ Y_{it} &= \alpha + \hat{R}_{it} + X_{it}\theta + v_{it} && \text{(Reduced form)} \end{aligned} \tag{2}$$

The structural form represents the baseline OLS regression. Due to the endogeneity problems described above I fear that $cov(R_{it}, u_{it}) \neq 0$, which would lead to inconsistent estimates. The first stage describes the influence of the instruments on the binary retirement variable R_{it}. More specifically, the instrument is an indicator of whether the individual's age S_i is above the early or full retirement age $\bar{S}$. The predicted values for retirement from the first stage are used and substituted into the structural form. The resulting reduced form is supposed to yield unbiased and consistent results if the instruments are valid. Only the standard errors must be corrected to take into account the first stage estimation. In accordance to the LATE, the resultant estimates can be interpreted as the effect of retirement on those whose retirement status was actually changed by the instrument.

In order to obtain the intended occupational-based effects of retirement, I include different interaction terms between the instrumental variables and selected psycho-social job characteristics or occupational groups. For example the interaction between the retirement instrument and a dummy variable indicating whether an individual is a blue collar worker reports the retirement effect on health for those blue collar workers who are induced to retire by the instrument.

5. Data

The analysis is based on the *Survey of Health, Ageing and Retirement in Europe (SHARE).* This multidisciplinary, cross-national panel dataset contains information on health, socioeconomic status and social and family networks of more than 40.000 individuals over age 50 in different European countries. SHARE offers a variety of different health variables starting with self-assessed health to physical measures such as grip strength or body-mass index through to psychological indicators. This makes the SHARE dataset unique for the analysis of questions related to the population aging and the life of elderly in Europe.

More precisely, data was drawn from the first and the second wave[5] for the following 11 European countries: Austria, Germany, Sweden, Netherlands, Spain, Italy, France, Denmark, Greece, Switzerland and Belgium. The data for the first wave was collected in 2004, for the second wave in 2006/2007. Additionally, information was also drawn from the third wave, which is called SHARELIFE and which is conceptually different from the first two waves since it is retrospective. That means that while the respondents are still the same, the questionnaire for the third wave is different and focuses on the previous life history of the respondents. The five main areas of interest in SHARELIFE are children, partners, accommodation, work and health. The information is gained towards the method of a life history calendar, where first the most memorable life events are asked for, such as birth of first child and then all the other events are filled in according to the pattern "Was this event before or after your first child was born?". Through this way of questioning, the whole life history of the respondent can be reconstructed with more or less reliable time designation. The method might be questionable and especially information from the early life of the respondent can be imprecise. However, this should not compromise my study since the only information taken from the SHARELIFE is information about the last occupation and on the number of children, which can be regarded as memorable and therefore reliable.

Concerning the overall data reliability, SHARE data can be considered to be very advanced, especially judging from the fact that it is very difficult to collect individual-based data in different countries. In order to ensure that the questionnaires for the different countries follow the same structure, a centrally-developed Computer-Assisted Personal Interviewing (CAPI) program was applied for the questionnaires which have been translated into different languages. Cultural differences can have a severe influence on how the individuals answer questions which imply some kind of subjective assessments, such as "On a scale from 0 to 5, how satisfied are you with your health?". In order to account for these differences and to improve the cross-national comparability, SHARE data uses anchoring vignettes. These vignettes show how the respondents would evaluate the health status of a hypothetical person on the basis of a detailed health description. This evaluation gives an anchor which is then used to assimilate the differences in the response scale assessment across different countries. The usage of the vignettes is one example for the efforts SHARE made to "deliver truly comparable data, so we can reliably study how differences in cultures, living conditions and policy approaches shape the quality of life of Europeans just before and after retirement." (Bösch-Sepan and Jürges (2005), p.5)

5.1. Sample selection

In order to increase the number of observations a pooled dataset from the first and the second wave is constructed. The sample is restricted to male individuals aged between 50 and 69. Incomplete survey

[5] Release 2.5.0

records are eliminated and so are observations of individuals who participated in only one wave of the survey. Since the interest of the study lies in the effect of the change from working status to retirement status, I eliminate individuals who have never done paid work in their life or that have not been working since they reached the age of 50. The remaining sample contains 12.011 individuals.

It is noteworthy that this high number of observations is only possible through the appliance of multivariate imputations for chosen variables. A common problem for individual-based survey data is item non-response. There are different reasons why respondents do not provide answers for certain questions, for example privacy concerns, lack of knowledge etc. This leads to the fact that especially variables like income or private health concerns are reported less frequently and therefore lead to missing values in the dataset. There are different ways to treat missing values and the first one is to simply disregard all observations with missing values. This method appears to be most straightforward, but it has two important implications. First, it implies a loss of valuable information. In SHARE, the prevalence of missing values for individual-level demographic variables is typically below 1% of the sample, but it varies depending on the variable and on the country (see Christelis (2011), p. 3). Although this percentage seems to be very low, it accumulates in the end and leads to a big loss of data if all incomplete records are deleted. The remaining sample will be small and provide less efficient estimates. The second implication of disregarding all observations with missing values is that one automatically makes the strong assumption that the missing values are completely random. Thus, one assumes that the underlying reasons for missing values are uncorrelated with any other variables present in the survey such that the remaining sample after deleting those observations with missing values is still representative of the original sample.

One typical non-item response variable is the question after the household income. It is realistic that many respondents do not want to answer this question due to privacy reasons and if those respondents have an income higher or lower than the average, then the missing values won't be truly random any more and the remaining sample would for the most part exclude those individuals with very high or very low income. This example shows that the missing completely at random (MCAR) assumption is easily violated in an individual-level survey and therefore estimates based on samples including only complete records can be biased and inconsistent.

To sum up, simply disregarding all observations with missing values will lead to inefficient, biased and inconsistent estimates and therefore missing values have to be treated carefully. One alternative method is to impute missing values, that means to find reliable substitutes for the missing values on the basis of other information in the survey. SHARE recognizes the need of imputations and offers additional information for this purpose. Based on a fully conditional specification approach (see Christelis (2011)), a set of possible values are generated conditional on all the sample information available. These generated variables can then be used as substitutes for missing values. Instead of founding the analysis only on one prediction of the missing value, SHARE provides a distribution of five possible values, which enriches the imputation process and provides better substitutes for the missing values.

On the basis of these five generated variable sets, I perform multivariate imputations of missing values for the following variables: household income, number of children and being in self-employment or public employment. Thanks to this imputation procedure, I do not have to delete all observations with missing values and therefore end up with a sample of 12.011 individuals which is representative for the full sample.

Name	Definition
Bad health	1 if respondent reported health as poor, bad or very bad; 0 if good or very good
Euro-D	Number of perceived feelings according to the Euro-D Depression Scale: depression; pessimism; suicidality; guilt; sleep; interest; irritability; appetite; fatigue; concentration; enjoyment; tearfulness (0-12)
Grip strength	Maximal grip strength measured with a dynamometer on a scale from 0-100 kg
Limited	1 if limited in activities due to health; 0 otherwise
Chronic conditions	Number of chronic diseases: heart attack; high blood pressure or hypertension; high blood cholesterol; stroke; diabetes; lung diseases; asthma; arthritis; osteoporosis; cancer; stomach or duodenal ulcer; Parkinson's disease; cataracts; hip fracture or femoral fracture (0-14)
Chronic symptoms	Number of chronic symptoms: pain in the back, knees, hips or any other joint; heart trouble; breathlessness; persistent cough; swollen legs; sleeping problems; falling down; fear of falling down; dizziness, faints or blackouts; stomach or intestine problems; incontinence (0-11)
Mobility limitations	Number of limitations in: walking 100 meters; sitting two hours; getting up from chair; climbing several flight of stairs; climbing one flight of stairs; stooping, kneeling, crouching; reaching arms above shoulder; pulling or pushing large objects; lifting or carrying weights over 5 kilos; picking up a small coin from a table (0-10)
ADL limitations	Number of limitations with activities of daily living among the following: Dressing; Walking across a room; Bathing or showering; Eating; Getting in and out of bed; Using the toilet (0-6)
IADL limitations	Number of limitations with instrumental activities of daily living among the following: Using a map to get around in a strange place; Preparing a hot meal; Shopping for groceries; Making telephone calls; Taking medications; Doing work around the house or garden; Managing money such as paying bills (0-7)
Hospital stay	Number of nights stayed in the hospital in previous year
Overweight	1 if Body Mass Index is between 25-29.9; 0 otherwise
Obese	1 if Body Mass Index is 30 or higher; 0 otherwise
Exercise	1 if doing activities and sports requiring a moderate level of energy
Smoking	1 if smoking at the present time; 0 otherwise
Alcohol	Number of days a week consumed alcohol in the last 3 months

Table 2: Health variable definitions

5.2. Variable Choice

Health as dependent variable

The most challenging variable in most studies of this kind is the measurement of health. The SHARE data set provides information both on self-assessed health and different objective health measures. For my study, I include six different indicators of health which are described in the following. The first indicator is designated to assess the mental health of an individual by measuring the degree of depression according to the official **Euro-D Depression Scale**. The individual is asked to report the number of perceived mental feelings described in Table 2.

The second indicator contains the individual's **self-assessed health status** which is rated on a categorical five-point scale with the answers very good, good, poor, bad or very bad. A binary variable of reporting bad health is created according to the classification described in Table 2. Using self-assessed health has a long tradition in socioeconomic empirical studies, but special attention has to be spent on potential problems in the reliability of this subjective measure since self-assessed health is concerned to be subject to different bias factors possibly leading to measurement errors. In general, the main concern in this context is the existence of reporting bias, which means that individuals with the same health status but from different population groups report different health assessments. This happens because different populations systematically use different threshold levels when assessing their health and therefore interpret the question in their own specific context (see Lindeboom, M. and van Doorslaer E. (2004), p. 1084). The different thresholds can be influenced by the culture, age, gender, education, language, income and health related life experiences of the individual. Despite from these concerns, self-assessed health has been shown to be a good predictor for both mortality and the use of medical care by various studies (see for example Burström, B. and Fredlund, P. (2001); Benjamins et al. (2004)). Furthermore, by the usage of the vignettes described earlier, the bias of self-assessed health in the SHARE data will be reduced substantially. To sum up, self-assessed health is an interesting parameter to use as a dependent variable, but if there are other measures available in the data, one should take advantage of this to approve the results of the self-assessed health.

As a result of the discussion about self-assessed health, I exploit the availability of objective measures in the dataset and therefore the third health indicator contains a declaration of **chronic diseases**. It is objective in the way that the individuals do not have to judge their symptoms themselves, but they are asked whether the doctor diagnosed one of 14 chronic diseases described in Table 2. The fourth indicator called **ADL** describes the number of limitations an individual experiences in doing activities of daily life. The last two indicators have the advantage that they are more objective than the self-assessed overall health status, but the disadvantage is that they depict very specific health aspects and therefore are limited in their applicability as a measure of the overall health status. As a consequence, I follow a latent variable approach which has been gaining popularity in empirical work and which aims to create a health index encompassing all available objective measures of health.

There are various approaches to ameliorate a number of measures into one single index variable and I apply two different methods. The first method follows a latent variable model introduced by Bound (1999). This approach enables me to summarize various objective health measures into one single measure and at the same time correct the reporting bias. According to this approach, the baseline relationship can be described as follows:

$$\eta_{it} = X_i'\pi_t + Z_{it}'\gamma + v_{it} \tag{3}$$

with η_{it} reporting the true health status of the individual, X_{it} being a vector including different socioeconomic characteristics and Z_{it} represents different health measures. The error term v_{it} includes all unobserved factors and is assumed to be uncorrelated with both X_{it} and Z_{it}. The problem is that the true health η_{it} is not directly observable, but only the self-assessed health status h_{it} can be observed. This self-assessed health is error-ridden, thus the relation between the true health and the self-assessed health can be described as:

$$\begin{aligned} h_{it} &= \eta_{it} + \mu_{it} \\ h_{it} &= X_i'\pi_t + Z_{it}'\gamma + (v_{it} + \mu_{it}) \\ h_{it} &= X_i'\pi_t + Z_{it}'\gamma + u_{it} \end{aligned} \tag{4}$$

The error term in the last equation can be decomposed in $u_{it} = v_{it} + \mu_{it}$, thus in a part reflecting the unobserved factors of health and a part reflecting the reporting errors of self-assessed health. By applying a latent variable model, all objective health measures described in Table 2 are used to instrument the error-ridden self-assessed health. More precisely, I estimate Equation 4 and use the estimated coefficients in order to predict the following health measure:

$$\hat{h}_{it} = X_i'\hat{\pi}_t + Z_{it}'\hat{\gamma} \tag{5}$$

This latent variable approach has been approved to produce valid proxies for the true health by Bound (1999) and has also been applied by Coe and Zamarro (2011).

The second method to create an encompassing health index is called a Multiple Indicators and Multiple Causes (MIMIC) model. The idea behind this model is that the observed variables can be related to the underlying latent variable in two different ways: they can either be causal indicators or effect indicators (see Fayers, P., Hand, D. (1997), p. 145). Effect indicators are manifestations of the latent variable, which means that a higher level of the latent variable implies that the effect indicator will have high levels as well. It is noteworthy to state that this however cannot be interpreted as a causal relationship. For example if health as the latent variable indicates good health, then the effect indicator such as blood pressure is expected to be better as well, but better health does not cause the blood pressure to be better. All objective measures described in Table 2 are used as effect indicators. Causal indicators in contrast are assumed to influence the latent variable. Again, this is no strict causal relationship, but with a higher education level as a causal indicator for example, the latent health variable is more likely to be better. Causal indicators can be the socioeconomic status or different behavior such as smoking, diet or exercising. The MIMIC model and the included causal and effect indicators are illustrated in Figure 4. This model can be estimated by a new feature in the statistical computer software called Structural Equations Modeling (SEM).

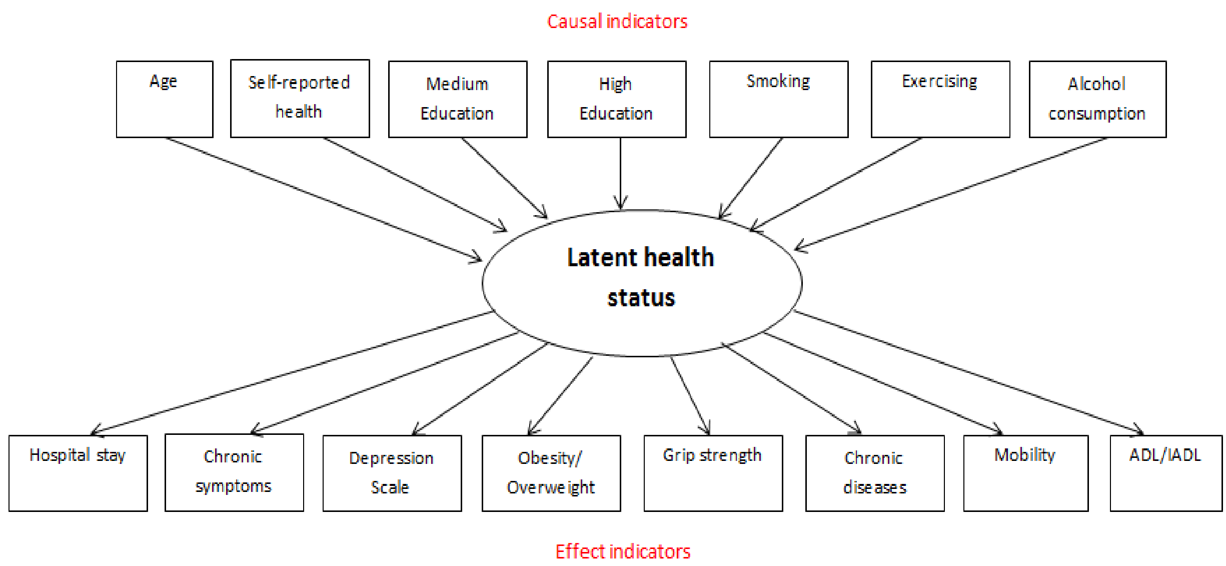

Figure 4: Multiple Indicators and Multiple Causes (MIMIC) model

Both methods of creating a general health index are reasonable and it will be shown later that both health indices show similar empirical results. One challenge for both methods is that most of the health measures are not continuous variables, but ordinal data. However, the statistical software only allows to estimate the models described above by the maximum likelihood method. Several studies have shown that the maximum likelihood method using ordinal data will produce acceptable results when the number of categories is 5 or higher (see for example Beauducel, A., Herzberg, P. (2006); DiStefano, C. (2002)). This is true for the self-assessed health, which is the key variable in the latent variable model following Bound (1999) and for the most of the ordinal variables included in the MIMIC model. As a consequence I argue that the maximum likelihood estimates still provide good results since the number of categories is sufficiently large although probit models would be more suitable for ordinal variables.

To sum up, following six health indicators serve as dependent variables: **EURO-D Depression Scale, SAH, number of chronic diseases, ADL, Bound health index, MIMIC health index**.

Independent variable choice

Retirement as the variable of interest is defined as being over 55 years old and being out of active and paid labor force and therefore it also includes homekeepers, sick and disabled people and the unemployed besides the pensioners in the usual sense. Since I want to identify the effect of the work status on health, I need individuals who change from working status to non-working status. For this purpose I eliminate those persons who have never done paid work and those who have not worked since they have been 50 years old. In order to control for further aspects influencing both the retirement decision and the health outcome I include the usual socio-demographic covariates such as age, education, marital status, number of children and income. A more detailed listing of the used variables can be found in Table 3.

Name	Definition
Age	Continuous between 50 and 69
Over early age	1 if being over the respective statutory early retirement age; 0 otherwise
Over full age	1 if being over the respective statutory full retirement age; 0 otherwise
High education	1 if following levels[a] apply: Level 4 (Post-secondary non tertiary education), Level 5 (First stage of tertiary education), Level 6 (Second stage of tertiary education); 0 otherwise
Medium education	1 if following levels apply: Level 2 (Lower secondary or second stage of basic education), Level 3 ((Upper) secondary education)
Married	1 if married, 0 otherwise
Children	Number of children
Income	Household income in Euro adjusted for the number of household members
Self-employed	1 if respondent is self-employed; 0 otherwise
Public-employed	1 if respondent is employed in the public sector; 0 otherwise

Table 3: Variable definitions

[a]according to the International Standard Classification of Education (ISCED)

Occupations

The main interest of the analysis is to study how different occupations influence the health effect of retirement according to the three hypotheses defined earlier. The SHARE dataset offers different variables that can be used in this context. In the first and second wave, the individuals have been asked several questions about the quality of their job. Each question is measured on a 4-point scale from "strongly agree" to "strongly disagree". On the basis of these assessments, the socio-psychological impact of work on health can be analyzed. These are the particular statements that are available in the dataset:

Q1: My work is physically demanding.
Q2: I am constantly under pressure because of a heavy workload.
Q3: I have little freedom to decide how to do my work.
Q4: I have the opportunity to develop new skills.
Q5: I receive the recognition I deserve for my work.
Q6: Taking into account the psychological demand expended, my salary is correct.
Q7: My prospects of promotion/personal advancement are not good.

Following Debrand and Lengagne (2008) I create different indicators for the socio-psychological degree of the work. Q1 and Q2 sum up to the indicator **Demand**, Q3 and Q4 to the indicator **Control** and Q5, Q6 and Q7 to the indicator **Reward**. I furthermore construct the ratios **Demand/Control** and **Demand/Reward** weighted such that a higher value of the ratio indicates a higher imbalance. By including these indicators into the regression, I am able to empirically test the hypotheses H1-H2.

The third wave SHARELIFE offers additional information that enables to test the hypothesis H3. The type of occupation is given according to the International Standard Classification of Occupations (ISCO). Including all different occupation groups as dummy variables is not very straightforward since it can lead to insignificant values and multicollinearity. Furthermore, the interpretation of the marginal effects is difficult because the characteristics are too specific.

According to the hypothesis I want to test, the occupational categories are grouped together into four main groups following the official classification. These groups specify white collar workers, blue collar workers, pink collar workers and unskilled labor force. A more detailed itemization is given in Table 4.

Occupation	**Collar group**	**Description**
O1 Legislator, senior official, manager O2 Professionals O3 Technician, associate professional	White collar	Member of working class performing office work
O4 Clerk O5 Service, shop or market sales worker	Pink collar	Member of working class providing different kind of services
O6 Skilled agricultural or fishery worker O7 Craft or related trades worker O8 Plant/Machine operator or assembler	Blue collar	Member of working class performing manual labor
O9 Elementary occupation	Unskilled	Member of working class performing elementary occupations

Table 4: Classification of occupations

5.3. Descriptive Statistics

Table 5 presents the descriptive statistics of all important variables used in the analysis. The full sample consists of 12.011 individuals. The average person in the sample is approximately 60 years old. 25.1% of the sample are over the country specific full retirement age and 27.3% are between the early retirement age and full retirement age. A high level of education is reached by 25.1% of the sample, 36.3% have a medium level of education and consequently 38.6% have a low level of education. The average household income amounts to 27516 Euro. 81.4% individuals are married and on average they have 2 children.

On average, the individuals assess their own health as being fair, bad or very bad with a probability of 26.3%. Only 1.6 depressive feelings out of 12 according to the Euro-D Scale are reported on average. Similarly low are the numbers of other reported health measures such as the chronic conditions and symptoms or the different limitation indicators. However, 31.1% of the individuals report that they are limited in any activities due to health. The mean maximum grip strength amounts to 46 from possible 100. Around 50% of the sample are overweighted and 16.7% obese. Anyhow, 88.1% report to exercise moderately at least once a week, whereby this measure could suffer from interpretation bias. On average, the individuals report to drink alcohol on 3.5 days of the week and 27.6% of the sample are smoking at the time of the interview. Only 7.8% of all individuals are self-employed and 9.2% are employed in the public sector, whereas the rest of the sample is employed in the private sector. Approximately 50% of the individuals are retired.

Overall, the descriptive statistics are very similar to those presented in Coe and Zamarro (2011), in due consideration that they only had one wave available and that I pooled two waves together. This comparison adds to the certainty that the variables have been correctly specified in this analysis.

	Mean	**SD**
Demographics		
Age	59.424	5.527
Over full retirement age	0.251	0.434
Over early retirement age	0.273	0.446
High education	0.251	0.434
Medium education	0.363	0.481
Married	0.814	0.389
Number of children	2.092	1.313
Household income (in Euro)	27516.41	10062.007
Health measures		
Self-assessed health (1-5)	0.263	0.440
Euro-D Depression Scale (0-12)	1.597	1.831
Grip strength (0-100)	46.415	9.528
Limited due to health	0.311	0.463
Chronic conditions (0-8)	1.183	1.227
Chronic symptoms (0-9)	1.081	1.309
Mobility limitations (0-10)	0.704	1.466
ADL limitations (0-6)	0.092	0.502
IADL limitations (0-7)	0.109	0.556
Hospital stay in last 12 months	0.113	0.317
Overweight	0.509	0.450
Obesity	0.167	0.373
Exercise	0.881	0.324
Alcohol consumption	3.505	2.123
Smoking	0.276	0.447
Employment		
Retired	0.492	0.499
Self-employed	0.078	0.268
Public-sector employed	0.092	0.289

Table 5: Descriptive statistics

6. Empirical Results

6.1. Instrument Validity

I use the early and full retirement ages in the 11 European countries as instruments for the retirement variable. As specified in the methodology part, four assumptions have to fulfilled in order to receive valid estimates. The instrument relevance assumption requires a strong first stage, which means that the early and full retirement ages must have significant effects on the propensity to retire. This requirement can be empirically tested. Table 6 shows the results of a country fixed-effects estimation of the first stage relationship indicating the probability of retirement given the the statutory retirement ages and further control variables.

Being retired	(1) OLS	(2) SE
Early retirement age	0.152***	0.012
Full retirement age	0.229***	0.020
Age	-0.017	0.021
Age squared	0.000	0.000
Public employment	0.035***	0.013
Self-employment	-0.130***	0.014
Married	-0.019**	0.010
High education	-0.128***	0.010
Medium education	-0.061***	0.009
Children	-0.009***	0.003
Household income	0.000	0.000
Year 2004	0.061***	0.007
Constant	-0.239	0.609
Observations	12,011	

*** p<0.01, ** p<0.05, * p<0.1

Instrumental Validity		*p-value*
F-statistic	20.17	0.0000
Kleibergen-Paap rk LM statistic	7.710	0.0212
Kleibergen-Paap rk Wald F statistic	26.99	
Anderson-Rubin Wald Test	9.29	0.0096
Hansen J statistic	0.238	0.6256

Table 6: First Stage results

The results indicate that both statutory retirement ages have predictive effects on the retirement behavior. Being over the early retirement age increases the probability of retirement by 15.2 percentage points at a 1% significance level and being over the full retirement age increases the probability by 22.9 percentage points at a 1% significance level. The influence of the age of the individual itself is not significant after controlling for the statutory retirement ages. This means that in general, retirement can be defined as a continuous function of age, which exhibits discontinuous jumps at the early and full retirement ages. This strong first stage approves the relevance of my instruments.

The other coefficients are as expected: Being employed in the public sector increases the probability of being out of the labor force by 3.5 percentage points compared to being employed in the private sector. Self-employment by contrast decreases the probability of retirement by 13 percentage points. The likelihood of retirement gets lower with the increasing level of education, which means that those with a high level of education are less likely to retire than those with a low level of education by 12.8 percentage points and those with a medium education still by 6.1 percentage points. Individuals who are married or have children are less likely to retire. Furthermore, individuals reveal a slightly higher likelihood to retire in the first wave in year 2004 than in the second wave. Comparing these numbers to the first stage results presented in Coe and Zamarro (2011) shows that the signs of the coefficients are consistent and the size of the coefficients to each other are also compatible, with the only difference being my results depict higher size effects and higher significance levels since my sample size is twice as high as the sample in Coe and Zamarro (2011) thanks to the pooling of two waves together.

Since the validity of the instruments are the crucial point for the analysis, I perform further robustness checks to support the strength of the first stage.[6] The F-statistic denotes a test of joint significance of all excluded instruments. The rule of thumb (see Steiger and Stock (1997)) requires the F-statistic to be higher than 10, which is met by my F-statistic of 20.17 with a p-value of 0.0000, indicating that my instruments are not weak. According to Baum et al. (2007), further test statistics should be presented to test for weak identification because the F-statistic relies on a non-standard distribution. Since I use clustered robust standard errors, it is appropriate to report the Kleibergen-Paap rk Wald F statistic as a weak identification test. Again, the rule of thumb of the F-statistic to be at least 10 is passed with an actual value of 26.99.

I furthermore present the Kleibergen-Paap rk LM statistic to provide an underidentification test. The null hypothesis for this test is that the full equation is underidentified or, in other words, that the matrix of the reduced form coefficients is rank deficient. With a p-value of 0.0212 I can reject the null hypothesis on a 5%-level and therefore consider the model to be well identified.

The Anderson-Rubin statistic provides another test of joint significance which is robust to weak instruments. The null hypothesis is that all endogenous regressors are jointly equal to zero and since I can reject this null hypothesis with a p-value of 0.0096 at the 1% level, this provides further support that weak instruments are not problematic in my model.

Finally, since I use two instruments in my model, a test of the overidentifying restriction can be performed. I apply the Hansen J statistic as an overidentification test of all instruments. The joint null hypothesis is that the instruments are valid and uncorrelated with the error term. With a p-value of 0.6256 the null hypothesis is not rejected.

Other than presenting different statistics to test the instrument validity, it is helpful to graphically illustrate the discontinuous jumps at the early and full retirement ages in order to examine the instruments. For this purpose, I plot the retirement rates for the corresponding ages separately for each country. Further I include fitted values which are quadratic predictions from a piecewise regression before and after the cut-off points of the early and full retirement rates. The corresponding graphs are presented in the Appendix. Some countries exhibit high jumps at the early retirement age such as Italy and the Netherlands. Others on the contrary, display higher jumps at the cut-off point of the full retirement age, for example Sweden, Denmark and France. These pattern can be explain in the context of the country specific design of the pension system. In countries with only small reductions of pension benefits at the early retirement age, individuals are much more likely to retire early than in countries where the pecuniary injuries are high when retiring at an early age. Thus, by setting the financial incentives differently, governments can, up to a

[6] Since the statistical package used for the multivariate imputations does not support any test statistics, the following test statistics are taken from the non-imputed dataset excluding the household income variable

certain degree, control the labor market participation of older people. Table 7 shows a brief overview over the requirements to be eligible for early retirement and the connected reductions in benefits for each country.

Country	**Reduction in Benefits**	**Requirements for early retirement**
Austria	reduction of 4.2% per year of early retirement	37.5 years of contribution
Belgium	-	35 years of contribution
Denmark	-	30 years of contribution to program Efterløn
France	reduction to 57% of full pension value	42 years of contribution
Germany	reduction of 3.6% per year of early retirement	-
Greece	reduction of 6% per year of early retirement	-
Italy	-	35 years of contribution
Netherlands	Special conditions according to early retirement program VUT	-
Spain	reduction of 6%-8% per year of early retirement	30 years of contribution
Sweden	actuarial reduction depending on age of early retirement	-
Switzerland	reduction of 6.8% per year of early retirement	-

Table 7: Early retirement pension designs[7]

Most of the countries apply actuarial fair reductions which are about 4%-8% for every year entering retirement before the normal retirement age. Some of the countries further limit the eligibility of early retirement to those who contributed to the system a certain amount of time in their life.

It can be seen that France is very strict in its pension design. Individuals who retire at the early age of 57 instead of the normal age of 60 get their pension reduced to 57% of the full value, which is more than the corresponding actuarial rate of other countries. Furthermore, to be eligible for the early retirement, a contribution of 42 years is necessary. Due to these high requirements and due do the fact that retiring with full benefit is possible only three years later, most of the individuals choose to wait until the normal retirement age. This leads to the fact that France exhibits a high discontinuous jump in the retirement rates at the age of 60 and no substantial increase in the retirement rate at the early age of 57.

The graphs for Denmark show similar patterns with a small difference at the early retirement age and a jump at the full age. This can be interpreted in the way that Denmark has no official statutory early retirement age, but offers an early-retirement program called *Efterløn*. In order to receive early retirement payments, one must have paid into this program for at least 30 years. Since this program was originally implemented to allow individuals with physically demanding jobs to retire earlier, not all individuals contributed to this program and therefore are not eligible for early retirement. This explains why most individuals in Denmark retire at the normal retirement age, which is illustrated in the respective graphic in the Appendix.

Interestingly, the Netherlands also introduced a special early retirement program called *Vervroegde Uittreding (VUT)*, which has opposite consequences on the retirement rates as in Denmark, since the Netherlands exhibit a high jump at the early retirement age. This is because the VUT raises high incentives to retire early. The program was introduced to reduce youth unemployment and therefore the government wanted older people to retire early and made early retirement financially more attractive.

Similar jumps in the early retirement ages can be found for Italy, where the only requirement for receiving full benefit also at early retirement age is to have contributed to the pension system at least for 35 years. Even Austria displays a significant increase at the early retirement age since both the reductions

[7]Source: Own elaboration with statistical data information from OECD (2005), OECD (2007) and OECD (2011)

with 4.2% and the requirements of 37.5 years of contribution are moderate.

The conclusion of the graphical analysis is that the strength of the instruments of early and full retirement ages depends on the country-specific pension design and also on the cultural background and behavior of the residents of the respective country. For the purpose of my analysis, Switzerland and Spain exhibit the perfect pattern since there is a considerable jump both at the early and full retirement age, which supports the appropriateness of the instruments. Although not all of the countries display this preferred pattern, taken all countries together adds to the significance of both the early and the full retirement age as instruments.

So far, only the instrument relevance assumption has been tested. Concerning the other three assumptions for the LATE, there are no empirical tests, but one must use common sense to argue for the fulfillment of the assumptions. The exclusion restriction requires that the instruments influence the health status only through the direct effect of retirement. That means that the statutory retirement ages of a country are not allowed to have any correlation with the resident's health status on the individual level. One apparent threat could be that those countries with a comprehensive public pension system might also put special efforts into the health care system and thus the setting of the retirement age might be correlated with improved health of the residents. To control for such mechanisms between the public pension system and the health care system, I apply country-level-fixed-effects, which should account for any systematic differences in the organization of the public systems between countries. Thanks to the country-fixed-effects approach, Coe and Zamarro (2011) argue that "although not directly testable, we believe that it is appropriate to assume that there are no other discrete changes to individual health that coincide with the retirement ages" (Coe and Zamarro (2011), p. 78).

Despite the control of country-fixed effects, there could still be threats to the exclusion restriction within the countries. For instance, if there is a psychological effect of reaching a certain age and the setting of the retirement age coincides with this psychological cut-off age, then reaching the retirement age influences the health of an individual other than through the channel of the retirement. Another example would be the adaptation of the health behavior of an individual in anticipation of the retirement. For instance, if a country increases the statutory retirement age, it could lead to an irritation of the older workers and this in turn could decrease the incentives to invest in health for the sake of labor productivity. Therefore, the setting of higher retirement ages could influence the health of an individual also through the channel of decreased health investments.

The independence assumption requires that the statutory retirement ages are independent of both the potential health outcomes and the treatment assignment. The latter means that a person who is eligible for retirement should display the same likelihood of retirement than a non-eligible individual would have if it were eligible. This means that the instruments should be as good as randomly assigned and there should not be systematic differences between the treated and untreated individuals. This requirement would be problematic if the retirement ages would be set according to special characteristics. If for example individuals in occupations with exclusively shift work were allowed to retire at the early retirement age and all other workers had to wait until the normal retirement age, then the statutory retirement ages would not be randomly assigned. One could suspect systematic differences in education, gender or the like between the night shift workers and the other workers and in this case, the independence assumption would be violated. However, since the retirement ages in the selected countries are set independently and universally, the independence assumption can be regarded to be fulfilled.

A further threat to the instrument could be a violation of the monotonicity assumption, which requires the instrument to affect the retirement decision only in one direction. A violation of this assumption is regarded as unlikely since it is unrealistic that people are in retirement before the statutory retirement age and start working as soon as they become eligible for the pension benefits.

The discussion of the potential threats of the instrument validity shows that an instrument can never be perfectly validated because not all assumptions are empirically testable. Nevertheless, I can argue that the statutory retirement ages can be regarded as reasonable instruments since they pass all testable requirements and can be reasoned to be appropriate also on the basis of common sense. Furthermore the application of country-fixed effects reduces the potential threats to the instrumental validity.

6.2. Regression Results

After having discussed and approved the validity of the instruments, I can use the predicted values from the first stage and estimate the effect of retirement on different measures of health by a two-stage least squares estimation. The empirical results for the different methods of estimation are presented in Tables 8 - 11 in the Appendix. All methods are applied for the pooled dataset and therefore cluster-robust standard errors are used for all estimations.

OLS estimations

Before actually applying the 2SLS estimation, I first run a simple OLS regression for the six different health measures described above. For each measure, three different specifications are estimated. The first specification is referred to the baseline model, which includes a binary retirement variable and sociodemographic covariates. This model has also been used in Coe and Zamarro (2011) and the results can be compared under consideration of the different sample sizes. The second specification includes variables indicating the degree of control, demand and reward of occupations and interactions between them. Furthermore, I include interactions between these job characteristics and the retirement instruments in order to control for the retirement effect on health based on the occupation. In the third specification I replace the job characteristics by dummy variables indicating the different occupational groups, namely blue collar workers, pink collar workers and unskilled workers, whereas white collar workers represent the reference group. I also include interactions between these occupational groups and the retirement instruments.

For the baseline specification, retirement has a significant positive coefficient for all six health measures. Since the health measures are constructed such that higher values mean worse health, these positive coefficients indicate that retirement has a negative effect on health. Considering the self-assessed health for example, the result is interpreted as follows: retirement increases the likelihood of reporting bad health by 16% on a 1%-significance level. Concerning the mental health of individuals, retirement also displays a positive coefficient indicating an increase in the number of depression related symptoms and therefore a negative correlation between retirement and mental health. The same is true for the health index according to Bound (1999), where the state of retirement leads to a 0.4 unit decrease in the health index. The health index according to the MIMIC model is comparable in the sign of the effect, although a lot smaller in size.

Regarding the objective measures of health, retirement leads to a 0.4 standard unit increase in the number of chronic diseases and to a 0.09 standard unit increase in the number of ADL limitations. To sum up, the results obtained by a simple linear probability model indicate a negative correlation between retirement and all health measures on a significance level of 1%.

The effect on health of the other covariates included into the baseline specification are as expected. Both age and age squared show small and insignificant influence since the effect is mostly captured by the retirement status. Individuals that have been employed in the public sector are less likely to report bad health by 6% compared to those employed in the private sector. Being married decreases the likelihood of reporting bad health by 3%. As expected, having a medium or high education significantly reduces the likelihood of assessing a bad health status compared to having a low education by 8.1% and 12.5% respectively. The number of children seems to have a small negative effect on health, which is explained by a lower wealth indication rather than a direct effect of the children by Coe and Zamarro (2011). Since the effects of the control variables are very similar for the different health measures, it is sufficient to interpret them in the context of self-assessed health.

In the second and third specification I include the variables indicating different job characteristics and occupational groups. A detailed interpretation of the occupational related OLS results is not regarded necessary at this point since the results display mixed evidence and because I consider the IV estimation method to be more reliable in this context.

IV estimations

The results of the IV estimation are presented in Table 10 and Table 11. Most interestingly, the coefficient of retirement which has been positive for all health measures in the OLS estimation, changes from positive to negative when performing an instrumental variable estimation. This would support the theory of a health-preserving effect of retirement. Since the IV results of the baseline specification are mainly insignificant except for the SAH and for the Bound health index, a reliable causal negative relationship cannot be concluded.

It is difficult to compare the OLS and the IV results since the the former captures the ATE whereas the latter refers to the LATE. Therefore, the estimations are based on different subgroups and if for example the compliers are on average different from the other subpopulations, the LATE could be categorically different from the ATE leading to different observed estimations of OLS and IV. However, the differences between the OLS results and the IV results could also indicate that there is indeed a problem of endogeneity in simple linear regressions and therefore special identification strategies would be indispensable in order to reveal the true causal effect of retirement on health.

So far, my empirical approach resembles very much the analysis done in Coe and Zamarro (2011) except for the sample size and once again the results can be compared for three health measures in order to verify the correctness of the regression results. By tendency the results are similar in sign and also in size after considering the higher number of observations in my study. Even Coe and Zamarro (2011) can only provide significant IV estimates for the SAH and the Bound health index.

Based on the strong first stage validity and on the similarity of my estimates and the results in Coe and Zamarro (2011), I regard the IV method as providing the statistically reliable results and use the second and third specification to interpret the occupational related health effects of retirement, which is the main interest and contribution of this study.

The second specification includes different job characteristics. Recalling the theories describing the relation between the psycho-social characteristics of work, I am particularly interested in the interaction variables. First, the theory claims that a high level of demand and a low level of control is a risk for health. It is notable that a higher value of the interaction between Demand/Control means a higher imbalance. According to the theory I therefore expect positive coefficients for this interaction indicating a negative correlation with health. My empirical results support this theory since the Demand/Control variable reveals significant, positive coefficients for all health measures. Based on this theory I set up the hypothesis H1 that retiring from a job with the risky Demand/Control combination should have positive effects on health and I therefore expect negative coefficient signs. My empirical results do not confirm this hypothesis since the interaction variable of the instrumented retirement with Demand/Control displays significant positive effects on only two health measures. Concerning the Euro-D scale, the effects is negative but insignificant, so that at least this result does not refute my hypothesis. This is important under the assumption that the imbalance between demand and control in an occupation mainly affects the mental health of the workers.

The second theoretical model claims that an imbalance between a demanding job and the corresponding reward has negative effects on health. Therefore positive coefficients are expected from the interaction Demand/Reward, but this cannot be affirmed by the empirical results since I find significant negative coefficients for this interaction for all six health measures. Again, I further included an interaction between the instrumented retirement with the Demand/Reward ratio in order to test the hypothesis H2 that retiring from a job with a high imbalance between demand and reward should have positive effects on health, revealed by negative coefficients of the interaction. In the empirical results, significant negative coefficients can be found for the Bound health index, for the number of chronic diseases and for the number of ADL limitations. While these coefficients support my hypothesis, the effect on mental health measured by the Euro-D depression scale is small in size and significant on a 10%-level only. To sum up, testing for the psycho-social characteristics of work show very mixed evidence and no clear conclusion can be drawn yet from these results. One possible explanation could be that the self-assessed information concerning the quality of work might suffer from reporting bias or cultural differences despite the usage of vignettes.

The third specification implies three dummy variables for different occupational groups, namely blue collar workers, pink collar workers and unskilled workers. White collar workers represent the reference group. Furthermore, I include interactions between the instrumented retirement and all three occupational groups. Since blue collar workers usually have physically demanding jobs, they are expected to be in worse health during the employment phase than white collar workers. Therefore the coefficients are expected to be positive, for example indicating a higher likelihood of reporting bad health. My empirical results confirm this expectations because all three lower occupational groups display significant positive coefficients for five health measures. Again, what I am especially interested in is how retirement affects the health of different occupational groups. Recalling hypothesis H3, I claim that retiring from a blue collar job has positive impacts on health because they are released from physical efforts. Therefore I expect negative coefficient signs from the interaction between the instrumented retirement and the blue collar group. These expectations are affirmed by significant negative coefficients on the 1%-level for five health measures. Only the effect on the number of chronic diseases is insignificant, but the sign shows in the right direction. I therefore consider hypothesis H3 to be confirmed. The pink collar group and the unskilled workers have also been included into the model as separate groups because of two reasons. First they provide a more detailed differentiation and more interesting results. Furthermore they cannot universally be declared as being blue collar workers because some of the occupations belonging to those groups might be physically demanding, but others not. Therefore adding them to the blue collar group would distort the results. However, because there are no clear characteristics regarding the health efforts in these jobs, I did not set up hypothesis regarding the health effects on retirement for these groups. The results show that unskilled workers reveal worse health both before and after retirement. This could be explained by a lower socioeconomic status and milieu of unskilled workers leading to health damaging lifestyle behavior such as bad diet, smoking or alcohol consumption. The interpretation of the health effect for pink collar workers is more difficult since some of the coefficients are negative or insignificant, but overall retirement seems to have a negative effect on health.

6.3. Robustness Checks

During the analysis, various challenges in the study design appeared but not all of them could be solved due to data limitations. One drawback for example is the lack of exact information about the length of time an individual spent in retirement. If the exact date of entering retirement would be known, it would be able to control for the impact of the length of retirement instead of only including a binary indicator of the retirement status. Furthermore I could have provided information on the effective retirement ages, preferably by showing the densities of the change in the retirement status at different ages. This would have been interested especially for different occupational groups to see if there are differences in the distribution of effective retirement ages, for example if blue collar workers on average tend to retire earlier than white collar workers.

Another drawback refers to the construction of the household income variable. According to the SHARE methodology report (see Börsch-Supan and Jürges (2005)), there should be a separate dataset including already generated variables concerning all financial affairs. This dataset was not available however, even on request. I therefore constructed the income variable myself by summing up different components such as the annual net income and interest payments from bank accounts and adjusting for differences in purchasing power. The coefficients of the household income variable are 0.000 for all specifications and therefore they differ a lot from the effect of household income in Coe and Zamarro (2011). Consequently, this variable must be interpreted with caution, but since Coe and Zamarro (2011) find uniformly insignificant coefficients for household income, I claim that the potential misspecification does not influence the analysis crucially.

Due to such drawbacks, it is necessary to present some further robustness checks in order to eliminate any doubts about the empirical results. The most important part of the statistical robustness checks have already been done by proving the validity of the instruments. Besides pure statistical testing, it is also interesting to consider themed aspects that might have neglected in the analysis. Coe and Zamarro (2011) for example examine the impact of bad conditions during the life cycle such as the circumstances in World War II or famines to assure that the health effect is not only due to worse initial conditions of certain cohorts. They find that the results are robust when including indicators of birth conditions.

As a sensitivity check, it would be interesting to examine how the observed health effects depend on the level of the retirement ages. The question is whether the health effect is more pronounced or maybe even reverse in countries with higher statutory retirement ages than in countries with lower statutory retirement ages. Thanks to the parallelism of my analysis to Coe and Zamarro (2011) I can refer to their results of the sensitivity check. The authors restrict the variation of the retirement ages by constructing three groups depending on the age when the individual retire (ages 57-59, ages 60-64, and ages 65-69). The authors reject significant differences between the coefficients on the age categories, therefore I can assume that the effect of retirement does not depend on the specific age of retirement.

Since the main purpose of the analysis is to allow for occupational heterogeneity, it makes sense to provide further robustness checks in this area. The main result was that retiring from a blue collar occupation has positive effects on health compared to retiring from a white collar occupation. This result was obtained by adding interaction terms to the baseline specification. Another possibility is to run the baseline specification separately for the four different occupational groups and then to interpret the coefficient of the retirement variable. The IV results for these separate regressions are presented in the Tables 12 - 15 in the appendix. Table 12 displays that retirement has a positive effect on health for blue collar workers indicated by negative coefficient signs. The size of the effect is substantial. For example retirement increases the probability of reporting bad health by 80% and leads to an decrease in the Bound health index by 2 standard deviations, indicating better health. However, the results are not significant except for the Euro-D variable, maybe attributed to the lower number of observations.

The IV results for the white collar group indicate that retirement has a negative impact on all health measures except for mental health. However, no causal relationship can be deducted since the coefficients are insignificant. Similarly to the interaction variables above, the IV results for the pink collar group displays mixed evidence with a negative impact on the mental health and on the Bound health index and a positive impact on the four other health measures, although again insignificant. Unskilled workers display negatively, but insignificant coefficients of retirement on all health measures.

Although the relevance of the separate regressions as robustness check is limited due to the lack of significance, the results support the main results presented before. To sum up, thanks to the strong first stage, to the congruence to Coe and Zamarro (2011) and to the consistency in the signs of the results in different specifications and health measures, the results can be regarded as robust.

7. Discussion of Occupational Effects

The main interest of this study was to allow for heterogeneous occupational effects of retirement on health. While the socio-psychological aspects of work did not provide unambiguous results, the results for different occupational groups are robust. I can affirm my hypothesis that retiring from a blue collar job has positive effects on health. Interestingly, this can be related to the theoretical models of the retirement effect of health presented at the beginning of the study. The life-event theory predicted a negative effect of retirement on health because retirement is seen as a single-time event related with a loss of income, status and supportive networks. These losses apply especially for white collar workers and therefore the empirical results support this theory. On the other hand, Atchley (1976) defines retirement as a continuous process with different phases and predicts a health-preserving effect of retirement, which is illustrated by the results for the blue collar workers. Thus, my results provide empirical support for both theoretical models.

The next step is to consider the implications of the varying retirement effects for different occupations, especially in terms of public policies. In general, my results suggest a more flexible public pension system allowing workers with physically demanding occupations to retire earlier. Some countries already implemented special treatments for workers with hazardous jobs, but according to my empirical results such special treatments should not be rare exceptions, but rather be implemented on a broad base.

However, the exact design of such an early retirement treatment for blue collar workers requires a detailed welfare analysis considering the trade-off between the potential gain from reduced health care costs and the potential loss from an early exit from the labor market.

Furthermore, the practicability of such differentiated statutory retirement ages needs to be examined, because the system should not become over- bureaucratic. First of all, a straightforward but at the same time delimitative definition for physical demanding jobs is required. One possibility is to introduce a sector-specific retirement age. Belgium sets an example for this by applying special pension rules to specific sector: Miners, marine workers and flight crew of civil aviation are allowed to retire at the age of 55 instead of 60, which is the usual early retirement age (see Zaidi and Whitehouse (2009), p.36). Another practical aspect is the question of how long a worker must have done a physically demanding job in order to be eligible for the special pension scheme. This question is important since today's job market is characterized by high fluctuations and individuals are often changing the occupations. According to Zaidi and Whitehouse (2009) it would be straightforward to use a defined coefficient which is multiplied by the number of years worked in a blue collar occupation leading to an appropriate reduction in the retirement age.

One might also argue that the earlier exit for blue collar workers from the labour market will lead to a lack of labour forces and productivity losses in the related sectors. However, one could also see this as a chance to reduce youth unemployment. Often, blue collar occupations are not attractive to young people due to low salaries and also the arduous physical work. A special pension treatment would be a first step to make this kind of occupation more attractive and paired with some financial incentives, it could be beneficial to reducing unemployment in blue collar sectors. Certainly, as a further aspect, the financial feasibility and sustainability must be considered, but since this aspect depends on the mentioned welfare analysis, it is not discussed in detail here.

At first sight, the introduction of such differentiated retirement ages seems to be complicated and extensive, but the potential gains for the society provide high incentives. Furthermore, the different treatment of blue collar pensions cannot only be justified from a societal point of view, but also from an ethical perspective. It can be claimed that "hazardous or arduous work increases mortality and reduces life expectancy, thus reducing the time during which retirement benefits can be enjoyed" (Zaidi and Whitehouse (2009), p. 5). Therefore, blue collar workers should be eligible to access pension payments even before the usual early retirement age.

Besides Belgium, 18 other OECD countries provide some special pension schemes for workers in hazardous jobs (see Zaidi and Whitehouse (2009), p. 12). However, I claim that these special treatments are mostly exceptions and need to be broadened to more occupations. Spain for example allows ballet dancers to retire at the age of 60 instead of 65 and bullfighters even at the age of 55 instead of 60 under certain circumstances, but these treatments are very exceptional and will not have much impact on the social security systems. Additionally I have to note that more than half of all OECD countries do not provide any special pension treatment for blue collar workers.

My suggestion is to introduce an encompassing early retirement system for blue collar workers which allows them to retire earlier according to the number of years worked in physically demanding jobs. This would both compensate blue collar workers for their lower life expectancy and at the same time avoid increased health care costs since retirement has been proven to have a positive effect on health for blue collar workers. To bring everything back to the initial problem of the population aging, which induced most countries to set the statutory retirement ages higher, this would mean that the retirement ages should be increased only for white collar occupations, which would have two advantages: First, since they are kept in the labor force for a longer time the costs for the pension system decreases and since the negative effect that retirement has on health for white collar workers is delayed, the costs for the health care system decrease as well.

8. Conclusion

The research questions of this study are formulated as: How does retirement affect the mental and physical health of an individual? Are the effects varying for different occupational groups? After accounting for endogeneity I find that retirement overall has positive effects on physical health. Retirement decreases the likelihood of reporting bad health by 12 percent and improves the Bound health index by a one-quarter standard deviation. The other health indicators show insignificant negative coefficients, therefore no causal relationship can be derived concerning the mental health. With regard to the second research question I find that the retirement effects differ significantly for different occupational groups. In comparison to white collar workers, blue collar workers report bad health with a 8% decreased likelihood after retiring; mental health improves by a 0.4 standard deviation increase; both health indices are improved and the number of limitations in daily life is decreased by almost one-half standard deviation. Although these results are difficult to interpret in terms of quantity, the sign of the results is significant and robust to different specifications.

The instrumental variable approach has been justified both with regard to contents and to econometric conditions. This speaks for a high internal validity of the approach. However, one might worry about the external validity of the estimates, which means that it is questionable whether a generalization of the results would be accurate. The reason for this is that the effects that have been estimated in this study are very local. Firstly, since the LATE is estimated, the effects are only reported for the groups of compliers. If the other subpopulations of never-takers or always-takers are categorically different from the group of compliers, the results can not be generalized for those individuals. Secondly, the results are local concerning the age effects. The obtained results are only applicable to the specific retirement ages used in the study, but they can not undoubtedly be generalized to retirement ages below 57 or above 65. The threats to the external validity of the results might also have impacts on the suggested differentiated retirement ages. If the implementation of lower retirement ages for physically harmful occupation changes the composition of the group of compliers or the group of blue collar workers, the application of my results is not valid any more. Therefore, with respect to future research, it would be interesting to analyze how the existent special treatments in the 18 OECD countries influence the retirement effects on health and especially the retirement behavior of blue collar workers. This however requires an advanced study design since the statutory retirement ages then are not as good as randomly assigned anymore and therefore can not be used as instruments since the independence assumption would be violated.

Although my research questions can be answered satisfactorily, there are great potentials for future research. As already mentioned, a full welfare analysis would furthermore be appropriate in order to trade off the potential gains and losses of a delayed retirement for white collar workers against the potential gains and losses for blue collar workers. Furthermore, it would be interesting to examine how the effect on health depends on the after-retirement life. This point is especially crucial for white collar workers due to the demonstrated negative effect of retirement. Finding out about the key reasons for a worse health after retirement would possibly allow to mitigate the negative effects. The SHARE data offers information to take into account certain features of the life-style after retirement such as weekly amount of exercise, smoking or drinking behavior and a control for mental activities, so one could find out which factors can compensate the negative effects of retirement. With this knowledge, public policy programs could be introduced to prepare retirees for the challenges of retirement in advance and to accompany them in their first years of retirement to encourage a health stimulating leisure time.

Concerning future methodology potentials, individual fixed-effects would be an interesting additional way to control for the endogeneity problem when more waves of the SHARE data become available.

To sum up, further research and especially a more detailed elaboration of the occupational-based effects of retirement on health is necessary for the implementation of new policies and would contribute to the ongoing debate about the implementation of more flexible retirement ages. My analysis contributed to this research topic by pointing out that it would be advantageous to differentiate retirement ages between the occupational groups in order to reduce the burden of public expenditures and to keep the public pension and public health system solvable.

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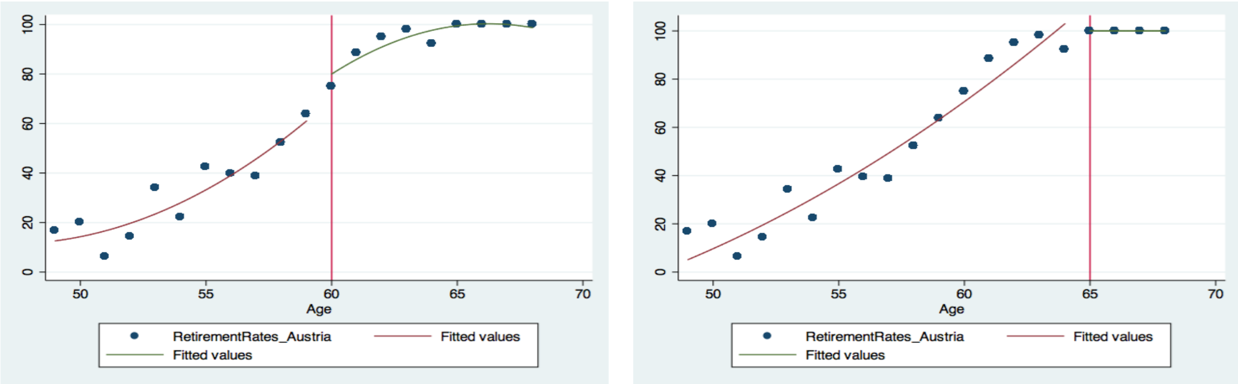
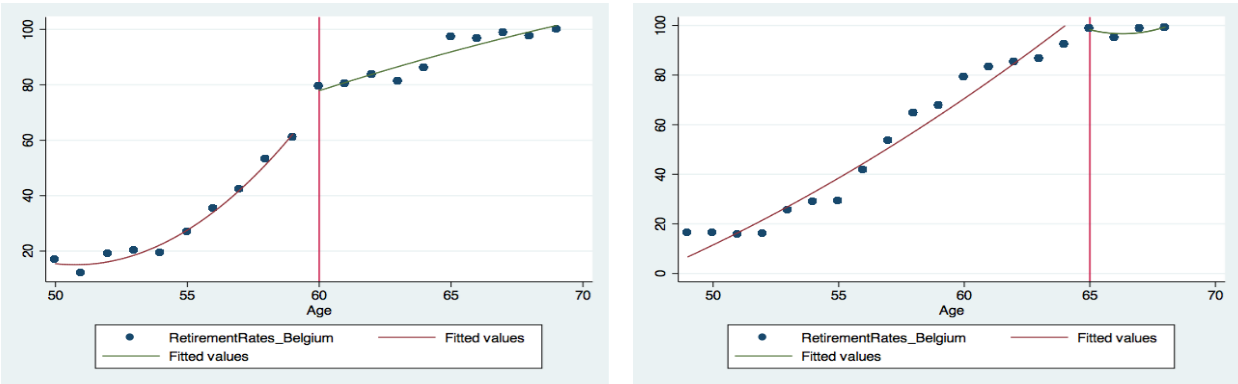
A. APPENDIX

A1. Graphical illustration of discontinuous jumps at early and full retirement ages



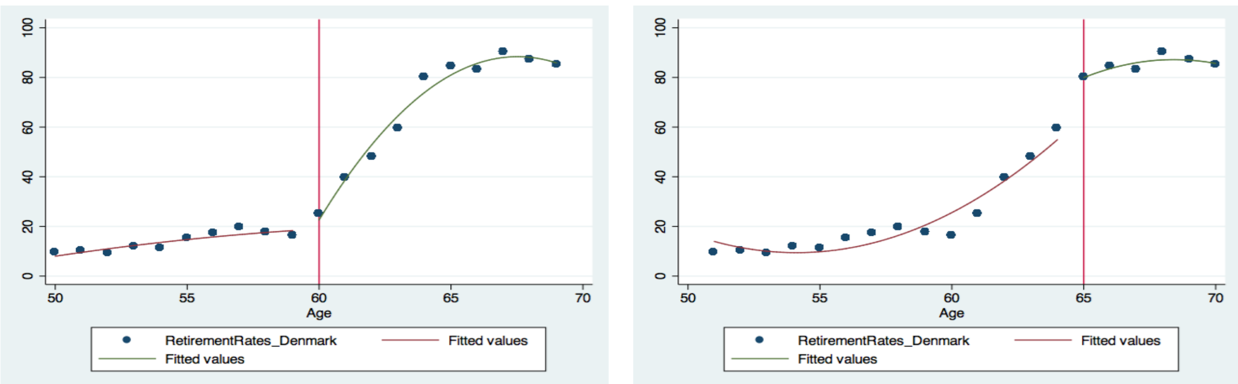
(a) Early Retirement Age (b) Full Retirement Age

Figure 5: Retirement Rates for Austria



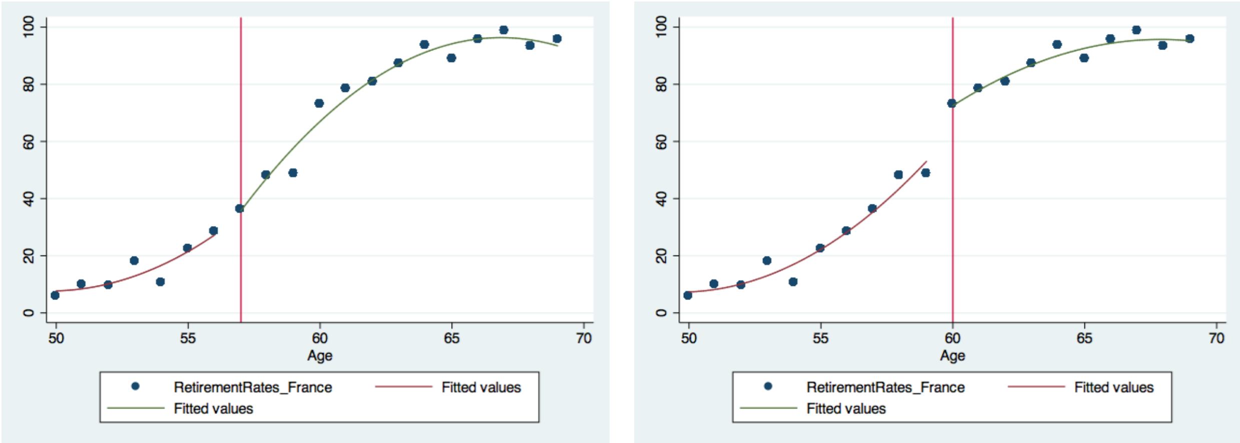
(a) Early Retirement Age (b) Full Retirement Age

Figure 6: Retirement Rates for Belgium



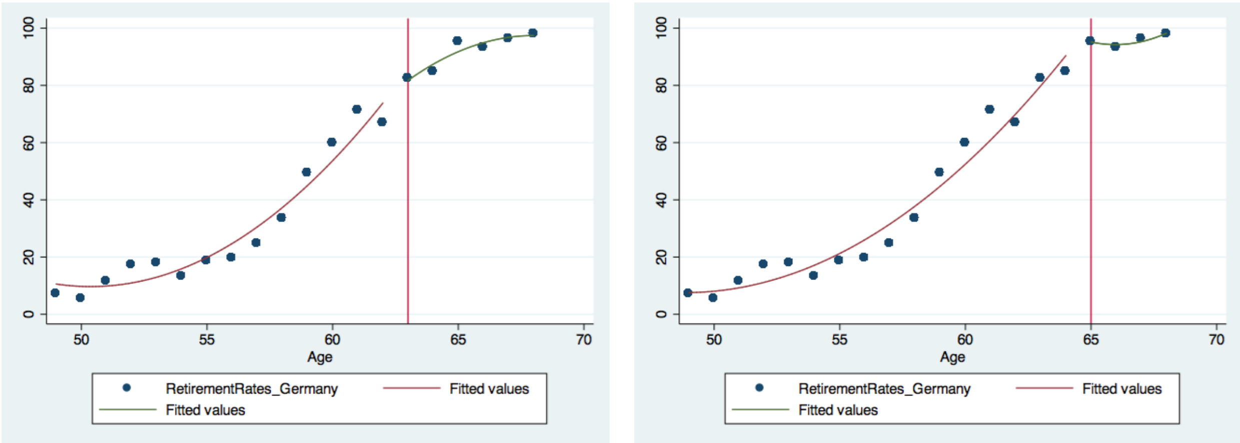
(a) Early Retirement Age (b) Full Retirement Age

Figure 7: Retirement Rates for Denmark



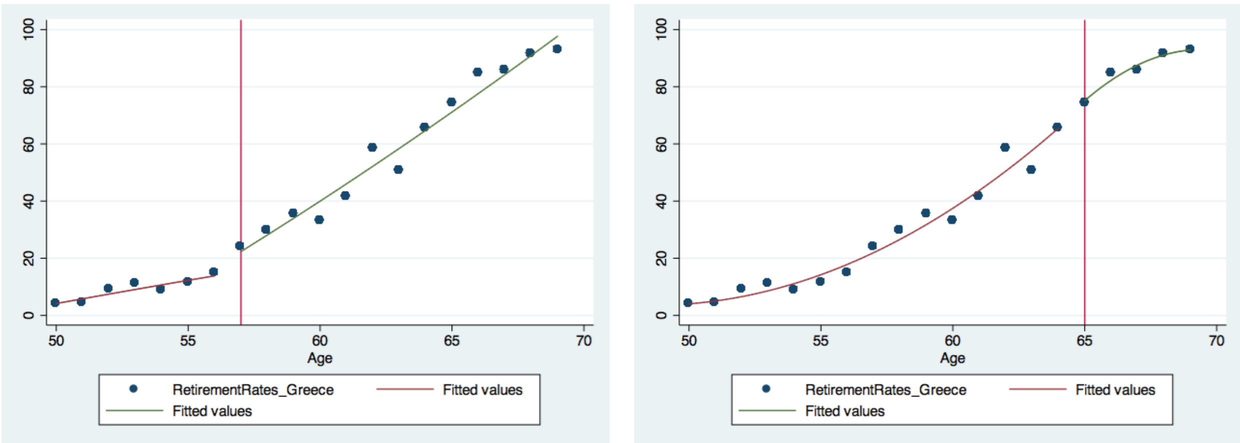
(a) Early Retirement Age (b) Full Retirement Age

Figure 8: Retirement Rates for France



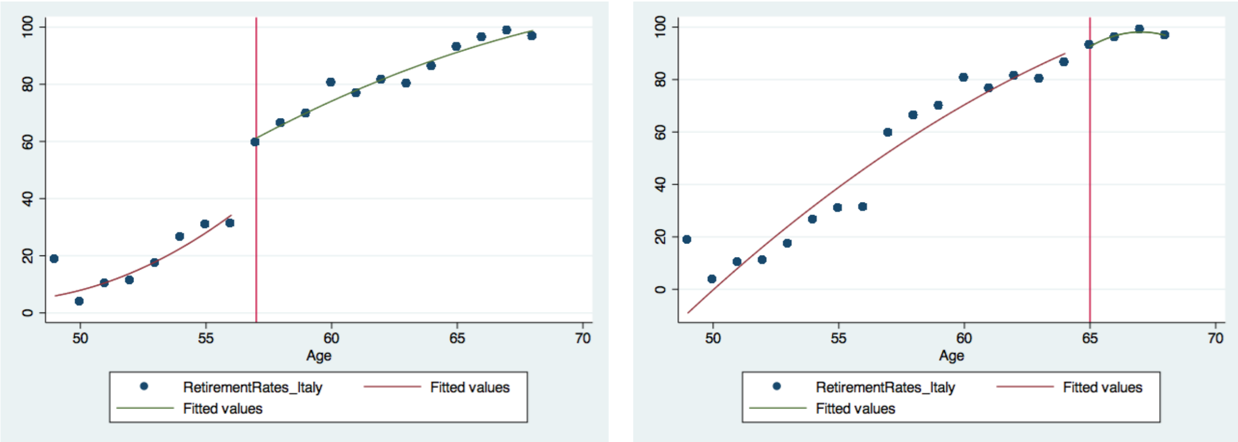
(a) Early Retirement Age (b) Full Retirement Age

Figure 9: Retirement Rates for Germany



(a) Early Retirement Age (b) Full Retirement Age

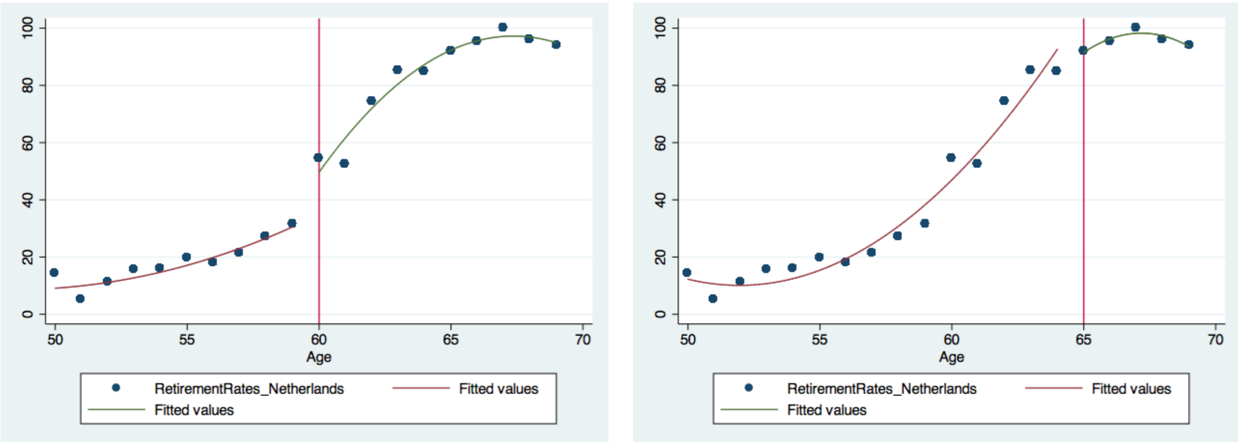
Figure 10: Retirement Rates for Greece



(a) Early Retirement Age

(b) Full Retirement Age

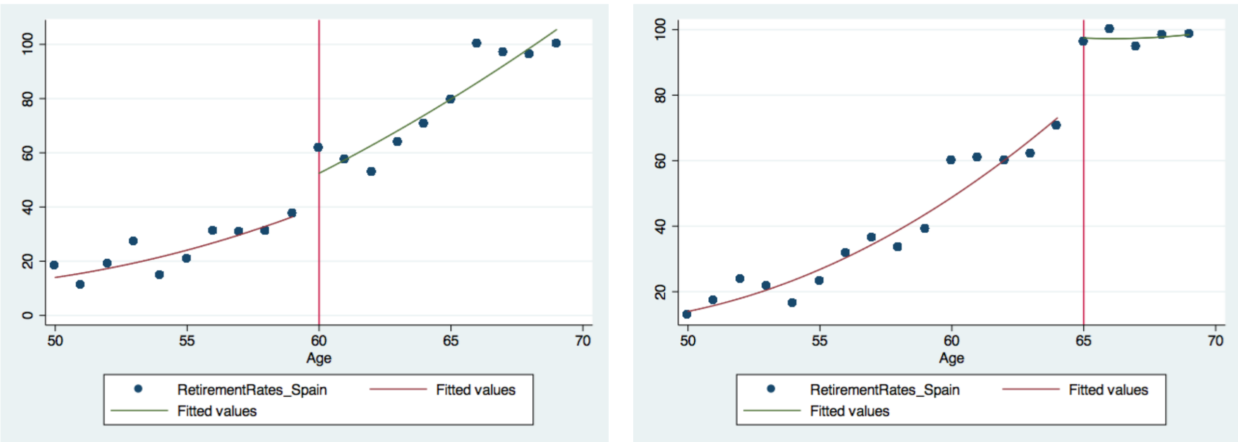
Figure 11: Retirement Rates for Italy



(a) Early Retirement Age

(b) Full Retirement Age

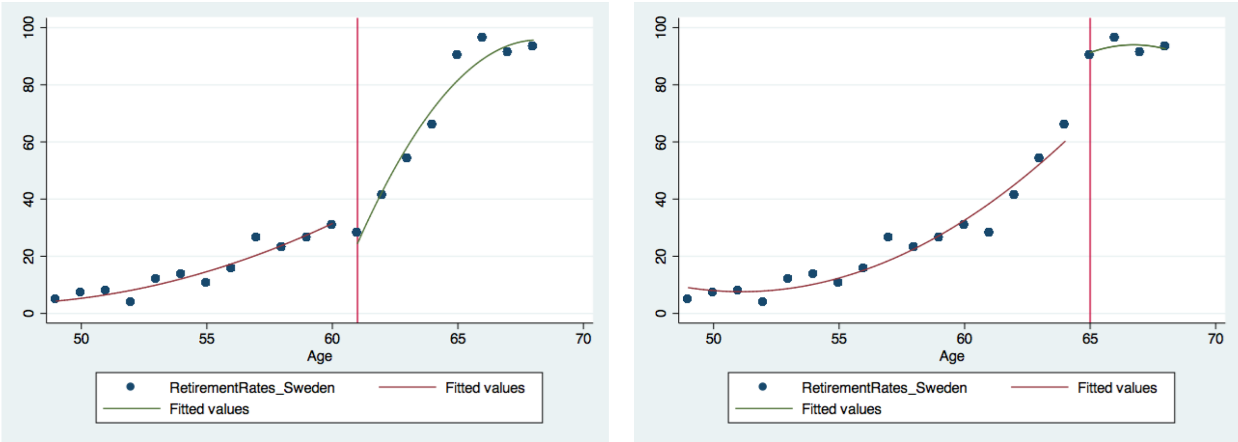
Figure 12: Retirement Rates for Netherlands



(a) Early Retirement Age

(b) Full Retirement Age

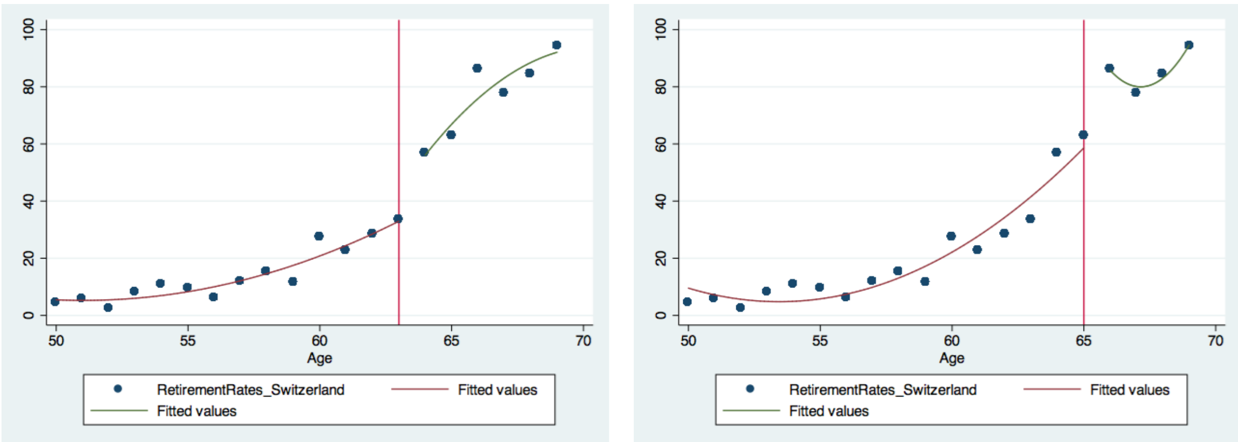
Figure 13: Retirement Rates for Spain



(a) Early Retirement Age

(b) Full Retirement Age

Figure 14: Retirement Rates for Sweden



(a) Early Retirement Age

(b) Full Retirement Age

Figure 15: Retirement Rates for Switzerland

A2. OLS Regression Results

Pooled OLS

VARIABLES	(1) SAH	(2) SAH	(3) SAH	(4) Euro-D	(5) Euro-D	(6) Euro-D	(7) Bound	(8) Bound	(9) Bound
Retirement	0.160***	0.092	0.129***	0.442***	0.439	0.385***	0.414***	0.271	0.361***
Age	-0.047***	-0.005	-0.051***	-0.261***	-0.068	-0.273***	-0.065***	0.056	-0.076***
Age squared	0.000***	0.000	0.000***	0.002***	0.000	0.002***	0.001***	-0.000	0.001***
Public employment	-0.060***	-0.031**	-0.049***	-0.202***	-0.094	-0.182***	-0.126***	-0.041	-0.108***
Self-employment	0.015	0.011	0.019	0.016	0.021	0.037	0.003	0.027	0.014
Married	-0.028**	-0.001	-0.025**	-0.348***	-0.253***	-0.340***	-0.111***	-0.055*	-0.106***
High education	-0.125***	-0.071***	-0.092***	-0.356***	-0.178***	-0.280***	-0.253***	-0.112***	-0.188***
Medium education	-0.081***	-0.037***	-0.064***	-0.279***	-0.157***	-0.235***	-0.158***	-0.024	-0.124***
Children	0.008**	0.006	0.008**	0.041**	0.040*	0.040**	0.025***	0.016	0.024***
year 2004	-0.040***	-0.023***	-0.043***	0.021	0.036	0.012	-0.001	0.026	-0.009
Household income	-0.000***	-0.000*	-0.000***	-0.000	0.000	-0.000	-0.000***	-0.000*	-0.000***
Job: Demand		0.003			-0.165***			-0.031**	
Job: Control		-0.003			0.004			-0.006	
Job: Reward		0.008**			0.079***			0.028***	
Job: Demand/Control		0.011***			0.078***			0.042***	
Job: Demand/Reward		-0.009***			-0.043***			-0.029***	
Retired/Demand		0.007			0.053			0.027	
Retired/Control		-0.001			-0.099			-0.043	
Retired/Reward		0.009			0.055			0.028	
Retired/Dem/Con		0.009			-0.051			0.000	
Retired/Dem/Rew		-0.009			0.031			-0.002	
Bluecollar worker			0.082***			0.184*			0.152***
Pinkcollar worker			0.000			0.090			0.063
Unskilled worker			0.078**			0.139			0.185**
Retired/Bluecollar			-0.008			-0.080			-0.015
Retired/Pinkcollar			0.043*			-0.010			0.022
Retired/Unskilled			0.059			0.257			0.085
Constant	1.687***	0.287	1.798***	10.263***	3.916*	10.570***	2.350***	-1.585	2.665***
Observations	11,994	5,751	11,994	11,828	5,703	11,828	11,546	5,611	11,546

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8: OLS results for SAH, Euro-D and Bound Index

A2. OLS Regression Results

	Pooled OLS								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	MIMIC	MIMIC	MIMIC	Diseases	Diseases	Diseases	ADL	ADL	ADL
Retirement	0.057***	0.043	0.046***	0.378***	-0.162	0.337***	0.088***	-0.131*	0.094***
Age	-0.012***	0.009	-0.015***	-0.012	0.066	-0.020	-0.058***	0.017**	-0.062***
Age squared	0.000***	-0.000	0.000***	0.000	-0.000	0.000*	0.000***	-0.000**	0.000***
Public employment	-0.022***	-0.006	-0.017***	-0.112**	-0.034	-0.101**	0.004	0.007	0.006
Self-employment	0.008	0.008	0.010	-0.054	0.010	-0.039	0.024	-0.026***	0.028
Married	-0.019***	-0.009	-0.018***	-0.047	0.006	-0.042	-0.026*	-0.023*	-0.025*
High education	-0.076***	-0.054***	-0.062***	-0.160***	-0.043	-0.112***	-0.059***	-0.026***	-0.049***
Medium education	-0.051***	-0.034***	-0.044***	-0.098***	0.049	-0.073**	-0.037***	-0.010	-0.031**
Children	0.002	0.001	0.002	0.013	0.011	0.014	0.001	0.006	0.001
year 2004	-0.126***	-0.115***	-0.128***	-0.013	0.024	-0.020	0.003	0.001	0.000
Household income	-0.000***	-0.000***	-0.000***	-0.000***	-0.000**	-0.000***	-0.000	-0.000	-0.000
Job: Demand		0.001			-0.008			-0.000	
Job: Control		0.000			-0.003			-0.001	
Job: Reward		0.008***			0.002			-0.000	
Job: Demand/Control		0.010***			0.023**			0.004	
Job: Demand/Reward		-0.007***			-0.016**			-0.003*	
Retired/Demand		-0.016			0.105			-0.018	
Retired/Control		-0.000			-0.027			0.014	
Retired/Reward		0.003			0.038			0.018	
Retired/Dem/Con		0.003			-0.011			0.017*	
Retired/Dem/Rew		-0.001			0.001			-0.010	
Bluecollar worker			0.041***			0.139**			0.051**
Pinkcollar worker			0.007			0.094			0.030
Unskilled worker			0.046***			0.064			0.060
Retired/Bluecollar			-0.008			-0.073			-0.051
Retired/Pinkcollar			0.015			0.012			-0.030
Retired/Unskilled			0.008			0.186*			-0.018
Constant	0.894***	0.130	0.960***	0.764	-1.789	1.001	1.846***	-0.441*	1.947***
Observations	12,011	5,752	12,011	11,992	5,750	11,992	11,991	5,751	11,991

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9: OLS results for MIMIC Index, Number of Chronic Diseases and ADL

A3. IV Regression Results

	Pooled IV								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	SAH	SAH	SAH	Euro-D	Euro-D	Euro-D	Bound	Bound	Bound
Retirement	-0.120**	-0.070	-0.141**	-0.216	0.666***	-0.216	-0.211*	-0.121	-0.237*
Age	0.007	-0.023	-0.008	-0.136***	-0.009	-0.175***	0.052*	0.000	0.017
Age squared	0.000	0.000	0.000	0.001***	-0.000	0.001***	-0.000	0.000	0.000
Public employment	-0.050***	-0.030**	-0.037***	-0.181***	-0.095	-0.155***	-0.104***	-0.036	-0.077***
Self-employment	-0.017	0.008	-0.009	-0.059	0.031	-0.027	-0.065	0.022	-0.044
Married	-0.028*	-0.004	-0.025*	-0.348***	-0.250***	-0.337***	-0.111***	-0.062**	-0.104***
High education	-0.156***	-0.072***	-0.098***	-0.429***	-0.171***	-0.292***	-0.319***	-0.115***	-0.198***
Medium education	-0.097***	-0.039***	-0.069***	-0.314***	-0.150*	-0.246***	-0.191***	-0.028	-0.135***
Children	0.006	0.006	0.006	0.036***	0.040***	0.037***	0.021***	0.016	0.021***
year 2004	-0.027**	-0.017	-0.036***	0.051	0.036	0.030	0.027	0.046	0.008
Household income	-0.000***	-0.000***	-0.000***	-0.000	0.000*	-0.000	-0.000***	-0.000	-0.000***
Job: Demand		0.007**			-0.170***			-0.019	
Job: Control		-0.003			-0.009			-0.010	
Job: Reward		0.006			0.095***			0.022**	
Job: Demand/Control		0.015***			0.067***			0.049***	
Job: Demand/Reward		-0.012***			-0.036***			-0.034***	
Retired/Demand		-0.038*			0.142**			0.109***	
Retired/Control		0.036***			-0.110***			-0.110***	
Retired/Reward		-0.048***			0.108***			0.026**	
Retired/Dem/Con		-0.012**			0.022			0.066***	
Retired/Dem/Rew		0.012**			-0.027*			-0.046***	
Bluecollar worker			0.139***			0.266***			0.282***
Pinkcollar worker			0.086***			0.198*			0.197***
Unskilled worker			0.193***			0.504***			0.408***
Retired/Bluecollar			-0.080***			-0.400***			-0.190***
Retired/Pinkcollar			0.076***			0.233***			0.131***
Retired/Unskilled			0.109***			0.294***			0.186**
Observations	11,994	5,751	11,994	11,828	5,703	11,828	11,546	5,611	11,546

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10: IV results for SAH, Euro-D and Bound Index

A3. IV Regression Results

	Pooled IV								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	MIMIC	MIMIC	MIMIC	Diseases	Diseases	Diseases	ADL	ADL	ADL
Retirement	-0.052	-0.042	-0.071**	-0.186	-0.353**	-0.217	-0.051	-0.052	-0.056
Age	0.008	0.003	0.004	0.095***	-0.018	0.069**	-0.032**	0.010	-0.038**
Age squared	0.000	0.000	0.000	-0.000	0.001	-0.000	0.000**	-0.000	0.000***
Public employment	-0.018**	-0.006	-0.012*	-0.092*	-0.028	-0.073	0.009	0.007	0.014
Self-employment	-0.005	0.008	-0.002	-0.118	0.004	-0.095	0.008	-0.026***	0.013
Married	-0.019***	-0.010	-0.018***	-0.049	-0.003	-0.042	-0.027**	-0.025*	-0.025**
High education	-0.088***	-0.055***	-0.064***	-0.222***	-0.047	-0.124**	-0.074***	-0.027***	-0.051***
Medium education	-0.057***	-0.035***	-0.046***	-0.129***	0.044*	-0.086**	-0.044***	-0.011	-0.033***
Children	0.001	0.001	0.001	0.010	0.013	0.010*	-0.000	0.006*	-0.000
year 2004	-0.121***	-0.113***	-0.125***	0.012	0.053*	-0.005	0.009	0.005	0.005
Household income	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000*	-0.000*	-0.000*
Job: Demand		0.001			0.018			0.000	
Job: Control		0.000			-0.003			0.001	
Job: Reward		0.007***			-0.010			0.000	
Job: Demand/Control		0.011***			0.030**			0.007***	
Job: Demand/Reward		-0.008***			-0.023***			-0.005***	
Retired/Demand		0.017			0.024			0.012	
Retired/Control		-0.003			-0.146***			-0.005*	
Retired/Reward		-0.005			0.094***			0.004	
Retired/Dem/Con		-0.005**			0.217***			0.018***	
Retired/Dem/Rew		0.003			-0.134***			-0.013***	
Bluecollar worker			0.062***			0.207***			0.047*
Pinkcollar worker			0.041***			0.217***			0.039
Unskilled worker			0.079***			0.358***			0.084***
Retired/Bluecollar			-0.012**			0.003			-0.043***
Retired/Pinkcollar			0.039***			-0.075			0.015
Retired/Unskilled			0.084***			0.165			0.045***
Observations	12,011	5,752	12,011	11,992	5,750	11,992	11,991	5,751	11,991

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11: IV results for MIMIC Index, Number of Chronic Diseases and ADL

A4. IV Regression Results for Different Occupational Groups

IV bluecollar

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	SAH	Euro-D	Bound	MIMIC	Diseases	ADL
Retirement	-0.514**	-0.547	-0.683	-0.170*	-0.878	0.211
Age	-0.047	-0.212	-0.066	-0.027	-0.021	-0.133***
Age squared	0.000*	0.002	0.001	0.000**	0.000	0.001***
Public employment	-0.050	-0.222	-0.115	-0.008	-0.233	-0.098***
Self-employment	0.026	-0.148	0.005	0.009	-0.055	0.112
Married	-0.039	-0.240***	-0.189**	-0.023	-0.239**	0.015
High education	-0.162***	-0.407**	-0.302**	-0.099***	-0.255**	-0.131**
Medium education	-0.092**	-0.252**	-0.203***	-0.057***	-0.095	-0.057**
Children	0.012	0.046	0.020	0.005***	0.014	-0.001
year 2004	-0.079***	-0.025	-0.036	-0.136***	-0.134***	-0.003
Household income	-0.000**	-0.000	-0.000	-0.000***	-0.000*	0.000
Observations	2,215	2,185	2,117	2,219	2,216	2,215

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12: IV results separately for blue collar workers

IV whitecollar

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	SAH	Euro-D	Bound	MIMIC	Diseases	ADL
Retirement	0.166**	0.122	0.431	0.051	0.307	0.196
Age	-0.142***	-0.427**	-0.259***	-0.052***	-0.118	-0.040
Age squared	0.001***	0.003**	0.002***	0.000***	0.001	0.000
Public employment	-0.062***	-0.148*	-0.149***	-0.019	-0.022	-0.032
Self-employment	0.098	0.175	0.084	0.046*	0.043	0.090
Married	-0.032	-0.313**	-0.050	-0.017*	0.051	-0.055
High education	-0.053*	-0.289**	-0.064	-0.053***	-0.080	-0.040
Medium education	-0.050***	-0.323**	-0.132**	-0.039***	-0.160	-0.028
Children	-0.002	0.038	0.010	-0.006**	-0.002	-0.010
year 2004	-0.040**	0.002	-0.088	-0.135***	0.043	-0.019
Household income	-0.000*	-0.000**	-0.000***	-0.000**	-0.000	0.000
Observations	2,339	2,313	2,279	2,341	2,338	2,338

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13: IV results separately for white collar workers

IV pinkcollar

VARIABLES	(1) SAH	(2) Euro-D	(3) Bound	(4) MIMIC	(5) Diseases	(6) ADL
Retirement	0.061	-0.026	0.161	0.044	-0.178	-0.039
Age	-0.053	-0.277*	-0.146	-0.030	0.041	-0.116**
Age squared	0.000	0.002**	0.001	0.000*	-0.000	0.001**
Public employment	-0.042	-0.228*	-0.171*	-0.023	-0.328**	0.026
Self-employment	-0.003	0.053	0.001	0.006	-0.240	-0.037
Married	-0.058	-0.472***	-0.285***	-0.021	-0.254**	0.006
High education	-0.121***	-0.111	-0.233**	-0.054***	-0.200	-0.049
Medium education	-0.095***	-0.186	-0.208**	-0.045***	-0.223	-0.007
Children	0.001	0.078**	0.050	0.001	0.030	0.013
year 2004	-0.055***	-0.064	-0.069	-0.149***	-0.109	0.015
Household income	-0.000*	0.000	-0.000	-0.000*	-0.000	-0.000**
Observations	1,523	1,504	1,466	1,531	1,525	1,525

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 14: IV results separately for pink collar workers

IV unskilled

VARIABLES	(1) SAH	(2) Euro-D	(3) Bound	(4) MIMIC	(5) Diseases	(6) ADL
Retirement	-0.193	-1.165	-1.581	-0.036	-1.978**	-0.002
Age	-0.047	-0.268	0.066	-0.024	0.112	-0.146
Age squared	0.000	0.002	-0.000	0.000	-0.000	0.001
Public employment	-0.128	-0.235	-0.245	-0.023	-0.562***	-0.102**
Self-employment	-0.150***	-0.049	-0.411***	-0.048***	-0.613***	0.032
Married	-0.020	-0.197	0.000	-0.008	-0.024	-0.051
High education	-0.128	-0.355	-0.240	-0.056	-0.166	-0.091
Medium education	-0.092***	-0.296	-0.160	-0.054***	-0.094	-0.110**
Children	0.010	0.029	0.032	0.004	0.014	0.018
year 2004	-0.086***	-0.170	-0.040	-0.128***	-0.165	0.017
Household income	-0.000	-0.000	-0.000	-0.000	-0.000	0.000
Observations	1,231	1,207	1,151	1,232	1,230	1,231

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 15: IV results separately for unskilled workers

Declaration of authorship

I, Felizia Hanemann, hereby declare that this present thesis was prepared independently, without help from others, and without using anything other than the named sources and aids. The texts, illustrations and/or ideas taken directly or indirectly from other sources, quoted verbatim or paraphrased, have without exception been acknowledged and have been referenced in accordance with academic guidelines.

The present work is being submitted for the degree of Master of Science in Economics to Lund University. It has not been submitted before for any degree or examination at this or any other University.

Place, Date

Signature